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Interprofessional collaboration through self-assessment and structured feedback: An exploratory mixed-methods study

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Abstract

Background: Increasing healthcare complexity requires healthcare professionals to collaborate effectively across disciplines. Although interprofessional education aims to strengthen interprofessional collaboration (IPC), measuring competence remains challenging because it encompasses knowledge, skills, attitudes, and context-dependent behaviors. Consequently, evidence on whether educational interventions improve both perceived competence and observable collaborative performance remains limited.

Objective: To explore the effects of a Collaborative Online International Learning (COIL) program on medical and allied health students' self-perceived interprofessional competence and observed collaborative behavior during an online simulated case discussion, and to examine changes in collaborative behavior following structured tutor feedback.

Methods: An exploratory mixed-methods study was conducted using pre- and post-intervention self-assessments alongside structured tutor observations. Students from medical and allied health programs participated in an online simulation-based interprofessional learning activity. Self-perceived IPC competence was measured before and after the program using a 10-point Likert scale, while tutors assessed collaborative behaviors across five IPC competency domains using a structured observation protocol.

Results: Participants reported high levels of perceived IPC competence at baseline (range) item scores 7.70–9.09), which increased significantly following the intervention (8.39–9.59; all $p < 0.05$). In contrast, initial tutor observations identified important deficiencies in collaborative performance: 44% of 114 observations were rated negative, 37% positive, and 19% mixed. Following structured tutor feedback, 85% of 26 subsequent observations demonstrated improvement across all five IPC competency domains, particularly in communication, role clarification, and shared decision-making.

Conclusions: While students self-assessed their interprofessional competencies rather high, structured observations identified behavioral gaps that were not captured by the self-assessment. Targeted feedback was associated with improvements in collaborative performance. These findings support the use of multimodal assessment strategies in interprofessional education and suggest that online simulation combined with guided feedback may facilitate the development of collaborative competencies. Further research with controlled study designs is warranted to determine the durability and transferability of these behavioral changes to clinical practice.

BACKGROUND

Healthcare systems around the world are increasingly challenged by the growing complexity of care needs, driven in part by ageing populations and the rising prevalence of multimorbidity [1] These developments place considerable strain on healthcare professionals, resources, and overall costs. Interprofessional collaboration (IPC) is frequently cited as a promising strategy to address these

challenges by enabling coordinated and integrated care for patients with complex conditions[2,3]. At the same time, advances in technology and the exponential growth of medical knowledge further highlight the need for integrated, interdisciplinary approaches to care.

The increasing specialization of healthcare professionals necessitates new forms of consultation and collaboration to ensure client-centred care and active participation. As a result, IPC has become a central theme in knowledge agendas and policy documents across various disciplines, including physiotherapy, dietetics, speech therapy, and medical specialties. Reflecting this priority, interprofessional education is increasingly embedded in curricula within higher education institutions. Nevertheless, professionals in primary care, in contrast to those in secondary care, often struggle to take shared responsibility for patient outcomes. On the one hand, practical barriers such as time constraints and the perceived complexity of coordination persist. On the other hand, primary care professionals sometimes overestimate their collaborative skills, a phenomenon that can be explained by the Dunning-Kruger effect[4–6], where individuals inaccurately evaluate their own competence.

Competence is generally associated with the possession of specific skills, knowledge and behavior, while capability encompasses the integration of knowledge, skills, personal qualities, and understanding, applied effectively not only in familiar contexts but also in dynamic and complex situations. In contemporary healthcare, where professional roles increasingly overlap and scope of practice boundaries are less distinct, the development of capabilities is of importance[7-9].

