

High-school teachers' experiences of interdisciplinary team teaching

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The purpose of this study is to identify vocational teachers' experiences with interdisciplinary team teaching (ITT). Participants were five teachers from a science and technology-based vocational high school in Thailand. Qualitative data collection involved focus groups, interviews and observations. Findings were grouped into the following categories: teaching across disciplines; supportive and sharing relationships and roles; communication and decision-making; benefits; and challenges. Findings suggest that the interdisciplinary aspect may be achieved through engagement in project-based learning (PBL). The PBL approach can provide both a shared purpose and a framework and guidelines to support teachers' planning. Findings also point to the value of shared decision-making and leadership, and to the need for supportive relationships that take into consideration professional and personal issues. Implications relate to the need for open forms of communication that reflect trust, support and respect. Use of social media to support communication and collaboration should be accompanied by guidelines and rules established in advance by team members.

Introduction

Sarason, Levine, Goldenberg, Cherlin and Bennett's (1966) seminal chapter entitled "Teaching is a lonely profession" highlighted a dilemma that persists in education to this day. As Butti (2016) explained, the profession is one in which you "plan your lessons, close your classroom door, go about your business with your students, mark your papers, and go home" (p. 12). Similarly, Sarason et al. described the lack of "formal structure" and opportunities for a teacher to discuss with anyone the successes in teaching or "day-to-day concerns of the classroom" (p. 74). Stewart (2018) argued that the high value placed on autonomy makes close collaboration "less likely to occur in schools" (p. 146). In contrast to these reports of isolation, recent studies (e.g., Harms, 2016) have linked retention with the personal relationships that teachers are able to form with colleagues. The importance of colleagues and relationships is also highlighted in Feille, Nettles and Weinburgh's study (2018) which found that, in the case of science teachers, community played the most important role in terms of bringing about change in practice. Likewise, Ashley (2017) associated significant increases in student achievement with a "collaborative school culture" (p. iv).

Beyond the solitary teacher: Team and co-teaching

One approach to moving beyond teacher isolation involves creating community and promoting collaboration through team teaching. As Murchú and Conway (2017) observed, the term 'team teaching' has been used "as a catch all for various configurations of actions

undertaken by two teachers and their students in one classroom" (p. 45) and represents "an overarching title for a range of activities instead of other similar terms, such as 'collaborative teaching', 'co-teaching', 'cooperative teaching', and 'coteaching'" (p. 47). Barahona's (2017) definition goes beyond the dyad to focus on "two or more teachers engaged in the process of teaching including preparation, planning, material design, actual teaching and assessment" (p. 147). Dong, El-Sayed and El-Sayed (2011) explained that team teaching is a method of coordinated classroom instruction involving a number of educators working together with a single group of students. Team teaching is perhaps most commonly practised in contexts of foreign-language learning (e.g., Glasgow, 2018) between two teachers such as a content specialist along with a second or foreign language teacher (Honigsfeld & Dove, 2012). Stewart and Perry (2005) noted the need for "increased collaboration between language teachers and colleagues in the subject-area disciplines" (p. 1).

Al Saaideh (2011, p. 170) distinguished between different forms of team teaching. At a very basic level, Al Saaideh described two teachers co-preparing but separately delivering – an approach that, he argued, could confuse learners. Another level according to Al Saaideh is "complimentary / supportive team teaching" whereby one delivers content while the other takes charge of "follow-up activities." Next is "parallel instruction" whereby "the class is divided into two groups and each teacher is responsible for teaching the same material to her/his smaller group." Other approaches include splitting the class based on students' particular needs with different teachers responsible for the different needs. The "monitoring teacher" approach involves one teacher responsible for the class while another monitors learning and behavior (Al Saaideh, 2011).

As Heck, Bacharach and Dahlberg (2008) explained, co-teaching refers to the collaborative planning and delivery of teaching involving a co-operating and a student teacher. Co-teaching often refers to a form of learning that "allows a pre-service teacher to co-teach alongside a cooperating teacher collaboratively planning, instructing, and assessing" (Guise, Habib, Thiessen & Robbins, 2017, p. 370). With co-teaching, as Heck et al. observed, "the cooperating teacher and teacher candidate collaboratively plan and deliver instruction from the very beginning of the experience" (p. 1). Co-teaching is also a popular approach for special education contexts in secondary schools (Nierengarten, 2013). Friend, Cook, Hurley, Chamberlain and Shamberger (2010) noted that co-teaching began as a means to promote inclusion among students with disabilities. Similarly, Bauwens, Hourcade and Friend (1989) described "cooperative teaching" as a delivery model designed to overcome the "traditionally dichotomous relationship between general and special education" (p. 17).

Interdisciplinary team teaching

Interdisciplinary team teaching (ITT) is more than team teaching and unlike co-teaching, ITT involves groups of teachers from multiple disciplines and with various experiences collaborating together to improve students' performance (Akpan, Usoro, Akpan & Ekpo, 2010). Stewart (2018) described ITT as "one extreme of the teaching collaboration continuum" using a "fully collaborative model of instruction by teachers with different

area specializations" (p. 144). The ITT teams "design a curriculum, instruct the class, and grade teams of students for time periods that can possibly extend to more than one year" (Jones, 2010, p. 76). Evans (2001) described ITT as "a team of two or more subject teachers who share the responsibility for the teaching and learning of a group of learners at the same time, and in the same area and who share planning time in order to draw connections between their subjects" (p. 14). Evans also described ITT as "a way to organize teachers and students into smaller learning communities" (p. 14). Nungsari, Dedrick and Patel (2017) outlined the implications of the interdisciplinary aspect of team teaching. The authors noted that it involves "two or more distinct disciplines brought to bear upon a single subject matter" (p. 26).

