



## Research

## Effects of a cross-university interprofessional education programme on nursing students: A concurrent nested study

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## ARTICLE INFO

## Article History:

Accepted 4 April 2025

## Keywords:

Attitudes  
Competency  
Interprofessional education  
Knowledge  
Skills

## ABSTRACT

**Background:** Interprofessional collaborative practice has caused considerable interest but the effects of integrating interprofessional education (IPE) into a nursing therapeutics subject have not been investigated.**Aim:** To evaluate students' attitudes, knowledge, skills, competency in interprofessional collaboration, and experiences in IPE.**Methods:** A concurrent nested design was adopted. Students were assessed using scales before and after the programme. A focus group interview was also conducted.**Results:** Among 159 nursing students, a statistically significant increase after the programme was found in knowledge of the roles and scopes of medicine, social work, pharmacy, traditional Chinese medicine, engineering, and law ( $p < 0.05$ ), interprofessional team skills ( $p < 0.001$ ), and competency ( $p < 0.001$ ). Four main categories were identified: "thoughts on interprofessional collaboration," "gains from the education programme," "barriers to a positive learning experience," and "working towards a better learning experience."**Conclusion:** IPE had positive effects on students. The results provide valuable insights for educators to integrate IPE into the nursing curriculum.© 2025 The Authors. Published by Elsevier Inc. on behalf of Organization for Associate Degree Nursing. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

## Introduction

Interprofessional collaborative practice is a healthcare delivery model that involves professionals from different health backgrounds working together to provide high-quality care to patients, their families, careers, and communities across various settings (World Health Organization, 2010). This collaborative model has demonstrated positive effects on patients. A meta-analysis showed that interprofessional collaboration significantly reduced systolic blood pressure, diastolic blood pressure, glycosylated hemoglobin, and low-density lipoprotein cholesterol in people with various chronic diseases (Pascucci et al., 2021). Interprofessional collaborative practice also improved the quality of life and activities of daily living of older people (Wong et al., 2020). The World Health Organization (2021) also emphasizes that teamwork and collaborative care help to enhance patient safety.

With the growing emphasis on interprofessional collaborative practice, interprofessional education (IPE) has emerged as a crucial focus within healthcare education. IPE refers to 2 or more professions

learning about, from, and with each other to make collaboration effective and improve the health outcomes of clients (World Health Organization, 2010). A systematic review demonstrated that in 17 of the 19 included studies IPE was effective in improving attitudes towards those in other professions and in demonstrating the value of adopting a team-based approach to health services in both prelicensure learners and professionals, although there were conflicting results among the 12 included studies on the effect on collaborative skills (Spaulding et al., 2021). Another recent systematic review similarly showed that IPE improved interprofessional attitudes and perceptions (such as collaboration and teamwork), skills and knowledge (such as communication and conflict management), behaviors (such as team performance), organizational outcomes (such as ability to fulfil the needs of families), and patient outcomes (such as patient safety) (Shuyi et al., 2024).

IPE is important in nursing practice. It promotes patient safety (Zenani et al., 2023) and increases patient satisfaction (Schlosser-Hupf et al., 2024). A qualitative content analysis of 6 landmark white papers and exemplars from national organizations indicated that nurses are central to an interprofessional team and help to improve communication and teamwork (Luther et al., 2019). The National Interprofessional Competency Framework (Canadian

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Interprofessional Health Collaborative, 2010) describes 6 domains of competency: role clarification, team functioning, patient/client/family/community-centered care, collaborative leadership, interprofessional communication, and interprofessional conflict resolution.

Despite the benefits of IPE, there are challenges in adopting it in the nursing curriculum. A previous survey showed that students found it difficult to participate in IPE learning activities because of a heavy study workload and conflicts with class scheduling (Li et al., 2022). IPE can be conducted in different educational settings, such as a classroom, online, in a simulation, and/or in clinical settings (Spaulding et al., 2021). The effects of integrating IPE in existing core nursing subjects in classroom settings remain unclear. Based on the findings of the abovementioned studies, it was hypothesized that IPE in classroom settings would have positive impacts on students' interprofessional attitudes, knowledge, and skills. This study thus integrated IPE into a nursing therapeutics subject.

