María Azucena Gutiérrez González, TRONDHEIM MUNICIPALITY and NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, maria.gonzalez@trondheim.kommune.no
Caitlin Mandeville, NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, caitlin.mandeville@ntnu.no
Ferne Edwards, UNIVERSITY OF SURREY, f.edwards@surrey.ac.uk
Paula Rice, NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY, pari@ntnu.no

Innovating Interdisciplinarity in Higher Education: Exploring the Impact of a Grassroots Community of Practice

ABSTRACT

Skills in interdisciplinary collaboration are required to address many complex problems facing society. As such, interdisciplinarity is a critical competency for students to develop. However, teachers' effectiveness in teaching interdisciplinarity is often hindered by silo structures within university faculties. To address this in the Experts in Teamwork (EiT) programme, a MSc in a Norwegian university that develops students' interdisciplinary teamwork skills through projects that address real-world challenges, a community of practice (CoP) evolved among teachers from different EiT classes. Over 20 months, CoP members participated in digital and in-person discussions, lecture exchanges, student and professional conferences, and co-evaluation of student work, with an aim of better understanding interdisciplinarity and approaches for teaching it to students. The success of the CoP in achieving these aims was evaluated through a series of focus groups consisting of members of the CoP. The CoP achieved some success in fostering pedagogical conversations that were transformative for participants' understanding of interdisciplinarity in their practice. Participants reported that CoP participation influenced their interactions with students, ultimately helping students to develop a better understanding of interdisciplinarity. However, participants reported limitations in the CoP as a professional development resource, citing its newness and the required time commitment. Participants felt that these issues could be addressed via greater institutional support.

KEYWORDS

interdisciplinarity, communities of practice, teacher development

INTRODUCTION

The world faces growing threats to sustainable, healthy socio-ecological systems. Such challenges are often considered to be "wicked problems": that is, complex situations that are impossible to address within one disciplinary framework (Brown, Harris, and Russell 2010). Instead, solutions to "wicked" socio-ecological problems require interdisciplinary expertise while relying on engagement with and accountability to local stakeholders and communities (Folke et al. 2016; Norris et al. 2016).

The need for interdisciplinary solutions to societal challenges requires training the next generation of professionals in interdisciplinary approaches, including the formation, facilitation, and engagement of interdisciplinary teams (Kawa et al. 2021; McCune et al. 2021). Such teamwork requires complex skills, including communication and interpersonal skills, individual reflection, and the ability to contextualise disciplinary expertise (Spelt et al. 2009). Experiential learning is a useful approach for introducing students to the practice of interdisciplinary teamwork (Cantor et al. 2015). A classroom group project addressing a real-world problem, for example, allows students to work through the processes of interdisciplinary teamwork while incorporating structured reflection and guidance (Stauffacher et al. 2006).

Instructors training students in interdisciplinarity often come from different disciplines but have minimal experience participating in interdisciplinary teams themselves (Lindvig, Lyall, and Meagher 2017; Turner et al. 2022). This lack of direct experience with interdisciplinary teamwork may limit their ability to guide students' skill development. Drawing from our experience with a cross-faculty obligatory master's-level course in interdisciplinary teamwork, we argue that a community of practice (CoP) that enables an informal exchange of knowledge between teachers from different backgrounds may provide a supportive overarching framework for educators to further develop their understanding and pedagogical practice in interdisciplinary teamwork (Beauchamp et al. 2022).

BACKGROUND: COMMUNITIES OF PRACTICE AS A TOOL FOR TEACHER DEVELOPMENT

As an experienced-based, relational approach to professional development, CoPs may be effective instruments for improving teachers' ability to facilitate interdisciplinary education. A CoP provides an opportunity for professional development through "loop-input," defined as "an alignment of the process and the content of learning" (Woodward 2003, 301), which enables supervisors to apply reflections on their own experiences to their teaching approaches. In other words, a CoP can extend experience-based learning to its participants, mirroring their experiences with those of their students (Andresen, Boud, and Cohen 1995).

The CoP approach (Lave and Wenger 1991) has been used extensively as a tool for continuous professional development, though less so in higher education (HE) (Mercieca 2017). The approach provides an arena for significant conversations among colleagues, characterised by mutual respect, reciprocity, and the sharing of values and practices—and by some degree of risk and vulnerability when conversation partners wrestle with the uncertainty, complexity, and failure that are inherent to teaching (Pleschová et al. 2021). CoPs provide spaces where teaching professionals can create new knowledge and bring change to pedagogical approaches and content knowledge (Goodyear and Casey 2015; Hunuk, Ince, and Tannehill 2012; Yildirin 2008).

Studies of CoPs have identified characteristics that facilitate positive learning outcomes for members, finding that the social aspect of learning in a CoP increases the diversity of members' perspectives (MacGillivray 2017). Lave and Wenger (1991) explore learning as a "descriptor of engagement in social practice that entails learning as an integral constituent" (35). Social interaction contributes to learning through members' willingness to share with one another, creating a mutual repertoire and awareness of the effects on teaching practice (Wenger 2000). Kensington-Miller (2021) suggests that the social interaction in a CoP creates a sense of connection that helps teachers to identify possibilities for change, supporting Goodyear and Casey (2015), who demonstrate that participating in a CoP could bring about pedagogical change both at an individual and institutional level. This is provided that the CoP has sufficient time to develop a shared history, an aspect that Nistor et al. (2015) also found to be a predictor of members' willingness to share knowledge.

