INTERPROFESSIONAL EDUCATION

Intertwined, multidirectional and interactive: A qualitative study of students' experiences of interprofessional competencies during an oral pathology module

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Abstract

Introduction: Interprofessional competencies have been studied using quantitative methods, predominately involving self-reported measures of knowledge and attitudes of students from a limited number of professions. There is scope to investigate interprofessional competencies using qualitative approaches within underrepresented health professions. We aimed to investigate interprofessional competency development of oral health, medical laboratory sciences and dental surgery students during an interprofessional education initiative.

Methods: We used an interpretive perspective to frame this qualitative study involving 15 students and 3 facilitators from the three professions during an oral pathology module composed of three 90-minute sessions. Reflective prompts about role understanding and interprofessional communication were used to generate written responses analysed with a reflexive thematic approach and interpreted in relation to interprofessional competencies.

Results: Not only were students learning about role understanding and interprofessional communication, but they were also learning about interprofessional values, coordination and collaborative decision making, reflexivity and teamwork. Students appear to experience these competencies as intertwined, multidirectional and interactive.

Conclusions: The experience of interconnectedness among interprofessional competencies should be further investigated with students from health professions beyond medicine. This interconnectedness should be considered when designing, teaching and assessing interprofessional competencies. Additionally, the combination of students should reflect professional work relationships and include currently underrepresented professions.

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Introduction

Interprofessional education can be defined as "occasions when two or more professions learn from and about each other to improve collaboration and the quality of care" (Barr, 2002, p. 6). Competencies are used to describe how well health professionals interact to provide patient care (Thistlethwaite et al., 2014). These competencies include roles and responsibilities, ethical practice, conflict resolution, communication, collaboration and teamwork (van Diggele et al., 2020). Health professional education programs use competencies to design interprofessional education initiatives (Brewer & Flavell, 2020; Pullon & Symes, 2019). Given this work to identify and teach interprofessional practice competences, there is a need to gather evidence about competency development.

Researchers have been gathering evidence to expand our knowledge of how interprofessional education initiatives can build interprofessional competencies. This evidence is composed of self-reported quantitative and qualitative information from students about knowledge they have gained and their opinions or reactions to interprofessional education events they experience (Allvin et al., 2020; Fox et al., 2018; Mink et al., 2021; Norris et al., 2015; Roberts et al., 2019; Simmons & Wagner, 2009). Self-reported information has been supplemented with observational data of student performance in simulated scenarios embedded in single interprofessional education sessions (Champagne-Langabeer et al., 2019; Riesen et al., 2012) or in longitudinal programs (Brashers et al., 2016). A common finding among these studies is improvement in measures of discrete interprofessional competencies, however these evaluation-focused studies do not necessarily provide insights about how interprofessional competencies develop.

Studies about how interprofessional competencies develop are less common in the literature but have provided important insights about the process. For example, an interview study involving pharmacy and nursing students yielded insights about how role understanding appeared to begin from students' prior personal experiences (Wilbur & Kelly, 2015). Initially, role understanding appeared to be stereotypical and could be reinforced or challenged during formal and informal interactions when students participated in professional learning opportunities in workplace settings. Focus group interviews conducted with nursing and social work students after they participated in two interprofessional education seminars about collaborative interdependence indicated students were dynamically building their knowledge about roles and teamwork (Chan et al., 2013). This process was characterised by students becoming responsive to the communication needs of their interprofessional peers when interacting with them. Insights about roles and responsibilities were provided from the analysis of individual interviews with medicine and nursing students after four classroom-based

interprofessional education sessions focused on interprofessional collaboration (Teuwen et al., 2022). For these two groups of students, exchanging information about each other's roles prompted them to reexamine their ideas about their own professional role and responsibilities and gave a better understanding of behaviours that they would have previously interpreted as unhelpful displays of hierarchical social status. Likewise, appreciation and more nuanced understandings of roles and responsibilities, communication preferences and teamwork behaviours were identified in the reflective journals by medicine and nursing students after they participated in a 2-day simulation-based interprofessional education program (Lee et al., 2020). In sum, these studies demonstrate insights about the process of interprofessional competency development. This process appears to be rooted in previous experiences, builds through interaction with others dynamically and can be fostered with prompts for reflection.

It is noteworthy that not all health professions are equally represented in interprofessional education studies. Dentistry is an integral part of a patient's primary healthcare. We can find studies documenting interprofessional education activities involving dentistry students (e.g., Branch-Mays et al., 2017; Carlisle & Taing, 2021; Saraiva et al., 2018), since interprofessional education has become an imperative requirement for dentistry program accreditation (Haber et al., 2021). However, we are concerned that less visible health professions are underrepresented in interprofessional education literature. For example, recent review articles that include dentistry do not specify if oral health therapists are included (Saragih et al., 2023; Wang et al., 2019). However, oral health therapists are important contributors to the general health and wellbeing of their local communities. When oral health students were paired with nursing students, the former learned how to monitor and screen clients for hypertension (Grant, 2011). Different roles and shared responsibilities were the focus, but the process of interprofessional competency development was not investigated.

