

How Effective is Interprofessional Education? A Mixed-Methods Evaluation of Collaborative Learning in Health Professional Programs

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Received: June 5, 2026

Revised: August 20, 2026

Accepted: September 22, 2026

Abstract

Interprofessional education (IPE) is widely used to prepare collaborative-practice-ready health professionals, but evidence remains concentrated in short-term, single-method evaluations from university settings, with limited process-oriented evidence from vocational health-professions education. This study evaluated the implementation and perceived educational outcomes of a three-year IPE program (2022–2024) and examined conditions associated with perceived effectiveness. A convergent mixed-methods evaluation guided by the Context, Input, Process, Product (CIPP) framework was conducted across three annual sixth-semester cohorts. Of 326 eligible students from nursing, midwifery, nutrition, medical laboratory technology, and environmental health, 297 completed a collaborative-competency questionnaire. Qualitative data comprised six coordinator interviews, two faculty focus group discussions ($n = 14$), and four student focus group discussions ($n = 30$). Quantitative and qualitative strands were analyzed independently and integrated through a joint display. Composite collaborative competency was moderate-to-high ($M = 3.87$), with teamwork ($M = 4.12$) and interprofessional communication ($M = 4.03$) highest and role-boundary understanding lowest ($M = 3.46$). Program-level process ratings increased across successive annual cycles, although participation remained uneven across disciplines. Interaction quality during community-based activities showed the strongest association with perceived IPE effectiveness ($\beta = 0.41$, $p < 0.001$), whereas infrastructure adequacy was weakly associated ($\beta = 0.12$, $p = 0.052$). Mixed-methods integration showed convergence around communication, teamwork, and role ambiguity, and expansion around facilitator readiness and scheduling. Because the annual cohorts were distinct and no pre-program baseline or control group was available, the findings do not establish causal effectiveness. The results suggest that authentic, well-facilitated interprofessional interaction may be more educationally consequential than structural provision alone.

Keywords: CIPP evaluation; collaborative learning; health science education; interprofessional education; mixed methods

INTRODUCTION

Contemporary health systems require professionals to coordinate knowledge across disciplinary boundaries in response to multimorbidity, chronic disease, patient-safety risks, and increasingly integrated models of care. These pressures are not only service-delivery problems; they are also educational problems because health-science programs must prepare students to reason, communicate, and make decisions with colleagues whose expertise differs from their own. Failures in communication and coordination remain important contributors to unsafe care, making collaborative competence a core outcome of health professions education rather than an optional professional attribute (Reeves et al., 2017; Tan et al., 2024). For applied and vocational health science education, this requirement is especially salient because graduates are expected to transfer disciplinary knowledge directly into team-based clinical and community practice.

Collaborative competence does not emerge automatically from placing students from

different programs in the same setting. It requires structured opportunities to develop interprofessional communication, role understanding, shared decision-making, teamwork, and the ability to negotiate hierarchy and conflict (Interprofessional Education Collaborative [IPEC], 2023; Rogers et al., 2017). Traditional curricula, however, commonly socialize students within profession-specific content, routines, and identities before expecting them to collaborate in practice. This separation creates a pedagogical mismatch between how students learn and how contemporary health care is delivered (Hammick et al., 2007).

Interprofessional education (IPE) is the principal educational strategy used to address this mismatch. The World Health Organization (WHO, 2010) defines IPE as learning that occurs when students from two or more professions learn about, from, and with one another to enable effective collaboration and improve health outcomes. The definition emphasizes reciprocal learning rather than simple co-attendance. In pedagogical terms, effective IPE should create tasks in which disciplinary perspectives are mutually necessary, interaction is purposeful, and students are required to explain, negotiate, and integrate knowledge. These principles align with the IPEC (2023) domains of values and ethics, roles and responsibilities, interprofessional communication, and teams and teamwork.

The international evidence base is encouraging but uneven. Systematic reviews report positive effects of IPE on knowledge, attitudes toward collaboration, communication, and selected teamwork outcomes, while effects on interprofessional competence and behavior are less consistent (Saragih et al., 2023, 2024; Tan et al., 2024). Clinical and work-based reviews similarly suggest that authentic interprofessional tasks can support collaborative-practice competencies, although the quality of study designs and outcome measurement remains variable (Madisa et al., 2022; Mattiazzi et al., 2023). This pattern indicates that the question is no longer simply whether students value IPE, but which program conditions and learning processes are associated with stronger collaborative outcomes.

Recent mixed-methods and longitudinal work has also drawn attention to professional identity, role clarity, and the quality of interaction. IPE can strengthen collaboration perceptions and interprofessional identity, yet role boundaries and hierarchical patterns may remain difficult to change (He et al., 2024; Price et al., 2025). Evidence from Indonesia likewise shows that project-based and mixed-methods IPE can improve readiness and perceptions of teamwork while still revealing challenges in roles, field implementation, and facilitation (Faizin & Fahreza, 2024; Hermasari et al., 2024). These findings are highly relevant to science education because collaborative learning in health programs depends on students' ability to integrate applied scientific knowledge with communication, reasoning, and shared problem-solving.

Four gaps remain important. First, much IPE research evaluates short interventions or immediate post-intervention outcomes, providing limited evidence about program maturation across successive implementation cycles. Second, outcome-only and single-method evaluations still dominate, even though IPE is a complex educational program whose effectiveness depends on context, resources, facilitation, and implementation processes. Third, although the Context, Input, Process, Product (CIPP) model can connect program design to implementation and outcomes, CIPP-informed IPE evaluations remain relatively uncommon (Meiklejohn et al., 2023). Fourth, evidence from low- and middle-income countries and applied or vocational health-education settings is still comparatively limited (Kitema et al., 2024; Joshi et al., 2025). These gaps restrict the transferability of findings from well-resourced university contexts to institutions where community-based learning, cross-program scheduling, and faculty capacity may shape IPE differently.

The novelty of the present study lies in a CIPP-guided, three-year, convergent mixed-methods evaluation of IPE within an underrepresented vocational health professions education context. Rather than treating IPE as a single classroom intervention, the evaluation examines the program as an educational system and links contextual justification, institutional inputs, implementation processes, collaborative-competency outcomes, and stakeholder experience.

The three years represent successive annual program cohorts rather than longitudinal follow-up of the same students; consequently, temporal patterns are interpreted as evidence of program-level maturation, not within-student development.