Little and Hoel (2011) noted the benefits of ITT in terms of the "positive impact on student learning outcomes" as well as increased student participation and opportunities for student-teacher interaction (p. 36). Nungsari et al. (2017) found that ITT produces "more knowledge than that produced by any constituent discipline" (p. 26). ITT can also serve as a form of professional development (Stewart, 2005) and results in a more positive school climate, job satisfaction and higher student achievement (Flowers, Mertens & Mulhall, 1999). In spite of these benefits, it can present challenges for teachers. ITT requires "collaboration, teamwork, and ongoing communication", sharing responsibilities and setting goals (p. 53) which are often tasks for which teachers have not been trained. Not surprisingly, the effectiveness of the team's interactions, the ability to work together and support each other affect the success of the team (Flowers, Mertens & Mulhall, 2000). Little and Hoel (2011) argued that teachers should "move beyond ... specific disciplines to engage students in an interdisciplinary learning process" (p. 36). Flowers et al. (2000) found that successful and sustainable ITT does not simply involve forming teams and putting them in a classroom. Flowers et al. noted the challenges associated with having teachers move "from the security of their often isolated classrooms" and from different subject areas to ITT (p. 53).

Review of the literature

There have been studies of co-teaching involving the collaborative planning and delivery of teaching between a co-operating (in-service) and a student teacher (pre-service) (Heck et al., 2008). For example, Guise et al. (2017) investigated co-teaching implementation and conditions necessary for co-teaching to occur in the USA with university supervisors and pre-service teachers. However, these types of studies do not have the same aims as those of in-service teachers who are already in practice and who are focused on integrating different disciplines. Likewise, there have been studies of team-teaching that were not interdisciplinary. For example, Kafyulilo, Fisser and Vooght (2016) studied the impact of teacher design teams with 12, in-service science, secondary school teachers.

There have been many studies that reported on students' experiences or perceptions of ITT. Money and Coughlan (2016) used interviews to explore the experiences of 15 students in the UK who were both team-taught and individually taught. Self and Baek (2016) in South Korea examined the pedagogical strategies of team teaching and how it

influenced students' learning experience. They also explored the conditions of team and non-team teaching. However, there has been less interest in teachers' experiences.

Studies have been conducted with teachers at the primary or elementary levels (e.g., Mayer, 2017). For example, Hestenes, Laparo, Little, Chakravarthi and Cranor (2009) conducted a study of IIT in early childhood education. There are also studies that investigated what is sometimes referred to as a four-handed model (Corin, 1997) whereby two teachers, often a content specialist and a foreign-language teacher co-teach. There have been numerous studies of IIT in higher-education. In fact, studies of IIT have been more commonly conducted at the post-secondary level (e.g., Hrivnak, Southam, U'Ren & West, 2017; Stewart, 2018). Helms, Alvis and Willis (2005) described team teaching as a common phenomenon in the higher-education context. Weinberg and Harding (2004) set up interdisciplinary teams for law students. The teams combined sociology, economics and politics. Fenollera, Lorenzo, Goicoechea and Badoui (2012) formed a team for engineering students. Jenkins and Crawford (2016) investigated the impact of a combination of blended learning and team teaching in a university-level music program. Perry and Stewart (2005) gathered impressions of the team teaching process by interviewing 14, English as foreign language (EFL) teachers in a university in Japan.

Studies of IIT are much less common in secondary schools than in higher education. Evans (2001) investigated three middle-school teachers' "feelings of efficacy" in IIT (p. 13) in an "integrated occupation program" in rural Canada with students who had learning disabilities (p. 3). Her anecdotal reports were grouped into four headings as follows: "Shared Responsibility, Professional Development, Fun/Motivation, and Empowerment" (p. 30). Evans concluded that the IIT experience offered her and the other two teachers "opportunity for support, validation, celebration and companionship, all of which help to alleviate stress" and provided support for "personal crises" (p. 33). Evans concluded that being part of a team empowered her to take risks and, as she noted, "try things I never would have tried on my own" (p. 37).

Al Salami, Makela and de Miranda's (2017) study was motivated by the need to "infuse engineering and technology into K-12 curriculum" (p. 64) through professional development opportunities. The study was based on the premise that "exposing teachers to an interdisciplinary STEM 'ideology' would promote the implementation of various teaching strategies and teamwork" (p. 66). The study focused specifically on assessing teachers' attitudes towards IIT and teamwork, resistance to change and satisfaction. In Al Salamiet al.'s study, six doctoral candidates provided technical and content support. It was a five-day experience with 42 teachers. Results revealed no significant changes. Gunn and King (2003) recounted Gunn's 10-year long experiences in IIT at the secondary school level during the 1990s with a four-member team. Students learned a "humanities curriculum ... organized around the themes of justice and global studies" (p. 178). The team's initial planning involved identifying specific areas of inquiry around "essential questions" (p. 179). Gunn and King concluded that, in IIT, "Hierarchies can emerge, individualistic tendencies can persist, genuine consensus can be elusive, and members can be silenced" (p. 191).

Concerning IIT in high-school vocational education, our review uncovered only one study. Al Saaideh (2011) investigated team teaching in a context of pre-vocational education in Jordan. Al Saaideh used closed-ended questionnaires to focus on teachers' perceptions of the need for team teaching, difficulties facing pre-vocational education teams, potential of others to join the teams, and whether other teachers perceive pre-vocational education as useful. Participants were 256 science, arts-education, math, and physical education teachers. Al Saaideh found that team teaching was necessary because of time limitations, challenges delivering certain subjects, and getting assistance from other teachers. Participants in the study reported that team teaching allowed them to collaborate with others. However, they also reported challenges related to "interference in teachers' timetables", teaching load increases, the need to modify content as well as "administrative issues" (p. 283). Compared to the present study, Al Saaideh focused more on breadth than depth. The study relied on a large group of 256 teachers whereas the present study relied on five only. It involved administration of a questionnaire as opposed to an IIT intervention in the present study that was observed and in which the principal investigator (PI) was active.

The present study

The review of the literature revealed a lack of studies of IIT at the high-school level particularly in terms of understanding teachers' experiences. The review found no studies of teachers' experiences of IIT in a context of vocational education at the high-school level. However, it can be argued that IIT is a relevant topic to explore at this level because vocational schools are designed to form workers for the labour market. Such markets often demand that workers be able to apply their skills within a real-world context in which knowledge is not parceled into subjects. IIT in that context is highly relevant for providing learners with experiences that will promote what Kim, Jackson and Keiller (2016) referred to as "integrated performance" (p. 1). Understanding teachers' experiences of IIT in this context can provide insights into what potentially works and does not work in a context of IIT.

The purpose of the study reported on in this paper was, therefore, to identify vocational teachers' experiences with IIT. The findings will be relevant for teacher-education programs and for the professional development of in-service teachers, in general, and vocational education teachers in particular. Teachers and schools interested in promoting more interdisciplinary teaching may also identify practical implications for their context.