Bouchamma and Michaud (2011) highlight reflection as part of social learning in a CoP. Kowalczuk-Walędziak and Underwood (2021) suggest that a diversity of perspectives can enable a reflective creative process that impacts teachers' pedagogical knowledge, especially if there is also some positive impact on learners. Chapman (2008) concludes that the reflective process encouraged by a CoP positively influences learning.

The benefits of participating in a CoP expand as longevity increases (Goodyear and Casey 2015), so establishing a foundation of best practices at the start of a CoP increases the likelihood of ongoing success. Pleschová et al. (2021, 3) summarises five foundational conditions necessary for transformative pedagogical conversations: cross-disciplinary participation, trustful relationships, conducive spaces, co-construction practice, and caring attitudes. The discussion section of this article explores the extent to which the case study CoP meets and responds to these conditions.

AIMS OF THIS ARTICLE

This article describes a CoP that emerged among instructors from different departments and faculties, responsible for seven distinct classes for a master's-level interdisciplinary course. This subset of classes was based on pre-existing collaborations between supervisors, shared themes (e.g., nature, sustainability, and citizen engagement), and the supervisors' mutual professional focus on interdisciplinarity. The resulting CoP represented a multicultural research group with extensive experience in team development, interdisciplinary collaboration, research, and teaching.

Over its 20-month duration, members of the CoP participated in various modes of engagement between and within their classes to develop a better understanding of interdisciplinarity and its relevance to their students. The CoP further sought to use the lessons from their shared experiences to contribute to the overall interdisciplinary course. The CoP impact was evaluated through a series of focus group discussions among participants. These discussions identified the opportunities and challenges that an interdisciplinary CoP can offer for student learning outcomes, instructors' pedagogical approaches, and the real-world impacts of student work.

Based on the outcome of the focus group discussions, this article addresses the following research questions:

1. How did participation in the COP affect the supervisors' understanding of interdisciplinarity?
2. How did supervisors' participation in the CoP affect their ability to guide students in implementing projects with real-world impact?
3. What factors hindered and supported the formation and development of the CoP?

CASE STUDY: EXPERTS IN TEAMWORK COURSE

Structure and pedagogy of Experts in Teamwork

Experts in Teamwork (EiT) is a cross-faculty obligatory course for most master's students at the Norwegian University of Science and Technology (NTNU). It aims to help students develop skills and competencies for working in interdisciplinary teams. It was first introduced into the master's programme in 2001 as part of a major revision of the civil engineering curriculum, using experiential learning as a theoretical framework. It aimed to address the needs of local businesses, specifically their desire to employ graduates who had the skills and competencies necessary to work in teams comprised of people from different professional backgrounds (Sortland 2015). The course has continued to develop, bringing in teachers and students from a wider range of faculties. This also has resulted in an expansion of pedagogical approaches used in EiT, which have been drawn from a wide range of discipline pedagogies.

The course is implemented through classes of approximately 25 students drawn from across NTNU's eight faculties, including students from engineering, the social sciences, arts, and the University Museum. Each class is organised around a societally relevant theme and is supervised by one or more academic teaching staff. These classes are either semester-based, meeting one day per week throughout a 15-week semester, or intensive, meeting each weekday over three weeks. Individual classes may be in-person, virtual, or hybrid.

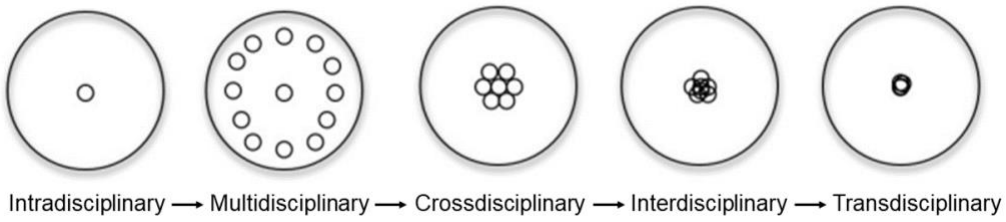
Through working collaboratively on projects related to the class theme, students develop an understanding of interdisciplinary teamwork. This experiential learning is supported by the class supervisors and trained learning assistants. Students are evaluated with two final assessments: an oral or written project report and a written process report that explores team development. Evaluation is carried out jointly by the students' own supervisor and the supervisor of another class. The common structure between course classes offered an opportunity for the emergence of an informal CoP between EiT class supervisors.

Interdisciplinarity in Experts in Teamwork

There is a growing focus on interdisciplinarity in higher education, and it has been embraced by EiT for over two decades. However, as the term has grown more common, its use has become conflated with related approaches such as "multi," "cross," and "trans" disciplinarity.

These terms can be understood along a rough continuum, as illustrated in the figure adapted from Refsum Jensnius (2012; based on original drawing by Zeigler 1990).

Figure 1. A continuum of disciplinary definitions



To clarify the interdisciplinary learning objectives of EiT, definitions from recent literature are listed in Table 1 (Choi and Pakk 2006; Piaget 1972; Refsum Jensenius 2012, sourced from Edwards and Nilstad Pettersen 2022).

Table 1. A summary of disciplinary definitions

Intradisciplinary	Working within a single discipline.
Crossdisciplinary	Viewing one discipline from the perspective of another.
Multidisciplinary	Drawing on knowledge from different disciplines but staying within disciplinary boundaries; using information from another discipline to solve a problem (i.e., borrowed information with no feedback).
Interdisciplinary	A synthesis or collaboration of approaches that analyses and harmonises links between disciplines into a coordinated and coherent whole; includes both academic disciplines and external sectors with the goal of addressing societal issues; can enrich the disciplines involved.