The study is anchored in complementary educational and evaluative frameworks. The WHO (2010) framework provides the policy logic for preparing a collaborative-practice-ready workforce, while the IPEC (2023) competencies specify the collaborative capabilities that health professions education should cultivate. Social interdependence and situated-learning perspectives explain why authentic, reciprocal interaction around shared problems can promote learning across disciplinary boundaries (Johnson & Johnson, 2009; Lave & Wenger, 1991). The CIPP model provides the evaluation architecture for examining whether program outcomes are consistent with the needs, resources, and processes that produced them (Stufflebeam & Zhang, 2017).

Accordingly, the study addresses four research questions aligned with the CIPP framework: (RQ1) How do contextual needs and institutional conditions justify and shape the IPE program? (RQ2) How adequate are program inputs, including learning resources, coordination, and facilitator preparation? (RQ3) How is the program implemented across successive annual cycles, and what facilitators and barriers characterize interprofessional interaction? (RQ4) What perceived educational outcomes are observed in collaborative competency, teamwork readiness, role understanding, and stakeholder experience, and how do the quantitative and qualitative findings converge or diverge?

The evaluation therefore aims to generate evidence for curriculum design, facilitator development, and program improvement in applied health science education. Because the design does not include a control group, individual longitudinal tracking, or a pre-program competency baseline, the term effectiveness is used in an evaluative rather than a causal sense.

METHODS

Study Design

This study used a mixed-methods program evaluation design to appraise the implementation and perceived educational outcomes of an IPE program delivered over three consecutive academic years. Evaluation research was selected because the purpose was to judge the program's merit, implementation quality, and improvement needs rather than to estimate a causal treatment effect. The design therefore combined outcome measurement with analysis of the context and processes through which those outcomes were produced.

A convergent mixed-methods design was used. Quantitative and qualitative data were collected within the same overall evaluation phase, analyzed independently, and then integrated during interpretation. The quantitative strand described collaborative-competency patterns and program-level differences, whereas the qualitative strand examined how participants experienced the program and how facilitation, role understanding, scheduling, and authentic community tasks shaped those experiences. Integration was used to identify convergence, complementarity, expansion, and any meaningful tensions between the two strands.

The CIPP model developed by Stufflebeam provided the overarching evaluation framework. CIPP was selected because it treats an educational program as an evolving system: Context examines needs and alignment; Input examines resources, design, and readiness; Process examines implementation and interaction; and Product examines outcomes. This structure was especially appropriate for IPE because apparently similar programs may produce different outcomes depending on facilitation, task authenticity, cross-program coordination, and the quality of interprofessional interaction (Meiklejohn et al., 2023; Stufflebeam & Zhang, 2017).

Study Setting

The study was conducted at a vocational higher education institution in the health sciences (health polytechnic) that delivers applied, competency-based education across multiple allied health disciplines. The institution was selected purposively because its multidisciplinary

structure provided an authentic setting in which students from different health professions could learn with, from, and about one another. Its vocational orientation, emphasis on practice readiness, and use of community-based health problems also positioned the program as a form of applied health science education rather than solely as a health-services activity.

The IPE program was implemented in three successive annual cycles (2022–2024), each involving a different sixth-semester cohort rather than the same students followed longitudinally. Five study programs participated: Nursing, Midwifery, Nutrition, Medical Laboratory Technology, and Environmental Health. Each cycle used a nationally salient public-health theme requiring contributions from all five disciplines: stunting in 2022, diabetes mellitus in 2023, and hypertension in 2024. Across cycles, the core instructional architecture combined faculty-facilitated mixed-discipline learning, shared analysis of community health problems, interprofessional discussion, and joint problem-solving. The three-year window therefore enabled evaluation of program-level continuity and maturation across iterations, not within-person change.

Participants and Sampling

For the quantitative strand, all eligible sixth-semester students who completed the relevant annual IPE cycle were invited to participate. Across the three cycles, 326 students were invited and 297 completed the questionnaire (response rate = 91.1%): 101 in 2022, 99 in 2023, and 97 in 2024. A total-sampling (census) approach was used to maximize disciplinary representation and avoid sampling-induced distortion of program-level comparisons. Because the annual cycles comprised different cohorts, between-year patterns were treated as repeated program observations rather than longitudinal student trajectories.

For the qualitative strand, purposeful sampling was used to recruit participants with direct experience of program governance, facilitation, or learning. The final qualitative sample comprised six IPE coordinators interviewed individually, 14 faculty members participating in two FGDs, and 30 students participating in four FGDs, with representation from all five disciplines. Inclusion required involvement in at least one complete annual cycle and informed consent. Sampling sought role and disciplinary coverage, and data collection continued until the research team judged that additional sessions were no longer adding substantively new perspectives relevant to the CIPP questions.

Evaluation Framework

Context evaluation drew on program documents, coordinator and faculty accounts, and student perceptions to examine the rationale for IPE, institutional commitment, relevance to future practice, and clarity of program objectives. This dimension assessed whether the program responded to a credible educational need and whether its goals were aligned with collaborative-practice expectations in vocational health education.

Input evaluation examined the resources and design supporting IPE, including learning materials, facilities, faculty support and availability, scheduling and cross-program coordination, standard operating procedures, and facilitator preparation. Student ratings were interpreted alongside coordinator and faculty accounts so that material adequacy could be distinguished from readiness to facilitate interprofessional learning.

Process evaluation examined how the program was enacted across the three annual cycles. Indicators included attendance, student participation, facilitator-rated communication quality, balance of contribution across disciplines, depth of interdisciplinary discussion, student engagement, and qualitative accounts of interprofessional interaction during community-based activities. The facilitator rubric used a five-point scale and was applied to program-level process indicators in each annual cycle; the resulting trends were interpreted as indicators of implementation maturation rather than individual student growth.

Product evaluation examined perceived educational outcomes, including teamwork, interprofessional communication, collaborative learning, readiness for collaborative practice,

understanding of professional role boundaries, and overall perceived IPE effectiveness. Quantitative questionnaire results were integrated with qualitative themes to determine not only which outcomes were relatively strong or weak, but also how participants explained those patterns.

Data Collection Procedures

Quantitative data were collected using a structured questionnaire available in online and paper-based formats to maximize access. The same five-point Likert response scale, ranging from 1 (strongly disagree) to 5 (strongly agree), was used across formats. The instrument measured five constructs: teamwork, interprofessional communication, collaborative learning, readiness for collaborative practice, and understanding of the scope and boundaries of other professions. Only completed questionnaires were included in the analytic sample. Higher scores indicated more positive self-reported collaborative competency.