Context: An innovative science and technology-based vocational college

The study took place in a vocational college in Thailand within an innovative type of education well-suited to the investigation of IIT with students aged 16 to 18. In Thailand, science and technology-based vocational colleges (STVC) were created by the Ministry of Education to respond to the need to build economic capacity through the supplying of skilled labour. The colleges depart from the traditional vocational colleges in that they aim

to form not technicians but creators of and innovators with technology (Policy Innovation Center, 2007).

The college in this study formed a collaborative partnership with a national institute of technology in Japan with a curriculum that focuses on innovation. The college also has a memorandum of understanding with a large university of technology in Bangkok. The university helps develop curriculum for the college and provides teacher professional development (PD). On average, two to three teachers per year are funded by the college to attend PD opportunities in colleges in other countries such as the UK and Japan.

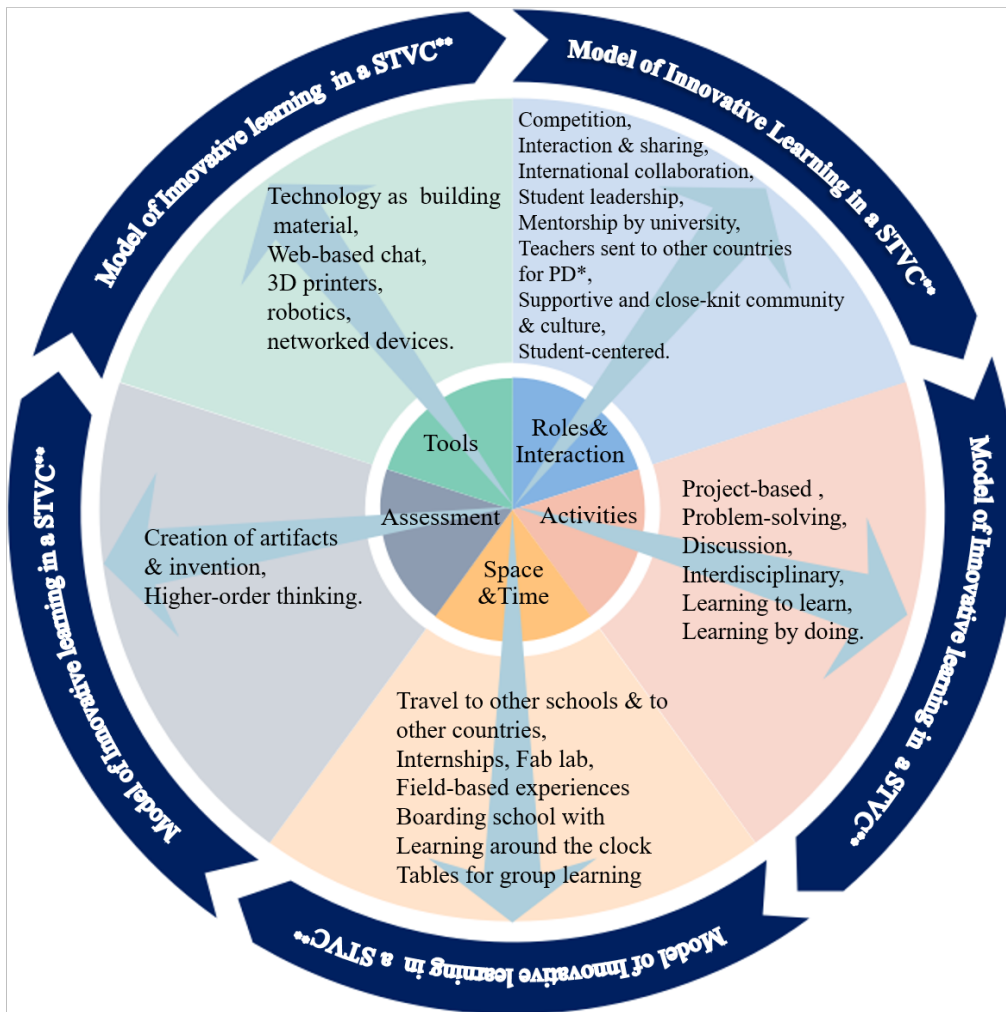


Figure 1: Model of innovative learning in a science and technology-based vocational college

(* PD professional development; ** STVC science and technology-based vocational college)

Using a project-based learning (PBL) approach, students typically complete six projects in three years. Students' learning is driven by their interests and activities are driven by their PBL plans. Classes start with the organisation of students into small teams depending on their interests. Facilities include a Fabrication Laboratory ("Fab Lab") featuring exhibits of students' inventions. It serves as a hands-on workshop space with tools that students need in order to complete their projects. It also includes a discussion room, computers, projectors and printers etc. Figure 1 summarises the model of innovative learning in the college.

Methods

Overview

Data collection involved interviews and focus groups with teachers. The principal investigator also engaged in observation of teachers as they implemented the ITT. Table 1 summarises the steps in the study.

Table 1: Summary of steps in ITT (interdisciplinary team teaching)

Step	Purpose	Activity	Duration
1	Identify teachers' pre-implementation perceptions of ITT	Focus group with five teachers	2 hours
2	Design ITT experiences with teachers	3 visits to college	1 day per visit
	Implement ITT	Visits to the teachers' classroom to observe activity	6 times total 8 hours
3	Identify teachers' post-implementation perceptions of their ITT experiences	Individual interviews with 5 teachers	30 minutes per teacher

Participants

Participants (see Table 2) included four females and one male teacher. The subject areas included chemistry, English as a foreign language (EFL), mechanical engineering, mathematics and social studies. Participants ranged in age from 25 to 35 with experience ranging from one to three years for this college. All teachers had on average two years' experience before they joined the college. All teachers held Bachelor degrees in their field. None of the teachers had prior experience in ITT.

Table 2: Participants' profiles

Content	Pseudonym	Gender	Experience	Years in STVC
Chemistry	Catherine	Female	7	3
Mathematics	Martha	Female	7	2.5
English	Angie	Female	5	1
Mechanics	Michael	Male	3	2.5
Social studies	Sandra	Female	1	1

Data collection

Data collection took place before, during and after the implementation. It began with identification of teachers' pre-implementation perceptions of ITT using a focus group. Questions focused on prior knowledge of and experiences with ITT, perceptions of challenges and benefits they might encounter, how they foresaw their participation and roles as well as their ability to collaborate and get along with each other. Questions were open-ended in order to allow participants the opportunity to add additional comments.

