



Interdisciplinary education in undergraduate health programs: A scoping review

Interdisziplinäre Ausbildung in den Gesundheitsberufen. Ein Scoping Review.

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Abstract

Background: Patients rely on multiple healthcare providers working cohesively as a team. However, learners in health-related disciplines are typically trained in isolation from one another. While some literature has explored how collaborative learning at the graduate level, undergraduate health programs are often not included in this discourse.

Objectives: This study aims to identify literature detailing collaborative, or interdisciplinary education (IDE), initiatives, attitudes, and interventions in undergraduate health-related programs.

Methods: The Arksey and O'Malley scoping review methodological framework was followed. A search was conducted (December 2023) using CINAHL, Embase, ERIC, Ovid MEDLINE, PsychInfo, and Web of Science. Studies were included if they involved two or more disciplines (at least one health-related) and/or post-secondary undergraduate learners, and if they were related to education. Studies were excluded if they discussed learners outside direct-entry undergraduate programs, were studies on working health professionals, or did not focus on IDE. Using the Donabedian model, results were synthesized into IDE structure, process, and outcomes.

Results: Thirty-five studies met the inclusion criteria. Micro, meso, and macro structures were found to facilitate or pose barriers to IDE. Regarding process, there were various disciplines, intervention types, durations, and teaching modalities. Positive outcomes included student knowledge, skills, attitudes and beliefs, and behaviors. Challenges included lack of support and difficulties with resources and logistics, learning activities, student group dynamics, and attitudes and beliefs. Studies offered recommendations for IDE. Our analysis revealed gaps in the literature concerning reporting of IDE process and outcomes.

Conclusions: We make recommendations for education researchers, educational developers, and policymakers regarding the design, implementation, evaluation, and reporting of IDE.

Abstract

Hintergrund: Patienten sind auf die Zusammenarbeit mehrerer Gesundheitsdienstleister angewiesen. Lernende in gesundheitsbezogenen Disziplinen werden jedoch typischerweise isoliert voneinander ausgebildet. Während wissenschaftliche Arbeiten das kollaborative Lernen auf Graduiertenebene untersuchen, werden grundständige Gesundheitsprogramme oft nicht in diesen Diskurs einbezogen.

Ziele: Ziel dieser Studie ist die Identifizierung von Literatur, die kollaborative bzw. interdisziplinäre Ausbildung (IDE), Initiativen, Einstellungen und Interventionen in grundständigen Gesundheitsprogrammen detailliert beschreibt.

Methoden: Es wurde der methodische Rahmen des Arksey- und O'Malley-Scoping-Reviews verwendet. Die Recherche (Dezember 2023) erfolgte mit CINAHL, Embase, ERIC, Ovid MEDLINE, PsychInfo und Web of Science. Studien wurden eingeschlossen, wenn sie zwei oder mehr Disziplinen (mindestens eine gesundheitsbezogene), Studierende im postsekundären Bachelor-Studium und einen Bezug zur Ausbildung umfassten. Studien wurden ausgeschlossen, wenn sie Lernende außerhalb von Direkteintrittsstudiengängen, berufstätige Gesundheitsfachkräfte oder keinen Fokus auf IDE hatten. Mithilfe des Donabedian-Modells wurden die Ergebnisse zu Struktur, Prozess und Ergebnissen des IDE zusammengefasst. **Ergebnisse:** 35 Studien erfüllten die Einschlusskriterien. Mikro-, Meso- und Makrostrukturen förderten oder erschwerten das IDE. Bezüglich des Prozesses gab es unterschiedliche Disziplinen, Interventionsarten, Dauer und Lehrmethoden. Zu den positiven Ergebnissen zählten Kenntnisse, Fähigkeiten, Einstellungen und Überzeugungen der Studierenden sowie ihr Verhalten. Herausforderungen waren mangelnde Unterstützung sowie Schwierigkeiten mit Ressourcen und Logistik, Lernaktivitäten, Gruppendynamik der Studierenden sowie Einstellungen und Überzeugungen. Die Studien lieferten Empfehlungen für das IDE. Unsere Analyse offenbarte Lücken in der Literatur zur Berichterstattung über den IDE-Prozess und die IDE-Ergebnisse.

Schlussfolgerungen: Wir geben Empfehlungen für Bildungsforscher, Bildungsentwickler und politische Entscheidungsträger hinsichtlich der Gestaltung, Umsetzung, Evaluation und Berichterstattung des IDE.



Keywords

Interdisciplinary – Interprofessional – Undergraduate – health sciences

Keywords

Interdisziplinär – Interprofessionell – Bachelor – Gesundheitswissenschaften

INTRODUCTION

A patient's healthcare experience is rarely isolated to a singular profession. Rather, patients rely on multiple healthcare providers working cohesively as a team to diagnose, treat, and support their health effectively. While the hope is that new healthcare professionals form and integrate into effective clinical teams as soon as they enter practice, this is not always the case.

Literature suggests there are three ways in which individuals will typically interact in a group setting: cooperatively, competitively, and individualistically (Johnson et al., 1981). In a cooperative environment, individuals work together to achieve a shared goal; competitive environments occur when individuals work to outperform each other; and individualistic environments occur when individuals work to accomplish goals independent of others (Johnson et al., 1981). While the goal for most workplace settings is to achieve a cooperative environment, this is particularly true in healthcare, where effective teams can improve patient outcomes and ineffective teams may pose significant harm (Cullati et al., 2019).