Qualitative data were generated through six semi-structured coordinator interviews, two faculty FGDs, and four student FGDs. Student FGDs included representation from all participating disciplines, while faculty FGDs were conducted separately to reduce authority-related inhibition. Interview and FGD guides covered program rationale, resources, facilitation, interaction dynamics, perceived learning outcomes, and recommendations for improvement. With consent, sessions were audio-recorded, transcribed verbatim, and supplemented with field notes.

Research Instruments

The quantitative questionnaire was constructed for this evaluation by adapting concepts from established interprofessional competency and readiness frameworks rather than reproducing a single instrument verbatim. Content validity was addressed through expert review and a content-validity procedure, followed by pilot testing with students outside the main sample. Internal consistency in the final sample was acceptable to strong across the reported constructs (Cronbach's $\alpha = 0.79\text{--}0.86$), with $\alpha = 0.91$ for the composite collaborative-competency score. The five constructs were aligned conceptually with the IPEC (2023) competencies and international recommendations for assessment of interprofessional learning outcomes (Rogers et al., 2017).

The qualitative instruments comprised semi-structured interview and FGD guides organized around the four CIPP dimensions. Questions were open and non-leading and addressed perceived need for IPE, adequacy of resources and facilitation, the dynamics of interprofessional interaction, perceived collaborative learning, role understanding, and recommendations for improvement. The guides were reviewed before use for clarity, coverage, and fit with the evaluation questions.

Data Analysis

Quantitative analysis included means, standard deviations, percentages, and frequency distributions for participant characteristics, program inputs, process indicators, and collaborative-competency constructs. Differences in the composite competency score among the five study programs were examined using one-way analysis of variance (ANOVA), with η^2 reported to communicate effect magnitude; the small omnibus effect was interpreted cautiously and program means were used descriptively rather than to support strong pairwise claims. An exploratory multiple linear regression examined perceived IPE effectiveness as the outcome, with interaction quality during community-based activities, infrastructure adequacy, and cumulative program exposure entered as predictors. Standardized β coefficients, p values, and adjusted R^2 were reported, and the regression was interpreted as associational rather than causal. Analyses were conducted in SPSS.

Qualitative data were analyzed using reflexive thematic analysis following Braun and Clarke (2006, 2021). Analysis involved familiarization, initial coding, development and review of candidate themes, definition and naming of themes, and construction of the analytic narrative.

Multiple researchers contributed to analytic discussion; differences were used to interrogate assumptions and refine interpretations rather than to treat coding agreement as a proxy for qualitative validity. Themes were organized in relation to the CIPP dimensions while remaining open to inductively derived insights.

Mixed-methods integration followed the convergent design. Quantitative and qualitative findings were first analyzed separately and then merged through a joint display. Integration examined convergence (agreement across strands), complementarity or expansion (one strand explaining or extending the other), and divergence or silence (patterns visible in one strand but not directly captured in the other). Meta-inferences were drawn only where the combined evidence supported a coherent interpretation.

Trustworthiness and Rigor

Quantitative rigor was supported by expert review, content-validity procedures, pilot testing, internal-consistency analysis, and standardized questionnaire administration. Qualitative rigor was addressed through triangulation across coordinators, faculty, and students; use of multiple data sources; reflexive analytic discussion; an audit trail linking themes to transcripts and field notes; and thick description of the program context. These procedures were intended to strengthen credibility, dependability, confirmability, and transferability while remaining consistent with reflexive thematic analysis (Braun & Clarke, 2021; Lincoln & Guba, 1985).

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional research ethics committee prior to data collection. All participants received an explanation of the study's purpose and procedures, and written informed consent was obtained before participation. Participation was entirely voluntary, and participants were informed that they could withdraw at any time without penalty. Confidentiality and anonymity were maintained throughout: identifying information was removed during transcription, pseudonyms or codes were used in reporting, and individual responses were not disclosed to coordinators or faculty in a manner that could identify participants. All data were stored securely, with access restricted to the research team, and were used solely for the purposes of this evaluation.

RESULT AND DISCUSSION

Results

Results are organized according to the CIPP framework. Across the three distinct annual sixth-semester cohorts (2022–2024), 326 eligible students were invited and 297 completed the questionnaire, yielding a response rate of 91.1%. The qualitative strand comprised six coordinator interviews, two faculty FGDs (14 participants), and four student FGDs (30 participants, with representation from all five disciplines). Because different students participated in each year, between-year trends are interpreted as program-level maturation across implementation cycles rather than longitudinal change within the same learners. Participant characteristics are summarized in Table 1.

Table 1. Characteristics of the quantitative sample (N = 297)

Study program	n	%	Female, n (%)	2022	2023	2024
Nursing	78	26.3	64 (82.1)	27	26	25
Midwifery	71	23.9	71 (100)	24	24	23
Nutrition	54	18.2	44 (81.5)	18	18	18
Medical Laboratory Technology	49	16.5	34 (69.4)	17	16	16
Environmental Health	45	15.2	28 (62.2)	15	15	15
Total	297	100	241 (81.1)	101	99	97

The quantitative sample reflected enrollment across the five programs and was predominantly female (81.1%), consistent with the demographic profile of the participating vocational health programs. Annual participation remained similar across cycles (2022: $n = 101$; 2023: $n = 99$; 2024: $n = 97$), supporting comparison of program-level patterns while not implying individual longitudinal follow-up.

Context Evaluation

Context evaluation indicated a generally supportive institutional environment for IPE alongside uneven shared understanding of its objectives. Document review and stakeholder accounts converged on a strong institutional commitment, expressed through the program's inclusion in the academic calendar and the allocation of dedicated coordination roles. Coordinators and faculty consistently described the program's rationale as aligned with national collaborative-healthcare competency expectations and with the institution's vocational, practice-readiness orientation.

Stakeholder support was broadly positive: in the closing questionnaire, 86.5% of students agreed or strongly agreed that IPE was relevant to their future practice, and 79.8% agreed that the institution supported the program. However, alignment of understanding varied across programs. When asked whether the objectives of IPE were clearly understood at the outset, agreement ranged from 81.0% among midwifery students to 62.2% among environmental health students, with a comparable gradient evident in faculty accounts. Several faculty noted that disciplines with less patient-facing curricula entered the program with a narrower conception of what interprofessional collaboration entailed, a divergence that context evaluation flagged as a structural rather than incidental feature of the program.

Input Evaluation

Input evaluation found the program's resources and governance to be largely adequate, with two recurrent limitations. Institutional policies formalizing IPE were in place, faculty support was available, and the learning resources and physical infrastructure, including community placement sites, meeting spaces, and instructional materials were rated sufficient by the majority of respondents (Table 2). Across the three cycles, 84.2% of students rated learning resources as adequate or better, and 80.5% rated facilities similarly.