Effective IPC requires healthcare professionals to communicate and coordinate efficiently, developing a common understanding, using inclusive language, and continuously sharing information[7-9]. Previous studies have demonstrated that IPC can reduce workload, enhance job satisfaction, and improve healthcare outcomes[10]. Accordingly, healthcare professionals need to be adequately prepared for collaboration through education and training. This preparation has traditionally focused on the development of interprofessional competencies, which enable professionals to work together from multiple perspectives, provide patient-centred, and with joint treatment plans and outcomes, and appropriate use of staff. Measuring interprofessional competence is inherently challenging because competence comprises knowledge, skills, attitudes, and context-dependent behaviour. However, evidence on how competencies should be accurately measured and/or combined within interprofessional education remains limited. Given these challenges in measuring competence, it remains unclear how educational interventions influence both perceived competence and actual collaborative performance. Effective training requires an understanding of participants' initial competency levels and their willingness to change. Only then can educational programs lead to meaningful changes in attitudes and behaviours. However, professionals' self-perception of IPC competence is often inaccurate[10], and it is uncertain whether this perception can be effectively altered. This highlights the need to evaluate the impact of educational interventions on both perceived competence, and observable collaborative behaviour.

Consequently, little is known about whether interprofessional educational interventions influence not only students perceived competence but also their observable collaborative behaviour. To address this gap, an exploratory study was conducted among students in medical and allied health programs. The aim of this exploratory study was to examine the effects of a Collaborative Online International Learning (COIL) program on medical and allied health students perceived interprofessional competence and observed IPC behavior during a simulated case discussion. In addition, changes in collaborative behavior before and after structured tutor feedback were explored.

Methods

Study design

This exploratory study used a mixed methods approach, combining an interprofessional competency pre- and post-training self-assessment with role play and active protocolized observations and feedback.

Study setting

The Collaborative Online International Learning (COIL) program was conducted between October and December 2024. Participants included medical students and students from allied health professions, such as physiotherapy, speech–language therapy, social studies, and occupational therapy. Students were studying at five different universities located in three different countries (e.g. Belgium, Kenya, and the Philippines). The COIL program consisted of ten three-hour sessions, self-study, and reflection. It represented five European Credit Transfer and Accumulation System (ECTS). A simulation-based training session was part of the pre-final session of the COIL program. The simulation-based training sessions were facilitated by the first two authors in close collaboration with ten trained tutors, with two tutors representing each participating institution. This project was conducted in the eighth session of the course.

Following the provision of detailed instructions and assignments, the tutors assumed the role of non-participant observers, systematically collecting field notes throughout the sessions. The simulation-based training framework offered a rich environment to observe authentic interprofessional interactions in a controlled, yet realistic setting. By immersing themselves in the dynamics of interprofessional collaborative teams, the researchers were able to observe spontaneous behaviors and interactions that provided valuable insights into the development of students' interprofessional competencies.

As part of the mixed method design, a structured and protocolized observational tool (see Attachment A) was used to ensure methodological rigor, consistency, and accuracy in data collection and reporting.

Participants

Ten groups of eight to 10 medical and allied health students from medical and allied health universities (N=104) from Thomas More Belgium, Santa Tomas Manila Philippines and Nairobi Kenia participated in the COIL program. Participants had a variety of backgrounds, experience working with children with Down Syndrome (DS), and lacked experience with interprofessional collaboration prior to the program. None had previous experience within the context of interprofessional goalsetting, as was used in the training. Each group had a tutor that guided and monitored their work in the flow of the program.

Procedure

The Case Study: Jonas[11]

The COIL program revolved around the case of Jonas, a 4-year-old boy with Down's syndrome. Participants were informed that Jonas lived at home with his parents and brother for six days a week (International Classification of Functioning- Children & Youth (ICF-CY) code e310) and stayed with a foster family one day a week (ICF-CY code e340) to alleviate the caregiving pressure on his parents. Both his parents and foster parents were highly involved and motivated to support his communicative development (ICF-CY code e310). On weekdays, Jonas attended a daycare center specializing in care for children with multiple disabilities (ICF-CY code e360), where he was seen by a speech–language pathologist and a physiotherapist. Occasionally, he also consulted a doctor and an audiologist (ICF-CY code e355). His parents expressed their primary need as follows: "Help us improve the communication of and with Jonas."