During implementation, the principal investigator (PI) observed the ITT. The instrument for observation is available in Appendix A. It was adapted from Murawski and Lochner (2010). The instrument supported the PI's observation of teachers' individual and group behaviours as well as students' responses to those behaviours. It allowed for a record of notable words and behaviours. Following implementation, the PI conducted individual interviews to identify teachers' experiences of ITT. The interviews were open-ended meaning the PI could ask additional questions to probe more deeply. Teachers could make additional comments that may not have always been relevant to the question but that were relevant to their experience. Questions focused on their specific experiences in terms of what worked, what failed and their overall perspectives on the experience.

Procedures

During the school's first semester, teachers participated along with the PI in the preparation of the ITT experience. During the face-to-face meetings, teachers were invited to bring their course outlines and materials that they typically relied on for teaching. The preparation involved discussions and decisions about responsibilities and roles in the classroom, co-planning activities, identifying and sharing activity-related resources, problem-solving and working together. The implementation began in the second semester. Implementation involved six two-hour classes. The PI observed six times by sitting in the back of the classroom and using the observation instrument. Teachers' interviews and focus groups took place in their classrooms and were recorded and subsequently transcribed.

Data analysis

The focus groups combined with the interviews and observations created a large corpus of data. The overall goal of the analysis was to make sense or meaning of this data in relation to teachers' experiences. The first step involved aggregating the data from different sources. The next step involved reading and re-reading "to obtain the sense of the whole" (Bengtsson, 2016, p. 11), to determine content relevant to the study's purpose, to eliminate "repetitions and oblique references to other things" (Burnard, 1994, p. 112) and to perform "systematic text condensation" (Malterud, 2012). The analysis then focused on inductive identification of patterns in keywords that "that pull together many separate pieces of data" (Miles, Huberman & Saldana, 2014, p. 277). Identification of patterns supported categorisation of units of meaning "that group together" (Burnard,

1994, p. 113). For this step, two of the researchers worked independently then categorised together to promote inter-rater reliability (Morse & Richards, 2002).

Results

Analysis resulted in the grouping of data according to the following categories: teaching across disciplines; supportive and sharing relationships and roles; communication and decision-making; benefits; and challenges. Each of these categories is presented separately in the following sections. For reporting, teachers' comments are referenced by the use of pseudonyms as shown as Table 2. The reporting aims to use the teachers' own words, in as much as possible.

Teaching across disciplines

During their initial planning, teachers decided to focus their activity around PBL since this is the approach used in the school. Sandra proposed that "the timeline of activities should be consistent with the steps of project-based learning." Michael stressed the importance of having activities that "relate together" and of allowing students to link their prior knowledge with their new learning. Angie suggested that the content teacher (Michael) should begin the activities so that the vocabulary will be clearer. She also proposed using "the same content but different languages" (Thai/English). Sandra proposed that the teachers could check the social studies content after she prepared it. Martha commented that she could "team up with everyone" as long as she knew the "details" of what was being taught.

Implementation began with the formation of student groups. Students decided that their project would focus on the design of a future car. Catherine introduced the team to the students then added that students must work with all teachers. Each week revolved around one aspect of designing the car. For example, in week two, students explored how the diesel engine works. In week three, they explored differences between a diesel and other types of engines. Activities included both a social aspect (e.g., the impact of cars on society) as well as a scientific aspect (e.g., impact on the environment). Activities included a blend of hands-on workshops combined with some lectures. Catherine would often coordinate responses to questions depending on the topic. She would invite particular teachers to deal with specific problems or provide examples. For example, during one activity led by the maths teacher, Martha presented the content at the beginning of the activity and related it to the previous activity. She assigned team members to work with specific students, to monitor their work and check the products of their learning. Martha explained that "teachers can design activities independently from each other [and] can switch if a team member cannot participate." Figure 2 summarises this category.

Supportive and sharing relationships and roles

During their initial planning, the teachers talked about how ITT would be a means to "build relationships with each other" (Angie), "support each other" (Michael), "help each other" (Catherine), for example, to "improve facilitator skills" (Catherine) or teaching

techniques (Martha). Sandra saw ITT as a means to "share experiences and techniques." Michael described the ITT experience as being together in the same class at the same time, sharing work and roles. Angie described the need for "trust and sincere support" and for "respect." She noted that conflict could "make the team stronger."