Table 2. Student ratings of program inputs ($N = 297$)

Input domain	2022 (%)	2023 (%)	2024 (%)	Overall (%)
Learning resources and materials	80.2	84.8	87.6	84.2
Facilities and infrastructure	77.2	81.8	82.5	80.5
Faculty support and availability	75.2	79.8	83.5	79.5
Scheduling and cross-program coordination	58.4	62.6	66.0	62.3
Clarity of standard operating procedures	70.3	74.7	79.4	74.8

Two input limitations were evident. Scheduling and cross-program coordination received the lowest input rating (62.3% overall), reflecting the practical difficulty of synchronizing five curricula, although ratings increased modestly across successive cycles. Faculty preparedness was more uneven than the material-resource ratings suggested: coordinators reported that facilitator briefings were provided, whereas faculty FGDs indicated variable confidence in managing mixed-discipline groups. This represents an important mixed-methods complementarity: infrastructure was generally adequate, but facilitation capacity remained a less uniform input.

Process evaluation

Process evaluation showed high participation and active interdisciplinary engagement, tempered by uneven interaction intensity across professions. Attendance across the three cycles averaged 92.4% of scheduled activities, and 88.6% of students reported active participation in

group discussions. Students particularly valued the community-based public-health cases: 83.8% agreed that working on real community health problems (stunting, diabetes mellitus, and hypertension) made the collaborative learning meaningful.

Facilitator ratings and student self-reports nevertheless indicated that interaction was not evenly distributed. Using a facilitator-rated interaction rubric (1–5), the perceived balance of contribution across disciplines and the overall quality of interprofessional communication both improved across the implementation period (Table 3), while discipline-level patterns persisted in which nursing and midwifery students more frequently led discussions and laboratory and environmental health students contributed less in the early stages of each cycle.

Table 3. Facilitator-rated process indicators by implementation year (rubric 1–5; M $\pm$ SD)

Process indicator	2022	2023	2024
Communication quality	3.4 $\pm$ 0.6	3.7 $\pm$ 0.6	3.9 $\pm$ 0.5
Balance of contribution across disciplines	3.1 $\pm$ 0.7	3.4 $\pm$ 0.6	3.6 $\pm$ 0.6
Depth of interdisciplinary discussion	3.3 $\pm$ 0.6	3.6 $\pm$ 0.6	3.8 $\pm$ 0.5
Student engagement	3.8 $\pm$ 0.5	3.9 $\pm$ 0.5	4.0 $\pm$ 0.5

Mean facilitator ratings for communication quality, contribution balance, and depth of interdisciplinary discussion were higher in later annual cycles than in 2022 (Figure 1). These are program-level trends across different cohorts and should not be read as within-student improvement. Qualitative accounts from students and faculty nevertheless provided a plausible implementation explanation: participants repeatedly described early uncertainty about their own and others' professional roles, followed by greater confidence as shared tasks and facilitated discussion progressed.

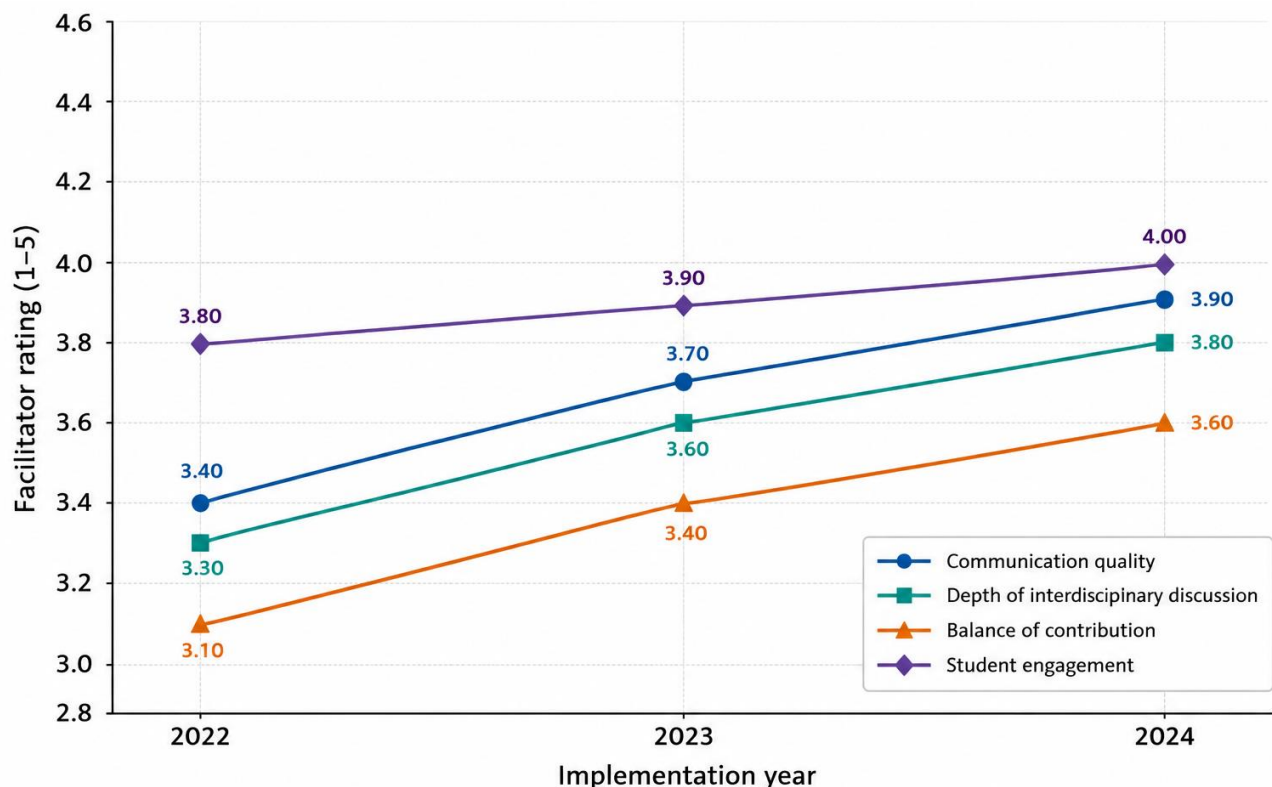


Figure 1. Facilitator-rated process indicators across the three implementation cycles (2022–2024), on a five-point rubric