Despite the importance of cooperative, team-based healthcare, health-sciences students are often trained in isolation from one another (Nelson et al., 2014). While this traditional teaching style has been in place for decades — due to logistical and practical reasons, such as scheduling or distinct learning objectives — this education structure may not be adequately preparing students for careers as interprofessional (IP) healthcare collaborators (Nelson et al., 2014).

To date, there has been strong theoretical support for educational environments which foster collaborative learning, where learning occurs through consensus building in a cooperative group environment (Laal & Ghodsi, 2012). The benefits of collaborative learning can be subdivided into three general categories: social, psychological, and academic (Laal & Ghodsi, 2012). The social benefits include building positive relationships between learners, improving oral communication skills, and creating space for diverse perspectives. Psychological benefits include decreasing levels of anxiety, and increasing self-esteem and/or confidence, in learners. Finally, academic benefits include improvements in critical thinking and problem-solving skills.

Within the health sciences, it has also been suggested that collaborative learning builds capacity for cooperative, and team-based interprofessional healthcare (Nelson et

al., 2014). By creating opportunities for health sciences learners to study and work together, it can prepare them to be part of a diverse healthcare team; to communicate effectively with their team; to understand each other's roles and limit the duplication of work; and, ultimately, optimize patient care (Nelson et al., 2014). Due to these benefits, different forms of collaborative learning have been gaining recognition globally, and it is now acknowledged as an integral part of educating future healthcare professionals (Steven et al., 2017). Indeed, for many healthcare-professions programs — such as nursing, physical therapy, occupational therapy, and medicine μ — interprofessional education is now included in accreditation standards (Grymonpre et al., 2021).

In these contexts, collaborative learning is often referred to as interprofessional education (IPE). Formally defined, IPE is any intervention, structured event, or setting where more than one profession learns with, about, or from others and vice-versa, and the different professions work together to achieve a certain shared goal related to patient health outcomes or quality of care (Ford & Gray, 2021). Within IPE, additional terms, such as “pre-qualifying” or “post-qualifying,” are sometimes used to define where in the learners' academic training the educational initiatives take place. Pre-qualifying IPE occurs during schooling or training in a certain profession, typically while the learner is still completing coursework and placements. Post-qualifying IPE, on the other hand, refers to education following licensing or professional certification exams; in this type of IPE, some learners have to complete additional training with supervision, such as internships or residency programs (Ford & Gray, 2021). Substantial IPE literature speaks to the benefits of collaborative learning within these contexts (Guraya & Barr, 2018).

Recent literature suggests that collaborative learning is most effective when offered incrementally throughout a learner's education (O'Neil-Pirozzi et al., 2019). Early collaborative learning, sometimes referred to as interdisciplinary (ID) learning or interdisciplinary education (IDE), includes learners from more than one discipline or broad field of study — typically at the post-secondary level — to gain deeper insight into a problem and/or develop a solution (Klein, 2006). This observation suggests that there may be particular value in incorporating collaborative learning during learners' undergraduate degree, as it would prepare students to further engage with these conversations in graduate and professional programs. This would also provide learners with opportunities to develop critical skills in



Table 1: Scoping review outline using the Arksey & O'Malley framework (Adapted from Arksey & O'Malley, 2005)

1. Identifying the Research Question	2. Identifying Relevant Studies	3. Study Selection	4. Charting the Data	5. Reporting Results
<p>2022</p> <p>Research Question: What literature is available regarding interdisciplinary education in health-related undergraduate programs?</p>	<p>December 2023</p> <p>Search terms: (interdisciplinary OR inter-disciplinary) AND health sciences AND (education or course OR intervention OR activity OR program) AND (undergrad* OR higher education OR post-secondary OR postsecondary), NOT medical students.</p> <p>Databases: CINAHL, Embase, ERIC, Ovid MEDLINE, APA PsychInfo, Web of Science</p>	<p>January 2024</p> <p>Inclusion Criteria: two or more undergraduate disciplines (at least one health-related program); post-secondary learners (university or college); focused on some aspect of IDE.</p> <p>Software: Covidence</p>	<p>April 2024</p> <p>Data Extracted: purpose/aim of the paper, type of article, region, country, institution, disciplines involved, number participants, interdisciplinary grouping (how learners were combined), interdisciplinary initiative (type, length, duration, focus, structure/format), type of data collected and method, analysis technique, outcomes, recommendations, and limitations.</p>	<p>May 2024</p> <p>Synthesis: Donabedian model (structure, process, outcomes); common terms; positive outcomes of interventions & challenges</p>

teamwork and collaboration should they choose to enter the workforce directly after their undergraduate degree. However, there does not appear to be much literature on the implementation or evaluation of IDE or collaborative learning at the undergraduate level (Schijf et al., 2023). The question lends itself to a scoping-review approach (i.e., mapping the existing literature on the topic). Thus, the purpose of this study was to identify literature on IDE at the undergraduate level. Specifically, this scoping review aimed to identify work detailing IDE attitudes and interventions in health-related undergraduate programs.

METHODS

Scoping-review framework

A scoping review using the Arksey and O'Malley methodological framework was conducted to capture the breadth and depth of literature available on IDE in health-related undergraduate programs. The framework is characterized by five methodological stages: identifying the research question; identifying relevant studies; study selection; charting the data; and collating, summarizing, and reporting results (Arksey & O'Malley, 2005, Table 1). The preparation of this report and the key items included was informed by the PRISMA extension for scoping reviews (Tricco et al., 2018).