There is scope to investigate the process of interprofessional competency development with medical laboratory science students. Medical laboratory scientists are integral to healthcare. They perform diagnostic tests that influence the majority of patient diagnostic and treatment decisions (Hallworth, 2011), but few interprofessional education studies include medical laboratory science students. Among studies available, outcome measures of interprofessional competencies are the focus rather than investigations of developmental processes (Cino et al., 2018; Leadbeater et al., 2021). Following the pattern in the literature, studies report students' perceptions of interprofessional education experiences (Salazar, 2017; Vasset, 2018). Furthermore, when included in studies with other more visible professions, there may be insufficient numbers of medical laboratory science participants to produce meaningful results (Smith & Anderson, 2018). Consequently, there are opportunities to enrich the interprofessional education evidence base by including underrepresented professions combined with a focus on investigating the process of how interprofessional competencies develop.

The aim of this study was to investigate interprofessional competency development of oral health, medical laboratory science and dental surgery students during an interprofessional education initiative.

Methods

Study design and context

Ethical approval for the study was obtained from the University of Otago Human Ethics Committee (D20/185). This qualitative study was conducted with staff and students from three health professional programs at the University of Otago, Dunedin, New Zealand: oral health, medical laboratory science and dental surgery. We used an interpretive perspective and a general inductive approach (Thomas, 2006) followed by qualitative content analysis (Elo et al., 2014). This methodology was consistent with the constructivist pedagogy we use in our programs (University of Otago, 2013). As educators, we present learning opportunities to students so they are encouraged to actively construct understanding by interacting with each other and the world around them. This pedagogical approach was chosen to guide the design of the instructional materials included in this study. The research team consisted of one medical laboratory science educator, one oral health educator, three dental surgery educators and one educational researcher who was not involved in any of the health professions represented by the study participants. Consequently, each of us brought different experiences with health professional education and practice to inform the study design and data generation and interpretation. At the University of Otago, interprofessional education activities are guided by a strategic plan that recommends targeting learning activities to the progression of students' degree program (Pullon & Symes, 2019). For students beginning a program of study, an exposure activity is recommended, such as giving a group of students from two or more health professions a case to discuss, enabling students to explore and share their views about the case and develop an understanding of their professions' scope of practice. For students midway through their program, an engagement activity is recommended. Here, students may experience learning opportunities such as a problem-solving clinical scenario through simulation or discussing detailed case information or by visiting a community or hospital setting to engage and reflect upon the interprofessional practice they observe. For students nearing completion of their program, an immersion activity is recommended. This activity may involve placing a student with a clinical team in a workplace so they can have opportunities to apply their developing interprofessional practice in more complex healthcare settings.

Educational activity and participants

An interprofessional oral pathology engagement activity was planned for oral health, medical laboratory science and dental surgery students midway through their respective degree programs. At our institution, the Bachelor of Oral Health degree is 3 years, the Bachelor of Medical Laboratory Science is 4 years and the Bachelor of Dental Surgery is 5

years in duration. Research team members constructed three cases using realistic patient information from their professions based on materials previously described (Olson et al., 2020). In addition to clinical notes, each case included laboratory test results and at least one clinical photo or histopathological image. The cases were designed to emphasise two interprofessional competencies: communication and role understanding (Centre for Interprofessional Education, 2020) using active learning strategies (Enomoto et al., 2022). Communication encompassed students asking each other questions, offering opinions, listening, taking turns to speak and summarising information discussed. Role understanding meant that students took turns to express their professions' point of view, sharing profession-specific knowledge and expressing that they notice the limitations of their own knowledge and the need for another profession's contribution.

Students were expected to work in small groups to discuss each case so the group could collectively construct a treatment plan. Groups were planned to have six members with two students from each profession per group (Daniel, 2019). This configuration was chosen so students might feel supported by a peer from their program when sharing their knowledge and thoughts about the case from the perspective of their profession. Student pairs from the same profession remained together for the duration of the study, however they worked with different student pairs from other professions at each workshop session. The reason for regrouping students was to optimise the potential for students to effectively communicate and develop an understanding of each other's roles while minimising familiar group dynamics.

Facilitators were available to answer logistical and knowledge questions but did not become involved in discussions about the case with the students. Due to a constraint imposed by differences in students' program schedules, final-year students from the dental surgery program were invited to participate rather than mid-program students. Consequently, the cases were revised to ensure they contained sufficiently advanced material to engage the dental surgery students, who were near the end of their program of study.