Product evaluation

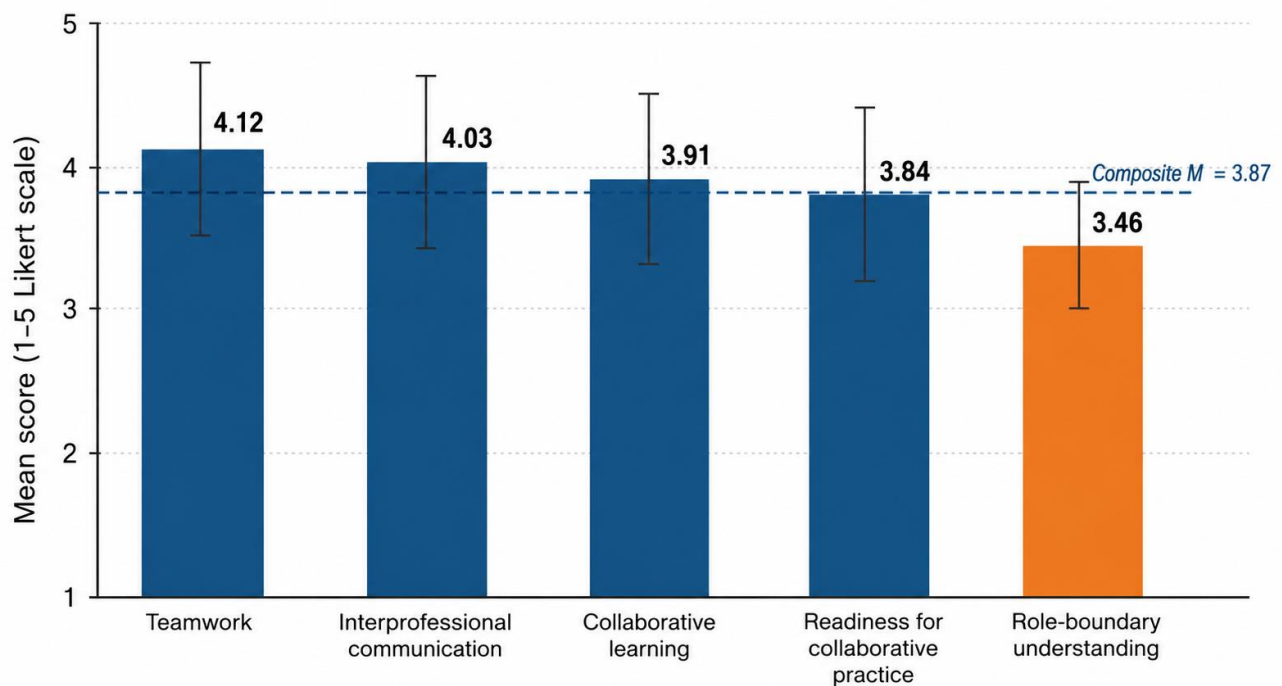
Quantitative findings

Product evaluation yielded moderate-to-high self-reported collaborative competencies (Table 4). On the five-point scale, the highest mean scores were observed for teamwork (M = 4.12, SD = 0.52) and interprofessional communication (M = 4.03, SD = 0.55), followed by

collaborative learning ($M = 3.91$, $SD = 0.58$) and readiness for collaborative practice ($M = 3.84$, $SD = 0.61$). The lowest scores were recorded for understanding the scope and boundaries of other professions ($M = 3.46$, $SD = 0.67$), which was the only construct for which a substantial minority of respondents (22.6%) returned neutral or disagreeing responses (Figure 2).

Table 4. Descriptive statistics for collaborative-competency constructs ($N = 297$; scale 1–5)

Construct	M	SD	% agree/strongly agree	Cronbach's α
Teamwork	4.12	0.52	88.2	0.86
Interprofessional communication	4.03	0.55	85.5	0.84
Collaborative learning	3.91	0.58	81.1	0.82
Readiness for collaborative practice	3.84	0.61	78.5	0.83
Understanding scope/boundaries of other professions	3.46	0.67	61.6	0.79
Composite collaborative competency	3.87	0.49		0.91



Note. Error bars represent standard deviation.

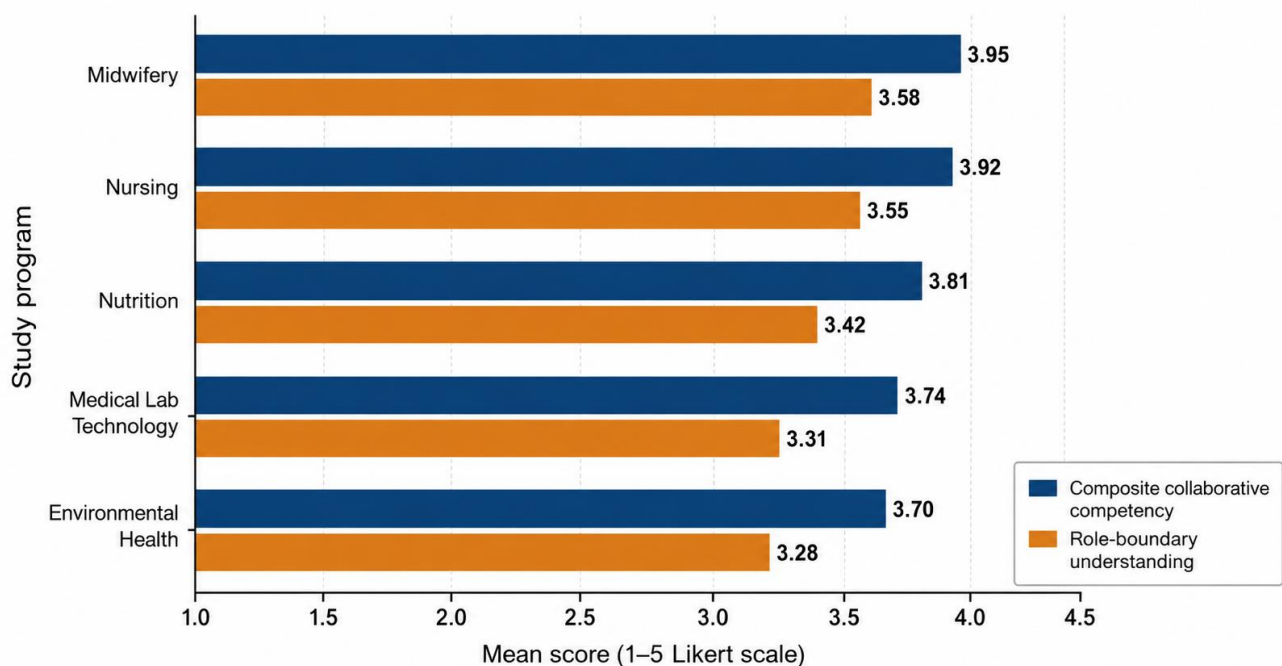
Figure 2. Mean self-reported scores ($\pm$ standard deviation) for the five collaborative-competency constructs at the product stage ($N = 297$; five-point Likert scale).