Search strategy


An initial search was conducted in 2022 to confirm the gaps in the literature and refine the research question. A formal search was then conducted in December 2023 to identify specific studies. Keywords included (interdisciplinary or inter-disciplinary) and health sciences and (education or course or intervention or activity or program) and (undergrad* or higher education or post-secondary or postsecondary), not

medical students. Medical students were specifically excluded in the search terms, as this review focused on undergraduate (pre-professional) education. This is because in Canada, while medicine is often classified as an undergraduate degree, it is typically discussed as part of the IPE literature as a professional program, and is usually completed as a second degree. Databases searched included CINAHL, Embase, ERIC, Ovid MEDLINE, APA PsychInfo, and Web of Science. Terms were not restricted to any particular field and searches were inclusive to all years to maintain a broad scope. Search results (titles and abstracts) were extracted from the databases as a .ris file and imported into Covidence (Covidence systematic review software, 2024).

Selection of sources of evidence

The Covidence platform was utilized to identify and remove duplicates. Five members of the research team (NM, EL, LD, LS, and SE) worked collaboratively in Covidence to independently screen the studies. Studies had to have been included by two independent reviewers to continue to the next phase of review. In the case of a conflict, a third team member would review the study, and the team would meet to discuss the outcome to ensure that everyone was in agreement.

Studies were included if they involved the following: two or more disciplines both at the undergraduate level (at least one of which was a health-related program); post-secondary learners in a direct-entry program (university or college); and some aspect of collaborative education. The study team met prior to study selection to discuss what would they would consider "health-related" or not; if issues arose, these were discussed by the group until consensus was reached. All study types, including commentaries, review papers, methods papers, and experimental studies, were included. Studies were excluded if they included or discussed professionals



working in healthcare, or learners outside direct-entry undergraduate programs (e.g., medical and dentistry students); were not related to health studies in some way; or did not discuss some aspect of collaborative education.

Data extraction

Once the full-text review was completed, the studies were divided amongst the research team for data extraction. A data extraction form was created using the Covidence platform. The data extraction form included fields for the purpose/aim of the paper; type of paper; region; country; institution; disciplines involved; number of participants/learners; interdisciplinary grouping (how learners were combined); interdisciplinary initiative (type, length, duration, focus, structure/format); type of data collected and method, analysis technique, outcomes, recommendations, and limitations. The team met one or two times a week throughout the data-extraction process to discuss and verify a consistent approach. The extracted data was then verified by one team member (EL).

Synthesis of results

The Donabedian model was used as an organizing framework to synthesize the extracted data. According to the Donabedian model, structure (the attributes of the setting), process (what is being done), and outcome (the effect that the process has brought about) are linked (Donabedian, 1988). This model was originally a framework for the assessment of healthcare quality, but has since been applied in IPE contexts (Botma & Labuschagne, 2017; Sherman et al., 2020). This model was chosen because knowing the structure and process that led to a set of outcomes for a specific IDE intervention can help bring to light its supporting factors and challenges in order to inform future implementations or improvements.

In addition to the summary extraction table using the Donabedian model, a summary of common terms related to IDE was created with the definitions used in the included studies. When terms were not formally defined by the included studies, we looked to the broader literature to supplement our definitions. Finally, a table of outcomes of the IDE initiatives was created. The outcomes table includes the positive outcomes and challenges identified in the educational interventions.

RESULTS

In synthesizing the results, we aim to present the range of evidence identified detailing IDE initiatives, attitudes, and interventions in undergraduate health-related programs. The evidence will be presented through visual, table, and narrative formats.

Selection of sources of evidence

Following the search, 528 studies were initially identified. After duplicates were removed, there were 468 studies remaining. During title and abstract screening, 334 studies were excluded due to studying the wrong population (e.g., students from medicine or dentistry; graduate students; no health-related discipline); wrong study design/intervention, or not being a study at all; not being collaborative or interdisciplinary; or not having the full text available in English. The remaining 134 full texts were assessed for eligibility, 35 of which met the criteria and were included in the review (Figure 1). A summary of included studies is provided in [Appendix A](#).

Study context

The 35 studies included in the review were published between 1981 and 2022, with one study in the 1980s, one in the 1990s, six in the 2000s, 19 in the 2010s, and eight in the 2020s (with the most recent studies being three from 2022). Although our search was conducted in December 2023, we found no articles from 2023 that met the inclusion criteria. Most studies (15) were conducted in the United States of America, followed by Australia (six), Canada (four), and South Africa (four). The remaining studies were from Israel, the Netherlands, Spain, Switzerland, and the United Kingdom.

Terminology

The studies in this review made reference to collaborative learning by using the terms “cross-disciplinary,” “interdisciplinary,” “interprofessional,” “multidisciplinary,” and “transdisciplinary education.” Some of the studies provided definitions of the terms by citing the literature, as in the definitions for “cross-disciplinary” (Mulligan et al., 2011) and “interprofessional” (Hendrick, et al., 2014; Hoffman & Cowdery, 2020; Pumar Méndez et al., 2008). Many studies used two or more terms interchangeably, or without providing specific definitions to differentiate one type of education from the other (e.g., Hoffman & Cowdery, 2020; LaDuca et al., 2019; Satterwhite et al., 2020; Wingert et al., 2011). Table 2 provides an overview of common terminology and definitions that were located within the studies included in the present review. Note that while the tables and appendices include the exact language used by the authors of the included studies, we have used “IDE” throughout our main text to describe any initiative where learners from two or more disciplines come together at the undergraduate level.

