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Teaching Interprofessional Collaboration through Experiential Learning with Behavioural Psychology, Business, and Engineering Students

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Teaching Interprofessional Collaboration through Experiential Learning with Behavioural Psychology, Business, and Engineering Students

Abstract
Research has indicated that interprofessional collaboration improves client outcomes, enhances work life, optimizes costs, and allows professionals to tackle complex situations with increased knowledge and creativity. However, the inherent barriers and challenges of developing effective interprofessional teams have been documented in the literature. This research explores whether teaching interprofessional collaboration improves students' perceptions of their own interprofessional collaborative competencies. This research provides two experiential learning projects to teach interprofessional collaboration among behavioural psychology, engineering, and business students. In Study 1, interprofessional teams were presented with complex cases, and teams created a functional assessment and developed a function-based treatment using technology developed by the engineering students. During Study 2, community stakeholders provided interprofessional teams with community-based challenges. Students worked collaboratively to analyze why the challenge existed and created innovative solutions based on behavioural economics. Significant increases in the Interprofessional Collaborative Competency Attainment Scale scores were found in both studies. Sentiment analysis results suggested that most students felt that the interprofessional collaboration project benefitted them in terms of communication, collaboration, and synergy. Findings support the effectiveness of IEP in increasing student perceptions of their interprofessional collaborative competency.

La recherche a montré que la collaboration interprofessionnelle améliore les résultats pour les clients, améliore la vie professionnelle, optimise les coûts et permet aux professionnels de faire face à des situations complexes avec des connaissances et une créativité accrues. Cependant, les obstacles et les défis inhérents à la mise en place d'équipes interprofessionnelles efficaces ont été documentés dans les publications. Cette recherche vise à déterminer si l'enseignement de la collaboration interprofessionnelle améliore la perception qu'ont les étudiants et les étudiantes de leurs propres compétences en matière de collaboration interprofessionnelle. Cette recherche propose deux projets d'apprentissage par l'expérience pour enseigner la collaboration interprofessionnelle aux étudiants et aux étudiantes en psychologie comportementale, en ingénierie et en commerce. Dans l'étude 1, des cas complexes ont été présentés à des équipes interprofessionnelles, qui ont créé une évaluation fonctionnelle et élaboré un traitement basé sur la fonction à l'aide d'une technologie mise au point par les étudiants et les étudiantes en ingénierie. Au cours de l'étude 2, les parties prenantes de la communauté ont proposé aux équipes interprofessionnelles des défis à relever au niveau de la communauté. Les étudiants et les étudiantes ont travaillé en collaboration pour analyser les raisons de l'existence du défi et ont créé des solutions innovantes basées sur l'économie comportementale. Des augmentations significatives des scores de l'échelle de réalisation de la compétence de collaboration interprofessionnelle ont été constatées dans les deux études. Les résultats de l'analyse des sentiments suggèrent que la plupart des étudiants et des étudiantes estiment que le projet de collaboration interprofessionnelle leur a été bénéfique en termes de communication, de collaboration et de synergie. Les résultats confirment l'efficacité de l'EIP pour améliorer la perception qu'ont les étudiants et les étudiantes de leur compétence en matière de collaboration interprofessionnelle.

Keywords
interprofessional, interdisciplinary, collaboration, IPE, applied behaviour analysis, business, engineering; collaboration interprofessionnelle, interdisciplinaire, EIP, analyse comportementale appliquée, commerce, ingénierie

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Ethics approval was granted by St. Lawrence College, for one year on November 24, 2021 (SLC-REB#: 2021F-11PS). Research was conducted in accordance with ethical standards of Tri-Council Policy Statement (based on the 1964 Declaration of Helsinki and its amendments) and the ethics code for Behavior Analysts. Freely given informed consent to participate and publish was obtained from all participants included in the study, prior to research. Potential coercion related to power imbalance was addressed by using an RA to collect consents.

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Many of the world's complex issues require innovation, which often transcends the expertise of a single discipline, necessitating interprofessional collaboration. Research has indicated that working across disciplines allows professionals to provide the highest quality of services, improves client outcomes, enhances work life, optimizes costs, enables professionals to tackle complex situations, and increases knowledge, skills, and innovation (Robertson & Bandali, 2008; Slim & Reuter-Yuill, 2021). The medical field has embraced interprofessional collaboration in areas such as diabetes (Conca et al., 2018), geriatrics (Tsakitzidis et al., 2016), autism (Kelly & Tincani, 2013), and mental healthcare (Reeve et al., 2016). To underscore the importance, the World Health Organization (WHO) has created a framework for action on interprofessional education and collaborative practice, encouraging improved interprofessional education and greater adoption of interprofessional collaborative practices (WHO, 2010).

According to the World Health Organization (2010), collaborative practice occurs when health workers from diverse professional backgrounds work together with patients, families, and communities to deliver the highest quality of care. Similarly, the Canadian Interprofessional Health Collaborative (CIHC; 2010) defines interprofessional collaboration as a partnership between a team of professionals and the client in a participatory, collaborative approach with shared decision-making. Other terms include interdisciplinary, referring to two or more academic or scientific disciplines, and transdisciplinary, which involves transcending an individual discipline to collaborate and construct knowledge (Center of Innovative Teaching and Learning, 2020). Another common term in health care is integrated care, which focuses on improving the patients' experiences by creating efficient, coordinated, and continuous care with a shared vision (Shaw et al., 2011). Working models of combining disciplines range from providing separate disjointed treatments to models in which disciplines work cooperatively together from the beginning to the end, sharing knowledge and creating solutions based on consensus and collaboration (Boyer & Thompson, 2013; King et al., 2009). Much of the information about interprofessional collaborative models and definitions has been gained through the field of medicine.

While collaborative service models have been an area of interest in medicine for many decades, our rapidly evolving world and complex problems have demanded innovative solutions in many fields. Interprofessional collaboration has been a focus in disciplines such as business, engineering, speech and language, education, and applied behaviour analysis (Boni et al., 2009; Dosser et al., 2001; Khalafi et al., 2023; LaFrance et al., 2019; Slim & Reuter-Yuill, 2021; Tang, 2019; Taylor et al., 2019; Wilson et al., 2017; Zwarenstein et al., 2009). Within the field of engineering, increased demand for technology innovation across industries has changed practices from monodisciplinary to transdisciplinary. Keeping up with industry standards, educators have examined transdisciplinary design (Butt et al., 2018) and project-based course designs (Blakeney et al., 2020). Similarly, ethical codes and the task list in the field of applied behaviour analysis identify the importance of the collaborative relationship with the family, clients, and other professionals (Behavior Analyst Certification Board, 2017). Research within these fields recognizes the collaborative approach; however, despite its significance, interprofessional collaboration remains challenging due to numerous barriers.

Barriers to Interprofessional Collaboration

Inherent challenges impeding effective interprofessional collaboration implementation have been well documented. Goldman et al. (2018) observed 160 hours of clinical practice in an

intensive care unit (ICU) and found that interprofessional collaboration within hospital ICUs was affected by contextual factors such as pressures to discharge, staffing, and lack of prioritization. Research has found that collaboration can be affected by differing ideologies, professional role conflicts, and poor interprofessional communication (Brodhead, 2015; Dosser et al., 2001). Within education, students are taught highly technical skills, technical language, and discipline pride (Kelly & Tincani, 2013; Taylor et al., 2018). These essential skills may lead to a lack of understanding of other professionals and an inability to recognize knowledge limitations and value the expertise of other professionals trained in different areas. Kazemi et al. (2022) found that many professionals experienced conflict with other professionals to the level of losing clients and wishing to leave the workplace. Given the inherent challenges and shortfalls of ineffective interprofessional collaboration, one may consider education and training as a possible solution.

Traditional undergraduate and graduate education tend to occur within disciplinary silos. While graduates are usually aware of the importance of interdisciplinary collaboration, few possess the tools to participate in interdisciplinary work effectively (Kazemi et al., 2022). At times, students may be fortunate to obtain experience during placements working within interdisciplinary teams; however, during placements, there is little intentional training in effective strategies to work collaboratively within these teams. Kelly and Tincani (2013) interviewed 302 behavioural professionals and found that most participants had little to no formal training in the area of collaboration, yet 62% of respondents reported collaborating with other disciplines daily. In order to address these gaps and advance training in interprofessional collaboration, pertinent skills must be identified to create effective collaborators.

Core Competencies of Interprofessional Collaborative Practice

One vital resource to isolate interprofessional collaborative skills is the Interprofessional Education Collaborative (IPEC). This national organization representing healthcare professionals created multidisciplinary teams with over 60 professionals from over 30 fields, including behavioural, law, and veterinary medicine. These teams created and published a list of four core competencies for interprofessional collaborative practice (Interprofessional Education Collaborative, 2016). These include: 1) values and ethics (create a climate of mutual respect and shared values); 2) roles and responsibilities (share and acknowledge team members' roles and abilities); 3) interprofessional communication (communicate in a responsive manner); and, 4) teams and teamwork (apply relationship-building values and principles). The Canadian Interprofessional Health Collaborative (CIHC; 2010) similarly created a national interprofessional competency framework of six competency domains: interprofessional communication, patient/client/family/community-centered care, role clarification, team functioning, collaborative leadership, and lastly, interprofessional conflict resolution. Other research has identified enhanced communication (listening, inviting, acknowledging differences, and validating), embracing diversity of perspectives, role clarification, and synergistic solutions based on grouped knowledge and compromise (Block, 2011; Cox, 2012; CIHC, 2010; IPEC, 2016; Slim & Reuter-Yuill, 2021). Farrell (2016) emphasized the importance of creating an inclusive culture that is open to and welcomes a team approach, ensuring that the contributions of each member are heard and respected. Brodhead (2012) discussed the importance of interpersonal skills and professional humility within the collaborative skill repertoires. Researchers have identified many essential skills necessary to be effective interprofessional collaborators. However, there is quite a different ideology for educating future professionals in these areas.

Interprofessional Education

Teaching interventions offer a promising avenue to reduce barriers and foster increased interprofessional skills by equipping professionals with the necessary skills and knowledge to navigate interprofessional contexts. Interprofessional education (IPE) focuses on teaching future professionals the capacity to effectively work collaboratively and to learn from other professionals (Jones et al., 2015). The pedagogy of IPE is diverse, and there has been a call for greater alignment (IOM, 2015). To identify the most effective strategies in IPE, past research has been explored.

Guraya and Barr (2018) completed a meta-analysis of the effectiveness of interprofessional education in healthcare workers in terms of improvement in students' knowledge, skills, and attitudes. These researchers found limited literature meeting their requirements on the effectiveness of IPE, and the authors suggested an overreliance on qualitative methods. The researchers found that out of 8453, only 12 articles met the criteria. However, the meta-analysis found that IPE reduced barriers and misconceptions and increased professionalism. The meta-analysis found that the teaching pedagogy was varied. One common approach represented was a combination of didactic and interactive activities.