Transdisciplinary	A unity of intellectual frameworks that integrate the natural, social, and health sciences in a humanities context, transcending their traditional boundaries; includes both academic disciplines and external sectors with the goal of addressing societal issues; not only interacting but also reintegrating in a whole where the traditional boundaries disappear.

As the terms from Table 1 are often used interchangeably, the term "interdisciplinarity" increasingly means many things to different people.

In this article, we use the term "interdisciplinary" as a general term to capture these varied meanings, yet also acknowledge the differentiations in goal and approach. Indeed, many of the supervisors embraced different approaches and aspirations associated with interdisciplinarity. For example, some veered towards transdisciplinarity in their desire for transformational change—either on an individual, group, or societal level. One CoP participant expressed:

> I think it's important to think about why, what's the purpose of the course . . . resolving societal issues . . . I want transformational interdisciplinarity . . . because in order to resolve those issues we need to go beyond disciplinary boundaries . . . it's teamwork that goes to real world goals.

Alternatively, other supervisors in the CoP interpreted interdisciplinarity as critical reflection of their own discipline from which they could explore connections with others. This was particularly apparent between science and the arts where this critical reflection also applied to students. One participant said:

> To get to the end of the course they're moving from, you know, discipline to discipline, but bringing something along with them and learning something new along the way . . . to get some of the science students to be critical of their own disciplines and also to be critical of the way of doing science . . . So, we sort of came to this point . . . where they can still bring together data and scientific knowledge, so on, but then to be able to—to put it plainly—to tell stories with it.

To establish a baseline for how the EiT curriculum encourages supervisors to interpret the term "interdisciplinary," a keyword search was performed for any terms ending in "disciplinary" across all core course materials for the 2022 presentation of EiT. From these documents, "interdisciplinary" concepts were often referred to in generalised short sentences with little explanation. For example, "Interdisciplinary" was often used concerning group or teamwork, such as a course material stating: "they should help to make the most of other people's knowledge in interdisciplinary teamwork" (EiT 2022, 4).

The goal of interdisciplinarity was also included in the assessment criteria, requesting that students "clearly [show] how the individuals have each expanded their perspective on their own academic learning through interdisciplinary cooperation" (EiT 2022, 11). More instruction on this approach was provided in the weekly team-based reflection assignments, where students were asked to "reflect on better ways that their skills could be communicated and used in cooperation with students from different subject areas" (EiT 2022, 11). Rather than focus on details of how interdisciplinarity occurs through synthesis and negotiation, EiT largely likened interdisciplinarity

with teamwork, conveying a relatively superficial understanding that does not engage with possible diverse interpretations or consequences of this term.

METHODS

The data was collected via recordings made of digital meetings among CoP members and from recorded interviews between CoP members between February 2021 and September 2022. Interviewers were also members of the research team. Class supervisors worked across two NTNU campuses in Norway, which, in addition to the COVID-19 pandemic, meant that a hybrid (virtual and face-to-face) CoP was most suitable.

Key components of the CoP development

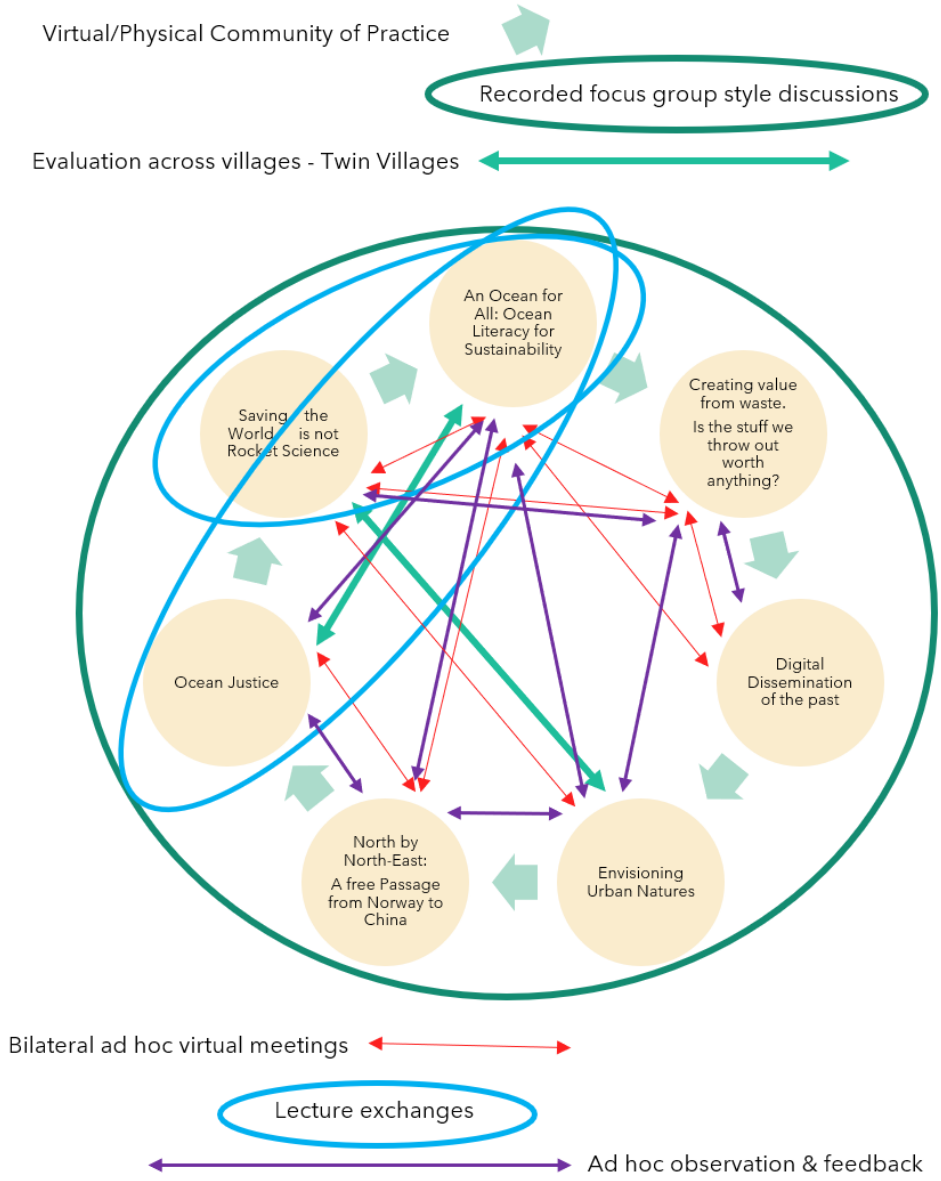
Initial engagement—Increased level of interactions in 2020 among some EiT supervisors led to the establishment of a CoP. Initial informal exchanges were catalysed by one supervisor in a hybrid kick-off meeting (November 2021), followed by another joint meeting two weeks later. The resulting CoP then met regularly throughout the semester. This group shared a positive outlook toward the aims of the EiT programme but was invested in opportunities to deepen engagement with interdisciplinarity.