Composite collaborative-competency scores varied modestly across study programs (Table 5). The omnibus one-way ANOVA was statistically significant, $F(4, 292) = 3.41$, $p = 0.009$, but the effect was small ($\eta^2 = 0.045$). Midwifery and nursing students reported the highest descriptive means, while medical laboratory technology and environmental health students reported the lowest. The same descriptive pattern was most visible for role-boundary understanding (Figure 3). Given the small effect size and the evaluative, non-experimental design, these differences are interpreted as modest disciplinary variation rather than evidence of strong or causal program effects.

Table 5. Composite collaborative-competency score by study program ($M \pm SD$)

Study program	n	Composite score	Teamwork	Communication	Role-boundary understanding
Midwifery	71	3.95 ± 0.46	4.20 ± 0.49	4.10 ± 0.51	3.58 ± 0.63
Nursing	78	3.92 ± 0.47	4.18 ± 0.50	4.09 ± 0.52	3.55 ± 0.64
Nutrition	54	3.81 ± 0.50	4.05 ± 0.53	3.97 ± 0.56	3.42 ± 0.68

Medical Laboratory Technology	49	3.74 ± 0.51	4.02 ± 0.54	3.92 ± 0.58	3.31 ± 0.69
Environmental Health	45	3.70 ± 0.52	3.98 ± 0.55	3.90 ± 0.59	3.28 ± 0.71
Overall	297	3.87 ± 0.49	4.12 ± 0.52	4.03 ± 0.55	3.46 ± 0.67



Note. Higher scores indicate stronger perceived competency.

Figure 3. Composite collaborative-competency score and role-boundary understanding score by study program, ordered by composite mean (1–5 Likert scale)

Qualitative Findings

Thematic analysis generated five themes that elaborated the quantitative findings and clarified how participants experienced the program. The themes were interpreted as explanatory and contextual evidence rather than as a separate estimate of effectiveness.

Theme 1: Enhanced appreciation of other professional roles. Participants across disciplines described a broadened recognition of what other professions contributed, particularly through working on shared community cases. Several students reported that prior assumptions about other disciplines were revised once they observed those disciplines reasoning through a problem.

Theme 2: Improved communication confidence in interdisciplinary settings. Students reported growing ease in speaking and questioning across professional lines as the program progressed, mirroring the upward trend in facilitator-rated communication quality. Faculty noted that this confidence was more evident in later cycles and in students who had completed more than one community activity.

Theme 3: Community-based learning strengthened collaborative problem-solving. Both students and faculty identified the real-world public-health cases as the most valuable component, describing them as the point at which collaboration became concrete rather than theoretical. The authenticity of stunting, diabetes, and hypertension cases was repeatedly cited as the driver of genuine joint reasoning.

Theme 4: Persistent challenges in understanding role boundaries. Consistent with the lowest-scoring quantitative construct, participants described continuing uncertainty about the precise scope and limits of other professions, especially between technically oriented and patient-facing disciplines. This uncertainty was reported to diminish but not resolve over the course of the program.

Theme 5: Need for stronger institutional integration of IPE. Coordinators and faculty emphasized that the program remained somewhat peripheral to the core curricula and called for tighter scheduling integration and more systematic facilitator preparation, echoing the input-

evaluation limitations.

Mixed-methods integration

Integration through the joint display (Table 6) showed substantial convergence but also important expansion and tension. Quantitative strengths in teamwork and communication aligned with qualitative accounts of growing confidence and shared problem-solving, while the low role-boundary score converged with persistent qualitative uncertainty about professional scope. The qualitative strand expanded the survey findings by identifying repeated community-based interaction and facilitator behavior as mechanisms that may explain the positive communication pattern. A complementary tension was also evident: material resources and facilities were generally rated as adequate, yet faculty accounts highlighted uneven facilitator readiness and cross-program coordination. No major direct contradiction between strands was identified, but several implementation issues were visible more clearly in the qualitative data than in the questionnaire.

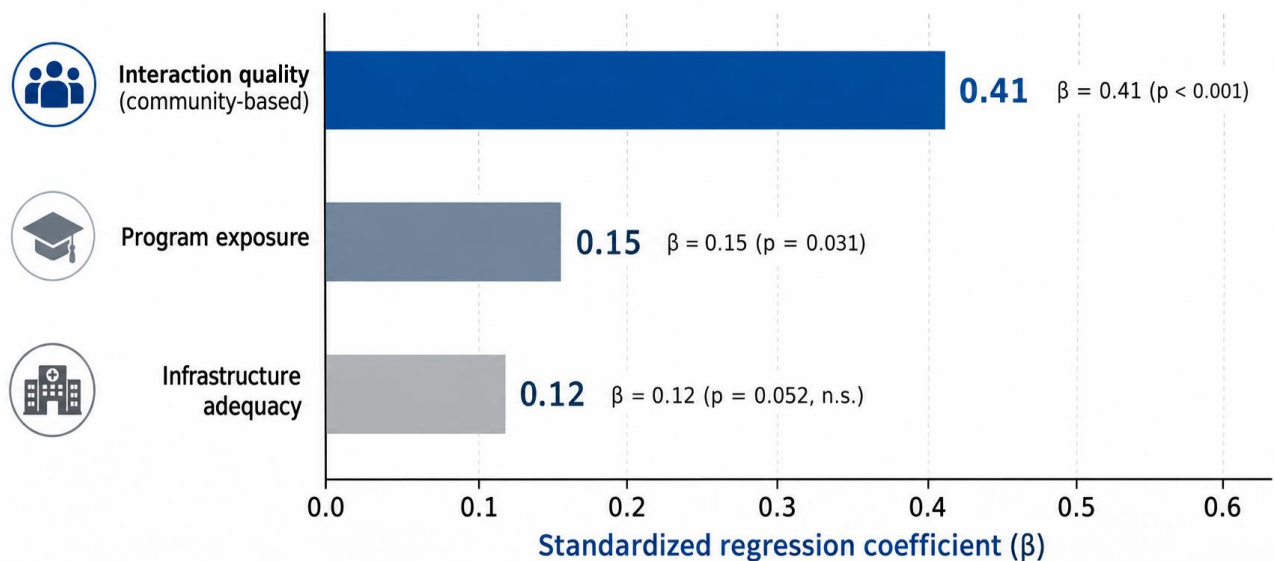
Table 6. Joint display integrating quantitative and qualitative findings