The Committee on Measuring the Impact of Interprofessional Education on Collaborative Practice and Patient Outcomes (2015) has proposed an evaluation model based on the Kirkpatrick 4-Level Training Evaluation Model. The Interprofessional Conceptual Model covers the evaluation of learning outcomes (learner's reaction, attitudes/perceptions, knowledge/skills, collaborative behavior, and performance in practice), individual and population/public health outcomes, and system outcomes (Committee on Measuring the Impact of Interprofessional Education on Collaborative Practice and Patient Outcomes, 2015). At the subject level, the learning outcomes of the Interprofessional Conceptual Model (including learner's reactions, attitudes, knowledge, and skills) were evaluated. Since competency is required to achieve an acceptable level of performance in practice, self-perceived level of competency was also evaluated. This study thus aimed to evaluate the effects of the IPE programme on students' attitudes, knowledge, skills, and competency in interprofessional collaboration and to explore their experiences of taking part in the programme.

Methods

Study design

Mixed-methods research integrates both qualitative and quantitative approaches within a single study. A concurrent nested method, a type of mixed-methods design, involves the simultaneous collection of qualitative and quantitative data, with 1 approach being primary and the other secondary. In our study, the quantitative approach was the dominant component, while the qualitative approach was embedded within it to provide complementary insights. This design was chosen to obtain a broader perspective (Taherdoost, 2022), allowing a more comprehensive understanding of the impact of the intervention. Quantitative data were collected through pre- and postprogramme surveys to evaluate the effects of the IPE on nursing students' attitudes, knowledge, skills, and competency in interprofessional collaboration. Additionally, qualitative data were collected through focus group discussions to provide in-depth insights into the students' experiences and perceptions of the programme. Through this method, the understanding of the research questions could be enhanced by integrating both types of data, facilitating a more nuanced interpretation of the results.

Setting and sampling

This study was conducted at a university in Hong Kong. The quantitative sample size was determined based on a previous study evaluating interprofessional training outcomes, which reported an effect size of 0.35 (Mette et al., 2021). Adopting that effect size,  $\beta$  of 0.8, and  $\alpha$  of 0.05, a total sample size of 70 would be required for quantitative

data. For the qualitative component, the recommendation from a systematic review indicating that data saturation is typically achieved with 4–8 focus group discussions was followed (Hennink & Kaiser, 2022).

A total of 231 undergraduate nursing students who joined the IPE programme in the Nursing Therapeutics subject were invited to take part in this study. Among them, 203 consented to join and completed the preprogramme survey before the commencement of the IPE programme. After the IPE programme, 159 (78.3%) completed the postprogramme survey. Students were also invited to join a focus group interview, and 7 accepted. Voluntary participation was adopted because it allowed for a wider range of voices and experiences and helped capture diverse perspectives.

Interprofessional education programme

The design of this 4-day cross-university and cross-faculty IPE programme was guided by the 6 competency domains of the National Interprofessional Competency Framework (Canadian Interprofessional Health Collaborative, 2010). The aim was to increase the students' knowledge of the roles and responsibilities of those in other professions, improve their attitudes on interprofessional collaboration, enhance their collaborative skills, and thus increase their competency in interprofessional collaborative practice through providing patient-centered care in a collaborative manner. The scenario, which was co-designed by the teaching team (including academic scholars and healthcare and nonhealthcare professionals in different disciplines), involved a case of COVID-19. Due to class scheduling and the availability of participants, activities were carefully selected and prioritized to maximize engagement in meaningful discussions, interactions, and interprofessional collaboration within the given timeframe. The activities are summarized in Table 1. All activities were group-based, with a group size of about 10, and were facilitated by the teaching team of the IPE programme. In the activities, 3–4 nursing students collaborated with students in different years of

Table 1  
Interprofessional education programme.