Dosser et al. (2001) taught a course on children's mental health, which was delivered by collaborative interdisciplinary practice using a team-teaching approach of interdisciplinary faculty. The course focused on the types of interdisciplinary models within family services and their strengths and challenges. The teaching model included didactic instruction, role plays, guest lectures, case studies, and panel discussions. The descriptive results indicated that students gained a more sophisticated knowledge of interdisciplinary collaboration. Hessels et al. (2015) provided an interactive toolbox workshop in a 14-week course for 15 undergraduate nursing students. Results of a pre-and post-survey indicated that students perceived an improvement in competencies. Zanotti et al. (2015) implemented a course on interactions with healthcare professionals for 277 second-year medical students. The program consisted of field observations and skilled activities tutored by nurses or other healthcare professionals. Statistically significant improvements were found on the Interdisciplinary Education Perception Scale (IEPS).

Another strategy represented in the literature is the use of simulated learning in an interprofessional environment to replicate experiences students may face within their professions (Banks et al., 2019; Khalafi et al., 2023). Simulation can be defined as a set of conditions that present problems authentically to reproduce a wide variety of clinical conditions (Rauen, 2004). The learners are required to respond to the problems as if under natural circumstances. The advantages of a simulation model are that students are learning within context, experiencing communication challenges, and experiencing collaboration and the unique contribution of each member of the team (Mattick & Bligh, 2003; Robertson & Bandali, 2008). Hayward et al. (2016) used an experiential learning model with five engineering, physical therapy, and speech-language pathology students to design, create, and deliver communication devices to nonverbal orphans in Ecuador. The research included a small group of students, and the qualitative results were positive. Khalafi et al. (2023) used three simulation scenarios for 72 anesthesiology residents and nurse anesthesia students. They evaluated the students using the Readiness for Interprofessional Learning Scale (RIPLS) and found significant positive change. Within a systematic review of interprofessional simulation-based education programs, Sezgin and Bektas (2023) found eight articles on interprofessional simulation-based education programs matching their criteria. The researchers' outcome measures differed; however, all researchers found that simulation-based education programs significantly improved teamwork and communication.

Another promising model to examine IPE is using a behaviour analytic lens. Busch et al. (2020) suggested that interprofessional collaboration can be conceptualized as a meta-contingency. A meta-contingency is the relation between 1. interlocking behavioural contingencies (IBCs), which create an aggregate product, and 2. selecting consequences (Glen et al., 2020). In terms of interprofessional collaboration, individuals working in a team serve as both prompters and reinforcers for each other, which results in an aggregate product (say, an innovative computer app). The selecting consequences may be their company accepting the app or sending the team back to the drawing board. This selecting consequence will determine if the team engages in similar behaviours in the future or if the team is sent back to the drawing board; the group may change their interlocking contingencies. More simply, people are more likely to collaborate if they feel valued, heard and if the individuals they collaborate with are pleasant and encouraging and finally if the team is successful. Maintaining interprofessional collaboration will be more likely if effective interlocking contingencies occur and their product (what they created as a group) is reinforced. For example, one individual can serve as a cue for the behaviour (i.e., "What do you think we should do?") and as a reinforcer to another ("I love that idea, that is so creative, let's add this to your idea"). This interlocking behavioural contingency may be particularly effective in developing a collaborative relationship. Teaching individuals to ask questions will act as a prompt for another professional to share information. Further, teaching individuals to acknowledge and validate the answering behaviour will be reinforcing to the person participating, thus making this person more likely to participate in the future and may also act as a prompt to ask another professional a question. Thus, when considering teaching interprofessional behaviours that we want to maintain after education, researched-based meta-contingencies are important and may lead to a high-quality interprofessional collaboration that endures.

Measures of Competencies of Interprofessional Collaborative Practices

Yet another important aspect of teaching interprofessional collaboration is assessing the effectiveness of the instruction. Havyers et al. (2013) found in a review of IPE research that there were 73 unique instruments used to measure IPE. Having a common quantitative instrument to measure collaborative skills may be a helpful method of comparing the effectiveness of pedagogy. MacDonald et al. (2010) refined a psychometric test in an attempt to evaluate IPE quantitatively. The Interprofessional Collaboration Competencies Attainment Survey (ICCAS) was refined based on competencies identified by the CIHC. The 20-item self-report instrument was designed to assess behaviours associated with collaborative practices after receiving IPE. Schmitz et al. (2017) replicated the validation of the ICCAS and found the measure sound with solid overlaps in the constructs assessed and evidence of validity, with high internal consistency (0.90 and 0.87). There are limitations in the survey in that it is a self-report; thus, the actual interprofessional collaborative behaviours are not being measured. This instrument was also created to be administered at the end of IPE, and students were asked to reflect retrospectively on their ability before and after the IPE. There is speculation that a retrospective approach may create post-score inflation due to the students' desire to reflect on their efforts and abilities (Drennan & Hyde, 2008). Providing this evaluation before and after IPE may control for this variable. The current study will address this and other research gaps related to teaching interprofessional collaboration skills.

In summary, while there is a growing body of research to support effective interprofessional education within the medical field, inconsistent measurements have been used to evaluate the effectiveness of the IPE, the IPE pedagogy is inconsistent, the constructs of

interprofessional collaborative behaviours are not well defined, there is reported over-reliance on qualitative methods (IOM, 2015), and there is a lack of research using disciplines other than health care. This research explored the effectiveness of two interprofessional education experiences. These experiential projects were co-facilitated by interdisciplinary faculty. The first experience (Study 1) included a one-hour didactic instruction on interprofessional collaboration, an experiential learning project with interprofessional teams from engineering students and behavioural psychology students, and weekly reflective class discussions. The second experience (Study 2) included a one-hour didactic instruction, a practice activity with facilitation coaches, an experiential learning project with business and behavioural psychology students, and weekly reflective class discussions. Within both research studies, interprofessional collaboration was clearly defined using five constructs identified within research as important collaborative skills: establishing common goals, communication exchange, mutual respect, role clarification, and synergy (Block, 2010; Bush et al., 2020; Cox, 2012; CIHC, 2010; Farrell, 2016; IPEC, 2016; Slim & Reuter-Yuill, 2021). This research reported both qualitative and quantitative data using a validated measure. This research aimed to evaluate the effectiveness of these simulations and experiential learning opportunities using the ICCAS. Namely, does teaching IPC improve students' perceptions of their own IPC competency?

Study 1

Introduction

Effective collaboration across diverse disciplines is vital for addressing multifaceted challenges in today's complex and interconnected world. In particular, the integration of engineering and behavioural psychology offers promising avenues for problem-solving and innovation. Recognizing the importance of cultivating interprofessional collaboration skills early in students' academic journey, this research study explores a cross-disciplinary approach to enhance undergraduate students' collaborative competencies in engineering and behavioural psychology.

Method

Participants

Participants included 20 second-year degree-level behavioural psychology students. Using convenience sampling, behavioural psychology students were selected from a second-year undergraduate class of 60 students. Twenty class members provided consent and completed the revised ICCAS before and after the training. A total of 180 first-year engineering students participated in the experiential learning project, but their data were not part of this study for two reasons. The engineering students were from a different university and were international students. These students were excluded because of the vast potential for extraneous factors, as these students were online living in various countries during COVID-19. It was also particularly challenging to get consent from these students.

Research Design

A within-subject research design with a before-and-after approach was used to determine changes in interprofessional collaborative competency.

Measures

Participants were provided with the revised survey Interprofessional Collaborative Competency Attainment Scale (ICCAS; Macdonald et al., 2010) via Survey Monkey. The ICCAS contained 20 questions on which students rated their abilities on competencies necessary for interprofessional collaboration. For a more detailed description of this, please see the introduction section. Survey questions were based on a Likert scale from 1-5, which ranged from (1) *Poor* to (5) *Excellent* (see Appendix A). This measure was revised in two ways. It was used as a pre-post measure rather than a post-measure, and a final question was added to the end of the post-measure only (see Appendix B). This question was also a Likert scale and was placed as an overall self-assessment of their improvement after the intervention. The addition of this question was not validated in the literature. However, this question was not used in the pre-post analysis. Hence, the pre-post evaluation used the original questions, 1 to 20, to identify if students rated their competency higher on skills identified as required for interprofessional collaboration. Question 21 was analyzed in isolation (Appendix B).

Procedures

Consent was obtained online using a research assistant to remove a potential power imbalance of the professor being aware of students' participation and scores. Pseudonyms were used within the ICCAS to ensure students were not identified and to remove the potential for students to mark themselves higher in order to achieve higher grades. Freely given informed consent to participate and publish was obtained from all participants included in the study prior to research and approved by the institutional Research Ethics Board.

The study was 12 weeks within a typical 14-week semester. Two bachelor of behavioural psychology students (BPSYC) and six engineering students (BASc) were assigned to each team and provided with a fictitious complex case. Students were assigned teams at the beginning of the 14-week period. Each team member from the behavioural psychology background was asked to fill out the survey Interprofessional Competency Attainment Scale using Survey Monkey, using a pseudonym.

Didactic Lesson on Interprofessional Collaboration

Prior to the team meeting, a one-hour session on interprofessional collaboration occurred. The lesson defined interprofessional collaboration, including the advantages and inherent barriers. The lesson included discussion and elaboration on five key constructs of interprofessional collaboration (Table 1). Examples of each construct were provided in models, and students were asked to volunteer to practice the constructs. The constructs were taken from the research as discussed in the introduction. Each of the constructs was observable and measurable. For example, under communication exchange, specific behaviours such as encouraging everyone to participate and reinforcing individuals for participation are observable concrete behaviours. This created

behaviours that were easily modeled and easy to provide feedback for but also were more objective for students to self-monitor and discuss during the weekly check-ins.

Table 1

Five Constructs of Interprofessional Collaboration

Interprofessional Collaboration Construct	Operational Definition
Establish Goal	At the beginning of the collaboration, establish and record a goal. Restate the common goal during all meetings and when there are disagreements.
Communication Exchange	Defer judgment of any idea. Encourage and reinforce team members' wild ideas. Team members should ask their team members three questions for each statement and listen to their answers. If members are not participating, team members should encourage them. Team members should provide encouragement and praise for participating.
Role Clarification	What is your role, share knowledge from field using common terms, be prepared to represent information and be open to discuss.
Mutual Respect	Team members should embrace the diversity of expertise. Encourage varying cultural views and diverse perspectives. All team members should be respectful of each other and always professional, even when disagreeing. Disagreement should be expected and focused on the topic, not the person.
Synergy	Reflect and integrate unique competencies. Ensure ideas of each discipline are incorporated and built upon.

Simulation

The assignment was for the BPSYC students to develop a treatment by applying a technology designed by BEng students. The BPSYC students were asked to complete a functional behavioural assessment of a complex case and, based on the assessment, develop a competing model solution, including the use of innovative technology. The BEng students worked in collaboration with BPSYC students to understand the need that the technology must be designed to fulfill an application to the treatment and consideration of project constraints, environmental factors, and stakeholders. BEng students solicited formal feedback from BPSYC students during at least three formal meetings. Students were encouraged to maintain periodic communication throughout the 12-week period. The BEng students provided an overview of the technology for the BPSYC students, for its implementation, within the treatment procedures. BEng and the BPSYC students were assessed on separate deliverables related to the project. Throughout the 12-week period, professors and teaching assistants (TAs) provided weekly guidance and opportunities to discuss collaboration in an informal setting, focusing on the five constructs of interprofessional collaboration.