Input into CoP members' classes—Exchange across the CoP included regular discussions about classroom interactions, six lecturer exchanges, two informal conferences to share student work (May 2021 and April 2022), and one academic conference presentation (June 2022). Each participant engaged to differing degrees in the CoP, depending on their availability and the compatibility of the topics and approaches (Figure 2).

Online communication platform—A shared Microsoft Teams platform was established in December 2021 to support asynchronous internal communication between meetings, to collate literature, and to exchange knowledge and experience.

Evaluation across classes—Four of the seven supervisors were paired to assess each other's students.

Figure 2. Shared interactions across the community of practice



The impact of these activities was assessed by CoP participants in four focus group discussions (three in April 2022 and one in August 2022). These sessions used an open, semi-structured, and qualitative approach, where participants interviewed each other to distil and analyse their perceptions and experiences. This follows the approaches used by Kim, Zhu, and Weng (2022).

Supervisors from all seven groups participated in at least one of the four focus group sessions. The sessions were recorded and the text from the session transcripts was thematically grouped by the authors to identify and interpret common discussion themes. In addition, data was gathered from correspondences and notes across the group. The next section discusses the key themes that emerged from this process.

FINDINGS AND DISCUSSION

Impacts of the CoP on teachers' understanding and teaching of interdisciplinarity

Opportunities for reflection are often limited in HE environments, and it is recognised that HE is largely in an early phase of interdisciplinarity (Spelt et al. 2009). The CoP provided a place for participants to reflect on the purpose of interdisciplinarity for students while understanding how it also challenged them. One participant said:

> For me, inter/transdisciplinarity is experienced by pushing students to leave the comfortable spaces of their disciplines to be able to relate to each other and bring in aspects from either/both their professional and personal lives to the project and group work. The key hurdle is their reluctance to do this—the students dislike the discomfort and while they are participating in the course, don't always quite understand what this means in practice, why this is useful, or how it can be done.

The CoP participants were motivated to transcend the existing faculty silo structure, which they perceived as limiting their experience of interdisciplinary thinking and teaching approaches. They expressed hope that the CoP could provide a common arena for greater interdisciplinary depth to their teaching. Indeed, the social learning that occurs within CoPs has been shown to expand the diversity of perspectives among members (MacGillivray 2017).

Participants indicated that they had few avenues to develop diverse perspectives on teaching interdisciplinarity outside of the CoP. A participant who had been teaching in EiT since 2006 said that "there has never been any discussion about the interdisciplinarity of the supervisors . . . [it is assumed that we] know everything and there has never been any discussion about that." Limitations in how interdisciplinarity was understood and developed within EiT appeared to impact both supervisors' and students' engagement with the concept. As one participant said, "When you don't know what you're bringing to the table, it's very difficult then to put all these different tools and to use them, right?" Participants observed that, in the absence of thorough guidance in interdisciplinarity supported by supervisors' strong understanding of the concept, students accepted a relatively superficial understanding of the term. One participant commented:

> The end is the teamwork and the interdisciplinarity aspect, it gets lost. That it's not just about disciplinary work in the sense of academia but in the sense of diversity, inclusivity, different points of views, that flows into an ethical dimension. And when it's considered as a means to an end . . . they're not even part of the conversation.

Conversely, participants reported that an expanded understanding of interdisciplinarity enabled them to guide students into a richer, more nuanced interdisciplinary practice: "the fact that we are aware that the definitions are different makes our work in the disciplines we work in different, because then you open up for definitions from others," said one participant. Supervisors in the CoP recognised the importance of flexibility and awareness of students' diverse backgrounds: one reflected, "we're open to all these things because without that how could we possibly be open to our students, anyway?"

CoP members also worked together to identify and address practical aspects of the course that hindered effective interdisciplinary pedagogy. For instance, the oversimplified definition of interdisciplinarity was especially limiting in the intensive classes, where there was seldom time to directly address the goal of interdisciplinarity. The sharing of co-evaluation responsibilities between

classes was identified as another source of tension, due largely to variations in the definition and understanding of interdisciplinarity between classes. CoP participants found that sharing assessment duties with other CoP participants, rather than non-participating supervisors, allowed them to better standardise student assessment. For example, one participant said, "Because maybe my ambition when it comes to see the interdisciplinary activities in the group is . . . higher than the ambition of other [class] supervisors. And then I might be more critical and severe in evaluating my students."