This case was considered highly suitable for the program, as care for children with Down's syndrome is often complex due to the co-occurrence of multiple developmental and medical issues. Addressing these challenges typically requires close interprofessional collaboration between various professionals from both medical, allied health professionals, informal care and professionals working in schools.

The COIL (Collaborative Online International Learning) program

The first part of the eighth session of the COIL program commenced with a foundational lecture introducing participants to key concepts underpinning the interprofessional collaboration (IPC) assignment. Topics included the principles of IPC, shared decision-making, and the International Classification of Functioning, Disability, and Health for Children and Youth (ICF-CY). Special attention was given to the ICF-CY code set developed by Deckers et al. [12], which served as a central framework throughout the training.

Additional instructional content focused on language development in children with Down syndrome and the application of Augmentative and Alternative Communication (AAC) strategies. The selected ICF-CY code set served as a central framework throughout the program, as it provides a standardized, shared language that enhances mutual understanding and effective communication among professionals, which is essential for successful IPC [11] .

The eighth session of the COIL program further includes initial assignment instructions, video observations and role assignment, preparation and collaboration guidelines, interprofessional team meetings, self-assessment of interprofessional competencies, and observations by tutors.

Initial Assignment Instructions

Following the lecture, participants were instructed to apply several core principles of IPC throughout the assignment. Specifically, they were encouraged to formulate shared intervention goals, communicate using accessible and shared language, and recognize and value the complementary expertise of other health care professionals. Participants were also introduced to the ICF-CY codes relevant to Jonas' case and were asked to use this framework to analyze the case, identify priorities, and support collaborative decision-making.

Video Observations and Role Assignment

Participants watched three videos of Jonas in various contexts: interacting with his teacher and assistants during a lesson and snack break, playing with his parents at home, and wandering around the playground. Each video, eight minutes long, was viewed twice. During the first viewing, participants noted detailed observations, which were subsequently shared using a chat-bomb feature. This step ensured that participants less experienced in child observation could benefit from the insights of their peers.

A few days later, participants were assigned specific roles within an interprofessional team: (1) speech–language therapist, (2) parent, (3) foster parent, (4) audiologist, (5) teacher/day carer, (6) physiotherapist, (7) psychologist, (8) general practitioner, (9) secretary (responsible for documenting decisions and reasoning), and (10) observer (evaluating group dynamics, communication, and decision-making processes). To enhance learning, participants were assigned roles outside their professional background. For groups with only nine members, the roles of secretary and observer were combined. Each group also appointed a chairperson. Detailed role descriptions were provided (see Appendix A).

Preparation and Collaboration Guidelines

Participants received case information tailored to their assigned roles, with some roles sharing common details and others having unique insights. They were given two days before the assignment to familiarize themselves with the material, including unfamiliar ICF-CY codes. During this time, participants could seek clarification from trainers but were instructed not to share information with others before the official start of the interprofessional team meeting. Although this approach differs from real-world practices, it was implemented to structure the assignment and enable group comparisons.

Interprofessional Team Meeting

The assignment culminated in a 60-minute interprofessional team meeting, during which participants worked collaboratively to develop a treatment priority plan for Jonas. For the meeting objectives see

flowchart 1

Tutors guided the sessions, pausing the meeting after 10–15 minutes to provide structured feedback based on prior research involving over 60 groups [11]. Feedback suggestions included guidance on role clarification, shared decision-making, and effective communication strategies (see Table 1 for details).