Study procedures

To generate data with students, the educational researcher drafted four questions to prompt student reflections before and after each case-based discussion and to be followed by written responses. The set of prompts were reviewed and revised by the other research team members to ensure they would generate meaningful responses aligned to the aim of the study in the three workshop sessions. Parallel prompts were designed for the educators facilitating the case discussions. The reflective prompts used to generate data with students and facilitators before and after each case-based discussion are shown in Table 1.

Table 1

Reflection Prompts Used for Generating Data With Students and Facilitators Before and After Each Case-Based Discussion

	Reflection Prompts	
	Before	After
Students	How might you work together to understand the case information?	How did you work together to understand the case information?
	How might you help each other to develop a treatment plan?	How did you help each other to develop a treatment plan?
	How might others help you contribute to the treatment plan?	How did others help you contribute to the treatment plan?
	Any other thoughts?	Any other experiences?
Facilitators	How might students work together to understand the case information?	How did students work together to understand the case information?
	How might students from your program help students from other programs to develop a treatment plan?	How did students from your program help students from other programs to develop a treatment plan?
	How might students from other programs help students from your program to develop a treatment plan?	How did students from other programs help students from your program to develop a treatment plan?
	Any other thoughts?	Any other observations?

Students were invited to participate in the study via flyers presented in classes and a message sent through the university's learning management system. The first six students from each program who responded to an invitation were included if they were available to attend three 90-minute workshop sessions. Participants were provided with information about the study and written consent was obtained at the start of the first session. We revisited consent verbally at the start of the two subsequent sessions. Participants were free to withdraw from the study at any time up until their data were analysed.

The interprofessional education initiative took place in August and September 2021. The first workshop was held in person in an informal classroom setting and facilitated by one educator from each profession, who were also members of the research team. Data were generated by students and facilitators writing their responses to the reflective prompts on paper. Responses were collected in an envelope that was sealed in front of participants and returned to the educational researcher. The next two workshops were delayed due to social distancing measures implemented nationally during a wave of infection from the COVID-19 pandemic. These two workshops were held via video conferencing (https://zoom.us). Data generated during the online workshops were emailed to the educational researcher after each workshop.

Analysis

The educational researcher de-identified and anonymised responses for analysis by the research team. All members of the research team transcribed an equal proportion of the written responses from the first workshop into an Excel spreadsheet. The educational researcher collated digital responses into the same spreadsheet. Each response was given a randomly assigned numeric code (i.e., 1, 2, 3 …) to blind the research team to the participant, profession and timing (i.e., before or after a case-based discussion in a particular workshop session and which one of the 3 workshops). These randomised and anonymised responses were extracted from the spreadsheet for coding using qualitative data analysis software (NVivo, R1.6, QSR International). It is important to note that we could have made inferences about the possible timing of when a particular response was written and the profession of the author of a response based on the grammatical tense and other details in the response. However, we worked collaboratively to remind ourselves to keep focused on the aim and to challenge any assumptions we were making about our interpretation of the responses.

Over several meetings, the research team met to analyse the data. Codes were constructed from the phrasing used by participants that related to the aim of the study. Collaborative coding ensured that we questioned each other's interpretation and discussed assumptions until agreement on the code applied to a response was reached among all coders. More than one code could be applied to a response. Once response coding was complete, we examined the codes and their associated responses independently. We reflected on how the codes represented students' perspectives when learning interprofessional competencies. We noticed that responses mapped to more than the two competencies that were the focus of the workshop materials. Consequently, we decided to use a set of interprofessional competency assessment domains to report our findings (Rogers, Mey, & Chan, 2017). These domains are role understanding, interprofessional communication, interprofessional values, coordination and collaborative decision making, reflexivity and teamwork. These six domains are defined in Table 2, with an illustrative example of how each domain might look and sound during a workshop in this study.

We worked independently to select representative extracts from participants' written responses then met to collaboratively deliberate on the final selection of extracts reported in the results. Each of us took a turn to lead writing the first draft of the findings related to one interprofessional competency domain. Next, we met to collaboratively revise our interpretation of the findings until we agreed that they explained the perspectives of students and facilitators as clearly and succinctly as possible. For reporting results, the education researcher assigned participant responses a randomly assigned alphanumeric code (i.e., S1, S2, … for students; F1, F2, … for facilitators).