Behaviour Analytic Strategies

In order to develop a meta contingency that supports collaborative behaviours, skills to support interlocking behavioural contingencies (IBCs) were focused on within the communication category of the five constructs. Specifically, students were taught to reinforce wild ideas, and to ask three questions before making a statement. Students were taught to prompt wild ideas and prompt individuals not participating. Lastly, there was a great emphasis on praising group members for participation. These skills were taught through didactic lessons as well as role plays. Finally, these skills were discussed during the weekly discussion period.

Final Session

At the end of the semester, the programs evaluated separate components of the collaboration. Once the interprofessional simulation was completed, participants were again asked to complete the survey 'Collaborative Competency Attainment Scale' (Appendix B) in Survey Monkey using the identification pseudonym.

Results

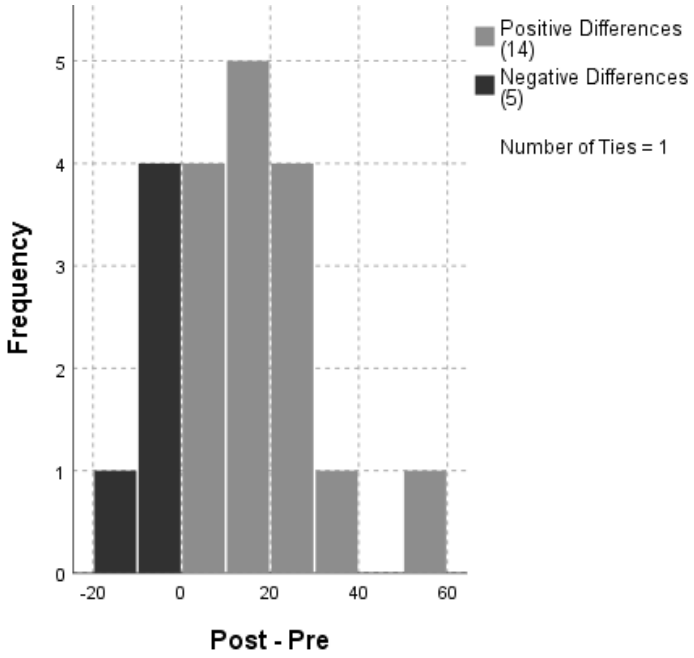
Of the 60 students enrolled in the course, approximately one-third (n = 20; 33%) completed the ICCAS survey before and after the project. The descriptive statistics can be found in Table 2.

Table 2
Descriptive Statistics of Behavioural Psychology Students' Performance on the Interprofessional Collaboration Competency Attainment Survey (ICCAS) Before and After Completing an Interprofessional Simulation

	N	Mean	Std. Deviation	Minimum	Maximum
Before	20	67.95	12.245	40	94
After	20	80.55	11.105	63	100

The mean score of ICCAS shows improvement (80.55) after training, which was 67.95 before training. Using SPSS Software, both the Wilcoxon Signed Rank test and the paired sample t-test were used to analyze the differences in the paired data of the ICCAS before-after scores. It was hypothesized that the after-training would show a greater skill score than the before-training. The results from the Wilcoxon Signed Rank test indicated that the mean difference between before and after scores of the ICCAS was significant (Z= -2.918167.50, $p < 0.001$). These results suggest that the null hypothesis can be rejected. These results support the hypothesis that the training impacted the ICCAS scores, with greater skill reported after the training. Paired sample t-test results (t = 3.478, $p < 0.001$) supported the outcome of the Wilcoxon Signed Rank test. Cohen's d value (16.332) and Hedges' Correction (17.015) indicate that the effect of training has been very powerful for this group. The frequency diagram demonstrates the positive differences (Figure 1).

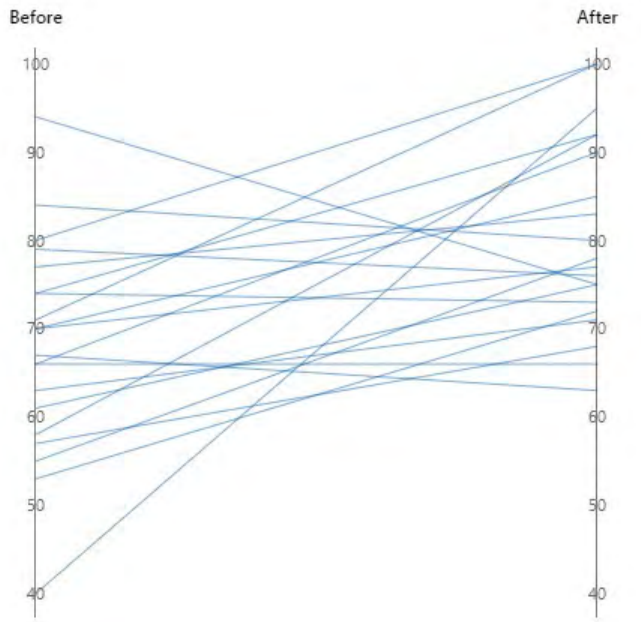
Figure 1
Related Samples Wilcoxon Signed Rank Test



The individual participant's scores in the ICCAS can be seen in the parallel coordinates plot of before and after (Figure 2). The before-training score values are widely scattered with a minimum of 40, a maximum of 94 scores with a standard deviation of 12.245 before training, and less scattered scores after the training with a minimum score of 63, a maximum score of 100 with a lesser standard deviation of 11.10. This implies that the score values increased after training, and the score variations also decreased.

Figure 2

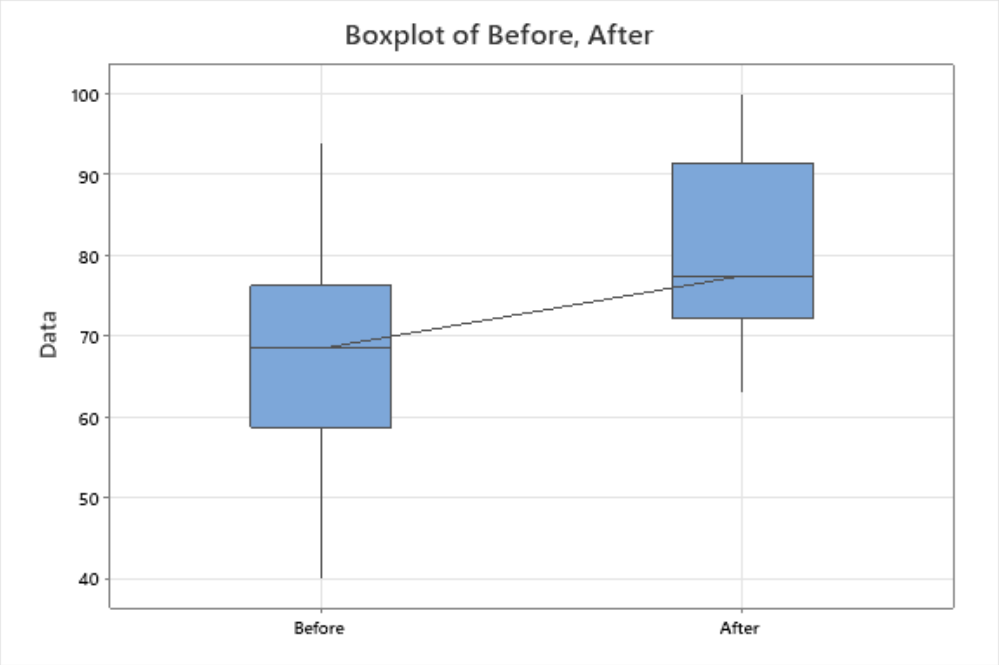
A Parallel Coordinates Plot of Before and After Scores of the ICCAS



The overall scores in the ICCAS can be seen in the Boxplot of before and after (Figure 3). The Boxplot demonstrates the increase in the mean score between before and after training. The visualization is on a group level of before and after training. The before-training Boxplot's mean value is lower than that of the after-training Boxplot, showing that the average score after training is greater than the before-training score. In addition, the whiskers before training are widely spread compared to training Boxplot's whiskers showing that scores are less scattered after training.

Figure 3

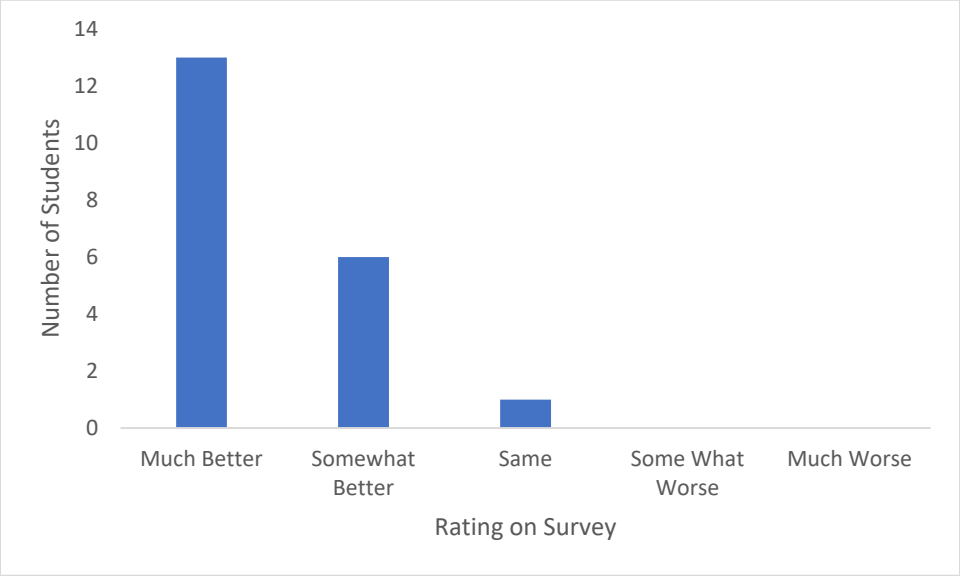
A Box Plot of Before and After Scores of the ICCAS



The additional question added to the ICCAS asked the students to reflect on their abilities in interprofessional collaboration compared to before the learning activity. In the analysis of these results, 95% of students indicated that they were much better or somewhat better after the intervention, and 5% felt there was no change (Figure 4).

Figure 4

Responses To Question 21 "Compared to The Time Before the Learning Activities, Would You Say Your Ability of Interprofessional Collaboration is… (Circle One)"



Discussion

This research study explored a cross-disciplinary approach to enhance undergraduate students' collaborative competencies in engineering and behavioural psychology students. Results indicated that the scores on the ICCAS increased significantly following the intervention for the behavioural psychology students. Ninety-five percent of these students indicated they felt better or somewhat better at interprofessional collaboration. This study led to a second study in which business and behavioural psychology students participated in a slightly modified approach to teaching interprofessional collaboration.

Study 2

Introduction

Study 2 was similar to Study 1, except the collaboration was between 4th-year undergraduate behavioural psychology students and senior business students. Also, the problems were real problems brought forward by industry stakeholders. Lastly, this study had the advantage of being in person. Thus, practice problems and coaches could be employed to facilitate the five constructs of interprofessional collaboration.