Table 1. Feedback given by tutors based on prior research[11]

Suggested feedback based on prior research
Think about the goal of the meeting
Make sure that role clarification is given
Talk to the parents
Enumerate topics to be discussed
Resolve differences through discussion
Do not decide on the goal after all important things are collected
Use easy to understand language
Shared decision making is different from convincing

Self-assessment of interprofessional collaborative competencies

To evaluate the perceived interprofessional collaborative competence of medical and allied health students and their demonstrated IPC behavior in a simulation setting before and after structured tutor feedback, students completed structured self-reflections both before and after the assignment. These reflections were based on a 10-point Likert scale aligned with the core competencies of interprofessional collaboration, as defined by the Interprofessional Education Collective (IPEC)[16]. IPEC is a nationally representative coalition of 22 health professions education associations and partner organizations whose work is guided by a strategic vision to ensure that all new and current health professionals are prepared for person/client-centered, community- and populationoriented, interprofessional collaborative practice. The IPEC competency framework is a widely used framework that describes the core competencies required for effective interprofessional collaboration in healthcare (see appendix B). Each competency and their general ability were evaluated as a single-item scale. Each item was scored separately, allowing domain-specific evaluation of perceived interprofessional collaboration competencies.

Self-assessment data were collected within a google form file. No personal information of the students was gathered. Paring of the before and after self-assessment data was done by combining the data with the same six-digit codes created by the students themselves.

Upon completion of the collaborative task, group secretaries and designated observers presented their objectives, underlying rationale, and evaluations to the entire cohort, fostering shared learning and critical reflection.

Observations by tutors

Throughout the assignment, tutors conducted systematic observations of group dynamics and interprofessional interactions. A non-structured observation form was employed (see attachment A) allowing tutors to document behaviors and interaction on paper in a flexible manner while still ensuring thorough and consistent reporting across settings. No personal or group information was gathered.

DATA analysis

Analysis of the self-assessment data

Descriptive statistics were performed for each competency domain, including means and standard deviations pre- and post-assignment. As the data were not normally distributed, median change scores and the 25^{th} and 75^{th} percentiles of the pre-post differences were reported. To evaluate the effect of the training, including tutor feedback, on participants' perceived interprofessional (IPC) competencies, differences between pre- and post-scores were analyzed using the Wilcoxon signed-rank test. Statistical significance was determined at a predefined alpha level of 0.05.

Analysis of the observation data

A directed content analysis was conducted using the framework of Deckers and Van Zaalen as a priori coding scheme. The framework provided predefined competency domains that guided the classification of tutor observations. Independent double-coding was performed by two researchers, after which consensus meetings were held to resolve coding differences and establish a final coding structure. Subsequently, observations within each competency domain were characterized according to their evaluative orientation (positive, negative, or neutral), allowing both the presence and quality of demonstrated interprofessional collaborative competencies to be examined. This approach facilitated a more nuanced understanding of the extent to which students demonstrated or failed to demonstrate these competencies in daily practice.

RESULTS

Pre- and post-assignment perceived interprofessional collaborative competencies

In total, 81 students participated in this online session of the training program, of which all gave consent. The pre-assignment self-assessment was filled in prior to the meeting by 72 medical and allied health

students, the post-assignment self-assessment by 68 medical and allied health students. The datasets were linked by the ID number assigned to the students by the tutor, resulting in 56 complete sets of pre- and post-assignment measurements.

Students gave (pre-assignment) mean scores between 7.70 and 9.09. The items with the lowest score was 'I am confident in my ability to collaborate interprofessionally and the 'I communicate with team members in a receptive, responsible, respectful manner' was scored the highest. See Table 2. After the assignment the scores on all items were slightly higher, they varied between 8.39 and 9.59 points on a ten-point scale. However, these differences were statistically significantly different for all items.

Table 2
Reflections on pre- and post-assignment interprofessional collaborative competencies

Reflective questions **(see appendix B)**	**Pre-assignment mean ± sd** **(min, max)** **n = 56**	**Post-assignment*** **mean ± sd** **(min, max)** **n = 56**	**P-Value(Wilcoxon signed rank test)**
1. I work with team members to maintain a climate of shared values, ethical conduct, and mutual respect.	8.75 ± 1.23 (6, 10)	9.14 ± 1.17 (5,10)	0.018
2. I use the knowledge of one's own role and team members' expertise to address individual and population health outcomes.	8.27 ± 1.36 (4, 10)	8.77 ± 1.39 (2, 10)	0.002
3. I communicate in a responsive, responsible, respectful, and compassionate manner with team members.	9.09 ± 1.23 (4, 10)	9.59 ± 0.71 (7, 10)	0.001
4. I apply values and principles of the science of teamwork to adapt one's own role in a variety of team settings.	8.07 ± 1.46 (4,10)	8.57 ± 1.45 (3, 10)	0.011
5. I am confident in my ability to collaborate interprofessionally.	7.70 ± 1.67 (4, 10)	8.39 ± 1.36 (5, 10)	< 0.001
*Post-test results can be affected by the midterm feedback on performance by the tutors			