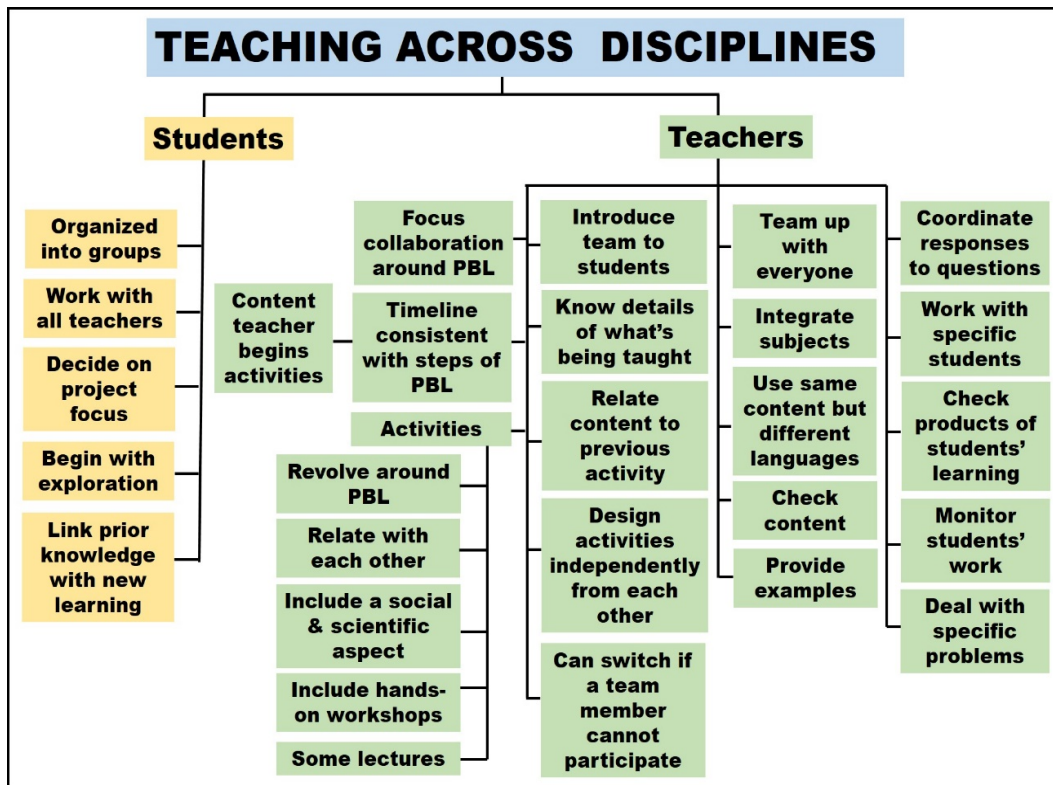


Figure 2: Summary of teaching across disciplines

During implementation, observations made evident how members relied on positive reinforcement. When the mechanics' teacher (Michael) finished leading students in a discussion about environmentally-friendly cars, Sandra complimented him and invited the other teachers and students to applaud him. She said: "Thank you so much for your hard work today. We did it together." She also nodded in agreement on numerous occasions. When another teacher asked if the pronunciation was correct, Angie courteously provided the correct pronunciation. She often praised the other teachers with comments such as "well done" or made encouraging remarks such as, "Don't worry about mistakes (in EFL). If you're not sure, you can ask me." When members made a mistake, she asked if she could give examples of how to pronounce a particular word. Teachers openly asked questions such as: "Can you help me explain this word in Thai? I have no idea what it means." On one occasion, Angie asked Michael to explain when she translated information about mechanics in Thai and some students seemed confused. Teachers also

noted mistakes. For example, Sandra apologised to team members: "I made a lot of mistakes today, but I'll do better next time."

Collaboration extended beyond professional relationships as evidenced by Catherine's comment that, "Sometimes, we need to help each other with personal problems too." The collaboration also involved mentoring, as Angie's comments illustrate. "I tried to encourage everyone on the team to do something new, especially those younger than me. I know they are unconfident. I just talk to them like my little brother or sister. I ask them about personal things to get close." Michael expressed his reaction to their familiar approach. "At first, I felt uncomfortable because I was the only man. But, Catherine and Angie always encouraged me to do everything with them ... It reduced the discomfort between us. After, I felt like they are my family."

Michael explained how during implementation they "worked together every single step." They "shared responsibility" for ensuring that students were on task and for answering questions (Martha), they shared "leadership" (Angie) and "everything in every step" (Sandra). As Angie observed, "It's hard to know everything. But when we share we can find the answer." They also shared roles, as Michael explained: "One teacher takes the role of leader in class and the other takes the role of supporter and walks around the classroom ... to make sure students understand." Figure 3 summarises this category.

Communication and decision-making

Sandra explained that, before joining the team, she did not share opinions because she is younger. However, she found that the other team members encouraged her to give opinions and listened to her carefully. She felt that, as a result of the experience, she had learned to concentrate more when others were speaking. She liked using a "dialogue technique with one person talking and the others listening." She also advocated "deep listening" as a "more powerful" means of working in a team and accepting other opinions. She noted "We talked a lot. We met often and more than normal." Michael felt that comments should be "short and clear" and that, when team members are not saying anything, they should be encouraged to speak. He also felt that "turn-taking" was important in communication.

Martha felt it was important to "listen to everyone and give everyone the opportunity to speak." Angie recommended that team members should "listen more than speak," as well as "listen carefully." She proposed that, when they disagree with a team member, they should, "just ask someone else's opinion" on the team. Catherine argued that it was important to "let everyone share their opinion and accept their differences." Michael appreciated when he prepared some suggestions and team members agreed with him. He added "we have to respect each other and give opinions when it's our turn and accept the others' opinion." Sandra explained their approach to decision-making: "Before we were a team, we asked the department head (Catherine) to decide something and followed her decision. But once we were team we just asked everyone's opinion and decided together. Sometimes, we vote if we cannot decide on an issue." Angie's comments echoed those of Sandra: "I felt comfortable sharing with everyone because if we disagreed with some topic

we just asked the others' opinions." Michael added: "The important decisions are easy when we decide together." Figure 4 summarises this category.