Method

Participants

Participants included fourth-year degree-level Behavioural Psychology students (BPSYC) and upper-level Bachelor of Business Administration (BBA) students.

Selection Procedures

Using convenience sampling, participants were selected from an undergraduate class of 41 fourth-year Bachelor of Behavioural Psychology (BPSYC) students and 13 upper-level Bachelor of Business Administration (BBA) students. Forty-two members of the two classes provided consent and completed the revised ICCAS before and after the training.

Research Design

A within-subject research design was used to determine changes in interprofessional collaborative competency.

Measures

Participants were provided with the revised survey Interprofessional Collaborative Competency Attainment Scale (ICCAS; Macdonald et al., 2010). Please refer to Study 1 for details.

Sentiment Analysis

A student reflection paper was distributed at the end of the study, and students could anonymously describe how they felt they developed in terms of communication, collaboration, synergy, and what they would change for the next team experience (Appendix C). This data was entered into Power BI to obtain a sentiment analysis.

Interprofessional Coaches

Four coaches received 30 minutes of training on interprofessional collaboration from the principal investigator. The five constructs were reviewed. The coaches were trained to prompt the behaviours and reinforce the constructs. The coaches were provided with cue cards of behaviours to reinforce during the kick-off. Students were encouraged to reinforce their peers. Thus, coaches faded out their reinforcement to allow teams interdependent reinforcement.

Procedures

Consent was obtained in person using a research assistant to remove a potential power imbalance of a professor being aware of students' participation and scores. Similar to Study 1, pseudonyms were used within the ICCAS to ensure students were not identified.

The period for the study involved a 6-week project within a typical 14-week semester. Four Bachelor of Behavioural Psychology students (BPSYC) and two Bachelor of Business Administration students (BBA) were assigned to each team and provided with an industry challenge from a community stakeholder. Students were pre-assigned teams during the project kick-off. Each team member was asked to complete the Interprofessional Competency Attainment Scale survey in person, using a pseudonym. The consent and surveys were collected by a research assistant with the professors out of the room.

Didactic Lesson on Interprofessional Collaboration

Prior to the team meeting, a one-hour session on interprofessional collaboration occurred, teaching the five key constructs as in Study 1, with the exception that the lesson occurred in person.

Behaviour Analytic Strategies

Behaviour analytic strategies were focused on similar to that of Study 1.

In-Person Rehearsal and Feedback

Teams completed an icebreaker problem of building a tower using the five interprofessional collaboration constructs. Coaches facilitated this process, prompting and reinforcing the target skills such as participants' reinforcement of team members' participation, reinforcing creative ideas, and restating goals. Following this, the team practiced a scenario to create a solution to a fictitious real-world problem using concepts from behavioural economics. The interprofessional coaches prompted and reinforced the target five constructs during this

process. Students were encouraged to reinforce their team members. Thus, coaches faded out their reinforcement to allow teams interdependent reinforcement.

Once the training was completed, two to three teams were randomly assigned to one of the four community stakeholders with an industry problem. Teams used tools presented in the didactic training and practiced within the practice scenario to gain information on the industry problem. Interprofessional coaches used subtle prompts and thumbs up to encourage interprofessional collaboration during this process. Participants had five weeks to work in teams to develop an innovative solution. Teams presented their solutions to the stakeholders in the final presentation.

At the end of the presentation, the industry stakeholders provided feedback on the solutions the teams created. The stakeholders chose the most creative solution that met the needs they had presented to the teams. Teams were required to hand in a summary of the industry problem as presented, the inherent function of the problem, and the innovative solution. Teams also handed in team minutes from at least five meetings. Grades were assigned based on creativity, their understanding of the presenting problem, and the effective use of behavioural economic strategies; five bonus marks were also provided to each winning team. Grading was completed by both teachers collaboratively.

Once the interprofessional activity was completed, participants were again asked to complete the survey 'Collaborative Competency Attainment Scale' in person, using the identification pseudo name and placed in a pile in front of the Research Assistant without identifying information (Appendix A).

Students were asked to hand in their reflections on the project (Appendix C) on the presentation date. Students were encouraged to fill this in before the date in order to provide more time to reflect on their experiences.

Results

Of the 54 students enrolled in the study, approximately three-quarters (n = 42; 78%) completed the ICCAS survey before and after the project. The descriptive statistics can be found in Table 3.

Table 3

Descriptive Statistics of Performance on the ICCAS Before and After Completing an Interprofessional Simulation

	N	Mean	Std. Deviation	Minimum	Maximum
Before	42	72.57	10.414	38	90
After	42	89.24	8.684	71	100

The mean score of ICCAS demonstrated improvement (89.24) after training which was 72.57 before training.

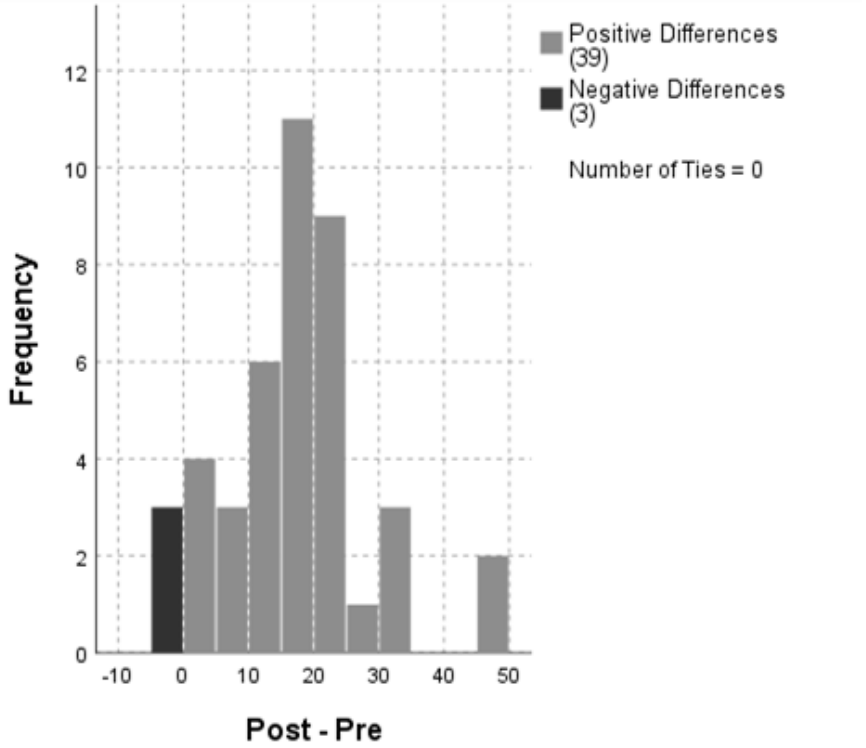
Using SPSS Software, both the Wilcoxon Signed Rank test and paired sample t-test were used to analyze the differences in the paired data of the ICCAS before-after scores. It was hypothesized that training would increase the scores from before to after training. The results from the Wilcoxon Signed Rank test supported the hypothesis and indicated that the mean difference between before and after scores of the ICCAS was significant (Z = -5.485, p< 0.001), and the null hypothesis could be rejected. In addition, a paired sample t-test results (9.705, p < 0.001) supported

the outcome of the Wilcoxon Signed Rank test. Cohen's d value (11.128) and Hedges' Correction (11.337) indicate that the effect of training has been very powerful for this group.

This supports the conclusion that the training positively impacted the students' perception of their interprofessional collaboration skills. Figure 5 visually demonstrates the positive differences.

Figure 5

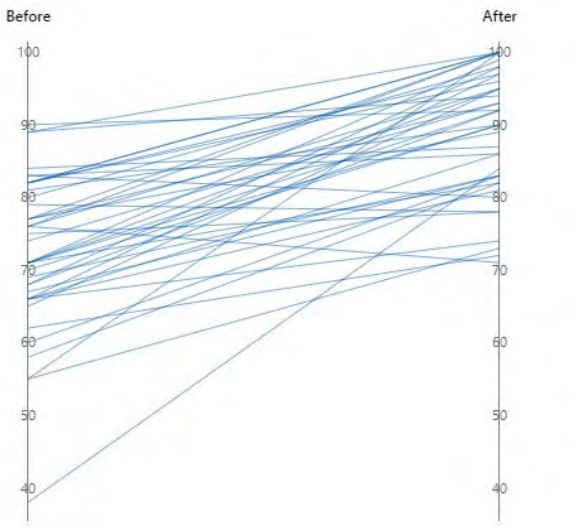
Related-Samples Wilcoxon Signed Rank Test



The individual participant's scores in the ICCAS can be seen in the parallel coordinates plot of before and after (Figure 6). The score values are widely scattered with a minimum of 38, a maximum of 90 scores with a standard deviation of 10.414 before training, and less scattered scores after the training with a minimum score of 71, a maximum score of 100 with a lesser standard deviation of 8.68. This implies that the scores have increased after training, and the score variations have also decreased.

Figure 6

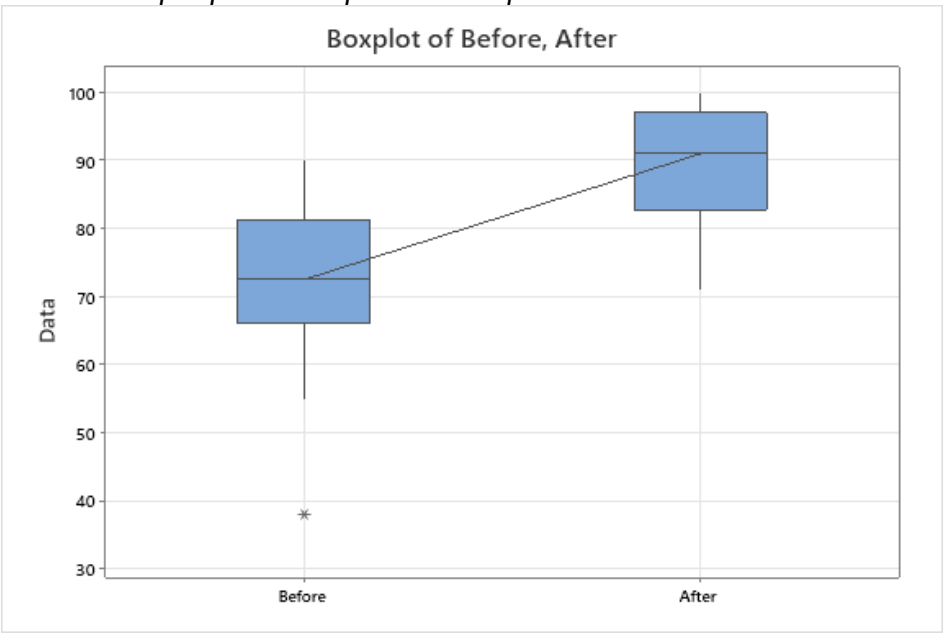
A Parallel Coordinates Plot of Before and After Scores of the ICCAS for Study 2



The overall scores in the ICCAS can be seen in the Boxplot of before and after (Figure 7). The Boxplot demonstrates the increase in the median score between before and after training. The before-training Boxplot's median value is lower than that of the after-training Boxplot, showing that the average score after training is greater than before. In addition, the whiskers of before training are widely spread compared to that of after training Boxplot's whiskers showing that after training, scores are less scattered.