Day	Mode	Learning activities
1	Online (preparation: self-directed learning)	<ul style="list-style-type: none"><li>• Meeting up with teammates</li><li>• Reading and discussing the articles</li><li>• Filling in a preprogramme survey</li><li>• Naming the teams</li></ul>
2	Face-to-face (readiness assurance process)	<ul style="list-style-type: none"><li>• Watching a video about a case scenario, then engaging in a discussion with teammates and answering questions</li><li>• Proposing a healthcare management plan for the case featured in the video</li><li>• Team reflection</li></ul>
3	Online (application exercise)	<ul style="list-style-type: none"><li>• Presentation of a healthcare management plan</li><li>• Critique of another group's plan</li><li>• Constructing an integrated management plan based on the strengths and weaknesses of the plans of both groups</li><li>• Team reflection</li></ul>
4	Face-to-face (Interactive session)	<ul style="list-style-type: none"><li>• Team discussion to arrive at a consensus answer in response to multiple-choice questions, with feedback from facilitators from relevant professions</li><li>• Presentation of an outstanding healthcare management plan with feedback from facilitators from different professions</li><li>• Debriefing</li><li>• Evaluation</li></ul>

Adapted from Ganotice, F. A., Gill, H., Fung, J. T. C., Wong, J. K. T., & Tipoe, G. L. (2021). Autonomous motivation explains interprofessional education outcomes. Medical Education, 55(6): 701–712. <https://doi.org/10.1111/medu.14423>.

study from 2 to 3 different professions including medicine, pharmacy, Chinese Medicine, speech - language pathology, social work, economics, law, and engineering in 3 universities in both Hong Kong and the United Kingdom. Due to the small number of students from certain disciplines, such as Chinese medicine and pharmacy (approximately 20 students each), proportional imbalances were unavoidable.

#### Ethical considerations

Ethics approval was obtained from the Institutional Review Board of The Hong Kong Polytechnic University (reference number: HSEARS20230824005). Students were given an explanation of the objectives of this study and were informed that their participation was voluntary, and that their participation would not be linked to their coursework. Informed consent was obtained from all participants.

#### Quantitative data collection

Demographic information was collected. The number of days of clinical experience, experience of hospitalization, and interprofessional collaboration experience were obtained because attitudes, knowledge, skills, competency, and experience in interprofessional collaboration may be influenced by prior experience or exposure to interprofessional collaborative practice. Age and gender were collected to obtain an understanding of the diversity of the participants.

Attitudes were assessed using the 20-item Jefferson Scale of Attitudes Toward Interprofessional Collaboration (Hojat et al., 2015). The scale has 2 factors: working relationship and accountability. The possible range of scores for the scale is 20–140, with higher scores indicating more positive attitudes. The subtotal score for working relationship and accountability is the sum of items 1–12 and 13–20, respectively. The internal consistency in terms of the Cronbach's alpha coefficient was 0.84–0.90 for total scores, 0.84–0.91 for working relationship, and 0.78–0.90 for accountability among the healthcare students in Hojat et al.'s study (2015).

Students' knowledge of the roles and scope of each profession was assessed using a Likert scale modified from Vari et al.'s study (2013). Students were asked to rate their knowledge from 0 (no knowledge) to 10 (high level of knowledge).

Interprofessional team skills were assessed using the 17-item Team Skills Scale (Hepburn et al., 1998). The possible range of scores of the scales is 17–85, with higher scores indicating a higher level of self-reported skills. The internal consistency in terms of the Cronbach's alpha coefficient was reported in the literature to be 0.94 (Hyer et al., 2002).

Competency was assessed using the revised Interprofessional Collaborative Competency Attainment Scale (Schmitz et al., 2017). This 20-item scale consists of 6 competency domains for collaborative practice: communication, collaboration, patient/family-centered approach, roles and responsibilities, conflict resolution and management, and team functioning. There was an additional item to evaluate students' perceptions of the changes in their overall abilities after the learning. The internal consistency in terms of the Cronbach's alpha coefficient was 0.87–0.90 in Schmitz et al.'s study (2017).

#### Qualitative data collection

The students' experience of the learning, including their interprofessional experience, was collected through a focus group interview. The guiding questions included (1) What is your learning experience? (2) What is your opinion about the education programme or learning experience? (3) What impacts have the learning experience had on improving your collaborative attitudes, knowledge, and skills? (4) What aspects from the education programme will you remember

when you participate in a clinical placement? (5) Which components of the programme helped you most / least in learning interprofessional collaboration? Broad questions minimized leading participants to specific responses. Follow-up prompts were used to further explore emerging themes. Fieldnotes were taken to facilitate accurate interpretation of the data. The data were validated with the participants at the end of the interview. The semi-structured interview, which lasted 90 minutes, was audio-recorded.