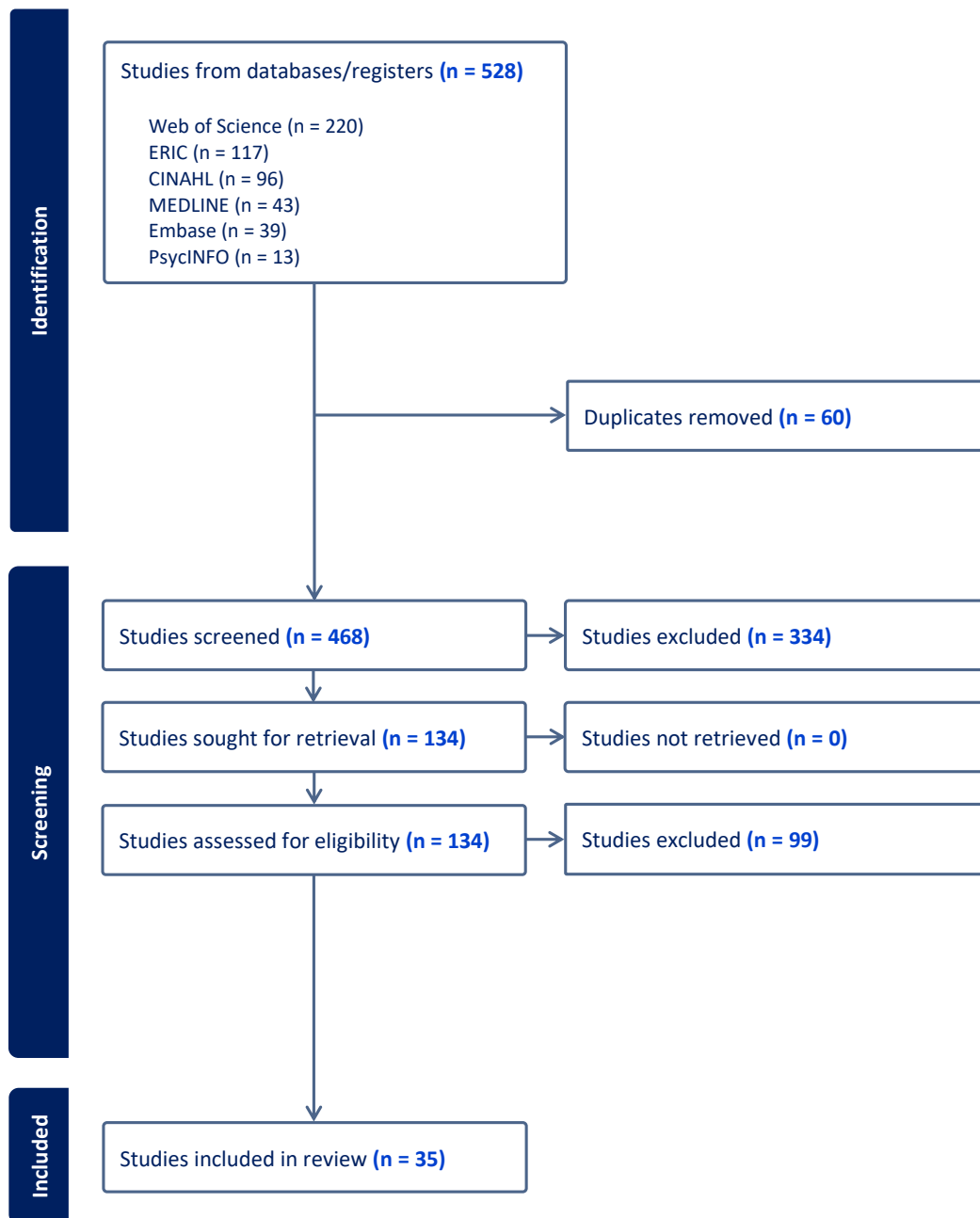


Figure 1: PRISMA diagram outlining study selection

Study characteristics

Study designs included four exploratory studies, three commentary/opinion pieces, one review, four methods/design papers, and 23 evaluation studies.

The exploratory studies examined student attitudes towards IP collaboration student and facilitator perceptions of effective IDE facilitators; student perceptions of IDE in relation to career direction; and student perceptions on

the interaction between different professions in the health care context.

Commentary/opinion pieces discussed the structure of undergraduate education; the need for IDE in undergraduate studies; implications of implementing IDE; and how IDE may be used to teach systems thinking. The review paper aimed to explore potentialities and limitations of IDE through student perspectives.