Table 2

Interprofessional Competency Domains, Descriptions and Illustrative Examples Used for Data Analysis

Competency Domain	Description	Illustrative Example of What a Student Might Say, Do or Write About
Role understanding	Students recognise the tasks, responsibilities, values and contributions of their specific health profession.	*As an oral health therapist, what would you think of this person's symptoms?* *As a medical laboratory scientist, what do these results mean?*
Interprofessional communication	Students are able to express information and ideas effectively and respectfully with colleagues in other professions. Skills include listening, negotiation, conflict management and resolution.	*Can you tell me what this terminology means?*
Interprofessional values	Students interact collegially, honestly and reliably. They show respect for others, act with integrity, appreciate diversity and maintain a patient-centred focus.	*I'm not sure what these symptoms suggest. Can you explain it to me?* *I would refer this person to the dentist. What would you do next?"*
Coordination and collaborative decision making	Students are able to synchronise professional activities in a unified manner with colleagues, patients, carers, families and communities to optimise patient care. Skills include advocacy, leadership and the ability to take turns.	*I think it could be an infection so I would request some tests, but I'm not sure which ones. What do you suggest for this patient?*
Reflexivity	Students are able to consider the effectiveness of personal and collective contributions to interprofessional collaboration with the aim of continuous improvement.	*When we thought we were on to something, we all started talking at once and over each other. It was fun that we were enthusiastic, but we became less productive as a team.*
Teamwork	Students are able to optimise work with complementary skills, make a commitment to a common purpose, set goals, monitor their own and others' performance and engage in collective accountability	*I would have been lost without the input from the other professions. Once we started working together, we came up with a diagnosis and treatment plan really quickly.*

Results

Study participants consisted of six second-year oral health students, six third-year medical laboratory science students and three fifth-year dental surgery students. Student participants were predominantly female (13), with the remainder identifying as male (1) or non-binary (1). Median age was 21 years (range 19 to 25 years). Student participants self-identified as Chinese (4), New Zealand (NZ) European (4), Filipino (2), Indian (1), Korean (1) and other Asian ethnicities (3). Three facilitators attended at the first session, representing each of the degree programs. For the two subsequent sessions that were held

online, only two facilitators were present, representing medical laboratory science and oral health. Facilitators identified as female (2) and male (1), of NZ European (1), European (1) and South Asian (1) ethnicity. Facilitator participants had at least 5 years of experience each as clinical educators and with facilitating interprofessional education.

We found students were quick to identify their own professional roles and then enquire about the roles of others. They noted the importance of role clarification early in the sessions to establish each other's scope of practice and areas of expertise before working together to resolve the diagnosis and management for each case. In our study, dental surgery students appreciated the knowledge of oral health and medical laboratory science students and how much they could contribute. Furthermore, dental surgery students recognised the role that oral health students can play in prevention, maintenance and follow up. They also acknowledged the contribution that medical laboratory science students make to interpreting test results and suggesting further investigations. As the groups worked together, the oral health and medical laboratory science students learnt about their key roles and how these fit with others to develop a shared care plan.

While we found evidence of students learning about role understanding and interprofessional communication, we also identified examples of interprofessional values, coordination and collaborative decision making, reflexivity and teamwork. Unexpectedly, we noticed that, for students, interprofessional competencies were experienced as intertwined entities.

Role understanding involved recognising the different responsibilities, values and contributions of the health professions present in a student's group, including their own profession. Students described role understanding as "applying knowledge from our own background" (S14) and noted that "dental and oral health students discussed how they would treat the symptoms. We discussed referrals, and the med lab [medical laboratory science] students discussed what the results of the tests meant and what further testing could be done (if necessary)" (S3). Students described how they had to "first understand the different roles we have" (S6) and recognised that students from other professional programs had "completely different experiences and knowledge, which really helped" (S15). A facilitator also noted that students "were really fast to understand their own knowledge, and where there was a gap from the other students, they filled them in!" (F1).

Interprofessional communication consisted of collegial discussions about patient information presented from different professional perspectives. Students described taking turns "initiating the conversation and starting it off and keeping the ideas going" (S4) and "giving inputs or critically evaluating everyone's comments" (S14). Interprofessional communication involved being "accommodating to other people's ideas [when] discussing the case information together by active listening" (S10) and "taking time to identify what each person thinks without talking over top of one another" (S6). We "confirmed with each other that everyone understood all the content and asked each other if we

were unsure" (S6). Each idea was discussed "fairly and without discrimination" (S6). A facilitator "noticed that they [students] weren't shy about asking questions of the other professional groups, which stimulated a lot of conversation" (F2).

Interprofessional values were expressed when students recognised that "everyone is from different backgrounds and may understand the information differently" (S4) and "being open to understanding where other people are coming from" (S10). Students realised they could rely on specialist knowledge of other students to:

> *fill in the blanks where our knowledge doesn't reach, such as any lab results, the MELS [medical laboratory science] students can help, and the BDS [dental surgery] students have more knowledge on pathology and surgery, where BOH [oral heath] is focused on advice and periodontal tissues.* (S13)

Another student noted that others "offered different ideas on how to approach the case and opened up to new ways of treating or diagnosing the patient to provide the best care" (S12).