#### Analysis of quantitative data

Quantitative data were analyzed using the Statistical Package for the Social Sciences. Because the data were not normally distributed, the Wilcoxon Signed Ranks Test was used to compare differences in the students' attitudes, knowledge, skills, and competency before and after the IPE programme.

#### Analysis of qualitative data

Content analysis was used for qualitative data. The audio-recorded interview was transcribed verbatim. The transcript was repeatedly read to better understand the contents. Working independently by 2 researchers, data were broken down into smaller units, coded, named based on the content the data represented, and categorized (Polit & Beck, 2022). Any disagreements were discussed to reach a consensus on the subcategories and categories. The initial analysis was conducted in its original language and later translated into English for reporting. Trustworthiness was established through taking field notes, audio-recording, verbatim transcription, checking the findings with participants and investigator triangulation. In analyzing the data, bracketing was used to separate the presuppositions of the researchers from the experiences of the participants. An audit trail was used to record the decision-making process.

#### Concurrent nested analysis

In the concurrent nested analysis, the results of the quantitative analysis were integrated with the qualitative data. The quantitative results were prioritized, while insights from the qualitative data were used to provide a more comprehensive evaluation.

## Results

The students ( $n = 159$ ) were either in the third or fourth year of their study. Their demographic characteristics are shown in Table 2.

**Table 2**  
Demographic characteristics of participants.

	Mean $\pm$ standard deviation
Age	20.67 $\pm$ 1.20
Number of days of clinical experience	12.25 $\pm$ 9.13
	N (%)
Gender	
Female	110 (69.2)
Male	49 (30.8)
Experience of hospitalization	
Yes	66 (41.5)
No	93 (58.5)
Interprofessional collaboration experience	
Yes	37 (23.3)
No	122 (76.7)

Quantitative findings

There was a significant improvement ( $p < 0.05$ ) in the participants' knowledge of the roles and scope of those in medicine, social work, pharmacy, traditional Chinese medicine, engineering, and law. Interprofessional team skills and competency also significantly improved after the education programme ( $p < 0.001$ ) (Table 3).

Qualitative findings

The qualitative analysis yielded 4 main categories: “thoughts on interprofessional collaboration,” “gains from the education programme,” “barriers to a positive learning experience,” and “working towards a better learning experience.”. Subcategories are shown in Table 4.

Thoughts on interprofessional collaboration

This category pertains to the students' thoughts on interprofessional collaboration, which were shaped through the learning tasks in the education programme. Four subcategories emerged from the analysis.

The first subcategory, “Influence on perception of interprofessional collaboration,” highlighted how students experienced interprofessional collaboration while discussing patient care plans in the case scenario. It prompted them to seek help from other professionals and make referrals, leading to a new perception. One student shared, “Collaboration is needed when something is lacking that I cannot provide (to the patient).” (FGP4)

The second subcategory, “Viewing from different angles,” revealed that the majority of students learned to examine patient care from multiple perspectives. A student acknowledged that “Each profession had its own viewpoint, resulting in discussions from various directions.” (FGP7)

The third subcategory, “Patient-centered care facilitated by interprofessional collaboration”, emphasized that interprofessional collaboration was seen as an effective approach to enhance patient-centered care. It helped professionals to work together and improve the overall quality of care. One student stated, “Comprehensive care does not only rely on nurses. It also requires support from other professionals.” (FGP1)

**Table 4**  
Categories and subcategories generated from qualitative data.

Categories	Subcategories
Thoughts on interprofessional collaboration	<ul style="list-style-type: none"><li>• Influence on perception of inter-professional collaboration</li><li>• Viewing from different angles</li><li>• Patient-centered care facilitated by interprofessional collaboration</li><li>• Positive reflections</li></ul>
Gains from the education programme	<ul style="list-style-type: none"><li>• Development of positive attitudes</li><li>• Understanding the work and roles of nurses and other professionals</li><li>• Enhanced communication skills</li></ul>
Barriers to a positive learning experience	<ul style="list-style-type: none"><li>• Varied ratios of students from different professions within a group and varying clinical experiences</li><li>• Insufficient running time</li></ul>
Working towards a better learning experience	<ul style="list-style-type: none"><li>• Adopting motivation strategies</li><li>• Enriching learning with input from experts</li></ul>