Methods/design papers (e.g., described an IDE initiative



Table 2: Common terminology used to describe collaborative learning. Definitions were located within the studies that were included in the present scoping review, except where marked with an asterisk (*)

Term	Definition
Collaborative Learning	
Cross-disciplinary Education	Cross-disciplinary learning involves exploring one discipline from the perspective of another without necessarily integrating the two disciplines (Davis, 1995, as cited in Mulligan et al., 2011).
Interdisciplinary Education	Interdisciplinary (ID) education (IDE) refers to the combination of distinct disciplines into complete integration (Mulligan et al., 2011). In particular, the notion of interdisciplinary learning is defined by “learning together to promote collaborative practice” (Cooper et al., 2001, as cited in Waggie & Laattoe, 2014).
Interprofessional Education	Interprofessional (IP) education (IPE) is a structured learning experience where students from two or more professions learn about, from, and with each other to achieve shared goals related to improving patient health outcomes and care quality. By fostering collaboration and mutual learning, IPE promotes a holistic perspective on patient care and prepares students for effective teamwork in multidisciplinary healthcare environments (Centre for the Advancement of Interprofessional Education, as cited in the following papers included in the scoping review: Hendrick et al., 2014; Hoffman & Cowdery, 2022; Pumar Méndez et al., 2008).
Multidisciplinary Education	Multidisciplinary education involves two or more disciplines who remain in their area of expertise independently while collaborating on a common subject (Townsend et al., 2015, as cited in Macdonald et al., 2022). While used interchangeably with IDE, multidisciplinary education focuses only on the aspect of “learning together,” instead of also promoting collaborative practices (Cooper et al., 2001, as cited in Waggie & Laattoe, 2014).
Transdisciplinary Education	Transdisciplinary education merges more than one discipline into a whole new entity — e.g., the fusion of chemistry and biology to form biochemistry (Macdonald et al., 2022). Scholars from multiple fields may collaboratively form new conceptual models and methodologies that integrate and go beyond the involved disciplines (Rosenfield, 1992, as cited in Misra et al., 2009).
Type of Learning Activities	
Community-Based Learning*	Community-based learning is a pedagogical approach in which universities collaborate with community entities to enhance education through practical experience, service learning, and outreach. Opportunities may be provided through the support of non-university stakeholders, including government, industry, and non-profit institutions, to ultimately support the production of professionals better prepared for real-world settings (Delaine et al., 2019).
Experiential Learning	Experiential learning can be separated into individual experiential learning and social experiential learning methods. Individual experiential learning refers to a process through which individuals may learn and apply knowledge by trial and error, such as simulations and projects. Social experiential learning refers to a process through which individuals learn knowledge and skills through shared experiences and interactions with others (Bonesso et al., 2015, as cited in Hawley, 2021).
Problem-Based Learning	Problem-based learning (PBL) is an active learning method particularly used in health sciences education, where students are divided into small, interdisciplinary groups and presented with real-world clinical cases. Through individual inquiry, shared language, and mutual respect, PBL helps students collaboratively navigate complex clinical scenarios, enhancing their ability to apply theoretical knowledge in practical settings (Lehrer et al., 2015, as cited in Avrech Bar et al., 2018).
Service Learning	Service learning is an experiential learning strategy where students engage with community partners to address community needs while learning course content and relevant skills. By integrating meaningful community service with academic instruction and reflection, it promotes authentic learning and civic engagement through interdisciplinary collaboration (Marx et al., 2021).
Team-Based Learning*	Team-based learning is “an active learning and small group instructional strategy that provides students with opportunities to apply conceptual knowledge through a sequence of activities that includes individual work, teamwork, and immediate feedback” (Parmelee et al., 2012). Within medical and healthcare education, TBL is considered to be resource-efficient and student-centred (Burgess et al., 2020).

without evaluating it) aimed to implement an IP electronic portfolio for learners; create a first-year IP course aligned with WHO frameworks; offer ID classes and a research project as part of a multidisciplinary minor; and create ID online modules for UG health learners.

Finally, most evaluation studies (i.e., studies that assessed an implemented IDE initiative) aimed to develop and/or implement an ID curriculum or course, and to evaluate its effect on students’ ID- or IP-related knowledge, skills, attitudes, beliefs, and/or behaviors. Other evaluation studies aimed to describe students’ and/or educators’ experiences in IDE; how IDE can be used for other learning (such as sustainability); or how IDE can be used as an approach in other contexts (such as service learning). Some studies used course evaluations and observations

as a data source, while others used additional metrics (e.g., artifact collection of coursework, reflections, 1:1 interviews, directed surveys/questionnaires, or validated evaluations).

Structure

In applying the Donabedian model to the included studies, we interpreted structure as elements of the context or of the broader educational environment that either justified the impetus for change (and thus the overall need for IDE) or for a specific educational intervention; facilitated the design or implementation of educational interventions; or presented a challenge to IDE design or implementation.



Macro level

At the macro level, elements that justified, thus directly or indirectly facilitating IDE, included recommendations for IDE from national organizations — e.g., calls from the National Science Foundation or National Institutes of Health (USA) (Robeva, 2009); education projects for the National Human Genome Research Institute (USA) (Marx et al., 2021); Canadian federal and provincial policies indicating the expectation of government planning authorities for pre- and post-licensure IPE (Kenaszchuk et al., 2012); the Australian government's National Action Plan on Education for Sustainability (Noy et al., 2017); or Spanish legislation to include IPE for communication skills (Pumar Méndez et al., 2008). Macro-level barriers also existed — e.g., the scarcity of IPE in health-professions students in Israel (Avrech Bar et al., 2018) or particularities of psychology training programs in Australia that potentially made students perceive IPE as non-relevant due to lack of work placement (Roberts & Forman, 2015).