Coordination and collaborative decision making occurred when individuals or group members were listening to each other; offering, explaining or debating ideas or information about the patient; and managing, negotiating, resolving or respecting differences. Coordination and collaborative decision making were identified when students "offered different aspects of knowledge from … [their] respective fields. This allowed for different views and different ways of interpreting the information" (S10). One facilitator observed that "students could pool this knowledge to complement each other" (F3), and a student noted that this knowledge could be used "to create a more holistic understanding of the patient and conditions" (S13). One student reflected that "we were able to work together to ensure a treatment plan was made to help the conditions we found as our differential diagnoses" (S5). By coordinating and collaborating, students were able to "agree on a likely diagnosis together and what is most important for the patient—solving the cause of the problem rather than treating only the symptoms of it" (S6).

Reflexivity was demonstrated when individual or collective thoughts about the interprofessional interactions in their group were stated with an aim to improve. Reflexivity was identified in responses where students reflected about the value of interprofessional interactions to "help each other through providing different types of information … to help diagnose case studies and offer different solutions that can be added to the treatment plan" (S12). One student wrote, "Honestly, [I would have] found it difficult without MedLabSci [medical laboratory science] to have diagnosed anything from it [the case information]. It could have been a variety of conditions, but bringing up blood cancers hadn't crossed my mind" (S6). As the students progressed through the activity, they "thought about the wider context" (S6). One student noted that "others helped by managing areas of the treatment plan which was out of my own scope of

practice" (S9). Students saw the benefits of "seeking opinion[s] from other professions to clarify any doubts we have" (S14) and that "their knowledge and experience was vital in forming a treatment plan which helped the patient both orally and systemically" (S5).

Teamwork was conveyed by how the group worked together to develop a care plan targeted to the patient's needs. Teamwork was expressed when students reported they were "open to understanding where other people are coming from and how we can work together towards the same goal—come up with the best treatment plan for our patient" (S10). To develop an optimal treatment plan, students had to "address the similarities and differences in our opinions and develop a problem list together" (S8). Team members "ensured that we all contributed and spoke of what we thought and that everyone had a chance to speak" (S4). When students considered how they were interacting with each other, they described aspects of teamwork:

> *We can first build rapport by understanding one another's profession and learn about the things we have in common as health professional students. We can also further address our knowledge in the case information topic and show each other what we have been taught within our courses. Then we can combine our knowledge together to form an interprofessional link in context of the case information.* (S1)

One facilitator noted that "in asking the other professions questions, it seemed to make them all think a bit deeper, which helped drive the diff [differential] diagnosis and final diagnosis" (F2). Not all groups achieved effective teamwork, however, with one student reporting, "The treatment plan was quite segmented, as in each profession stated what they would do in their own profession. In hindsight, we should have integrated it better and possibly worked out an order of which would be done first" (S8).

Interprofessional competencies appear to be intertwined, multidirectional and interactive because interprofessional interactions involve "asking questions about our respective roles, thinking how my profession can assist the other profession" (S14). Furthermore:

> *Others may explain terminology or clinical findings from the information presented to them. They will also provide an alternative perspective to the clinical diagnosis and may alter the course of treatment compared to if the treatment plan was done individually.* (S8)

Another student responded, "We will all have different responsibilities between maintenance, treatment, review [and] intervention, and some professionals may be suited to one part of treatment better than another and to utilise this appropriately" (S6).

Discussion

For students who participated in this study, interprofessional competency development appears to involve more than the two competencies that were the focus of the case discussion materials: role understanding and communication. Students may perceive interprofessional competencies as being intertwined, multidirectional and interactive

when enacted. "Intertwined" characterises the inseparable nature of actions performed by health professionals when collaborating interprofessionally. The multidirectional aspect involves how several people with different knowledge and experiences can contribute to patient care. The interactive quality encapsulates how different situations require people to exchange information and views to negotiate meaning and suggest future actions.

If students experience interprofessional competencies as deeply interconnected skills, then educators must consider several implications. Educators may intend their initiatives to focus on one or two competencies, however students may experience them as a seamless performance of many. Findings related to reflexivity appeared to be intertwined with role understanding. Students reflected on differences in their professional roles and considered how these could be applied to patient care in the case scenarios. This interconnectedness has been investigated from an affective and values-based perspective with more commonly studied professions (Macpherson et al., 2022; Rogers, Mey, & Chan, 2017). Our study provides evidence that a similar interconnection may be experienced by students in oral health, medical laboratory sciences and dental surgery programs.

This study enriches interprofessional education literature by involving underrepresented professions. It builds on preliminary work involving oral health, medical laboratory science and dentistry (Olson et al., 2020). Even though dentistry is well-represented in the literature, with insights to inform interprofessional education practice, findings from this study enrich the literature with the perspectives of students in oral health and medical laboratory science programs. When students engage in interprofessional learning, they can offer each other assistance, take advantage of each other's professional knowledge and develop an understanding that they all have important roles as members of the healthcare team (Olenick et al., 2010). When less visible professions are included, their value and contributions can be highlighted and recognised by others.