The fourth subcategory, “Positive reflections”, highlighted how students reflected on their collaborative experience and gained insights for their future work. They realized the importance of evidence-based practice. Comparing themselves to medical students, nursing students acknowledged the need for critical thinking. One student said, “We need to learn from medical students. They always think, but we, nurses, directly receive orders. They (medical students) will think whether something is correct or not.” (FGP2)

Gains from the education programme

All of the students in the focus group improved in their attitudes, knowledge, and skills after the education programme. Three subcategories emerged from the analysis.

The first subcategory, “Development of positive attitudes”, highlighted how students learned to respect the opinions of other professionals, even in the presence of differing viewpoints. One participant said, “Learn to respect the opinions of other professionals. . . . Learn to view the problems from the perspectives of other people.” (FGP2) Additionally, students developed an open-minded approach, acknowledging their own weaknesses in certain areas. One student said, “Be open-minded and accept that we have our weaknesses in some areas.” (FGP3)

**Table 3**  
Comparison of interprofessional attitudes, knowledge, skills, and competency before and after the education programme.

	Pre Mean ± standard deviation	Pre Median (interquartile range)	Post Mean ± standard deviation	Post Median (interquartile range)	Z	p-value
Jefferson Scale of Attitudes Toward Interprofessional Collaboration						
Working relationship	61.18 ± 10.15	61.00 (18.00)	61.73 ± 9.59	62.00 (18.00)	−1.12	0.262
Accountability	38.58 ± 5.82	38.00 (10.00)	38.77 ± 5.16	38.00 (8.00)	−0.60	0.551
Total score	99.76 ± 15.43	99.00 (28.00)	100.50 ± 13.99	101.00 (23.00)	−0.98	0.328
Knowledge of the role and scope of						
Medicine	6.51 ± 2.56	7.00 (4.00)	6.89 ± 2.29	7.00 (4.00)	−2.13	0.034*
Social work	5.42 ± 2.10	6.00 (3.00)	5.93 ± 2.06	6.00 (2.00)	−2.77	0.006†
Pharmacy	5.88 ± 2.41	6.00 (3.00)	6.36 ± 2.14	6.00 (3.00)	−2.30	0.022*
Speech therapy	5.50 ± 2.43	6.00 (3.00)	5.78 ± 2.32	6.00 (4.00)	−1.57	0.116
Traditional Chinese medicine	5.55 ± 2.37	5.00 (3.00)	5.97 ± 2.32	6.00 (4.00)	−2.16	0.031*
Engineering	4.30 ± 2.68	5.00 (4.00)	4.88 ± 2.50	5.00 (3.00)	−2.77	0.006†
Law	4.70 ± 2.77	5.00 (4.00)	5.53 ± 2.68	6.00 (5.00)	−3.59	<0.001†
Team Skills Scale	52.29 ± 10.86	51.00 (10.00)	56.47 ± 11.09	54.00 (14.00)	−4.77	<0.001†
Revised Interprofessional Collaborative Competency Attainment Scale	60.76 ± 11.70	60.00 (8.00)	66.77 ± 12.25	64.00 (17.00)	−5.95	<0.001†

\*  $p < 0.05$ .

†  $p < 0.01$ .



The second subcategory, “Understanding the work and roles of nurses and other professionals,” underscored the insights that the students gained into the work performed by other professionals even as they deepened their understanding of the roles and responsibility of nurses. One student stated, “I have gained more understanding about the work of other professionals.” (FGP6) Another student remarked, “This IPE made me learn about my nursing roles.” (FGP5)

The third subcategory, “Enhanced communication skills,” highlighted how students learned to effectively communicate with members of their group during the learning tasks. One student reflected, “I learnt how to communicate with other professionals on a problem, despite the fact that our focuses were not the same.” (FGP5)

#### *Barriers to a positive learning experience*

Students also identified barriers that negatively affected their learning experience. Two subcategories emerged from the analysis.