Figure 7

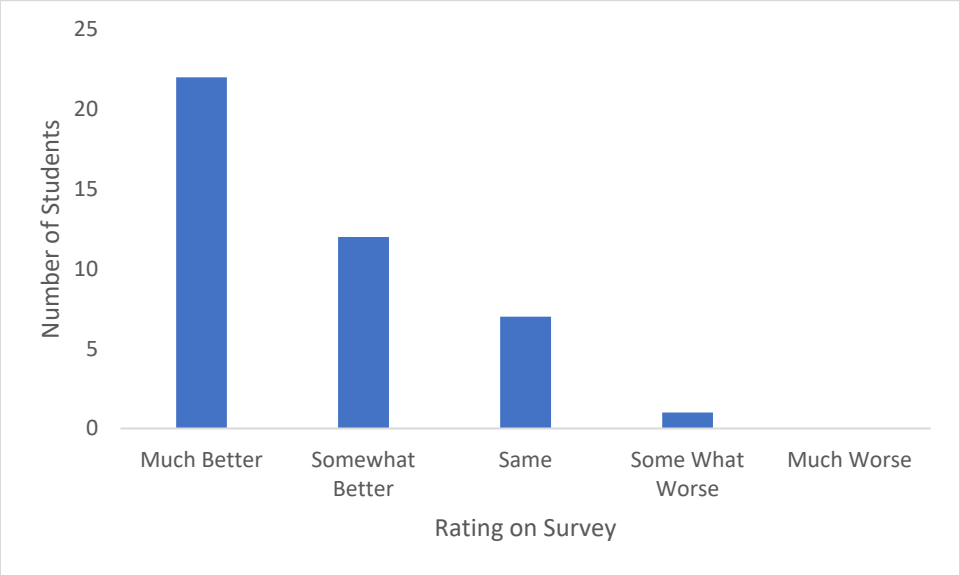
A Box Plot of Before and After Scores of the ICCAS



The additional question that was added to the ICCAS asked the students to reflect on how they felt their abilities of interprofessional collaboration compared to before the learning activity. In the analysis of these results, 81% of students indicated that they were much better or somewhat better after the intervention, 17% felt no change, and 2% indicated that they were somewhat worse (Figure 8).

Figure 8

Responses To Question 21 "Compared to The Time Before the Learning Activities, Would You Say Your Ability of Interprofessional Collaboration is… (Circle One)"



Qualitative Analyses

To better explore students' experiences within the experiential learning opportunities, a sentiment analysis was conducted using the visualization tool Power BI from the student feedback forms (Appendix C). The student responses were copied into the software, and the software organized buckets with the following parameters: a score sentiment of < 0.35 was categorized as strongly negative; a score sentiment of < 0.48 was moderately negative; a score sentiment of 0.51 was categorized as neutral; a score sentiment of < 0.8 was categorized as moderately positive and finally a score of 1 was categorized as strongly positive. The results of the 42 student reflections were summarized in terms of communication, collaboration, and synergy skills (Figures 9, 10, and 11).

The results of the sentiment analysis of the students' perspectives related to communication development found that 84% of participants were moderately or strongly positive (Figure 9). The students were positive about the training, benefiting them and improving their communication. Some students conveyed that they learned assertive and contextual communication while working in diverse teams, and their active listening skills improved (Table 4). The students reported that the training helped them understand that this project was a combination of team and individual efforts (Table 4). A negative response indicated that the individual had yet to learn any new communication skills but applied the communication skills they had previously learned.

Figure 9

Summary of the Sentiment Analysis of Student Perspectives Related to Communication Development

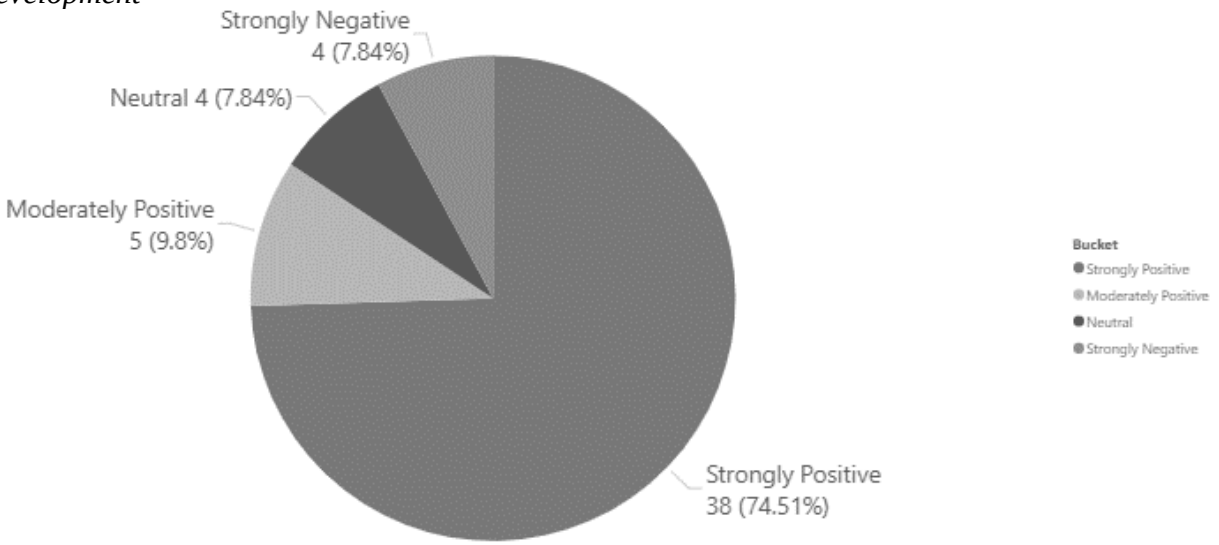


Table 4

Students' Reflections on Experiential Learning Projects

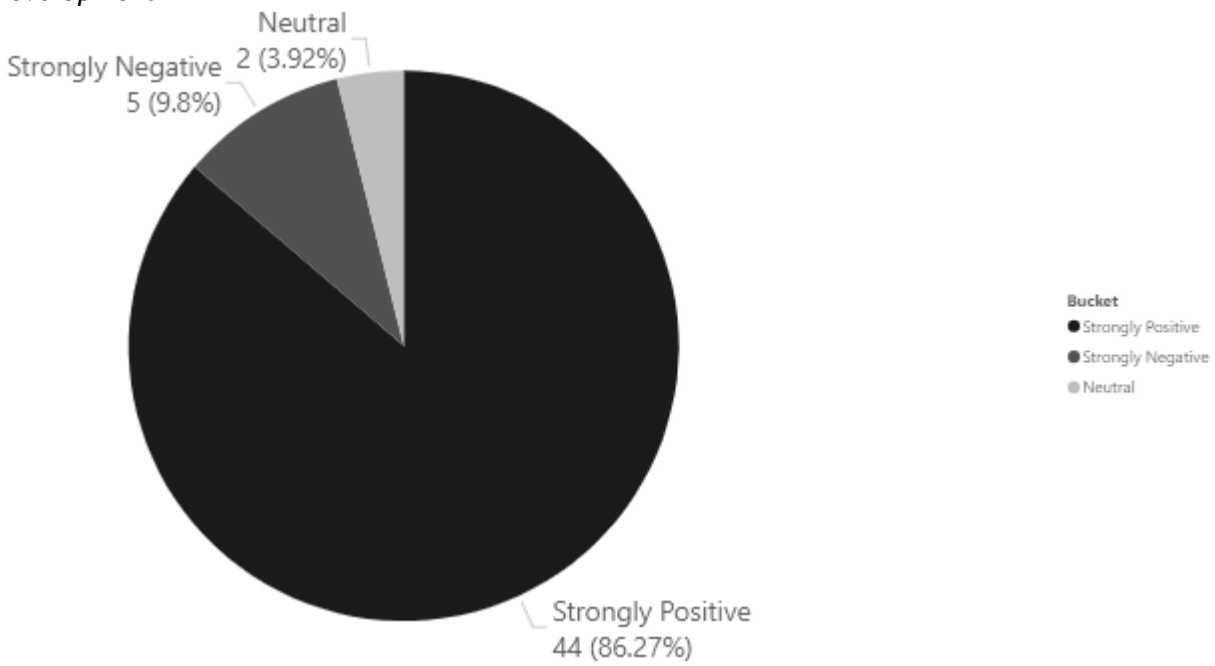
I learned that it is okay if someone has different opinions than me and found that if I wasn't sure about the idea, it just meant that I wasn't fully grasping what they were saying.
I believe this experience really pushed me to use my oral communication skills to share ideas and information. I took more initiative during this project to ensure the project remained relevant and on task.
Throughout this project, I had to effectively explain and simplify concepts. It allowed me to practice using concise and clear communication.
This project allowed me to practice and improve my abilities to encourage, support, and motivate others.
We learned to build on each other's ideas and concepts.
I learned that it is important to always make sure that each group member gets the opportunity to voice their opinions on the topic and to give others feedback in a supportive and respectful way.
I learned how to communicate with different interdisciplinary teams with different skill sets. At first, I was worried about feeling lost or confused. However, during this project, I learned how to explain our skills in layperson terms and how to ask questions about a different skill to be able to understand it.
We taught our business students some behavioural aspects, and they taught us some business topics. This project could not have been completed well without having both mindsets involved.

Note. Each statement are exact words written by students. Reflections were included if they represented themes that were expressed a minimum of three times.

The sentiment analysis results of the students' perspectives related to collaboration development found that 86.27% of participants were moderately or strongly positive (Figure 10). Students presented positively related to the inter-professional collaboration project and its benefits to improved collaboration skills within the team environment. Some participants shared that they learned about the significance of team goals, being open-minded and flexible, division of work, delegation, giving and receiving feedback, trust, self-awareness, valuing others' perspectives, diversity, mindfulness, problem-solving skills, teamwork, organizational skills, and inter-dependency (Table 4).