Tutor's observations regarding 5 domains of IPC

The tutors' reports revealed that students initially struggled to consistently demonstrate all five domains of IPC. Out of 114 recorded observations, 44% were negative, 37% positive, and 19% mixed. After the tutors provided feedback, an additional 26 observations were made, of which 85% indicated improved interprofessional behavior on all five IPC competency domains. Below, we present the main findings per category, illustrated with selected quotes.

Participants' view on collaboration: collaborative leadership

Before feedback, students often displayed monodisciplinary thinking, focusing on their own perspective without integrating others' contributions. Parents and foster parents sometimes felt sidelined. One foster parent shared during the feedback break: *"I felt not safe and comfortable to share my opinions, as constantly the professionals were talking and I couldn't interrupt."*

After feedback, groups demonstrated more collaborative leadership. For example, the audiologist was described as *"very professional, takes the lead in a very good client-centered and respectful way, listens to others and asks for their opinion."* This shift highlights how students began to recognize the importance of shared responsibility and client-centered focus.

Structure: team functioning

Initially, many groups lacked structure. Tutors noted that *"most students were waiting to speak up, nobody took the lead."* In several cases, important perspectives (e.g., those of parents) were overlooked in the discussion.

Following feedback, students organized their teamwork more explicitly. One tutor observed: *"At first they forgot about the parent, but after my intervention they took the feedback into action."* This resulted in a more balanced participation of all disciplines and increased parental involvement.

Collaboration process: role clarification

A recurring issue was the insufficient clarification of roles. One case illustrated the consequences: *"She did not introduce herself initially, leading to misunderstanding of her role and the entire team thinking she had a different role."* After feedback, students became more deliberate in presenting their roles and expertise. As one tutor noted: *"Role clarification did not happen until I gave feedback… but afterwards each student started to share their expertise and role in the care for Jonas."* This improved both team dynamics and parental understanding of professional responsibilities.

Collaboration process: Handling interprofessional conflict

At start of the assignment conflicts were often poorly managed. Some participants insisted on their own perspective without engaging in dialogue, while others disengaged: *"Observable behaviours: looking away, yawning, playing with their hair or earrings."* Following feedback, conflicts were handled more constructively. The foster parent, for example, became more influential: *"After the feedback break the foster parent was more leading in deciding what was important and how the others reacted."* This illustrates how feedback supported the group in valuing divergent perspectives.

Outcomes: Shared decision-making and goal setting

Before feedback, goal setting was mostly discipline-driven. For example, *"participants discussed the child's communication preference without seeking immediate parental input."* After feedback, groups shifted towards interdisciplinary and family-centered goals. Tutors noted: *"Initially goals were set within the disciplines and not across, later on they tried to agree on common goals, mainly inspired by the parent's input."* This indicates an emerging capacity for authentic shared decision-making.