The first subcategory, “Varied ratios of students from different professions within a group and varying clinical experience,” highlighted the challenge of limited interaction with students from specific professions due to an unequal number of students from each profession. Students expressed their concerns regarding the uneven distribution of students across groups, but acknowledged that it reflected the distribution of manpower in the actual healthcare system. They also pointed out the impact of varying levels of clinical experience within the group. One student said, “We have members from year 5, year 3, and year 1. The variation in clinical experience was great. They (year 1 students) did not know how to communicate or collaborate.” (FGP3)

The second subcategory, “Insufficient running time,” showed that students felt that the allocated time was inadequate for activities such as getting to know each other, engaging in in-depth discussions, and fostering collaboration. One student said, “The first class lasted for an hour. . . . It was inadequate for ice-breaking. Our group chatted only on the last day. Collaboration only started on that day, but it was the last day.” (FGP7)

#### *Working towards a better learning experience*

Students in the focus group actively provided suggestions on how to improve the learning experience, resulting in the identification of 2 subcategories.

The first subcategory, “Adopting motivating strategies,” highlighted the students’ appreciation of the use of game-based learning platforms, such as Kahoot, to make the learning process more interesting. One student expressed, “I think it is good to keep using Kahoot because it was interesting. It could increase teamwork. In the process, the members had more communications in order to get a champion. It was an interesting competition. When you have more discussions with other professionals, you will have a better understanding of them.” (FGP7)

The second subcategory, “Enriching learning with input from experts,” focused on the students’ suggestions on inviting professionals to share their own thoughts and experiences. One student highlighted the need for clarification of when to involve a doctor or seek assistance, stating, “In our work, we did not state when we would call a doctor or when I should seek help.” (FGP1)

#### *Concurrent nested analysis*

Data merging and an analysis of both quantitative and qualitative data were conducted. Although the quantitative data showed that there had been no improvement in attitudes, the qualitative analysis identified improvement in the subcategory “development of positive attitudes.” A student elaborated, “I found that my attitude had changed, probably because after contacting a social worker, I noticed that holistic care required the involvement not only of nurses.”

(FGP1) The quantitative data revealed that knowledge had improved. The result matched the qualitative analysis, “understanding the work and roles of nurses and other professionals.” A student explained, “I learnt more about what could not be performed. That’s about responsibility.” (FGP2) While the quantitative data showed that there had been significant positive changes in interprofessional team skills, “enhanced communication skills” was specified in the qualitative analysis. A student said, “When I communicate with a doctor, I will first learn their reasons and then make recommendations based on the current condition (of the patient).” (FGP7) The quantitative data showed that competency had also improved, and the qualitative analysis specifically identified “enhanced communication skills.” A student developed competency in communication and said, “I know how to agree and disagree (with other people).” (FGP2)

## **Discussion**

This study was the first to adopt an IPE programme in a core nursing subject. The findings show that knowledge of the roles and scopes of different professionals, interprofessional team skills, and competency significantly improved in such a learning approach. Students had thoughts about interprofessional collaboration and gained from taking part in the IPE. They also identified barriers to a positive learning experience and gave suggestions on how to improve the learning experience.

#### *Knowledge of the roles and scope of each profession*

The quantitative result showing improvement in knowledge aligned with the qualitative subcategory, “understanding the work and roles of nurses and other professionals.” In addition to increased knowledge of the roles and scopes of different professionals, an interesting finding of this study was that the nursing students gained a deeper understanding of their roles and responsibilities. Similar to a previous study of IPE (Zamjahn et al., 2018), students’ knowledge of the roles and scopes of other professionals, with the exception of those of speech therapists, significantly increased after the IPE intervention. The qualitative findings confirmed that students had opportunities to interact with students from other professions. Engaging in interprofessional activities with opportunities to interact with students from other professions helps to cultivate in students a deeper understanding of their roles and responsibilities and those of others (Goncalves et al., 2021). Since the number of students from speech-language pathology was small, the students in this study might have had limited interactions with them, thus explaining the lack of improvement in knowledge of the roles and scope of those engaged in speech therapy.