Including less visible professions has implications for educators when designing interprofessional education activities. Authentic scenarios that feature collaboration and teamwork should involve a wide range of health professionals in different configurations. Interprofessional activities can be designed to address reflexivity explicitly (e.g., Tubert-Jeannin & Jourdan, 2018). We suggest that educators design case scenarios that build upon the interconnected nature of competency development. This interconnectedness may enhance students' ability to view patients, health and disease from several perspectives and develop holistic care plans.

Strengths, limitations and future directions

Our decision to sample students who volunteered to participate in our study may have influenced our findings. Students may have been influenced by the responses given by their peers or in anticipation of pleasing the facilitators. If our study had involved all students from each of the three programs, reflections may have been more diverse or less positive. Due to scheduling logistics and staffing pressures, our sample included only

three dental surgery students rather than the intended six. Ironically, this constraint resulted in dentistry being the underrepresented profession in this study and may have contributed to findings that may be less applicable to students and educators in that profession. A future study could use a different sampling method to include students who may hold alternative views not represented in this study's findings. The views examined in this study may have also been influenced by the case-based discussions used to generate data. While student reflections were the primary data source, reflections from facilitators were included to enrich the data generated in this study because facilitators were able to make direct observations of students interacting during the interprofessional education activity. Importantly, the data generated and analysed by facilitators was influenced by each facilitator's professional background, their experience with facilitating interprofessional education and their investment in the study. Different insights may have been generated from the results if the researchers were not deeply embedded in the study as designers and facilitators of the interprofessional education initiative. Using the set of interprofessional competency assessment domains by Rogers, Thistlethwaite and colleagues (2017) to structure the content analysis may have limited our interpretation of the data. We may have overlooked findings that did not fit these domains. We are eager to see if these findings are detected with other educators and groups of students in different settings.

Conclusion

The finding that oral health, medical laboratory sciences and dental surgery students may perceive interprofessional competencies as being intertwined, multidirectional and interactive expands our knowledge of how interprofessional education initiatives can build interprofessional competencies. Recommendations generated from this study's findings also add to our knowledge about designing interprofessional education initiatives for health professional students that have been previously underrepresented in those initiatives. This study shows how a small-scale qualitative approach can generate evidence about the process of competency development. We encourage others to further investigate the idea that interprofessional development may be experienced as an interconnected phenomenon.

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References

Allvin, R., Thompson, C., & Edelbring, S. (2020). Assessment of interprofessional competence in undergraduate health professions education: Protocol for a systematic review of self-report instruments. *Systematic Reviews*, *9*(1), Article 142. https://doi.org/10.1186/s13643-020-01394-7

Barr, H. (2002). *Interprofessional education: Today, yesterday, and tomorrow*. https://www.caipe.org/resources/publications/caipe-publications/caipe-2002-interprofessional-education-today-yesterday-tomorrow-barr-h

Branch-Mays, G. L., Pittenger, A. L., Williamson, K., Milone, A., Hein, E., & Thierer, T. (2017). An interprofessional education and collaborative practice model for dentistry and pharmacy. *Journal of Dental Education*, *81*(12), 1413–1420. https://doi.org/10.21815/jde.017.101

Brashers, V., Erickson, J. M., Blackhall, L., Owen, J. A., Thomas, S. M., & Conaway, M. R. (2016). Measuring the impact of clinically relevant interprofessional education on undergraduate medical and nursing student competencies: A longitudinal mixed methods approach. *Journal of Interprofessional Care*, *30*(4), 448–457. https://doi.org/10.3109/13561820.2016.1162139

Brewer, M. L., & Flavell, H. (2020). *Embedding interprofessional education in the curriculum*. Higher Education Research & Development Society of Australasia.

Carlisle, C., & Taing, M. W. (2021). Interprofessional education between dentistry and pharmacy students: Delivery, barriers and facilitating implementation. *Australian Dental Journal*, *66*(4), 351–357. https://doi.org/10.1111/adj.12856

Centre for Interprofessional Education, Division of Health Sciences, University of Otago. (2020). *Interprofessional education* (Strategy document). https://www.otago.ac.nz/__data/assets/pdf_file/0016/332305/a-curriculum-and-quality-framework-for-interprofessional-education-at-otago-strategic-plan-2020-2024-full-report-737732.pdff

Champagne-Langabeer, T., Revere, L., Tankimovich, M., Yu, E., Spears, R., & Swails, J. L. (2019). Integrating diverse disciplines to enhance interprofessional competency in healthcare delivery. *Healthcare*, *7*(2), Article 75. https://doi.org/10.3390/healthcare7020075

Chan, E. A., Lam, W., & Lam Yeung, S. K. S. (2013). Interprofessional competence: A qualitative exploration of social work and nursing students' experience. *Journal of Nursing Education*, *52*(9), 509–515. https://doi.org/10.3928/01484834-20130823-01