Meso level

Meso structures were at the level of academic units (e.g., programs, faculty) and higher-education institutions. These included aims to implement IP competencies within curricula (Snyder et al., 2017; Valaitis et al., 2016); integrative ID or longstanding IPE curricula (Karuguti et al., 2017; Rango, 1981; Wingert et al., 2011); ID centres (Clark & Hoffman, 2019; Sponselee & Van Hoof, 2017) with a transdisciplinary educational framework (LaDuca et al., 2019); ID summer undergraduate research experience programs (Misra et al., 2009); IPE certificates of attendance (Hoffman & Cowdery, 2022); commitment from school administrations (Satterwhite et al., 2020; Waggie & Laattoe, 2014); funding for transdisciplinary work (LaDuca et al., 2019; Satterwhite et al., 2020); recognition of the value of ID or community partnerships (Macdonald et al., 2022; Satterwhite et al., 2020); and training faculty involved in IDE (LaDuca et al., 2019). Conversely, in some cases, existing structures were the impetus for change — e.g., the realization that faculties lack, or present barriers to, IDE opportunities for competency development (Gilbert et al., 2000; Cleak et al., 2007; Noy et al., 2017). Other studies referred to opportunities for IDE development, e.g., when subjects are shared requirements among program curricula (Cino et al., 2018; Hawley, 2021), or barriers, such as when it was difficult to determine where IPE would fit in curricula (Hinderer & Joyner, 2014) or when cross-listed courses created logistical problems (Hinderer & Joyner, 2014). Lastly, another meso challenge was the location of institutions; rural or remote areas meant no access

to collaborative local clinical placements (Hinderer & Joyner, 2014).

Micro level

At the micro level, studies highlighted structures that supported IDE, including faculty members' interest and collaboration (Hinderer & Joyner, 2014; LaDuca et al., 2019; Malachowski, 1990; Mulligan et al., 2011; Parker et al., 2022; Reitsma et al., 2019; Wingert et al., 2011). Conversely, the resistance of academic staff to participate in IPE presented a challenge (Hinderer & Joyner, 2014; Waggie & Laattoe, 2014). Within these structures, the physical spaces used to facilitate the interventions were also mentioned (Cino et al., 2018; LaDuca et al., 2019).

Process

We conceptualized process as being composed of the disciplines involved in IDE, the grouping of learners, the type of intervention, their duration, and their modality.

Disciplines involved in IDE

There were a variety of disciplines involved in the interventions across the studies. Nursing was the most common discipline, included in 21 interventions (Avrech Bar et al., 2018; Cino et al., 2018; Clark & Hoffman, 2019; Cleak & Williamson, 2007; Gilbert et al., 2000; Hawley 2021; Hendrick et al., 2014; Hinderer & Joyner, 2014; Hoffman & Cowdery, 2022; Karsten et al., 2015; Karuguti et al., 2017; Kenaszchuk et al., 2012; Kerry et al., 2021; Parker et al., 2022; Reitsma et al., 2019; Scrooby et al., 2019; Snyder et al., 2017; Sponselee & van Hoof, 2017; Valaitis et al., 2016; Waggie & Laattoe, 2014; Williams et al., 2008). Other common disciplines included physiotherapy (11 interventions), occupational therapy (10), and social work (8), respectively (Avrech Bar et al., 2018; Cleak & Williamson, 2007; Gilbert et al., 2000; Hendrick et al., 2014; Karsten et al., 2015; Karuguti et al., 2017; Kenaszchuk et al., 2012; Kerry et al., 2021; Reitsma et al., 2019; Snyder et al., 2017; Sponselee & van Hoof, 2017; Valaitis et al., 2016; Waggie & Laattoe, 2014; Williams et al., 2008). Most often the disciplines included in the studies were all health sciences-related, but there were nine studies that also included non-health based disciplines, such as mathematics, commerce, business, engineering, or education (Hawley, 2021; Kenaszchuk et al., 2012; LaDuca et al., 2019; Macdonald et al., 2022; Malachowski, 1990; Marx et al., 2021; Roberts & Forman, 2015; Robeva, 2000, Sponselee & van Hoof, 2017).

Grouping of learners

Regarding the grouping of learners, only nine studies explicitly stated how students from different disciplines were combined into groups (Cino et al., 2018; Cleak & Williamson, 2007; Gilbert et al., 2000; Hoffman & Cowdery, 2022; Kenaszchuk et al., 2012; Macdonald et al., 2022; Marx et al., 2021; Reitsma et al., 2019; Scrooby et al., 2019). The remainder of studies did not detail how disciplines were combined or how groups were formed (Avrech Bar et al., 2018; Hawley 2021; Hendrick et al., 2014; Hinderer & Joyner, 2014; Karsten et al., 2015; Karuguti et al., 2017; Kerry et al., 2021; LaDuca et al., 2019; Malachowski, 1990; Mirsa et al., 2009; Mulligan et al., 2011; Noy et al., 2017; Parker et al., 2022; Roberts & Forman, 2015; Robeva, 2009; Satterwhite et al., 2020; Snyder et al., 2017; Sponselee & van Hoof, 2017; Valaitis et al., 2016; Waggie & Laattoe, 2014; Williams et al., 2008; Wingert et al., 2011).

Type and duration of intervention

Building off the classifications of IP interventions by Sherman et al. (2020), we classified interventions as course, curricular, clinical, or extracurricular initiatives. All the methods/design, exploratory, and evaluation studies included in this review could be classified into the above categories. Commentaries and reviews included in our study could not be classified, as they did not describe interventions (Clark & Hoffman, 2019; Pumar Méndez et al., 2008; Rango, 1981; Rodrigues da Silva Noll Gonçalves et al., 2021).