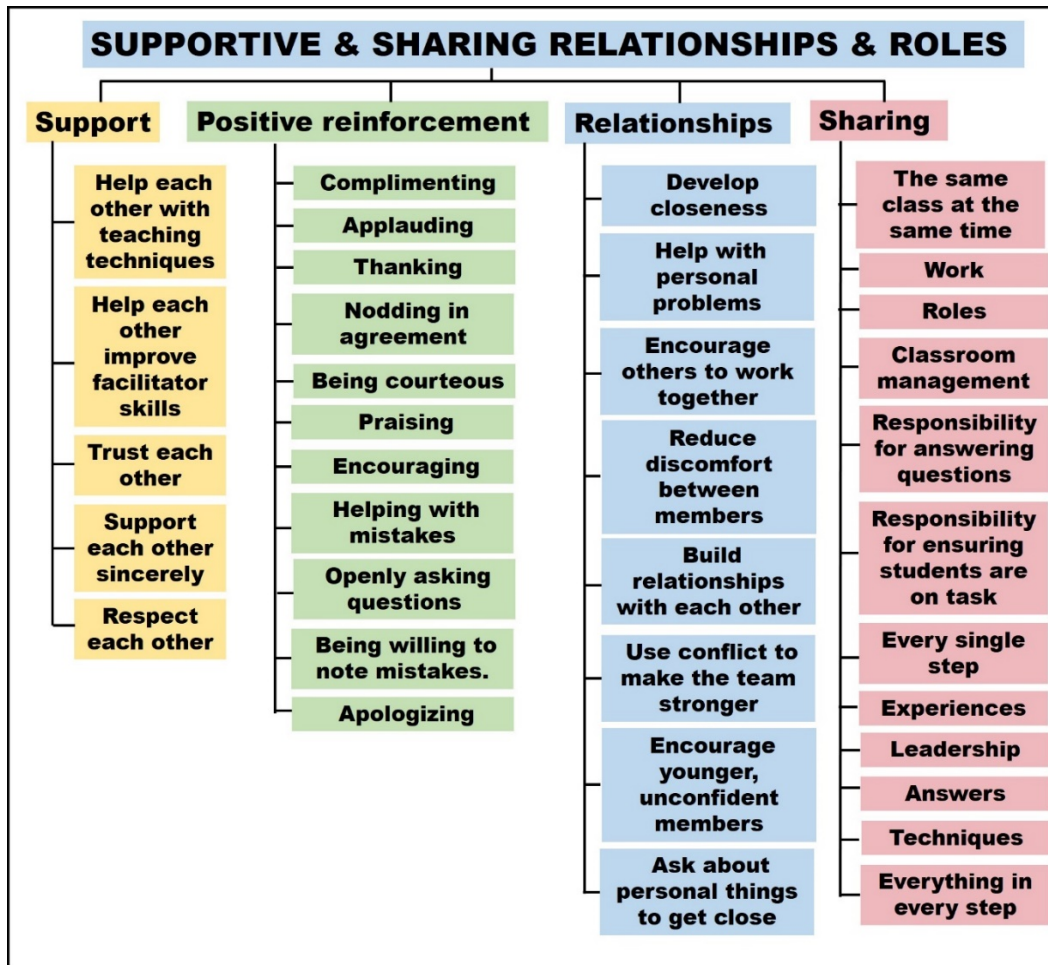


Figure 3: Summary of supportive and sharing relationships and roles

Benefits

Benefits identified by teachers included learning about new subject areas (Michael), opportunities to share and find new resources and to gain new ideas about integrating subjects (Angie), to get "new techniques and skills, learn about facilitating and develop new understandings and experiences" (Martha), learn new approaches (Catherine) integrate subjects more in relation to "real problems" (Sandra), develop students' vocabulary in real contexts where they can apply it (Angie), "integrate subjects, reduce lecture time and increase time for student practice" (Michael).

Benefits that teachers reported for students included increased interest (Michael), increased engagement and asking questions (Martha), more opportunities to interact with and encourage students (Catherine) increased skills (Catherine), more opportunities to give attention to all students (Angie), and to "connect knowledge between subjects" (Martha).

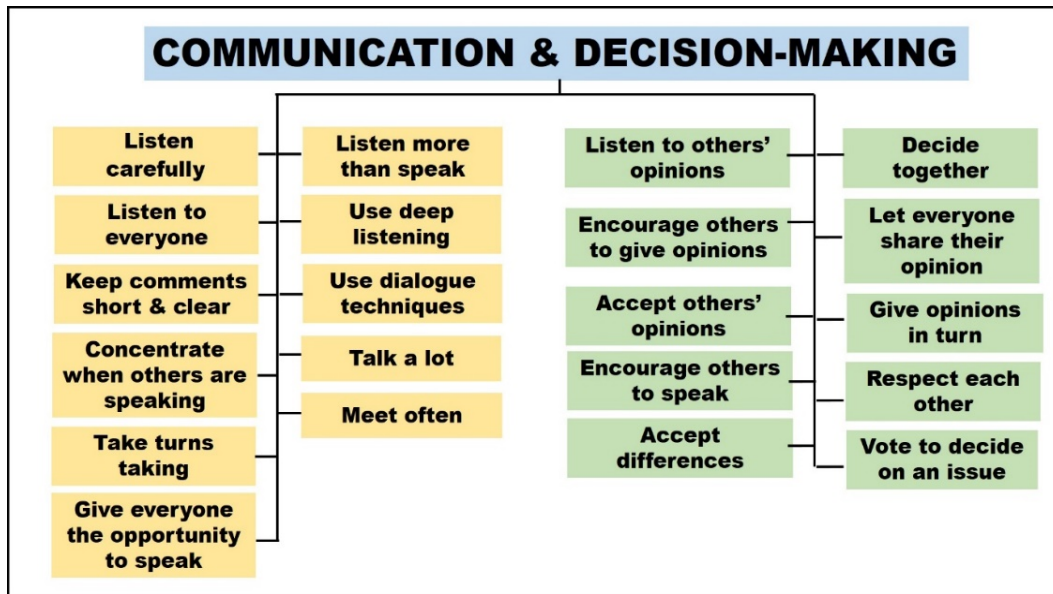


Figure 4: Summary of communication and decision-making

Angie described herself as someone who is "not good in technology" but the younger teachers such as Sandra and Michael taught her "a lot such as how to share files in *Google Docs*." Michael felt more interested and more motivated to teach with the other members. Sandra described how she was before they formed a team: "I was just a follower because I'm younger than everyone and a newcomer in this college. I was used to following orders from seniors." Being part of the team meant that she had to "grow up" because, as she explained: "we have to share so I have to speak. The first time, it wasn't easy but the informal meetings helped me a lot." She explained that she became "more confident to share [her] opinions in meetings." She added: "Everyone on the team motivated me to do better. I had to be better because I wanted to contribute to the team. At first, I thought I'm a hindrance to the team, so I had to develop my skills to equal the other team members."

Other personal changes related to communication and confidence. Catherine observed that she improved her communication skills: "I'm in charge of the department so I always order everyone to do something. But when we were a team, I listened to everyone a lot. I think I became a good listener. I know how to stop and control my emotions more than before." Martha explained that she had "more confidence to give opinions in meetings." Michael noted that his "weakness is English" and he lacks "confidence to teach in

English." By teaming up with an English teacher he was able to build on the strengths of others and gain confidence. Angie noted that occupying the role of leader made her "feel more responsible." Figure 5 summarises this category.