CIPP focus	Quantitative finding	Qualitative finding	Integrated inference
Collaborative competency (overall)	Composite M = 3.87 (moderate-to-high)	Themes 1–3: appreciation, confidence, problem-solving	Convergence: positive self-reported competencies were supported by themes on role appreciation, communication confidence, and shared problem-solving.
Communication	M = 4.03; facilitator rating rose 3.4→3.9 (2022–2024)	Theme 2: growing cross-disciplinary confidence	Convergence + expansion: higher communication scores aligned with growing confidence; qualitative accounts suggested repeated interaction and feedback as mechanisms.
Role-boundary understanding	Lowest construct, M = 3.46; 22.6% non-agreement	Theme 4: persistent role-boundary uncertainty	Strong convergence: both strands identified role-boundary understanding as the most persistent limitation.
Process/value source	Community-case relevance rated 83.8%	Theme 3: community cases as the locus of real collaboration	Convergence + expansion: community cases were valued quantitatively and described qualitatively as the locus of authentic interprofessional learning.
Institutional embedding	Scheduling/coordination lowest input (62.3%)	Theme 5: call for deeper institutional integration	Complementarity/tension: institutional support was generally adequate, but scheduling and facilitator readiness remained important implementation constraints.

Association between interaction quality and perceived effectiveness

An exploratory multiple linear regression examined factors associated with perceived IPE effectiveness. Interaction quality during community-based activities showed the strongest standardized association ($\beta = 0.41$, $p < 0.001$), whereas infrastructure adequacy was weaker and did not reach the conventional 0.05 threshold ($\beta = 0.12$, $p = 0.052$); cumulative program exposure showed a smaller positive association ($\beta = 0.15$, $p = 0.031$). The model accounted for a moderate proportion of variance (adjusted $R^2 = 0.34$). Because the outcome is a questionnaire-based perception measure and the data are observational, these coefficients are treated as correlational and do not establish that interaction quality caused program effectiveness.

The qualitative strand supported and extended this pattern. Participants consistently attributed the educational value of IPE to the quality of cross-disciplinary dialogue and shared problem-solving during authentic community tasks, while facilities were rarely described as the decisive influence. The integrated inference is therefore narrower than a causal claim: within this program, interaction quality was the factor most consistently associated with and used by participants to explain perceived educational value.



Note. β = standardized regression coefficient; adj. R^2 = adjusted coefficient of determination; n.s. = not significant.

Figure 4. Standardized regression coefficients (β) for predictors of perceived IPE effectiveness (adjusted $R^2 = 0.34$).

Discussion

This study evaluated a three-year IPE program across five vocational health disciplines using a convergent mixed-methods design structured by the CIPP framework. Three findings are most educationally important. First, self-reported teamwork and communication were relatively strong, whereas understanding of professional role boundaries remained weaker. Second, program-level process ratings were higher in later annual cycles, although these patterns represent successive cohorts rather than longitudinal student change. Third, the quality of interprofessional interaction during authentic community-based activities was the factor most strongly associated with perceived effectiveness. These findings position IPE as a problem of learning design and interaction quality, not simply of assembling multiple disciplines in the same activity.

Interpreting the pattern of collaborative-competency development

The pattern of stronger teamwork and communication than role-boundary understanding is consistent with recent systematic evidence. Meta-analytic findings suggest that IPE more reliably improves knowledge, attitudes, and selected collaborative processes than complex behavioral outcomes or durable interprofessional competence (Saragih et al., 2023, 2024; Tan et al., 2024). Reviews of clinical IPE likewise emphasize that authentic collaborative tasks can support practice-oriented competencies but that self-report measures and heterogeneous designs limit causal conclusions (Mattiuzzi et al., 2023). The present results therefore fit a broader pattern in which communication-related gains are more readily observed than deeper changes in role understanding.

The higher process ratings observed in later cycles are best interpreted as evidence of program maturation rather than student development. Successive implementation can improve scheduling, facilitator familiarity, task design, and expectations, producing better conditions for collaboration even when each year involves a different cohort. This distinction is important because program-level improvement and learner-level growth answer different questions. The former is compatible with the CIPP focus on continuous program improvement, whereas the latter would require individual longitudinal follow-up.

Interaction quality as the locus of educational value

The study's most distinctive finding is that interaction quality during community-based activities showed the strongest association with perceived IPE effectiveness. The claim should remain appropriately bounded: the outcome was perceived effectiveness, the analysis was observational, and standardized regression coefficients do not establish causation. Even with these constraints, the convergence of the regression pattern with participant accounts suggests that the educational substance of IPE may reside less in program structure itself than in the depth, reciprocity, and balance of interprofessional interaction.

This interpretation is consistent with social interdependence, social constructivist, and situated-learning perspectives. Learning becomes educationally productive when students need one another's knowledge, test explanations through dialogue, and jointly solve problems that cannot be completed adequately from a single disciplinary perspective (Johnson & Johnson, 2009; Lave & Wenger, 1991). In IPE, this mechanism is captured directly in the WHO (2010) formulation of learning with, from, and about other professions. The present results suggest that reciprocal interaction is not an implementation detail but a plausible mechanism through which collaborative competence is developed.

This interaction-focused interpretation may also help explain why IPE studies report heterogeneous effects even when program structures appear similar. Two activities can involve the same professions, duration, and topic but differ substantially in whether students actually exchange expertise, challenge assumptions, negotiate decisions, and share responsibility. Qualitative research on interprofessional learning similarly shows that feedback, rehearsal, and purposeful interdependence shape how collaboration develops (Almoghira et al., 2023). Structural descriptors alone may therefore be insufficient indicators of pedagogical quality.

The persistence of role-boundary ambiguity

Role-boundary understanding remained the weakest competency and was the principal residual challenge across both strands. This finding is consistent with research showing that IPE can improve collaboration perceptions and identity while leaving uncertainty about professional scope, hierarchy, and responsibility unresolved (He et al., 2024; Price et al., 2025). Role clarity is a more demanding educational outcome than positive attitudes because it requires students to understand not only what another profession contributes but also where expertise overlaps, where responsibility changes hands, and how decisions are negotiated in practice.

