A Community of Practice to Bridge Research and Practice in Science Education

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Abstract: Communities of practice (CoPs) have been used to support practitioners' efforts to adopt new teaching methods. In this paper, we summarize how our team facilitated knowledge transfer by forming and leveraging several CoPs that shared the common objective of implementing Inquiry-Based Labs (IBL) in science curricula. Over two years, our team members played the role of linkage agents in the CoPs to bridge the gap between education research, by sharing our own research findings, and practice, by collecting feedback directly from IBL practitioners about their challenges with implementation. As various needs of the members were well met – to be informed, to share thoughts, to belong – the CoPs have since evolved into stable, sustainable entities. Through these powerful social interactions, CoP members themselves have become linkage agents, connecting us to the larger community that would otherwise not engage with our research and thus further bridging the gap between research and practice.

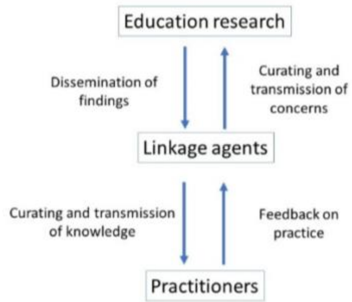
Introduction

Advances in education research are often unacknowledged by practitioners, notably those teaching in the domain of Science, Technology, Engineering and Mathematics (STEM) at post-secondary institutions (Ma et al., 2019). Despite overwhelming evidence regarding the effectiveness of numerous teaching approaches, many practitioners have difficulty adopting these classroom practices (Marion & Houlfort, 2015). Faculty report a number of barriers impeding their ability to change such as time, their personal identity and beliefs about instruction, departmental and institutional culture, and the lack of incentives to change one's teaching approach (Brownell et al., 2013; Henderson et al., 2011).

It is well documented that knowledge transfer in education is difficult to achieve (Becheikh et al., 2010) and the ability for practitioners to mobilize and apply new knowledge into practice is challenging for a number of reasons (Hemsley-Brown, 2005). Traditionally researchers resort to presenting their innovations, along with supporting evidence for their effectiveness, through conventional means of dissemination, however, such approaches have proven ineffective in inspiring practitioners to adopt new instructional strategies (Henderson et al., 2011). On the other hand, the literature does reveal several successful approaches for encouraging change. Such strategies are characterized as having i) focused objectives, ii) coordinated efforts by the individuals involved, iii) structures to provide time for work on these objectives over extended periods, iv) mechanisms for performance evaluation and feedback and v) the explicit intent to change faculty perceptions (Fullan et al., 2018; Henderson et al., 2011). Furthermore, questioning of the status quo, having a clear plan of action, being able to actively recruit new allies, and drawing personal confidence from collaborating with others are other hallmarks of successful change strategies (Fullan et al., 2018). Finally, linkage agents, or individuals who can function as intermediaries between researchers and practitioners, can prove useful in communicating the immediate needs and concerns of practitioners to researchers, as well as relaying research findings back to practitioners in a feedback loop (Becheikh et al., 2010), thus ensuring knowledge transfer is achieved.

Communities of Practice (CoPs) can serve to circumvent the challenges associated with knowledge transfer. Rooted in change theory, CoPs provide forums for faculty to share their concerns about teaching, to collaboratively design possible solutions to these challenges, to learn about best practices and, consequently, to participate in educational reform (Abigail, 2016; Gehrke & Kezar, 2017). Through a mix of knowledge sharing, knowledge-creation, identity building and social interaction, CoPs can be positive vehicles for engaging faculty in adopting novel practices (Abigail, 2016). A CoP composed of members acting as linkage agents can provide a mechanism through which knowledge transfer is more easily facilitated (Henderson et al., 2011). We started a number of CoPs to promote interest in our team's larger research on what types of scaffolding best support the development of scientific thinking in students exposed to Inquiry-Based Laboratory (IBL) instruction. The objectives of this project were to: 1) profile Quebec-based college (cegep) teachers who used or were interested in implementing IBL approaches, 2) identify the forms of scaffolding that best supported learning using an IBL approach, 3) assess whether there exist disciplinary differences in the implementation of IBL pedagogy, and 4) conduct design-oriented research to assess the development of the scientific process. We identified three key areas where our CoPs could address our research needs: a) the recruitment of qualified participants who teach either chemistry, biology, or physics; b) the need for both physical and temporal spaces through which we could consult with our participants routinely; c) the creation of a social community where participants could support or inspire each other in the practice of using IBL instruction. Consequently, the CoP is part of a feedback loop where our research team acts as a linkage agent, i.e., by communicating our findings to a captive audience, then later receiving feedback from IBL practitioners to further inform our research (Figure 1).

Figure 1
The role of linkage agents in facilitating knowledge transfer



Educational context

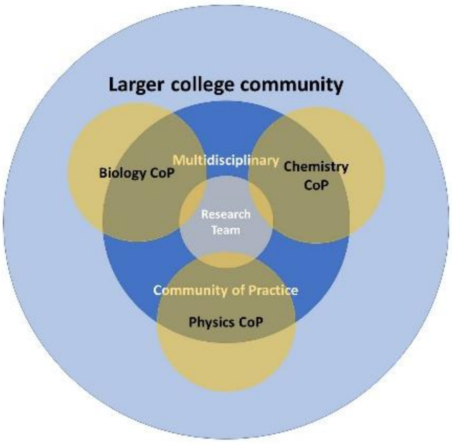
The educational context for this study is at the post-secondary level in the province of Quebec, the structure of which is unique from the rest of Canada: STEM-bound students must complete a two-year college or cegep degree (corresponding to grades 12 and 13) consisting of general education courses (literature and language, philosophy or humanities, and physical education) and domain-specific courses notably in chemistry, biology, physics, and mathematics. This degree is prerequisite to attend university STEM programs. There exist ~60 cegeps all teaching the same Ministry of Education-mandated program, either in French or in English. Colleges have the freedom to set their own program planners, grids, courses, etc. albeit within certain limitations, meaning that local programs and even departmental cultures vary from institution to institution. Instructors are discipline experts having at least a bachelor's degree in the discipline they teach, but most having a master's degree. Some teachers may have an education degree, but this is not mandatory to teach in the cegep system. Consequently, cegep instructors lacking such a background may be incapable of identifying with educational research.