#### *Interprofessional team skills*

Consistent with the finding of a previous systematic review (Ris-kiyana et al., 2018), this education programme led to an improvement in collaborative skills. Such a finding aligned with the qualitative analysis, which further emphasized the enhancement in communication skills. An integrative literature review reported that involvement in IPE trained nursing students in communication and teamwork skills, facilitated the learning of how other professionals provided patient care, exposed students to unknown nursing roles in clinical settings, and trained students to work in a team (Zenani et al., 2023). The improvement in their collaborative skills was also probably related to the group-based activities, which required the participants to work with students from different professions. Enhancement in communication skills may also improve students’ collaborative competency.

## Competency

This education programme also improved interprofessional collaborative competency. The findings concurred with those of a previous study (Jung et al., 2020). It is likely that the design of this IPE programme well addressed the 6 competency domains of the National Interprofessional Competency Framework (Canadian Interprofessional Health Collaborative, 2010). In the domain of interprofessional activities, nursing students deepened their understanding of their own role and the roles of those in other professions to address the needs of the case (role clarification). In the development of the care plan for the case in the scenario, students gained an understanding of the team dynamics involved in enabling team collaboration and functioning (team functioning), and tried to deal with any conflicts by respecting the opinions of others (interprofessional conflict resolution). Students also needed to communicate in a collaborative manner with those in other professions (interprofessional communication) and to collaborate to formulate an interprofessional care plan to enhance the health outcomes of the case (collaborative leadership). Although there was no patient to interact with the students, nursing students still valued those in other professions as partners in the development of patient-centered care (patient/client/family/ community-centred care). The qualitative findings showed that students strove to improve the care given to patients, respected students from different professions, and shared knowledge and ideas about the care that was given. Students also understood each other's role contributions, learnt to be open to different views, reviewed their own limitations, and valued the contributions of students from other professions.

## Attitudes

Different from previous findings, which supported the view that IPE is effective in improving attitudes toward interdisciplinary teamwork and shared problem-solving (Dyess et al., 2019), no significant improvement in attitudes toward interprofessional collaboration was found in the quantitative results, although students in the focus group developed positive attitudes. There may be 2 reasons for this counterintuitive result. First, learning activities need to involve interactions in interprofessional teams if attitudes towards interprofessional teamwork are to improve (Fox et al., 2018). The varied ratios of students from different professions within a group and their varying levels of clinical experience might have hindered interactions with those from different professions in the team. Second, while team building activities incorporated into IPE activities were designed to encourage members of the team to work together (Riskiyana et al., 2018), a student pointed out that the time for related activities was short and that there were inadequate ice-breaking games at the beginning. The impact of the overall duration of the programme on the depth of interprofessional learning is worthy of further study.

## Thoughts on interprofessional collaboration

Interestingly, the students developed their thoughts about interprofessional collaboration. It has been shown that contextual framing of the interprofessional learning was more relevant for students who had completed more of their degree and had clinical experience than it was for students who had completed less of their degree and no clinical experience (Vandergoot et al., 2018). This might also be why the students pointed out that variations in clinical experience were a barrier to having a positive learning experience. IPE causes students with a certain amount of nursing knowledge to reflect on what interprofessional collaboration should be like and how to work together. With some clinical experience, IPE deepens students' understanding

of interprofessional collaboration, in which professionals help to mitigate each other's weaknesses.

## Gains from the education programme

Gains from the education programme identified in the qualitative data were found to generally align with the aims of the programme. Reeves et al. (2007) commented that a key factor in the success of IPE was the use of a variety of interactive learning methods. In this education programme, scenario-based discussions and the construction of a care plan based on the patient's problems were used. IPE activities help students learn the work of each other's professions (van Diggele et al., 2020), respect other professionals, and appreciate each other's presence in the team (Kangas et al., 2021). Involving students with some, but not much, clinical experience and little interprofessional collaboration experience, this education programme had positive effects on their attitude, knowledge, and skills.