The finding has a direct pedagogical implication: role clarification should be taught explicitly rather than assumed to emerge automatically from exposure. Future cycles could incorporate structured role-mapping at the start of a case, profession-specific briefing cards that make scope and referral boundaries visible, rotating leadership so that each discipline leads when its expertise is most relevant, guided debriefing focused on overlaps and hand-offs, and assessment rubrics that reward accurate use of other professions' contributions. These strategies are consistent with competency-based IPE design, which treats roles and responsibilities as observable learning outcomes rather than background knowledge (IPEC, 2023; Rogers et al., 2017).

Community-based learning as a catalyst for collaboration

Both strands identified community-based cases on stunting, diabetes mellitus, and hypertension as the program component with the greatest perceived educational value. Authentic community health problems are well suited to interprofessional learning because they integrate applied biological, clinical, laboratory, nutritional, and environmental knowledge with social and behavioral reasoning. Students are therefore required to connect disciplinary science to a shared real-world problem, making collaboration necessary rather than decorative. Indonesian mixed-methods evidence similarly suggests that project-based or community-oriented IPE can strengthen readiness, teamwork, and appreciation of other professions when students work on meaningful health problems (Faizin & Fahreza, 2024; Hermasari et al., 2024).

The value of authentic settings is also supported by broader evidence from clinical and resource-constrained contexts. Work-based and clinical IPE reviews indicate that synchronous patient or community tasks, integrated planning, and interaction with real care teams can support collaborative-practice competencies (Madisa et al., [2022](#); Mattiazzi et al., [2023](#)). Reviews from lower-resource settings further show that IPE is feasible but sensitive to institutional capacity, hierarchy, and implementation conditions (Kitema et al., [2024](#); Joshi et al., [2025](#)). For vocational health-science institutions, this is important because authentic community learning may provide high pedagogical value without dependence on expensive simulation infrastructure.

Process matters more than resources

The contrast between generally adequate resources and the stronger association of interaction quality with perceived effectiveness supports a process-centered interpretation of program quality. Resources are necessary to create feasible learning conditions, but once a minimum level of adequacy is reached, additional infrastructure may contribute less than improvements in facilitation, task design, role clarity, and balanced participation. This interpretation should not be read as evidence that resources are unimportant; rather, it suggests that resource provision and interaction quality operate at different levels of the educational system.

This distinction is precisely why the CIPP framework is useful. Input evaluation identifies whether the program has sufficient resources and organizational support, whereas process evaluation asks whether those inputs are converted into high-quality learning experiences. The current evaluation showed that adequate facilities could coexist with scheduling difficulties and uneven facilitator readiness. Similar CIPP-based IPE work has shown the value of linking program structure to readiness and implementation rather than judging success from outcomes alone (Meiklejohn et al., [2023](#)).

Contributions to theory

The study contributes to three related areas. For IPE research, it adds three-cycle evidence from a vocational setting that is underrepresented in a literature still dominated by university-based studies. For mixed-methods evaluation, it demonstrates the value of integrating competency scores with stakeholder explanations, including not only convergence but also expansion and tension between apparently adequate resources and uneven facilitation. For science and health science education, it shows how authentic community problems can function as interdisciplinary learning environments in which scientific knowledge, professional roles, and collaborative reasoning are learned together. These contributions are evaluative and explanatory rather than causal.

Practical implications

The findings have several practical implications. Curriculum developers should prioritize authentic problems that genuinely require the knowledge of all participating professions and should map each profession's expected contribution before implementation. Program coordinators should protect shared timetable space, use balanced mixed-discipline group composition, and monitor participation patterns. Facilitators should receive preparation in managing hierarchy, eliciting quieter disciplines, questioning for integration, and conducting structured debriefs. Role clarity can be strengthened through role-mapping, briefing cards, rotating leadership, and assessment criteria focused on referral boundaries and collaborative decision-making. These strategies target the interactional mechanism identified in the study rather than assuming that additional infrastructure alone will improve learning.

Strengths and limitations

The study has several strengths. Its mixed-methods design allowed quantitative patterns to be explained and contextualised by qualitative insight, and the convergent integration through

a joint display strengthened the credibility of its conclusions. The three-year evaluation window permitted attention to the program's maturation rather than to a single snapshot, and the inclusion of five disciplines captured a genuinely multiprofessional setting. The use of the CIPP framework ensured that effectiveness was judged in relation to context, resources, and process, not outcomes alone.

Several limitations bound the interpretation. The evaluation was conducted in a single institution, limiting transferability to settings with different disciplinary mixes and organizational cultures. Outcomes relied largely on self-report, so reported competence may not correspond to observed collaborative performance and may be affected by social-desirability or hierarchy-related response bias. There was no pre-program competency baseline, no control group, and no individual longitudinal tracking; therefore, the higher process ratings across later annual cycles cannot be interpreted as within-student growth or as a causal program effect. The regression outcome was perceived IPE effectiveness rather than objective performance, and unmeasured variables may explain part of the observed associations. Finally, the available reporting did not include behavior-based or patient-level outcomes, which limits conclusions about transfer from educational experience to collaborative practice.

Future research

Future research should follow individual students from pre-IPE baseline through graduation and early practice, combine self-report with direct observation or performance-based assessment, and test whether explicit role-clarification strategies improve the weakest competency domain. Multi-institutional studies across vocational and university settings would clarify transferability, while mixed-methods and realist approaches could examine how task authenticity, facilitator skill, hierarchy, and institutional support interact to produce outcomes. Where feasible, quasi-experimental or longitudinal designs should be used to test the proposed interaction-quality mechanism more rigorously.

CONCLUSION

This three-year, CIPP-guided mixed-methods evaluation indicates that IPE in a vocational health professions setting was associated with moderate-to-high self-reported collaborative competency, particularly in teamwork and interprofessional communication, while professional role-boundary understanding remained comparatively weak. Across successive annual cohorts, program-level process ratings were higher in later cycles, and the quality of interaction during authentic community-based activities showed the strongest association with perceived IPE effectiveness. The mixed-methods findings suggest that adequate resources and institutional support are necessary but insufficient unless they are converted into balanced, reciprocal, and well-facilitated interprofessional learning. For curriculum practice, the findings support authentic community problems, explicit role-clarification activities, structured facilitation, and stronger cross-program integration. Because the study used a single institution, self-reported outcomes, distinct annual cohorts, and no pre-program baseline or control group, it does not establish causal effectiveness. Its principal contribution is therefore to identify interaction quality as a plausible educational mechanism and a practical target for strengthening IPE in applied health science education.

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