Finally, participants reported that the CoP offered opportunities to demonstrate interdisciplinary activity to students. In courses led by a single supervisor, students have few opportunities to observe role models engaging in interdisciplinarity. As one CoP participant observed, "We keep on talking about these topics but it's just not going in because the students don't see how it works, [so] they don't understand it." Supervisors noted that their interactions with one another in the classroom setting, for example during lecture exchanges and shared work sessions, allowed students to learn by observing productive interdisciplinary interactions.

Impact of the CoP on supervisors' ability to guide students in implementing projects with real-world impact

A typical challenge of practice-based education is that, while engaging with real-world issues offers a chance for impact beyond the classroom, the time and resource limitations inherent in a university course offer minimal support and incentive for students to extend the results of their work after the course. Participants agreed that the CoP offered a potential means to extend the real-world impact of student projects through leveraging shared resources and sharing the load of supporting student work, such as presentations to external stakeholders.

Participants pointed out that such systematic support for student projects should be considered an ethical requirement before attempting to conduct project work purporting to address societal challenges. One participant indicated that the lack of structural support for continuing a project limited the learning opportunities she was able to offer students:

> Integrating . . . academic disciplines with a broader community . . . would be great but we don't really discuss that much. We want them to consider stakeholders . . . but really working with people outside of academia, I feel like, requires much . . . longer term investment . . . so we don't really push them to go the extra step because it's outside the constraints of the course.

A CoP also provides a mechanism for rapid feedback on innovative teaching methods aimed at guiding students through the nuances of stakeholder engagement (Jakovljevic and Da Veiga 2020). Teaching high-level interdisciplinary skills relies on creative, active learning approaches that can be time-intensive for instructors to develop. These approaches benefit from regular evaluation and iterative adaptation based on student feedback and assessment; a single semester offers limited time for iteration and adaptation. A CoP can serve as a test lab for rapid iteration and evaluation, as participating supervisors can evaluate new teaching strategies and report results to the CoP, whose participants can test an adapted version of the exercise within the same semester. The rapid feedback offered by a CoP encourages more innovative teaching approaches. Some examples mentioned in focus group discussions include: "In my [class] we used Miro as a digital tool for students to learn to know each other without the initial constraints of being already in groups" and "I explicitly refer to innovation [in instructions to students], with respect to approaches: To bring in other innovative

techniques, such as sensory walks, citizen science, etc., and also to think outside the box—not just put a park on it."

The ability to workshop ideas also empowered supervisors to provide feedback to leadership within the EiT course. Within a large, well-established course such as EiT (or, analogously, within a large university department), a CoP can enable teachers to communicate collectively with leadership. Teachers are well equipped to identify potential programme updates to better support students, and they often feel that they have the best chance of enacting broad change if they raise an idea as a group rather than individually. CoP participants frequently mentioned changes that they would like to see: "A three-year project that different sets of [classes] will work on. Designing a project already from a sustainability perspective with the different phases, like a grant application project with a three-to-four-year scope," and "I would love to see EiT invest enough money that students could apply to for a small pool of funding to work on their project's outcomes and be genuinely evaluated." Participants in the CoP reported feeling more empowered to bring suggestions to relevant parties after discussing and, in some cases, piloting changes within the CoP.

Challenges to CoP formation and development

The research revealed some barriers that challenged the establishment of a CoP among supervisors. CoP participants perceived that the CoP's initial formation was impeded by the wide variation in supervisors' professional interests, pedagogical expertise, and motivation levels. Supervisors come from different disciplinary backgrounds and range from highly experienced to apprentice teachers. The limited time for formal training and team formation among supervisors may de-incentivise further engagement in EiT, making it less likely that supervisors would choose to become part of a CoP (Valenti and Sutton 2020). Some CoP participants also experienced that supervisors had varying levels of motivation and capacity to invest further in EiT. One participant said, "I think there are supervisors who would rather not be teaching EiT, and they are probably the ones who would not self-select [to] participate in, like, an optional group like this." CoP participants indicated that finding willing colleagues to form a CoP was a slow process because supervisors do not have much awareness of how other supervisors approach their classes, although exchanging this kind of information is one of the aims of the CoP.

Once the CoP was established, logistical restraints were the primary challenge to its continuation. Each EiT class was affiliated with at least two university institutions (their associated faculty as well as the EiT programme administration), with distinct obligations and practices. Meeting the objectives of each affiliation created a demand on supervisors' time that made it difficult to devote additional time to a voluntary CoP. This tension is typical of CoPs in HE, which uphold being voluntary while striving to improve outcomes for an organisation (Goodyear and Casey 2015). Still, participants felt strongly that the impact of a CoP for EiT could be strengthened with better communication between the CoP and the EiT academic section.

The CoP was especially vulnerable to external pressures because it was in an early stage. Issues regarding lack of continuity and not all members being available to meet up at the same times exacerbated challenges, making establishing strong personal connections across all the CoP members and group themes difficult. Valenti and Sutton (2020) identify these as challenges to the strength of community in a CoP, which is important for developing trust and subsequent knowledge sharing (Nistor et al. 2015). A CoP that has not yet achieved a high level of trust among members may not engage in the level of discussion achieved by CoPs with better internal and external support (Bolisani et al. 2021; Nistor et al. 2015). Because there is limited continuity among supervisors from year to year in this programme, it is difficult for a CoP to persist long enough to reap the benefits of longevity. For

this reason, participants identified the establishment of consistent norms, positive incentives for the role of CoP facilitator, and a CoP culture that can be passed down through shifting supervisors as critical for long-term success. Indeed, three out of four of the current authors no longer work as EiT supervisors.