## Barriers to a positive learning experience

In education, it is important to identify barriers to a positive learning experience. Different from previous studies, which involved people from only a few professions (Prentice et al., 2015; Sanko et al., 2020), this IPE involved people from 9 professions. Due to the uneven proportion of students from different professions, a student in the qualitative interview mentioned that the proportion might reflect the situation in real life. Students may make use of this opportunity to learn how to solve such a challenge. Since variations in clinical experience was also an issue raised by students, they may also learn how to collaborate with peers with less experience.

## Working towards a better learning experience

The students gave some suggestions on how to fine-tune the IPE programme. They highly recommended having a game-based learning platform. Studies have shown that such a platform allows students to collaborate with and compete against their peers, leading to fun and increased motivation (Cadet, 2023). Learning from experts is also a possible approach, as it has been suggested that having a good understanding of the role of each profession facilitates interprofessional learning (van Diggele et al., 2020).

## Limitations

There were several limitations in this study. First, while a randomized controlled trial is ideal for evaluating interventions, it could not be adopted to evaluate the effects of the IPE intervention due to a lack of acceptability if the control group was not provided with a comparable interprofessional learning experience. Second, the drop-out rate was not low. It was unclear whether the final sample was representative of the group. Also, as the reasons for dropping out were not known, it was unclear whether noncompleters might differ in attitudes, knowledge, skills, and competency in interprofessional collaboration from completers in this study. Bias might be present in self-selection. Third, only a very small proportion of students joined the qualitative interview, limiting the generalizability of the findings. In addition, joining the focus group was a case of self-selection. The students who participated might be particularly motivated or positive toward IPE, potentially influencing the findings. Fourth, due to the uneven proportion of students from different professions, meaningful interactions between the professions might have been limited, affecting the findings of this study. Fifth, since the IPE programme was embedded in a core nursing subject, students might have felt compelled to participate in the programme, leading to bias in the data. Sixth, potential confounding factors such as prior

interprofessional collaboration experience could have influenced outcomes, but these factors were not controlled in the analysis. Seventh, a comparative analysis across competency domains was not conducted. Last, the long-term impacts of this education programme remain unclear.

### Implications

This study has provided insights into the feasibility of embedding an IPE programme in a nursing therapeutics subject. To enrich students' learning, motivation strategies could be adopted and professionals could be invited to share their thoughts and experiences. To facilitate students learning from those in professions not present in their group, strategies may be needed to mitigate such gaps in future programmes. For example, to mimic real clinical settings in which healthcare providers consult each other for expert opinions, cross-group professional consultations can be adopted as one of the learning activities. Since it is common for healthcare providers to collaborate with others with varying clinical experience, the teaching team can offer additional support to students with less experience to participate in the collaborative care.

There are also implications for future research. This discrepancy in attitudes between quantitative and qualitative data warrants a deeper exploration of underlying factors affecting the measurement. To address the limitations of this study, a qualitative study may be conducted in the future to further explore students' experiences with the education programme. In the future, longitudinal studies to evaluate the long-term impacts on attitude, knowledge, skills, and competency in interprofessional collaboration are also warranted. The optimal duration of a programme on interprofessional learning is also worthy of examination. Future studies could also examine the effects of confounding factors on the outcomes of the IPE programme and weaker competency domains to provide more targeted improvements.

### Conclusion

A cross-university and cross-faculty IPE programme designed based on the competency domains of the National Interprofessional Competency Framework (Canadian Interprofessional Health Collaborative, 2010) had positive immediate effects on nursing students' knowledge, skills, and competency in interprofessional collaboration. The students' understanding of their roles and responsibilities, and their communication skills were enhanced. This study supports the integration of an IPE programme in core nursing subjects when students have a certain amount of nursing knowledge and some clinical experience. In the future, a longitudinal follow-up of the sustained impact of the changes in knowledge, skills, and competency over time would provide a deeper understanding of the lasting effect and inform the development of the IPE programme in a nursing therapeutics subject.

### Declaration of Competing Interest

The authors declare that they have no known competing personal relationships or financial interests that may have influenced the study reported in this paper.

### CRediT authorship contribution statement

**Lily Y.W. Ho:** Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Arkers K.C. Wong:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation,

Formal analysis, Conceptualization. **Fraide A. Ganotice:** Writing – review & editing, Formal analysis. **George L. Tipoe:** Writing – review & editing, Formal analysis.

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