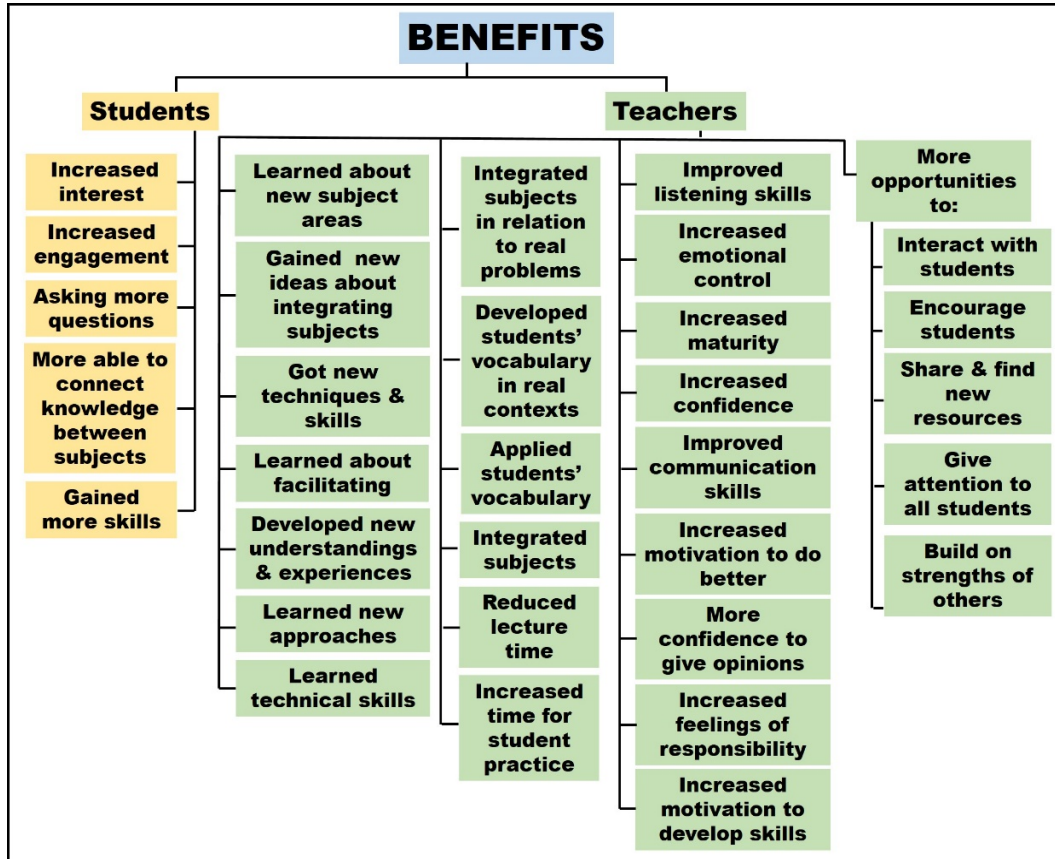


Figure 5: Summary of benefits

Challenges

Challenges related to ITT included "concerns with time" (Michael), "meeting a lot" (Sandra), workload (Michael), being worried about making mistakes (Angie), and students being confused if there is disagreement between teachers (Sandra). For Catherine, ITT presented challenges in terms of "how to keep good relations between team members and manage the class at the same time." She added that it was "very hard to manage strong feelings such as frustration, anger and anxiety." Angie felt that the ITT "required a lot of work before class." Communication challenges were related to initial lack of trust, members being talkative and not listening (Sandra), or team communication problems (Martha). Martha explained that they used a text-based online communication tool [*Line* - <https://line.me/en/>] and that the text sometimes confused her. Calling other team members after hours made her uncomfortable. Angie added that she had to "talk with

team members a lot" to reach a common understanding to "avoid conflict in class." Catherine commented that "texting with *Line* is very interesting but we have to make rules." She added that team members should not send messages (photos, links) unrelated to their teamwork. Figure 6 summarises this category.

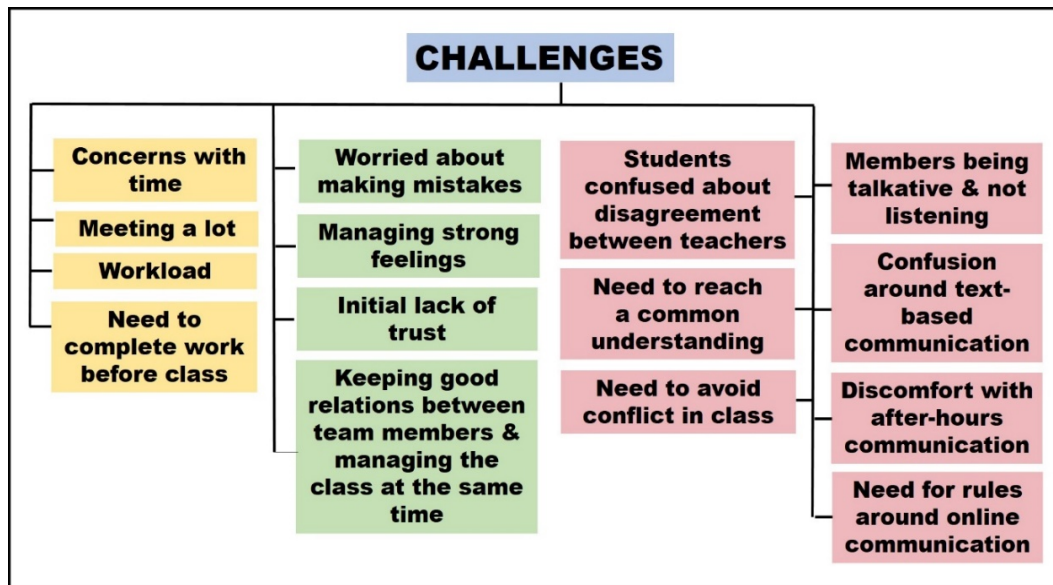


Figure 6: Summary of challenges

Discussion

This study began by highlighting the isolation inherent in a profession that typically puts one teacher in charge of a classroom. This isolation may be more prevalent at the high-school level where teachers tend to be more compartmentalised into specialised subject areas. ITT circumvents this isolation by partnering teachers with two or more colleagues on whom they can depend, not only for cognitive and professional support but affective, personal support as well. The findings of this study in relation to the category of supportive and communicative relationships made evident the professional and personal value of that support. Findings provide empirical evidence for Stewart's (2018) claim that the benefit of a "teaching partner" lies in having someone who can serve "as an informed soundboard for evaluating and developing teaching ideas" (p. 146). Stewart described this benefit as "a key strength" of ITT which was also made evident in this study. This study also provides empirical support for Lock, Clancy, Lisella, Rosenau, Ferreira and Rainsbury's (2016) argument that it is the "mutual trust and respect" that compensates for "the complex uncertainty" of working together (p. 33). Findings also confirm Lock et al.'s argument that, while "conflict and disagreement" may occur, being able to "to openly discuss and negotiate these tensions" can help to "ultimately enhance the relationship" (p. 33). In addition, findings point to the value of positive reinforcement by team members.