Cino, K., Austin, R., Casa, C., Nebocat, C., & Spencer, A. (2018). Interprofessional ethics education seminar for undergraduate health science students: A pilot study. *Journal of Interprofessional Care*, *32*(2), 239–241. https://doi.org/10.1080/13561820.2017.1387771

Daniel, B. (2019). Student experience of the maximum variation framework for determining sample size in qualitative research [Paper presentation]. In A. Stacey (Ed.), *18th European Conference on Research Methodology for Business and Management Studies*, *Wits Business School, 20–21 June, Johannesburg, South Africa* [pp. 91–100]. Academic Conferences and Publishing International. https://www.proceedings.com/content/049/049537webtoc.pdf

Elo, S., Kääriäinen, M., Kanste, O., Pölkki, T., Utriainen, K., & Kyngäs, H. (2014). Qualitative content analysis: A focus on trustworthiness. *SAGE Open*. *4*(1). https://doi.org/10.1177/2158244014522633

Enomoto, K., Warner, R., & Nygaard, C. (2022). *Active learning in higher education: Student engagement and deeper learning outcomes*. Libri.

Fox, L., Onders, R., Hermansen-Kobulnicky, C. J., Nguyen, T. N., Myran, L., Linn, B., & Hornecker, J. (2018). Teaching interprofessional teamwork skills to health professional students: A scoping review. *Journal of Interprofessional Care, 32*(2), 127–135. https://doi.org/10.1080/13561820.2017.1399868

Grant, L., McKay, L. K., Rogers, L. G., Wiesenthal, S., Cherney, S. L., & Betts, L. A. (2011). An interprofessional education initiative between students of Dental Hygiene and Bachelor of Science in Nursing. *Canadian Journal of Dental Hygiene*, *45*(1), 36–44.

Haber, J., Hartnett, E., Cipollina, J., Allen, K., Crowe, R., Roitman, J., Feldman, L., Fletcher, J., & Ng, G. (2021). Attaining interprofessional competencies by connecting oral health to overall health. *Journal of Dental Education*, *85*(4), 504–512. https://doi.org/10.1002/jdd.12490

Hallworth, M. J. (2011). The "70% claim": What is the evidence base? *Annals of Clinical Biochemistry*, *48*(6), 487–488. https://doi.org/10.1258/acb.2011.011177

Leadbeater, W., Pallett, R., Dunn, E., & Bashir, A. (2021). A virtual approach to promote inter-professional learning (IPL) between biomedical science and medicine in higher education for the benefit of patient care. *Frontiers in Public Health*, *9*, Article 747751. https://doi.org/10.3389/fpubh.2021.747751

Lee, W., Kim, M., Kang, Y., Lee, Y. J., Kim, S. M., Lee, J., Hyun, S-J., Yu, J., & Park, Y. S. (2020). Nursing and medical students' perceptions of an interprofessional simulation-based education: A qualitative descriptive study. *Korean Journal of Medical Education*, *32*(4), 317–327. https://doi.org/10.3946/kjme.2020.179

Macpherson, I., Roqué, M. V., Martín-Sánchez, J. C., & Segarra, I. (2022). Analysis in the ethical decision-making of dental, nurse and physiotherapist students, through case-based learning. *European Journal of Dental Education*, *26*(2), 277–287. https://doi.org/10.1111/eje.12700

Mink, J., Mitzkat, A., Krug, K., Mihaljevic, A., Trierweiler-Hauke, B., Goetsch, B., Wesing, M., & Mahler, C. (2021). Impact of an interprofessional training ward on interprofessional competencies: A quantitative longitudinal study. *Journal of Interprofessional Care*, *35*(5), 751–759. https://doi.org/10.1080/13561820.2020.1802240

Norris, J., Carpenter, J. G., Eaton, J., Guo, J. W., Lassche, M., Pett, M. A., & Blumenthal, D. K. (2015). The development and validation of the interprofessional attitudes scale: Assessing the interprofessional attitudes of students in the health professions. *Academic Medicine*, *90*(10), 1394–1400. https://doi.org/10.1097/ACM.0000000000000764

Olenick, M., Allen, L. R., & Smego, R. A., Jr. (2010). Interprofessional education: A concept analysis. *Advances in Medical Education and Practice*, *1*, 75–84. https://doi.org/10.2147/AMEP.S13207

Olson, H., Ronayne, C., Anakin, M., Meldrum, A., & Rich, A. (2020). Working together in clinical pathology: An interprofessional education initiative for dentistry, oral health, and medical laboratory science teachers and students. *MedEdPublish*, *9*, Article 9. https://doi.org/10.15694/mep.2020.000009.1

Pullon, S., & Symes, A. (2019). *A curriculum and quality framework for interprofessional education at Otago: Strategic plan 2020–2024: Full report*. Centre for Interprofessional Education, Division of Health Sciences, University of Otago. http://hdl.handle.net/10523/15182