Course initiatives (n = 15) were interventions that were offered as more than a one-off event (Cleak & Williamson, 2007; Hawley 2021; Hendrick et al., 2014; LaDuca et al., 2019; Malachowski, 1990; Marx et al., 2021; Mirsa et al., 2009; Mulligan et al., 2011; Noy et al., 2017; Reitsma et al., 2019; Robeva, 2009; Satterwhite et al., 2020; Snyder et al., 2017; Valaitis et al., 2016; Wingert et al., 2011). Of the 15 course initiatives, two were research courses, and four were service-learning or community-learning (Marx et al., 2021; Mirsa et al., 2009; Mulligan et al., 2011; Satterwhite et al., 2020; Valaitis et al., 2016; Wingert et al., 2011). Thirteen interventions lasted the duration of a semester (Cleak & Williamson, 2007; Hawley, 2021; Hendrick et al., 2014; Hinderer & Joyner, 2014; Kerry et al., 2021; LaDuca et al., 2019; Malachowski, 1990; Marx et al., 2021; Mirsa et al., 2009; Noy et al., 2017; Robeva, 2009; Snyder et al., 2017; Valaitis et al., 2016; Wingert et al., 2011). Nine interventions were less than one week in duration (Cino et al., 2018; Gilbert et al., 2000; Hoffman & Cowdery, 2022; Karsten et al., 2015; Kenaszchuk et al., 2012; Kerry et al., 2021; Parker et al., 2022; Williams

et al., 2008). In three studies, the duration of intervention was not detailed (Satterwhite et al., 2020; Scrooby et al., 2019; Waggie & Laattoe, 2014).

Beyond the course-based initiatives, there were also seven curricular initiatives that offered a structured curriculum or implemented assessments of attitudes toward IDE/IPE, which were then used to inform future curriculum (Avrech Bar et al., 2018; Karuguti et al., 2017; Kerry et al., 2021; Roberts & Forman, 2015; Sponselee & van Hoof, 2017; Waggie & Laattoe, 2014; Williams et al., 2008). Extracurricular initiatives (n = 4) were one-time events or interventions that did not contribute to a degree program (Cino et al., 2018; Gilbert et al., 2000; Hoffman & Cowdery, 2022; Macdonald et al., 2022). Finally, clinical initiatives (n = 5) incorporated patient-care into the intervention. Two of the clinical initiatives were courses with clinical-based initiatives (Hinderer & Joyner, 2014; Scrooby et al., 2019), and three were extracurricular with clinical-based initiatives (Karsten et al., 2015; Kenaszchuk et al., 2012; Parker et al., 2022).

Modality of intervention

Across the initiatives, there were three main teaching modalities: in-person, online, and blended (in-person and online components). Twenty interventions were conducted in-person (Cino et al., 2018; Gilbert et al., 2000; Hendrick et al., 2014; Hinderer & Joyner, 2014; Karsten et al., 2015; LaDuca et al., 2019; Macdonald et al., 2022; Malachowski, 1990; Marx et al., 2021; Mirsa et al., 2009; Mulligan et al., 2011; Noy et al., 2017; Parker et al., 2022; Reitsma et al., 2019; Robeva, 2009; Satterwhite et al., 2020; Snyder et al., 2017; Sponselee & van Hoof, 2017; Valaitis et al., 2016; Wingert et al., 2011) and only three interventions were conducted online (Hawley, 2021; Roberts & Forman, 2015; Williams et al., 2008). One intervention was in a blended format (Cleak & Williamson, 2007). Seven interventions did not specify their teaching modality (Avrech Bar et al., 2018; Hoffman & Cowdery, 2022; Karuguti et al., 2017; Kenaszchuk et al., 2012; Kerry et al., 2021; Scrooby et al., 2019; Waggie & Laattoe, 2014).

Outcomes

Positive outcomes

Positive outcomes were consolidated into six themes regarding the impact of IDE: knowledge; skills; attitudes and beliefs; behaviors; applicability and relevance; and outcomes related to the implementation of IDE. An overview of the positive outcomes and challenges reported in the studies is provided in [Appendix B](#).



In terms of outcomes pertaining to knowledge, many students reported improving, learning, or increasing their understanding around the significance of IDE itself (Hinderer & Joyner, 2014; Hoffman & Cowdery, 2022; Kenaszchuk et al., 2012; Robeva, 2009; Sponselee & Van Hoof, 2017). They also reported increased awareness about health-professional roles and responsibilities (Hoffman & Cowdery, 2022; LaDuca et al., 2019; Parker et al., 2022; Reitsma et al., 2019; Rodrigues da Silva Noll Gonçalves et al., 2021; Williams et al., 2008). Students also reported that the interventions offered an opportunity to understand their course curricula from another perspective (Hendrick et al., 2014; Malachowski, 1990; Mulligan et al., 2011) and to learn about what they could achieve, as individuals, with students from other disciplines and with community members (Valaitis et al., 2016). Finally, students reported increased knowledge related to the application of adaptive leadership (Hawley, 2021) and the benefits of team-based care (Cino et al., 2018; Parker et al., 2022).

With respect to skills, students reported that IDE initiatives were beneficial for collaboration with other disciplines. Specifically, the initiatives enhanced communication skills, professional identity-related competencies (Cino et al., 2018; Hinderer & Joyner, 2014; Noy et al., 2017; Macdonald et al., 2022; Reitsma et al., 2019; Scrooby et al., 2019), and increased their ability and confidence in working with other professions (Cino et al., 2018).