Conditions supporting CoP development

Despite challenges, participants found their experience with the CoP to be rewarding and constructive. We identified several factors that enabled the CoP to persist.

First, participants reported a clear perception of professional value and personal fulfilment from participation in the CoP. Members reported feeling isolated and unsupported in previous individual efforts to deepen their engagement with interdisciplinarity and support student work with real-world impact, and they appreciated the camaraderie of sharing these efforts with like-minded individuals. Strong cultural norms established by the CoP members, including respect, humility, listening, and diversity, made the CoP a welcoming community and assisted with rapidly building a level of trust that met the conditions for success as proposed by Pleschová et al. (2021). This motivated members to continue participating despite logistical challenges. One member reflected:

> I think the dialogue that we're having helps me to understand much better what we're trying to achieve and I'm learning a lot with these discussions, and I think that it will help me also to have a better alignment and provide better guidance to students between the teamwork development and interdisciplinary work that they must do and the project. These discussions are very important for me.

The CoP participants intentionally set group norms that offered flexibility to lower barriers to ongoing participation. University teachers face many competing demands on their time (Sutherland 2018), so a major challenge in retaining participants in a CoP is making efficient use of supervisors' time. The hybrid virtual format allowed members to participate even when they could not be physically present, and the Teams platform facilitated asynchronous conversation to keep the CoP connected between meetings. The mutual exchange of instruction responsibilities, including lectures, exercises, and assessment, further incentivised supervisors to continue participating in the CoP. In addition to their pedagogical benefits, these exchanges afforded supervisors increased flexibility in scheduling and teaching duties that could offset some of the increased time involved in participating in the CoP.

Despite their positive experiences with the CoP, participants reported that many of the improvements they hoped for in the EiT programme could not be achieved through CoP participation alone but would require a greater degree of top-down support from programme administration. Such support could formally recognise and allocate time and resources to objectives that were outside the scope of a CoP, such as aligning group topics, developing multi-year collaborative projects, building relationships with external stakeholders, and supporting extensions of student work. The main role of a CoP in instituting these developments may be through facilitating collective communication between supervisors and the programme leadership. However, even if the CoP has limited power to institute large-scale organizational changes, the pursuit of these changes may still have a positive indirect effect of strengthening the CoP: a shared pursuit of particular desired outcomes is a key factor of the longevity of a CoP (Pharo et al. 2014).

CONCLUSION

The CoP achieved some success in fostering pedagogical conversations that were transformative in terms of participants' understanding of achieving interdisciplinarity in their practice. The CoP both confirmed and extended participants' own understanding of interdisciplinarity. They reported that this impacted the way they facilitated their classes, which then enabled their students to develop a better understanding of interdisciplinarity both in theory and practice. Pleschová et al. (2021, 3) set out the five criteria, described above, that make this possible, and the CoP achieved all of these, at least to some extent: cross-disciplinarity among supervisors; interactions built over time, rooted in trusting relationships; conducive spaces in informal virtual meetings; an anchor at the institutional level reinforced through supervisors' contributions to conferences and co-construction of pedagogical practices; and communication and shared experiences establishing a strong base for a real community.

Participants felt that the collaborations developed as a direct result of the CoP further expanded students' understanding and better supported students' projects. However, the extent of these developments was often dependent on factors that were outside the control of the CoP, such as the timetabling and length of the module. Other factors that could be addressed via the work of the CoP, such as the understanding and expectations of students, were hindered by the newness of the CoP and the lack of participation by all the members in meetings. Participants felt that these issues could be addressed to an extent via greater institutional support. Specific recommendations for institutional support to increase the impact, persistence, and scalability of interdisciplinary CoPs include establishing CoPs before the start of the semester, defining thematic CoPs across faculties, ongoing evaluation of CoP impact, communication about the benefits of CoP participation, and incentivisation of supervisor participation in CoPs, for example through time release for CoP contributions or additional professional development opportunities.

Overall, CoP participants were in favour of continuing to use a CoP as a means of professional development for teaching and as an opportunity to increase collaboration across the university. The CoP's continuance is likely to depend on ensuring that good relationships can be fostered, even if there are changes in membership, which will depend both on the establishment of group norms within the CoP and increased institutional support for the CoP.

AUTHOR BIOGRAPHY

María Azucena Gutiérrez González (NOR) is project leader for "University City TRD3.0," a collaborative project between NTNU and Trondheim Municipality. Her work focuses on facilitating and leading the co-creation and implementation of interdisciplinary projects.

Caitlin Mandeville (NOR) is a postdoctoral researcher at the Gjærevoll Centre for Biodiversity Foresight Analyses, Department of Natural History, NTNU, whose work focuses on participatory science and biodiversity conservation.

Ferne Edwards (GBR) is a research fellow working on the EU FoodCLIC project at the University of Surrey. Her work focuses on just and sustainable cities, food systems, and social change.

Paula Rice (NOR) is an associate professor at the faculty of Economics and Management, NTNU. Her background is in teaching English to speakers of other languages (TESOL). Her current work is focused on the assurance of learning in higher education.