Figure 10

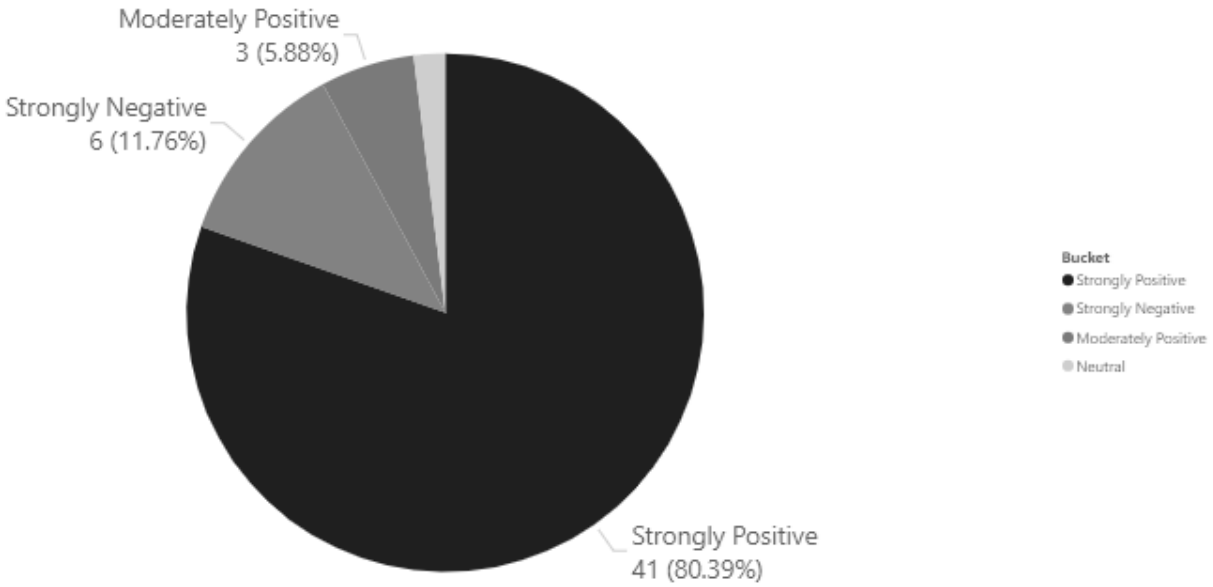
Summary of the Sentiment Analysis of Student Perspectives Related to Collaboration Development



The sentiment analysis results of the students' perspectives related to in-group synergy found that 86% of participants were strongly positive (Figure 11). Students were positive that their group had synergy while working on the inter-professional collaboration project. Participants elaborated on synergy in bouncing off each other's ideas, easy communication, easy acceptance of others' ideas, and being impressed with co-members' abilities to reach a solution (Table 4). Students reported the development of better inter-professional relations, being empathetic to each other, and engaging in cooperative group work. Among the 12% of negative responses, it was mentioned that being a full-time student means they have so much work in regular classes and hence less time to work on this project. Another explanation for not having a group synergy was the presence of many leaders in a group, resulting in difficulty reaching a single solution. Finally, it was shared that having a defensive member in a group affects group synergy negatively.

Figure 11

Summary of the Sentiment Analysis of Student Perspectives Related to Synergy Development



Discussion

This research study explored a cross-disciplinary approach to enhance undergraduate students' collaborative competencies in business and behavioural psychology. Results indicated that the scores on the ICCAS increased significantly following the intervention. Eighty percent of students indicated they were better or somewhat better at interprofessional collaboration. A sentiment analysis suggested that most students felt that the interprofessional collaboration project benefited them in terms of communication, collaboration, and synergy.

General Discussion

This research aimed to evaluate the effectiveness of IPE using the ICCAS. Namely, does teaching IPC improve students' perceptions of their own IPC competency? The two interprofessional education experiences included didactic instructions, interprofessional projects with teams of BPSYC students, engineering students, and business students, and weekly discussions focusing on the five constructs identified within research as essential collaborative skills: establishing common goals, communication exchange, mutual respect, role clarification, and synergy. The results from both experiments found an increase in students' ICCAS scores, supporting research that IEP was effective (Guraya &Barr, 2028: Mattick & Bligh, 2003; Robertson & Bandali, 2008; Hayward et al., 2016).

The main difference between the two studies was that Study 1 was entirely online. Also, coaches were added to the initial kick-off only for Study 2, and the stakeholders were real with industry challenges for Study 2. Another difference between the two studies was the addition of the sentiment analysis within Study 2.

The sentiment analysis of student reflections supports that students felt the experiential learning activity increased their ability to communicate and collaborate, and students experienced

synergy within their interprofessional teams. This helps to better understand the social validity of Study 2. The sentiment analysis suggested high social validity among students. Student reflections were also collected to provide more insight into student feedback related to the experiences. Student feedback (Table 4) helps identify areas of future work in interprofessional collaboration. Within the feedback, students spoke about the new awareness of other fields and the mutual respect gained for the disciplines within the study.

This study also extended research bridging interprofessional silos, which are not commonly explored, to broaden the range of subject areas from research in medicine to areas of engineering, business, and behavioural psychology. This provided insight into unfamiliar fields and broke down educational silos. Bridging silos within learning institutions provides a model of interdisciplinary collaboration to students, creates opportunities for students to become familiar with other disciplines, and generates building blocks for students to understand how to broaden their perspective to include information from other disciplines to help understand complex issues. These broadened perspectives may also be related to the concrete operationalization of interprofessional skills.

Constructs of interprofessional collaboration were operationalized using constructs identified by the CIHC, the IEC, and other research. These observable constructs provided opportunities to role model and practice and for students to better self-edit. Vague terminology, such as communicating in a responsive manner, was replaced with concrete behaviours, such as asking three questions before making a statement. This provided clear goals for students and led to effective discussions and often role plays within discussions. Also, during Study 2, coaches had clear concrete areas to prompt and reinforce. These may have also provided opportunities for a more concrete and accurate self-evaluation using the ICCAS.

The validated ICCAS provided a quantifiable measure of the students' perceived impact in areas related to interprofessional collaboration, such as promoting effective communication, actively listening to team members, and expressing ideas and concerns without judgment. Schmitz et al. (2017) suggested using a standardized tool to measure the effects of IPE to compare the effectiveness of IEP better. These researchers found that MacDonald et al. (2010) ICCAS had high internal consistency and felt that it measured interprofessional collaboration constructs identified by research. Providing the ICCAS before and after the studies removed concerns reported in past literature on students retrospectively self-editing their responses to support their value of skill development (Drennan & Hyde, 2008). Also, by allowing the students to use pseudonyms, the students were not compelled to elevate their perceived skills to impress the researchers/professors.

Another advantage of this study was that presenting and analyzing two studies allows researchers to speak to potential barriers and advantages of strategies. One advantage of the first study was that it was online. This design overcame some of the common logistical barriers in IPE. Finding common times and physical spaces provide barriers that can be challenging across disciplines. The online venue allowed students to link across distances, across universities, and even across countries saving travel time and providing opportunities to work around varying school schedules, increasing opportunities to work with students of different cultures, and increasing opportunities to bridge silos. While online training has clear advantages, multiple strengths were identified for Study 2.

Since Study 2 occurred in person, additional strategies for coaching and practicing interprofessional skills in team-building exercises could be included. This may be a particularly effective strategy for targeting skills, which may lead to developing an effective meta-contingency for interprofessional collaborative teams. Concrete skills to develop and maintain a collaborative

relationship could be modeled, practiced, prompted, and reinforced. Research suggests that skills that create an effective interlocking behavioural contingency may lead to effective collaborative relationships, which may be maintained by the interlocking contingency and by consequences to their aggregate product (Glen et al., 2020). Another advantage of the second study was that the presenting problems were real industry challenges provided by stakeholders, and the solutions were presented directly to the stakeholders. The students also received critiques from these stakeholders, providing more authenticity. Authentic assessments hold great value in education as they provide realistic evaluations of learners' knowledge, skills, and abilities (Rennert-Ariev et al., 2019). Unlike traditional assessments, authentic assessments emphasize the application of knowledge in real-world contexts, promoting higher-order thinking skills, such as critical thinking skills and problem-solving. They foster the development of essential 21st-century skills like collaboration and communication. Authentic assessments motivate learners by emphasizing the relevance and authenticity of the tasks, leading to increased engagement and deeper understanding. Ultimately, authentic assessments bridge the gap between theory and practice, preparing learners for real-world challenges and equipping them with the skills needed for success in their chosen fields (Rennert-Ariev et al., 2019).

An advantage observed in both strategies was the weekly discussions. This provided opportunities for feedback, and the benefits of collaboration became more salient to the participants. Positive feedback provided immediate rewards. In real life, the ultimate outcome is often unknown to the participants or significantly delayed. Research on proximal and distal outcomes suggests that more immediate rewards are more powerful (Cooper et al., 2020). These weekly discussions also provided opportunities to problem-solve conflicts using the five constructs. This provided multiple opportunities to operationalize and practice these essential constructs of IPC. This supports the advantages discussed in the simulation model, in which students are learning within context, experiencing communication challenges, and experiencing collaboration and the unique contribution of each member of the team (Mattick & Bligh, 2003; Robertson & Bandali, 2008). Having students reflect and discuss these challenges while experiencing them or hearing from peers' experiences provides valuable teaching tools.

Finally, this study supports past research on the effectiveness of didactic instruction using interdisciplinary instructors, role plays, and discussions (Dosser et al., 2001; Hessels et al., 2015), as well as simulated learning (Banks et al., 2019; Hayward et al., 2016; Khalafi et al., 2023). It also provides a model for project-based, interdisciplinary, experiential learning, which may provide students with multiple opportunities within their education to shape these skills rather than within a single course.

Limitations

Limitations associated with this research should be noted. This is a within-subject research design. The primary challenge with this design is time. Study 1 was 12 weeks in duration, and Study 2 was 6 weeks in duration. Students may have experienced other encounters or training in these areas or have matured within this time frame. Of note, both studies found significant differences in the ICCAS score regardless of the length of the study. Also of note is the decrease in the variance of scores on the post-tests compared to the pre-tests. This decrease in variability suggests a more aligned knowledge of professional collaboration. Thus, in both studies, students' knowledge became more consistent following interprofessional experiential learning. Research has indicated that when the responses of individuals are aligned, they have a similar knowledge

base, indicating that the increase in the ICCAS scores may be attributed to the projects (Rasmussen, 1983).

Secondly, the ethnic origin and racial characteristics of the participants had not been reported in the studies. Cultural differences may affect the education process. These researchers acknowledge the importance of research within all cultures to ensure that all cultures are equally represented. Future research may focus on cultures as they interrelate with interprofessional competencies and education.

Also, of note, only 33% of the students enrolled in the class in Study 1 were represented in the present study. This was likely due to the online version and the extra effort of sending in the signed consent as well as the two evaluations for both before and after the project. Study 2 was centre-based, requiring less effort to participate in the research requirements, and had a participation rate of 78%. The low participation rate in Study 1 may be seen as a bias in the sample in that only the most engaged students participated fully in the study. However, the results of both studies demonstrated similar increases in scores and a decrease in the variability of the post-test score.

Also of note, although these results were primarily quantitative, they are self-reports. Self-reports are less accurate than observing actual changes in human behaviour. Although the IPE appears to have improved the participants' perception of increased interprofessional collaborative skills, there is no direct cause-and-effect relationship between IPE and system outcomes. This study has not evaluated the actual skills. Future research can be directed to a causal relationship between IPE and skill outcomes.

A final challenge in both studies is the increased time in faculty facilitation required for these projects. The time commitment to organize and open communication across silos is a further barrier for faculty. Careful considerations of pedagogy, academic support, and required coursework should be considered when developing IPE.

Summary

Given the inherent challenges and barriers of interprofessional collaboration that professionals are struggling with, providing opportunities for students to practice and learn collaboration throughout their education may change the trajectory of these critical skills. Through two separate studies, the present investigation has shown that incorporating interprofessional experiential learning opportunities within the curriculum impacts students' self-perception of interprofessional competence. Students specifically reported increased skills in communication, collaboration, and synergy within the interprofessional experiential learning opportunities. These two studies provide models to intentionally explore effective best practice standards for IPE and focus on disciplines with little research in interprofessional training. The research provided defined constructs of IPC, supported by research. It incorporated behaviour analytic strategies and didactic and simulation-based training. It used a validated measure, the ICCAS, to provide a consistent measure of IPE for research and used the measure before and after the procedure. Interprofessional education holds tremendous potential in preparing future professionals to navigate a complex world. More research is needed to foster collaborative practice further and reduce educational silos.