Outcomes: Interpersonal communication

In the early phase, participants often used jargon and impersonal language: *"Talking about 'him' or 'the client' and not about Jonas; jargon was used very often and no one asked for clarification."*

Following feedback, communication became more inclusive. One tutor highlighted: *"In the second role play they directly asked and addressed the foster parent and used plain language more often… they more often used Jonas' name instead of he."* Although professional terminology was still present, students increasingly explained it in accessible ways, e.g., *"The SLP explained what the scores meant for Jonas."*

DISCUSSION

The main goal of this study was to investigate whether education in IPC through the COIL program leads to behavioral changes in medical and paramedical students. It resulted in integrated person-centered collaboration. After completing an intensive online training on interprofessional collaboration, this led to insights into personal reflection and possible impacts on the participants' level of interprofessional competence. Although the students lacked experience in interprofessional collaboration and although the observations classified different crucial points of improvement, participants graded their IPC competence with high numbers, not in congruence with the observations of the tutors in the program. The observations demonstrated that tutor feedback acted as a catalyst for change. The most pronounced improvements occurred in team functioning and role clarification, where groups shifted from fragmented, profession-centered approaches to more integrated, patient- and family-centered collaboration. Integrating both competencies and capabilities into pre-licensure curricula and health professional development programs may provide clearer direction for workforce training in IPC, ensuring alignment with the evolving demands of healthcare systems and ultimately contributing to improved quality of patient care. [13–15]

This study demonstrated that interprofessional collaboration has not yet become an inherent component of the professional practice of healthcare providers, who, until recently, were predominantly trained within monodisciplinary frameworks. Awareness of the need for interprofessional approaches is gradually emerging, and the curricula of various Dutch healthcare programs are beginning to incorporate attention to this domain. Central to this development is the adoption of a client-centered perspective, joint learning, mutual understanding of roles and competencies, as well as the capacity to apply one's own professional expertise effectively within the interprofessional team.

The importance of interprofessional education extends beyond initial training. For alumni, practitioners who have already been active in the field for several years, this may be of even greater relevance. Given the substantial and increasing pressures on healthcare systems, it is imperative to prioritize ongoing professional development and to embed interprofessional collaboration as a central element of continuing education.

The findings of this study reveal a notable discrepancy between students' self-assessment and the evaluations of their tutors, indicating the challenges inherent in defining and assessing competence. While participants of the study frequently rated their competence in IPC highly despite limited experience in interprofessional collaboration and the identification of areas requiring improvement by the tutors, previous research has demonstrated that individuals who perform well may conversely underestimate their own abilities [10]. Such inconsistencies suggest that self-perception is not a reliable indicator of actual performance, raising questions regarding the validity of self-assessment as a measure of competence.

Shared decision-making is a process in which healthcare professionals and patients work together to select tests, treatments, management, or support packages, based on clinical evidence and the patient's values and informed preferences [16–17]. Vulnerable patients' abilities to self-direction are predetermined by their level of health literacy [18]. Health literacy includes the practice of understanding the nature or risk of a condition, being aware of the possible preventative or treatment options and the likelihood of benefits and harms of each option, being able to integrate personal values and preferences into decision-making, participate in the decision to a level desired and have the confidence to implement the decision[19] The observations in our study show that interprofessional goal-setting and shared decision-making improved after receiving feedback during the interprofessional team meeting. While our observations are only indicative, the improvements showed an authentic intention for behavioral change, which is an important step towards actual behavior change in daily practice. Our intervention to educate medical and allied health students can be integrated in multifaceted implementation strategies to improve interprofessional competencies of medical and allied health professionals.[20]

Strength and limitations

In the debate about preferences to online or face-to-face learning, online education is often considered to be an online module followed by the student on a preferred time. In this case we examined online group courses where students and teachers were present during all activities online. The advantages of online education are widely recognized, for example efficiency, accessibility of time and place, affordability, improved student attendance and suiting different learning styles of students. In this COIL program students from different continents worked and learned together. The online COIL program allowed schools to reach out to a more extensive network of students, instead of being restricted by geographical boundaries. Additionally, online lectures were recorded, archived, and shared for future reference. This allowed students to access the learning material at a time of their comfort. Thus, online learning offers students the accessibility of time and place in education. Another advantage of online

learning is reduced financial costs, making the course affordable for students of low-income countries. Especially for students of low-income countries or informal carers, attending lessons inside the university building can be challenging. Since the classes could be taken from home or another location of choice, fewer students missed out on lessons. The disadvantage of it was that some students attended classes from a not so suitable location for online teamwork (e.g. in a bar, with loud surrounding sound) or missed out on classes. The disadvantages of online group learning are focused on scheduling/time and technology issues, especially when collaboration with people from a geographical distance. In our case some students participated in the late afternoon, while others participated in early morning. Intern consistency was not guaranteed in all participating countries. We were very lucky that during the shared decision role play, internet issues were not at stake.