Our research team is comprised of cegep teachers. We are both researchers and practitioners, which facilitates the implementation of an action-based research program. Our research questions are embedded in our teaching concerns and are developed to generate results that are both rigorous and applicable in a classroom. Aware of the difficulties of knowledge transfer in education, we planned this research project to be situated close to common concerns facing science educators, anticipating that our research questions and results would then be meaningful to them and their teaching practice.

The start of the multidisciplinary CoP

At the start of our research project, we invited science teachers from both French and English colleges to a large online meeting. Although the context was to discuss the common challenge of implementing the new cegep Science program slated to start in 2023-2024, the meeting served the dual purpose of forming a large, multidisciplinary community of practice (MCoP) that shared a common concern (Figure 2). At this meeting, we presented how our IBL research both aligns with the learning objectives of this new program, as well as also how this paradigm can help address shared challenges educators face in STEM education. To foster social connections between the participants, we asked them to discuss several topics raised during our presentation in small, disciplinary groups ("breakout rooms"). As Wenger (1999) describes, such participation is key to successfully forming a CoP as it provides both action as well as connections between members. The strategic use of breakout rooms also provided opportunities for reflection on the potential advantages of using IBL in the new Science program, enticing attendees to reach out to our research team about knowing more on IBL or even to become research participants. Finally, attendees of the MCoP were invited to join a mailing list, keeping them appraised of our research and of other meetings or workshops offered by our research team.

Figure 2
Organization of our Communities of Practice (CoPs)



Creation of discipline-specific CoPs

Following the creation of the MCoP, our research team invited members to join smaller, discipline-specific CoPs (DCoPs). DCoPs were composed of a small number of core participants who were always present at each meeting (Table 1). Topics for each DCoP meeting were set by coordinators who were members of our research team – i.e., linkage agents. Although many discussions were about IBL, multiple topics were discussed per session. Members were surveyed before meetings for their suggestions of discussion points and these persons often acted as moderators for these topic discussions. This bottom-up approach ensured that discussions were always meaningful to the participants and validated the time and effort required on their part to partake in the DCoP.

Table 1
Number of participants in CoPs meetings

	Chemistry	Biology	Physics
First gathering of MCoP	46	21	16
Typical DCoPs meetings	15	12	8

Modes of engagement

To facilitate attendance, both the MCoP and DCoPs operated in either of the following formats: completely online, which proved beneficial for connecting members both during and after covid pandemic isolation, or co-modal with members being present either in-person or via web-conferencing software simultaneously. These flexible modalities afforded members who could not make face-to-face meetings, or were uncomfortable doing so, access to the DCoP. Furthermore, Web 2.0 tools or group management software were used to store shared resources, to store recorded meetings or to continue asynchronous discussion between meetings.

Knowledge transfer via linkage agents

Given that it was the theme of our larger MCoP meeting, IBL was the focus of first meetings with the DCoPs. Members of our research team acted as linkage agents by not only presenting from existing literature the history and theoretical framework of IBL instruction, but by providing practical knowledge about how STEM instructors could successfully implement it. IBL-experienced DCoP members shared success stories affirming the literature findings, which in turn encouraged non-practicing DCoP attendees to reflect upon the merit of using IBL-based pedagogy. For those that opted to try implementation, both the time and effort needed to do so were considerably reduced through the sharing of expertise and ready-made resources offered by DCoP members. For new practitioners, this support also helped them gain the confidence to see the implementation through. Seeing value in what they were gaining, individual MCoP/DCoP members asked our team to host additional IBL workshops for their local departments or programs. These motivated CoP members helped bridge a gap between our research team and the wider cegep community who otherwise would not have engaged with our research (Figure 2). In so doing, these members not only became champions of change, but through interactions with us have become linkage agents themselves by connecting other practitioners to our IBL research.

Outcomes and future of the CoPs

Through our team's desire to challenge the status quo re: STEM lab instruction, we formed sub-groups of individuals willing to engage with our research and ultimately put it into practice. The CoPs provided the time and social support required for our participants to address the common goal of learning about and implementing IBL pedagogy and in so doing, helped move our research forward. However, what is worth noting is that our DCoPs have since evolved into self-sustaining entities that now address pedagogical questions beyond our original mandate. The self-selection of the members ensured we recruited individuals who were initially invested in a common goal, but our willingness to have members contribute their own pet topics of discussion ensured continued viability of the DCoPs. Additionally, multidisciplinary concerns continue to be addressed via larger gatherings of our MCoP where concerns and solutions raised there funnel back into discussions at the DCoP level. Consequently, members of the various CoPs are now positioned as members of the community that can connect us to other practitioners that would otherwise not engage with educational research. Technology also facilitates the exchange of resources between members and helps keep the CoPs socially connected.

It cannot be understated that our tiered CoP structure benefits from our research team's continued involvement as linkage agents who can connect practitioner concerns to the educational literature, and vice versa. We would recommend to those taking part in action-based research to consider leveraging CoPs as a means for ensuring knowledge transfer takes place, as well as to connect faculty, who would otherwise not engage with the educational research, to learn about it as well as its implementation in practice.

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