References

Alvinius, A., Kylin, C., Starrin, B., & Larsson, G. (2014). Emotional smoothness and confidence building: boundary panners in a civil-military collaboration context. *International Journal of Work Organization and Emotion*, *6*(3), 223 –239. https://doi.org/10.1504/IJWOE.2014.065757

Alwan, L. C., Craig, B. A., & McCabe, G.P. (2020). *The practice of statistics for business and economics*. W.H. Greeman & Company. https://doi.org/10.7205/MILMED-D-15-00558

Ancona, D. F., & Caldwell, D. F. (1992). Bridging the boundary: External activity and performance in organizational teams. *Administrative Science Quarterly 37*(4), 634–665. https://doi.org/10.2307/2393475

Bailey J., & Burch M. (2010). *25 essential skills and strategies for the professional behavior analyst.* Routledge Taylor & Francis Group.

Banks, S., Stanley, M. J., Brown, S., & Matthew, W. (2019). Simulation-based interprofessional education: A nursing and social work collaboration. *Journal of Nursing Education*, *58*(2), 110 –113. https://doi.org/10.3928/01484834-20190122-09

Baum, W. M. (2017). *Understanding behaviorism: Behavior, culture, and evolution*. John Wiley & Sons.

Behaviour Analyst Certification Board. (2017). *BCBA/BCaBA Task List (5th ed.).* https://www.bacb.com/wp-content/uploads/2020/05/170113-BCBA-BCaBA-task-list-5th-ed-.pdf

Blakeney, E. A. R., Kang, S., Henrikson, K., Liu, J. T., Seibel, E. J., Sprecher, J., Summerside, N., Vogel, M. T., Zierler, B. K., & Posner, J. D. (2021). Implementation and evaluation of team science training for interdisciplinary teams in an engineering design program. *Journal of Clinical and Translational Science*, *5*(1), 127. https://doi.org/10.1017/cts.2021.788

Block, P., & Markowitz, A. (2011). *The flawless consulting field book and companion: A guide to understanding your expertise* (3rd ed). John Wiley & Sons.

Boni, A. A., Weingart, L. R., & Evenson, S. (2009). Innovation in an academic setting: Designing and leading a business through market-focused, interdisciplinary teams. *Academy of Management Learning & Education*, *8*(3), 407–417. https://doi.org/10.5465/amle.8.3.zqr407

Boyer, V. E., & Thompson, S. D. (2013). Transdisciplinary model and early intervention: Building collaborative relationships. *Young Exceptional Child, 17*(3), 19–32. https://doi.org/10.1177/1096250613493446

Brodhead, M. T. (2015). Maintaining professional relationships in an interdisciplinary setting: Strategies for navigating non-behavioral treatment recommendations for individuals with autism. *Behavior Analysis in Practice*, *8*(1), 70–78. https://doi.org/10.1007/s40617-015-0042-7

Brodhead, M. T., & Higbee, T. S. (2012). Teaching and maintaining ethical behavior in a Professional organization. *Behavior Analysis in Practice, 5*(2), 82–88. https://doi.org/10.1007/BF03391827

Busch, L. P., Porter, J., & Barreira, L. (2020). The untapped potential of behaviour analysis and interprofessional care. *Journal of Interprofessional Care*, *34*(2), 233–240. https://doi.org/10.1080/13561820.2019.1633292

Butt, M., Sharunova, A., Storga, M., Khan, Y. I., & Qureshi, A. J. (2018). Transdisciplinary engineering design education: Ontology for a generic product design process. *Procedia CIRP, 70,* 338-343. https://doi.org/10.1016/j.procir.2018.02.019

Canadian Interprofessional Health Collaborative. (2010). *A national interprofessional competency framework.* https://phabc.org/wp-content/uploads/2015/07/CIHC-National-Interprofessional-Competency-Framework.pdf

Center for Innovative Teaching and Learning. (2020, Nov 17). Transdisciplinary and interdisciplinary approaches. https://citl.news.niu.edu/2020/11/17/transdisciplinary-interdisciplinary/

Conca, T., Saint-Pierre, C., Herskovic, V., Sepúlveda, M., Capurro, D., Prieto, F., & Fernandez-Llatas, C. (2018). Multidisciplinary collaboration in the treatment of patients with type 2 diabetes in primary care: analysis using process mining. *Journal of Medical Internet Research, 20*(4), 127. https://doi.org/10.2196/jmir.8884

Cooper, J. O., Heron, T. E., & Heward, W. L. (2020). *Applied behavior analysis, 3rd ed.*, Pearson.

Cortés-Rodríguez, A. E., Roman, P., López-Rodríguez, M. M., Fernández-Medina, I. M., Fernández-Sola, C., & Hernández-Padilla, J. M. (2021, December). Role-play versus standardised patient simulation for teaching interprofessional communication in care of the elderly for nursing students. *In Healthcare, 10*(1), 46. https://doi.org/10.3390/healthcare10010046

Cox, D. J. (2012). From interdisciplinary to integrated care of the child with autism: The essential role for a code of ethics. *Journal of Developmental Disorders, 42*, 2729–2738. https://doi.org/10.1007/s10803-012-1530-z

Critchfield T. S., Doepke K. J., Epting K. L., Becirevic A., Reed D. D., Fienup D. M., Kremsreiter, J. L., & Ecott, C. L. (2017). Normative emotional responses to behavior analysis jargon or how not to use words to win friends and influence people. *Behavior Analysis in Practice. 10*(2), 97–106. https://doi.org/10.1007/s40617-016-0161-9

Dillenburger, K., Röttgers, H-R, Dounavi, K., Sparkman, C., Keenan, M., Thyer, B., & Nikoloulos, C. (2014). Multidisciplinary teamwork in autism: Can one size fit all? *The Educational and Developmental Psychologist, 31*(2), 97–112. https://doi.org/10.1017/edp.2014.13

Dosser, D. A., Handron, D. S., McCammon, S. L., Powell, J. Y., & Spencer, S. S. (2001). Challenges and strategies for teaching collaborative interdisciplinary practice in children's mental health care. *Families, Systems, & Health*, *19*(1), 65. https://doi.org/10.1037/h0089464

Drennan, J., & Hyde, A. (2008). Controlling response shift bias: The use of the retrospective pre-test design in the evaluation of a master's programme. *Assessment & Evaluation in Higher Education, 33,* 699–709. https://doi.org/10.1080/02602930701773026

Farrell, C. (2016). The ethics and value of true interprofessional. *AMA Journal of Ethics, 18*(9), 887– 890. https://doi.org/10.1001/journalofethics.2016.18.9.fred1-1609

Friman, P. C. (2010). Come on in, the water is fine: Achieving mainstream relevance through integration in primary medical care. *The Behaviour Analyst, 33*, 19–36. https://link.springer.com/article/10.1007/BF03392201

Glen, S., Malott, M., Andery, M., Benvenuti, M., Houmanfar, R., Sandaker, I., Todorov, J., Tourinho, E., & Vasconcelos, L. (2020). Toward consistent terminology in behaviorist approach to cultural analysis in T. M. Cihon & M. A. Mattaini (Eds.), *Behavior science perspectives on culture and community*. (pp. 23-41). Springer.

Goldman, J., Kitto, S., & Reeves, S. (2018). Examining the implementation of collaborative competencies in a critical care setting: Key challenges for enacting competency-based education. *Journal of Interprofessional Care, 32*(4), 407–415. https://doi.org/10.1080/13561820.2017.1401987

Guraya, S. Y., & Barr, H. (2018). The effectiveness of interprofessional education in healthcare: A systematic review and meta-analysis. *The Journal of Medical Sciences, 34*(3), 160–165. https://doi.org/10.1016/j.kjms.2017.12.009

Havyers, R. D. L., Wingo, M. T., Comfere, N. I., Nelson, D. R., Halvorsen, A. J., McDonald, F. S., & Reed, D. A. (2013). Teamwork assessment in internal medicine: A systematic review of validity evidence and outcomes. *Journal of General Internal Medicine, 29*, 894–910. https://doi.org/10.1007/s11606-013-2686-8

Hayward, L. M., Meleis, W., Mahanna, J., & Ventura, S. H. (2016). Interprofessional collaboration among physical therapy, speech-language pathology, and engineering faculty and students to address global pediatric rehabilitation needs: A case report. *Journal of Physical Therapy Education, 30*(4), 24–34. https://doi.org/10.1097/00001416-201630040-00005

Hessels, A. J., Robinson, B., O'Rourke, M., Begg, M. D., & Larson, E. L. (2015). Building interdisciplinary research models through interactive education. *Clinical and Translational Science, 8*(6), 793–799. https://doi.org/10.1111/cts.12354

Hunt P, Soto G, Maier J, Doering K. (2003). Collaborative teaming to support students at risk and students with severe disabilities in general education classrooms. *Exceptional Children 69*(3), 315–332. https://doi.org/10.1177/001440290306900304

Interprofessional Education Collaborative. (2016). Core competencies for interprofessional collaborative practice: 2016 update. UNM Health Sciences. https://ipec.memberclicks.net/assets/2016-Update.pdf

IOM (Institute of Medicine). (2015). *Measuring the impact of interprofessional education on collaborative practice and patient outcomes*. The National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK338356/#sec_000022

Irwin, K., & Berigan, N. (2013). Trust, culture, and cooperation: A social dilemma analysis of pro-environmental behaviors. *Sociological Quarterly*, *54*(3), 424–449. https://doi.org/10.1111/tsq.12029

Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition, theory, and research*. Interaction Book Company.