As a younger, less experienced teacher, the ITT provided an opportunity for scaffolding and mentoring for Sandra. She became more comfortable sharing ideas. If teaching can be a lonely experience, it may be more isolating for the novice. Johnson, Harrold, Cochran, Brannan and Bleistein (2014) found that feelings of isolation were particularly high among novice teachers of EFL teaching abroad. Results of this study suggest that such loneliness can potentially be alleviated through ITT. Unlike Gunn's (see Gunn & King, 2003) personal experiences of ITT at the secondary school level, in this study, there were no findings related to power struggles and personal conflicts. The difference in the two situations could be partially due to the fact that, while in Gunn's case the ITT had a team leader and an "implicit authority structure" (p. 181), in this study, there was no official leader. Instead leadership was distributed throughout the group. Catherine may have provided more leadership than others, but she was not in a designated leader role that would have allowed her to direct their activity. One of the lessons learned from Gunn's experience (Gunn & King, 2003) was the need for teacher empowerment versus the power and leadership struggles that emerged in the ITT in that context. Results of this study suggest that a distributed/shared leadership style can be effective in terms of empowering team members.

As Somech and Drach-Zahavy (2007) reported, "Good working relationships and interaction between team members in teams are important for team functioning" (p. 305). The category of communication and decision-making shows how leadership can be shared effectively through open and supportive forms of communication that value each member's opinion. Shared leadership was also made possible through a democratic approach to decision-making, giving all members a voice and reinforcing the need to listen to others. This finding points to the personal and inter-personal skills that teachers deployed to make their ITT effective.

An important lesson identified by Gunn and King (2003) was the need for team members to "clarify their models of teaching and learning" (p. 190). For the teachers in this study, the reliance on PBL enabled them to teach within and across disciplines. Although the teachers had separate and distinct subject areas, they shared a common goal, i.e., the project goal of designing a future car. The PBL contributed to the implementation of the ITT by giving teachers (and students) a shared purpose or goal. A hypothesis that emerges from these findings is that having a shared purpose helps avoid certain forms of conflict. The interdisciplinary learning reflected real-world complexity. An example is the focus in the ITT on the mechanical and chemical aspects of cars as well as the social aspects. The results suggest that PBL is a valuable approach for ITT, and that ITT is a valuable and relevant approach for PBL. Additionally, it offered an effective means to promote foreign language learning.

The challenges' category made evident that ITT places demands on teachers' time and workload. Vesikivi, Lakkala, Holvikivi and Muukkonen (2018) also found that those teachers who engaged in team teaching faced time-management challenges but that their ability to overcome these challenges allowed them to benefit from the experience. One pre-service teacher in Crawford and Jenkins' (2018) investigation of team teaching combined with blended learning reported developing "extreme time-management skills"

(p. 138) as a result of participation. The reported challenges of trust and feelings in this study are an example of how the challenges can be balanced by benefits. The category of supportive relationships showed that participating teachers learned to develop trust and respect along with better communication skills as a result of participating in the experience.

Conclusions, limitations and implications

This study was conducted in only one country and in one school. In terms of external validity, it is up to readers to identify parallels with their own context. The ITT was conducted in a very unique type of school. It is not clear whether this type of teaching would be feasible in or scalable to other settings. Little and Hole (2011) found that team teaching demanded "different preparation than traditional, single-instructor courses" (p. 42). Teachers in traditional settings may not be prepared for the time required for this preparation. The ITT was conducted as part of a research project. We do not know if the teachers sustained the ITT once the project ended. However, the study does illustrate that ITT can be effective at the high-school level, and in vocational learning where there is a need or interest in having learning reflect the interdisciplinary complexity of the real world.

The logistics of ITT do not have to follow those portrayed in this study. Subject areas can vary beyond chemistry, mechanics, social studies and a foreign language. The number of teachers may not need to be five as was the case in this study. We do not know if groups of four or six might have altered the outcomes. This study included an "outside" principal investigator who observed and participated in meetings and planning. We do not know if her presence may have positively contributed to the effectiveness of the ITT. We might hypothesise based on these findings that an 'outsider' may potentially support more cohesive relationships between ITT members. However, we do not have any evidence to claim that this occurred in this study. The study investigated teachers' experiences only. We do not know much about students' experiences except through teachers' reported perceptions of benefits for students.

For those interested in engaging in ITT at the high-school level in their own context, findings of this study suggest that the interdisciplinary aspect may be achieved through engagement in PBL. The PBL approach and steps can provide not only a shared purpose but a framework and guidelines to support teachers' planning. Results also point to the value of shared roles and responsibility including shared leadership. In terms of the interpersonal relationships and coming together as a community, findings point to the value of and need for supportive relationships that take into consideration not only professional but personal issues. Open forms of communication that reflect trust, support, positive reinforcement and respect can also support the success of the collaboration. Use of social media for communication and collaboration should be accompanied by guidelines and rules established in advance by team members. Engagement in ITT might be carried out on a short-term and smaller-scale basis than was the case in this study as a means to engage teachers in learning to communicate effectively

together, to share decision-making and leadership, and/or as a means to mentor new and less experienced teachers.

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Appendix A: Interdisciplinary team teaching: Observation form

Activity:	Date:	Time:	
	Team members:		
	Other teacher present:		
Teaching observations			
What is this teacher saying and doing?	What are this teacher's duties and responsibilities in ITT?		
Behaviour management			
Describe student response.			
How does each teacher access all students?			
How do students work with ITT?			
Look for	Rating scale		
	0 - Didn't see it	1 - Saw an attempt	2 - Saw it done well
Instruction is well organized.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members share a lead role in the class.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The teachers share responsibilities for classroom management.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The class moves smoothly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members are involved in checking student understanding.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members begin and end class together and remain in room entire time.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members move around the classroom assisting and monitoring all students' learning.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Listen for	Rating scale		
	0 - Didn't see it	1 - Saw an attempt	2 - Saw it done well
ITT use of language (we; our) demonstrates collaboration and shared responsibility.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members ask questions to students.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ITT members asks someone in team to explain.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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