Our simulation-based assessment with tutor feedback can be integrated in multifaceted implementation strategies to improve interprofessional collaboration of medical and allied health students[21]. In pediatric rehabilitation, there is a belief in goal setting as a fundamental component of decision-making that encourages collaboration and motivation and improves outcomes[22]. Active involvement of parents throughout the process of setting and implementing goals increases their feeling of competency and partnership with professionals. Concrete goals based on families' preferences and concerns, participatory observation, and discussions with professionals, came out as valuable means for practice of functional tasks within home environments[23]. In this study, before tutor feedback, students tend to lose connection with parent wishes and needs, after the tutor's intervention, the interprofessional collaboration and communication improved, resulting in more attuned decisions, parent and professional engagement and parents’ self-direction.

We see another possible limitation in the use of the semi-structured observation form. The themes within this semi-structured observation were derived in a previous study. This way of observation has the risk of bias, when observations done were not within the themes and thereby not noted on the form. Being aware of this risk we decided to give tutor training prior to their observations, In the tutor training we informed the tutors that they could use white spaces in the form to write down these additional observations. Tutors did not use this option. This can be because they needed all the time to observe the themes or it can mean that in this direct observation no other observations were captured by the tutors.

Understanding each other's (professional) perspectives when collaborating is essential. In this study medical and allied health students collaborated, all sharing different educational programs, speaking in a for many non-native languages (English) and with a variety of cultural backgrounds. This situation clearly reflects daily practice in which professionals from different professional disciplines, often unfamiliar on a personal level, need to collaborate in health care settings. The findings suggest that if interprofessional communication and collaboration can be effectively fostered in an online environment, despite these challenges, similar or even greater benefits may be achievable in face-to-face settings.

We understand using a single item per construct as a standalone scale is highly debated. While widely criticized in quantitative research for lacking internal consistency and psychometric rigor, single-item

scales are highly practical and increasingly accepted in exploratory studies and daily diary research. The reason for choosing a single-item approach was based on low-respondent burden, high face validity and speed[24]. Single items are highly efficient when scoping out unresearched phenomena where you need a broad overview of many variables. For sample sizes smaller than 50, relying on a Single Item is likely to generate comparable predictive validity as that of the full scale [24]; Single-item measures can be particularly useful in daily diary studies, like our study, where you ask people to complete surveys several times per day. Such surveys, typically completed on a smartphone, must be as short as possible [25]. To maintain validity using Single-Item Scales we ensured the construct being measured to be unidimensional and concrete, meaning clearly understood by everyone the same way and in line with both the IPEC competencies and their concepts used within the COIL-program. But we did not pre-test the item to ensure it aligns with the broader conceptual definition we were exploring [26]. We used mixed methods to back up the single item with structured observations.

Simulation-based training has been conducted throughout the world. In the present study, we combined all our observations. It might be that cultural background plays a role in group observations or group dynamics. We did not check for the cultural sensitivity of the training per se. We discussed the assignment beforehand with university staff and did not encounter any comments about culturally insensitive information. Many groups of participants were indeed composed of different cultural backgrounds. Cultural background might influence the role somebody takes in a group discussion, so the cultural background of participants might have influenced the way they played their roles. We did not study this in further detail. Thus, our results might be influenced by cultural backgrounds; however, we did not observe substantial differences between group discussions and outcomes for different participants across the world. In a follow-up study, we advise taking the cultural background and communication styles of students into account[11]

Conclusion

This study shows that online simulation-based education as part of an online IPS training course can meaningfully strengthen interprofessional collaboration skills among medical and allied health students, particularly when supported by targeted tutor feedback. Although students initially overestimated their IPC competence, structured observation and guided reflection led to clear improvements in communication, role clarification, and shared decision-making. While our observations are only indicative, the improvements showed an authentic intention for behavioral change which is an important step towards actual behavior change in daily practice.[20] These findings highlight the value of experiential IPC education within health professional education and underscore the need for further research on skills development and the influence of cultural and contextual factors on interprofessional practice.