Jones, J., McQueen, M., Lowe, S., Minnes, P., & Rischke, A. (2015). Interprofessional education in Canada: Addressing knowledge, skills, and attitudes concerning intellectual disability for future healthcare professionals. *Journal of Policy and Practice in Intellectual Disabilities*, *12*(3), 172–180. https://doi.org/10.1111/jppi.12112

Kazemi, E., Carter, C. & Davies, M.S. (2022). Workplace conflict in applied behavior analysis: Prevalence, impact, and training. *Behavior Analysis Practice*, *15*(2), 608–618. https://doi.org/10.1007/s40617-021-00649-6

Khalafi, A., Sarmeydani, N. S., & Akhoondzadeh, R. (2023). Simulation-based interprofessional education (IPE) for enhanced attitude and teamwork of anesthesiology residents and nurse anesthesia students in Iran. *Journal of Advances in Medical Education & Professionalism*, *11*(2), 105. https://doi.org/10.30476/JAMP.2022.95701.1657

Kelly, A., & Tincani, M. (2013). Collaborative training and practice among applied behavior analysts who support individuals with autism spectrum disorder. *Education and Training in Autism and Developmental Disabilities*, *48*(1), 120–131. https://www.jstor.org/stable/23879891

King, G., Strachan, D., Tucker, M., Duwyn, B., Desserud, S., & Shillington, M. (2009). The application of a transdisciplinary model for early intervention services. *Infants and Young Children*, *22*(3), 211–223. https://doi.org/10.1097/IYC.0b013e3181abe1c3

LaFrance, D. L., Weiss, M. J., Kazemi, E., Gerencser, J., & Dobres, J. (2019). Multidisciplinary teaming: Enhancing collaboration through increased understanding. *Behavior Analysis in Practice*, *12*(3), 709–726. https://doi.org/10.1007/s40617-019-00331-y

LeBlanc, L. A., Heinicke, M. R., & Baker, J. C. (2012). Expanding the consumer base for behavior-analytic services: Meeting the needs of consumers in the 21st. century. *Behavior Analysis in Practice*, *5*(1), 4–14. https://doi.org/10.1007/BF03391813

MacDonald, C., Archibald, D., Trumpower, D., Casimiro, L., Cragg, B., & Jelly, W. (2010). Designing and operationalizing a toolkit of bilingual interprofessional education assessment instruments. *Journal of Research in Interprofessional Practice and Education*, *1*(3), 304–316. https://doi.org/10.22230/jripe.2010v1n3a36

Mattick, K. & Bligh, J. (2003). Interprofessional learning involving medical students or doctors. *Medical Education*, *37*(11), 1008–1011. https://doi.org/10.1046/j.1365-2923.2003.01681.x

Pedler, M. (Ed.). (2011). *Action learning in practice*. Gower Publishing, Ltd.

Rasmussen, J. (1983). Skills, rules, and knowledge; signals, signs, and symbols, and other distinctions in human performance models. *IEEE transactions on systems, man, and cybernetics*, *13*(3), 257–266. https://doi.org/10.1109/TSMC.1983.6313160

Rauen, C. A. (2004). Simulation as a teaching strategy for nursing education and orientation in cardiac surgery. *Critical care nurse*, *24*(3), 46-51. https://doi.org/10.4037/ccn2004.24.3.46

Reeve, J., Cooper, L., Harrington, S., Rosbottom, P., & Watkins, J. (2016). Developing, delivering and evaluating primary mental health care: The co-production of a new complex intervention. *BMC Health Services Research, 16*, 470. https://doi.org/10.1186/s12913-016-1726-6

Reeves, S., Perrier, L., Goldman, J., Freeth, D., & Zwarenstein, M. (2013). Interprofessional education: Effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews*, *1*(3). https://doi.org/10.1002/14651858.CD002213.pub3

Rennert-Ariev, P. (2019). A theoretical model for the authentic assessment of teaching. *Practical Assessment, Research, and Evaluation*, *10*(1), 2. https://doi.org/10.7275/a7h7-4111

Robertson, J., & Bandali, K. (2008). Bridging the gap: Enhancing interprofessional education using simulation. *Journal of Interprofessional Care*, *22*(5), 499–508. https://doi.org/10.1080/13561820802303656

Schiller, U., Jaffray, P., Ridley, T., & Du Plessis, C. (2021). Facilitating a participatory action learning action research process in a higher educational context. *Action Research*, *19*(2), 301–317. https://doi.org/10.1177/1476750318776715

Schmitz, C. C., Radosevich, D. M., Jardine, P., MacDonald, C. J., Trumpower, D., & Archibald, D. (2017). The interprofessional collaborative competency attainment survey (ICCAS): A replication validation study. *Journal of Interprofessional Care*, *31*(1), 28–34. https://doi.org/10.1080/13561820.2016.1233096

Scott, K. S. (2017). An integrative framework for problem-based learning and action learning: Promoting evidence-based design and evaluation in leadership development. *Human Resource Development Review*, *16*(1), 3–34. https://doi.org/10.1177/1534484317693090

Sezgin, M. G., & Bektas, H. (2023). Effectiveness of interprofessional simulation-based education programs to improve teamwork and communication for students in the healthcare profession: A systematic review and meta-analysis of randomized controlled trials. *Nurse Education Today*, *120* (105619). https://doi.org/10.1016/j.nedt.2022.105619

Shaw, S., Rosen, R., & Rumbold, B. (2011). What is integrated care. *Nuffield Trust*, *7*, 1–23.

Slim, L., & Reuter-Yuill, L. M. (2021). A Behaviour-Analytic Perspective on Interprofessional Collaboration. *Behaviour Analysis in Practice*, *14*(4), 1238–1248. https://doi.org/10.1007/s40617-021-00602-7

Stern, P. C., & Dietz, T. (1994). The value basis of environmental concern. *Journal of Social Issues*, *50*(3), 65–84. https://doi.org/10.1111/j.1540-4560.1994.tb02420.x

Tang, M. (2019). Fostering creativity in intercultural and interdisciplinary teams: the victory model. *Frontiers in Psychology*, *10*, 2020. https://doi.org/10.3389/fpsyg.2019.02020

Taylor, B. A., LeBlanc, L. A., & Nosik, M. R. (2019). Compassionate care in behavior analytic treatment: Can outcomes be enhanced by attending to relationships with caregivers? *Behaviour Analysis in Practice*, *12*(3), 654–666. https://doi.org/10.1007/s40617-018-00289-3

Tsakitzidis, G., Timmermans, O., Callewaert, N., Verhoeven, V., LopezHartmann, M., Truijen, S., Meulemans, H. & Van Royen, P. (2016). Outcome indicators on interprofessional collaboration interventions for elderly. *International Journal of Integrated Care*, *16*(2), 5. https://doi.org/10.5334/ijic.2017

Wilson, L., McNeill, B., & Gillon, G. T. (2017). Inter-professional education of prospective speech–language therapists and primary school teachers through shared professional practice placements. *International Journal of Language & Communication Disorders*, *52*(4), 426-439. https://doi.org/10.1111/1460-6984.12281

World Health Organization. (2010). *Framework for action on interprofessional education and practice.* https://apps.who.int/iris/bitstream/handle/10665/70185/?sequence=1.

Zanotti, R., Sartor, G., & Canova, C. (2015). Effectiveness of interprofessional education by on-field training for medical students, with a pre-post design. *BMC Medical Education 15*, 1–8. https://doi.org/10.1186/s12909-015-0409-z

Zwarenstein, M., Goldman, J., & Reeves, S. (2009). Interprofessional collaboration: effects of practice-based interventions on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews, 2017*(3). https://doi.org/10.1002/14651858.CD000072.pub2

Appendix A:
The Interprofessional Collaborative Competency Attainment Scale (Revised)(ICCAS)

Using the following scale, please rate your ability for each of the following statements: 1 = "Poor"; 2 = "Fair"; 3 = "Good"; 4 = "Very good"; 5 = "Excellent"

Before participating in the learning activities, I was able to:
1. Promote effective communication among members of an interprofessional team 1 2 3 4 5
2. Actively listen to interprofessional team members' ideas and concerns. 1 2 3 4 5
3. Express my ideas and concerns without being judged. 1 2 3 4 5
4. Provide constructive feedback to interprofessional team members. 1 2 3 4 5
5. Express my ideas and concerns in a clear, concise manner. 1 2 3 4 5
6. Seek out interprofessional team members to address issues. 1 2 3 4 5
7. Work effectively with interprofessional team members to enhance the project. 1 2 3 4 5
8. Learn with, from and about interprofessional team members. 1 2 3 4 5
9. Identify and describe my abilities and contributions to the project. 1 2 3 4 5
10. Be accountable for my contributions to the interprofessional team. 1 2 3 4 5
11. Understand the abilities and contributions of interprofessional team. 1 2 3 4 5
12. Recognize others' skills and knowledge. 1 2 3 4 5
13. Use an interprofessional team approach with the project. 1 2 3 4 5
14. Use an interprofessional team approach with idea generation. 1 2 3 4 5
15. Value the interprofessional approach to generating innovative solutions. 1 2 3 4 5
16. Actively listen to the perspectives of interprofessional team members. 1 2 3 4 5
17. Take into account the ideas of interprofessional team members. 1 2 3 4 5
18. Address team conflict in a respectful manner. 1 2 3 4 5
19. Develop an effective project with interprofessional team members. 1 2 3 4 5
20. Negotiate responsibilities within overlapping scopes. 1 2 3 4 5

Adapted from "Designing and operationalizing a toolkit of bilingual interprofessional education assessment instruments," by C. MacDonald, D. Archibald, D. Trumpower, L. Casimiro, B. Cragg, and W. Jelly, W. (2010). *Journal of Research in Interprofessional Practice and Education, 1*(3), 304–316. https://doi.org/10.22230/jripe.2010v1n3a36 In the public domain. Adapted with permission.

Appendix B
The Interprofessional Collaborative Competency Attainment Scale (Revised)(ICCAS)

Using the following scale, please rate your ability for each of the following statements:
1 = "Poor"; 2 = "Fair"; 3 = "Good"; 4 = "Very good"; 5 = "Excellent"

After participating in the learning activities, I was able to:
1. Promote effective communication among members of an interprofessional team 1 2 3 4 5
2. Actively listen to interprofessional team members' ideas and concerns. 1 2 3 4 5
3. Express my ideas and concerns without being judged. 1 2 3 4 5
4. Provide constructive feedback to interprofessional team members. 1 2 3 4 5
5. Express my ideas and concerns in a clear, concise manner. 1 2 3 4 5
6. Seek out interprofessional team members to address issues. 1 2 3 4 5
7. Work effectively with interprofessional team members to enhance the project. 1 2 3 4 5
8. Learn with, from and about interprofessional team members. 1 2 3 4 5
9. Identify and describe my abilities and contributions to the project. 1 2 3 4 5
10. Be accountable for my contributions to the interprofessional team. 1 2 3 4 5
11. Understand the abilities and contributions of interprofessional team. 1 2 3 4 5
12. Recognize others' skills and knowledge. 1 2 3 4 5
13. Use an interprofessional team approach with the project. 1 2 3 4 5
14. Use an interprofessional team approach with idea generation. 1 2 3 4 5
15. Value the interprofessional approach to generating innovative solutions. 1 2 3 4 5
16. Actively listen to the perspectives of interprofessional team members. 1 2 3 4 5
17. Take into account the ideas of interprofessional team members. 1 2 3 4 5
18. Address team conflict in a respectful manner. 1 2 3 4 5
19. Develop an effective project with interprofessional team members. 1 2 3 4 5

20. Negotiate responsibilities within overlapping scopes. 1 2 3 4 5
21. Compared to the time before the learning activities, would you say your ability to collaborate interprofessional is... (circle one) 1 = Much better now; 2 = Somewhat better now; 3 = About the same; 4 = Somewhat worse now; 5 = Much worse now

Adapting from "Designing and operationalizing a toolkit of bilingual interprofessional education assessment instruments," by C. MacDonald, D. Archibald, D. Trumpower, L. Casimiro, B. Cragg, and W. Jelly, W. (2010). *Journal of Research in Interprofessional Practice and Education, 1*(3), 304–316. https://doi.org/10.22230/jripe.2010v1n3a36 In the public domain. Adapted with permission.

Appendix C
Self-Reflection

What communication skills did I learn during this project?

What are collaborative skills did I learn during this project?

Do you feel your group had synergy? Why/Why not

What would you do differently when working within an interprofessional team next time?