Riesen, E., Morley, M., Clendinneng, D., Ogilvie, S., & Murray, M. A. (2012). Improving interprofessional competence in undergraduate students using a novel blended learning approach. *Journal of Interprofessional Care*, *26*(4), 312–318. https://doi.org/10.3109/13561820.2012.660286

Roberts, S. D., Lindsey, P., & Limon, J. (2019). Assessing students' and health professionals' competency learning from interprofessional education collaborative workshops. *Journal of Interprofessional Care*, *33*(1), 38–46. https://doi.org/10.1080/13561820.2018.1513915

Rogers, G. D., Mey, A., & Chan, P. C. (2017). Development of a phenomenologically derived method to assess affective learning in student journals following impactive educational experiences. *Medical Teacher*, *39*(12), 1250–1260. https://doi.org/10.1080/0142159X.2017.1372566

Rogers, G. D., Thistlethwaite, J. E., Anderson, E. S., Abrandt Dahlgren, M., Grymonpre, R. E., Moran, M., & Samarasekera, D. D. (2017). International consensus statement on the assessment of interprofessional learning outcomes. *Medical Teacher*, *39*(4), 347–359. https://doi.org/10.1080/0142159X.2017.1270441

Salazar, J. H. (2017). Interprofessional education themes in a clinical laboratory sciences curriculum. *American Society for Clinical Laboratory Science*, *30*(2), 99–104. https://doi.org/10.29074/ascls.30.2.99

Saragih, I. D., Tarihoran, D. E. T. A. U., Sharma, S., & Chou, F. H. (2023). A systematic review and meta-analysis of outcomes of interprofessional education for healthcare students from seven countries. *Nurse Education in Practice*, *71*, Article 103683. https://doi.org/10.1016/j.nepr.2023.103683

Saraiva, A. M., Silva, I. R. G., Lolli, L. F., Fujimaki, M., das Neves Alves, R., Miguel, E. R. A., da Rocha Mialchi, N., & da Rocha, N. B. (2018). Interprofessional discipline in health: Assessment of dentistry students. *Revista da ABENO, 18*(4), 3–13. https://doi.org/10.30979/rev.abeno.v18i4.598

Simmons, B., & Wagner, S. (2009). Assessment of continuing interprofessional education: Lessons learned. *Journal of Continuing Education in the Health Professions*, *29*(3), 168–171. https://doi.org/10.1002/chp.20031

Smith, B. S., & Anderson, K. (2018). Attitudes toward interprofessional education: Comparing physical therapist and other health care professions' students. *Journal of Physical Therapy Education*, *32*(2), 183–190. https://doi.org/10.1097/JTE.0000000000000039

Teuwen, C., van der Burgt, S., Kusurkar, R., Schreurs, H., Daelmans, H., & Peerdeman, S. (2022). How does interprofessional education influence students' perceptions of collaboration in the clinical setting? A qualitative study. *BMC Medical Education*, *22*(1), Article 325. https://doi.org/10.1186/s12909-022-03372-0

Thistlethwaite, J., Forman, D., Matthews, L., Rogers, G., Steketee, C., & Yassine, T. (2014). Competencies and frameworks in interprofessional education: A comparative analysis. *Academic Medicine*, *89*(6), 869–875. https://doi.org/10.1097/ACM.0000000000000249

Thomas, D. R. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Evaluation*, *27*(2), 237–246. https://doi.org/10.1177/1098214005283748

Tubert-Jeannin, S., & Jourdan, D. (2018). Renovating dental education: A public health issue. *European Journal of Dental Education*, *22*(3), e644–e647. https://doi.org/10.1111/eje.12347

University of Otago. (2013). *University of Otago teaching and learning plan 2013–2020*. https://www.otago.ac.nz/staff/otago027123.pdf

van Diggele, C., Roberts, C., Burgess, A., & Mellis, C. (2020). Interprofessional education: Tips for design and implementation. *BMC Medical Education*, *20*(Suppl. 2), Article 455. https://doi.org/10.1186/s12909-020-02286-z

Vasset, F. P. (2018). Nursing and biomedical laboratory science (BMLS) students' interprofessional training in the simulation laboratory. *Journal of Research in Interprofessional Practice and Education, 8*(1), 1–13. https://doi.org/10.22230/jripe.2018v8n1a271

Wang, Z., Feng, F., Gao, S., & Yang, J. (2019). A systematic meta-analysis of the effect of interprofessional education on health professions students' attitudes. *Journal of Dental Education*, *83*(12), 1361–1369. https://doi.org/10.21815/JDE.019.147

Wilbur, K., & Kelly, I. (2015). Interprofessional impressions among nursing and pharmacy students: A qualitative study to inform interprofessional education initiatives. *BMC Medical Education*, *15*(1), Article 53. https://doi.org/10.1186/s12909-015-0337-y