REFERENCES

Andresen, Lee, David Boud, and Ruth Cohen. 1995. "Experience-Based Learning." In *Understanding Adult Education and Training*, 2nd edition, edited by Griff Foley, 225–39. London: Routledge.

Beauchamp, Gary, Sammy Chapman, Angelica Risquez, Susan Becaas, Cheryl Ellis, Michaël Empsen, Fiona Farr, Laüra Hoskins, Wouter Hustinx, Liam Murray, et al. 2022. "Moving Beyond the Formal: Developing Significant Networks and Conversations in Higher Education: Reflections from an Interdisciplinary European Project Team." *Teaching in Higher Education*. https://doi.org/10.1080/13562517.2022.2056833.

Bouchamma, Yamina, and Clémence Michaud. 2011. "Communities of Practice with Teaching Supervisors: A Discussion of Community Members' Experience." *Journal of Educational Change* 12: 403–20. https://doi.org/10.1007/s10833-010-9141-y.

Bolisana, Ettore, Monica Fedeli, Laura Bierema, and Valentina De Marchi. 2021. "United We Adapt: Communities of Practice to Face the Coronavirus Crisis in Higher Education." *Knowledge Management Research & Practice* 19 (4): 454–58. https://doi.org/10.1080/14778238.2020.1851615.

Brown, Valerie A., John A. Harris, and Jacqueline Russell. 2010. *Tackling Wicked Problems Through the Transdisciplinary Imagination*. New York: Earthscan-Taylor & Francis Group.

Cantor, Alida, Verna DeLauer, Deborah Martin, and John Rogan. 2015. "Training Interdisciplinary 'Wicked Problem' Solvers: Applying Lessons from HERO in Community-based Research Experiences for Undergraduates." *Journal of Geography in Higher Education* 39 (3): 407–19. https://doi.org/10.1080/03098265.2015.1048508.

Chapman, Robbin. 2008. "The Reflective Mentor Model: Growing Communities of Practice for Teacher Development in Informal Learning Environments." In *Communities of Practice: Creating Learning Environments for Educators*, vol. 1, edited by Chris Kimble, Paul Hildreth, and Isabelle Bourdon, 39–64. Information Age Publishing. http://www.chris-kimble.com/CLEE/ToC.html.

Choi, Bernard C.K., and Anita W.P. Pak. 2006. "Multidisciplinarity, Interdisciplinarity, and Transdisciplinarity in Health Research, Services, Education and Policy: 1. Definitions, Objectives, and Evidence of Effectiveness." *Clinical and Investigative Medicine* 29 (6): 351–64.

Edwards, Ferne, and Ida Nilstad Pettersen. 2022. "Envisioning Urban Natures: Speculative Futures for the More-than-Human City [Manuscript submitted for publication]." Department of Design, Norwegian University of Science and Technology.

EiT (Experts in Teamwork). 2022. "Guide for Village Leaders and Learning Assistants in Experts in Teamwork, Spring Semester 2022." Trondheim, Norway: Norwegian University of Science and Technology.

Folke, Carl, Reinette Biggs, Albert V. Norström, Belinda Reyers, and Johan Rockström. 2016. "Social-Ecological Resilience and Biosphere-Based Sustainability Science." *Ecology and Society* 21 (3): 41. http://dx.doi.org/10.5751/ES-08748-210341.

Goodyear, Victoria A., and Ashley Casey. 2015. "Innovation with Change: Developing a Community of Practice to Help Teachers Move Beyond the 'Honeymoon' of Pedagogical Renovation." *Physical Education and Sport Pedagogy* 20 (2): 186–203. https://doi.org/10.1080/17408989.2013.817012.

Hunuk, Deniz, Mustafa Levent Ince, and Deborah Tannehill. 2012. "Developing Teachers' Health-related Fitness Knowledge through a Community of Practice: Impact on Student Learning." *European Physical Education Review* 19 (1): 3–20. https://doi.org/10.1177/1356336X12450769.

Jakovljevic, Maria, and Adéle Da Veiga. 2020. "An Integrated Academic Community of Practice Model (ACoPM)." *Innovations in Education and Teaching International* 57 (3): 339–51. https://doi.org/10.1080/14703297.2019.1623061.

Kawa, Nicholas C., Mark Anthony Arceño, Ryan Goeckner, Chelsea E. Hunter, Steven J. Rhue, Shane A. Scaggs, Matthew E. Biwer, et al. 2021. "Training Wicked Scientists for a World of Wicked Problems." *Humanities and Social Sciences Communications* 8 (189). https://doi.org/10.1057/s41599-021-00871-1.

Kensington-Miller, Barbara. 2021. "'My Attention Shifted from the Material I Was Teaching to Student Learning': The Impact of a Community of Practice on Teacher Development for New International Academics." *Professional Development in Education* 47 (5): 870–82. https://doi.org/10.1080/19415257.2019.1677746.

Kim, Grace Jue Yeon, Jingyi Zhu, and Zhenjie Weng. 2022. "Collaborative Autoethnography in Examining Online Teaching During the Pandemic: From a 'Teacher Agency' Perspective." *Teaching in Higher Education*. https://doi.org/10.1080/13562517.2022.2078959.

Kowalczuk-Walędziak, Marta, and James M. Underwood. 2021. "International Communities of Practice: What Makes Them Successful Vehicles for Teachers' Professional Development?" *Educational Studies* 49 (6): 973–90. https://doi:10.1080/03055698.2021.1927673.

Lave, Jean, and Etienne Wenger. 1991. *Situated Learning: Legitimate Peripheral Participation*. Cambridge, UK: Cambridge University Press.