Abbreviations

AAC

Augmentative and Alternative Communication
COIL
Collaborative Online International Learning
DS
Down Syndrome
ETCS
European Credit Transfer and Accumulation System
IPC
Interprofessional Collaboration
ICF-CY
International Classification of Functioning- Children & Youth

Declarations

Ethics approval and consent to participate

All experiments were performed in accordance with the Netherlands Code of Conduct for Research Integrity. Ethical review and approval were waived by the Thomas More Institutional Review Board for this study since this training was part of an educational program. Informed consent was waived from all subjects involved in the study due to their enrollment in a course on interprofessional collaboration. Research data collected was anonymous.

Consent for publication

Not applicable.

Data Availability Statement

Data are available on students' evaluation of their reflections on interprofessional competencies and tutors' observations of the interprofessional collaborative role play. No publicly archived datasets were analyzed or generated during the study. The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors report there are no competing interests to declare**.**

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Author Contributions

Conceptualization, YZ, TH, MD, PW, ME; Formal analysis, YZ, CS, TH; Investigation YZ, MD, PW, ME; Methodology YZ, TH Project administration Resources YZ, KM, CS, TH Supervision YZ, KM Validation YZ, MD, PW, ME Visualisation YZ, TH Writing original draft, YZ, TH, MD, PW, ME. All authors have read and agreed to the published version of the manuscript.

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Declaration of generative AI and AI-assisted technologies in the writing process.

During the preparation of this work, the authors used ChatGPT (OpenAI) to assist with grammar. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the manuscript.

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Figures

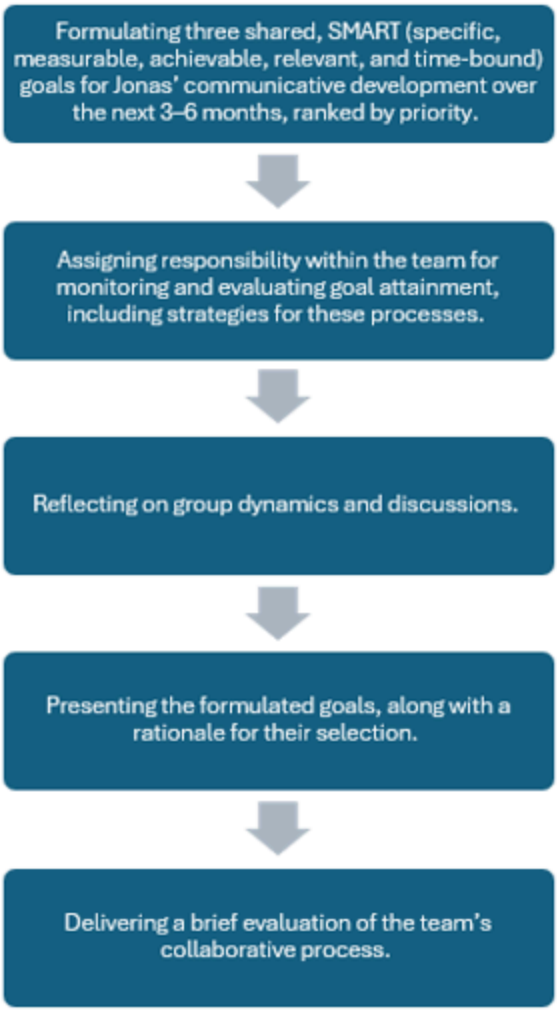


Figure 1

Flowhart 1. Meeting objectives interprofessional team meeting

Supplementary Files

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- AppendixA.docx