Lindvig, Katrine, Catherine Lyall, and Laura R. Meagher. 2017. "Creating Interdisciplinary Education Within Monodisciplinary Structures: The Art of Managing Interstitiality." *Studies in Higher Education* 44 (2): 347–60. https://doi.org/10.1080/03075079.2017.1365358.

MacGillivray, Alice E. 2017. "Social Learning in Higher Education: A Clash of Cultures?" In *Communities of Practice, Facilitating Social Learning in Higher Education*, edited by McDonald, Jacquie, and Aileen Cater-Steel, 27–45. Singapore: Springer.

McCune, Velda, Rebekah Tauritz, Sharon Boyd, Andrew Cross, Peter Higgins, and Jenny Scoles. 2021. "Teaching Wicked Problems in Higher Education: Ways of Thinking and Practising." *Teaching in Higher Education* 28 (7): 1518–33. https://doi.org/10.1080/13562517.2021.1911986.

Mercieca, Bernadette. 2017. "What is a Community of Practice?" In *Communities of Practice, Facilitating Social Learning in Higher Education*, edited by McDonald, Jacquie, and Aileen Cater-Steel, 3–25. Singapore: Springer.

Morgan, David L., and Margaret T. Spanish. 1984. "Focus Groups: A New Tool for Qualitative Research." *Qualitative Sociology* 7: 253–70. https://doi.org/10.1007/BF00987314.

Nistor, Nicolae, Irene Daxecker, Dorin Stanciu, and Oliver Diekamp. 2015. "Sense of Community in Academic Communities of Practice: Predictors and Effects." *Higher Education* 69: 257–73. https://doi.org/10.1007/s10734-014-9773-6.

Norris, Patricia E., Michael O'Rourke, Alex S. Mayer, and Kathleen E. Halvorsen. 2016. "Managing the Wicked Problem of Transdisciplinary Team Formation in Socio-ecological Systems." *Landscape and Urban Planning* 154: 115–22. https://doi.org/10.1016/j.landurbplan.2016.01.008.

Pharo, Emma, Aidan Davison, Helen McGregor, Kristin Warr, and Paul Brown. 2014. "Using Communities of Practice to Enhance Interdisciplinary Teaching: Lessons from Four Australian Institutions." *Higher Education Research and Development* 33 (2): 341–54. http://dx.doi.org/10.1080/07294360.2013.832168.

Piaget, Jean. 1972. Intellectual Evolution from Adolescence to Adulthood. *Human Development* 15 (1): 1–12. https://doi.org/10.1159/000271225.

Pleschová, Gabriela, Torgny Roxå, Kate Eileen Thomson, and Peter Felten. 2021. "Conversations that Make Meaningful Change in Teaching, Teachers, and Academic Development." *International Journal for Academic Development* 26 (3): 201–09. https://doi:10.1080/1360144X.2021.1958446.

Refsum Jensenius, Alexander. 2012. "Disciplinarities: Intra, Cross, Multi, Inter, Trans." Last modified March 12, 2012. https://www.arj.no/2012/03/12/disciplinarities-2/.

Sortland, Bjørn. 2015. "Læringsarena for Tverrfaglig Amarbeid – Eksperter I Team." *Uniped* 38 (4): 284–92. https://www.idunn.no/doi/full/10.18261/ISSN1893-8981-2015-04-04.

Spelt, Elisabeth J. H., Harm J. A. Biemans, Hilde Tobi, Pieternel A. Luning, and Martin Mulder. 2009. "Teaching and Learning in Interdisciplinary Higher Education: A Systematic Review." *Educational Psychology Review* 21: 365–78. https://doi.org/10.1007/s10648-009-9113-z.

Stauffacher, M., A.I. Walter, D.J. Lang, A. Wiek, and R.W. Scholz. 2006. "Learning to Research Environmental Problems from a Functional Socio-cultural Constructivism Perspective: The Transdisciplinary Case Study Approach." *International Journal of Sustainability in Higher Education* 7 (3): 252–75. https://doi.org/10.1108/14676370610677838.

Sutherland, Kathryn A. 2018. "Holistic Academic Development: Is it Time to Think More Broadly About the Academic Development Project?" *International Journal for Academic Developmen*t 23 (4): 261–73. https://doi:10.1080/1360144X.2018.1524571.

Turner, Rebecca, Debby Cotton, David Morrison, and Pauline Kneale. 2022. "Embedding Interdisciplinary Learning Into the First-Year Undergraduate Curriculum: Drivers and Barriers in a Cross-Institutional Enhancement Project." *Teaching in Higher Education*. https://doi.org/10.1080/13562517.2022.2056834.

Valenti, Sandra, and Sarah Sutton. 2020. "Strengthening Virtual Communities of Practice (VCops): An Evidence-based Approach." *Journal of Education for Library and Information Science* 61 (1): 106–25. https://doi.org/10.3138/jelis.61.1.2018-0045.

Wenger, Etienne. 2000. "Communities of Practice and Social Learning Systems." *Organization* 7 (2): 225–46. https://doi.org/10.1177/13505084007200.

Woodward, Tessa. 2003. "Loop Input." *ELT Journal* 57 (3): 301–04. https://doi.org/10.1093/elt/57.3.301.

Yildirim, Rana. 2008. "Adopting Communities of Practice as a Framework for Teacher Development." In *Communities of Practice: Creating Learning Environments for Educators*, vol. 1, edited by Chris Kimble, Paul Hildreth, and Isabelle Bourdon, 39–64. Information Age Publishing. http://www.chris-kimble.com/CLEE/ToC.html.