Regarding attitudes and beliefs, students held mostly positive views of IDE or related initiatives (Avrech Bar et al., 2018; Cleak & Williamson, 2007; Gilbert et al., 2000; Kenaszchuk et al., 2012; Misra et al., 2009; Noy et al., 2017; Robeva, 2009; Satterwhite et al., 2020; Scrooby et al., 2019; Williams et al., 2008). In some cases, misconceptions about health professional roles were clarified (Hoffman & Cowdery, 2022), with students enjoying multidisciplinary teamwork (Misra et al., 2009) and the initiatives boosting their confidence in their professional identities (Rodrigues da Silva Noll Gonçalves et al., 2021). Positive attitudinal changes in students related to engaging in IPE for Indigenous health were also reported (Hendrick et al., 2014).

In several studies, students commented on the applicability and relevance of IDE to the real world and/or their future education, training or careers (Cleak & Williamson, 2007; Hawley, 2021; Hinderer & Joyner, 2014; Marx et al., 2021; Mulligan et al., 2011; Roberts & Forman, 2015; Valaitis et al., 2016; Williams et al., 2008). Additional benefits to IDE found in the studies were increased participation in the ID classroom (Misra et al., 2009), as well as overcoming different cultures of communication (MacDonald et al., 2022) and power dynamics (Reitsma et al., 2019). Studies also noted that some of these benefits appeared to be strengthened

by modeling IDE with an ID team-teaching approach (Robeva et al., 2009); student-based mentoring (Robeva, 2009); and having non-professionally-biased and well-prepared facilitators (Kerry et al., 2021).

Challenges

Challenges to IDE were also identified across the studies. These challenges were classified into seven categories: support for IDE; resources and logistics; facilitation of IDE; learning; case studies of IDE; ID group dynamics; and attitudes and beliefs ([Appendix B](#)).

In terms of planning IDE initiatives, studies reported that a limited number of disciplines were able to participate in the intervention (Cino et al., 2018; Parker et al., 2022), along with other logistical issues, such as coordination between disciplines and professions (Hinderer & Joyner, 2014); scheduling issues (Valaitis et al., 2016); curriculum approval difficulties (Hinderer & Joyner, 2014); competing student interest in elective courses (Hinderer & Joyner, 2014); and access to resources (e.g., true IP settings) due to an institution's remote location (Hinderer & Joyner, 2014). One study also reported that IDE had faced initial resistance from staff and faculty (Hinderer & Joyner, 2014).

In terms of implementation of the initiatives, limited attendance was mentioned and was attributed to recruitment challenges (Hinderer & Joyner, 2014; Parker et al., 2022). Challenges around the facilitation of IDE included faculty presenting bias towards their discipline when directing discussions within the intervention, as well as inconsistencies between facilitators in how the intervention was implemented (Reitsma et al., 2019). Students cited the size of the workload as a challenge (Cleak & Williamson, 2007; Mulligan et al., 2011), as well as mismatches between IPE curriculum content and assessment criteria (Karuguti et al., 2017), with differences in assessment weighting between disciplines interfering with a sense of equal ownership in the ID project (Marx et al., 2021). Some case studies also lacked adequate information (or relevancy), which ultimately impacted IP relationships (Reitsma et al., 2019). The dynamics of ID groups also presented challenges for students (Cleak & Williamson, 2007; Malachowski, 1990; Scrooby et al., 2019), with some struggling to integrate their own profession's scope of practice (Reitsma et al., 2019). Finally, with regard to attitudes and beliefs, some studies reported that students held unfavorable opinions about the value of IDE (Scrooby et al., 2019; Wingert et al., 2011), and that these negative perceptions correlated with their own weakened professional identities (Rodrigues da Silva Noll Gonçalves et al., 2021).



Recommendations

The included studies often offered recommendations around either context-specific implementations of IDE or broader ideas that could be applied to a range of ID contexts, designs, and interventions ([Appendix A](#)).

Studies called for the continued implementation or reform of IDE (Clark & Hoffman, 2019; Macdonald et al., 2022; Parker et al., 2022; Rango, 1981; Robeva, 2009; Snyder et al., 2017; Sponselee & Van Hoof, 2017), and emphasized the need for structures that both facilitated and supported it. Proposed ideas included supports for co-instruction of research-based courses; increased funding, time allocations, and administrative support; addressing classroom capacity and faculty workload; acknowledging and incentivizing ID activities; having structures that foster collaboration across faculties; and establishing IPE committees to manage staff development, curriculum planning, and timetabling (Gilbert et al., 2000; Karsten et al., 2015; Parker et al., 2022; Satterwhite et al., 2020; Waggie & Laattoe, 2014).

Another recommendation was related to the timing of IDE, with suggestions that it commence early in a student's higher-education career (Clark & Hoffman, 2019; Rodrigues da Silva Noll Gonçalves et al., 2021) and be designed in a way that anticipates this earlier participation, as well as the possibility of limited enthusiasm from student (Kenaszchuk et al., 2012). Pumar Méndez et al. (2008) suggested introducing IDE on a continuum across the academic careers of learners. The importance of IDE in light of expectations for professional standards and program accreditation should also be shared with students (Parker et al., 2022).

Three papers made suggestions for getting more disciplines and professions involved in IDE (Hinderer & Joyner, 2014; Rodrigues da Silva Noll Gonçalves et al., 2021), with Hoffman & Cowdery (2022) specifically citing a lack of representation of public health in IDE initiatives. It was suggested that expanding to more disciplines/professions would favor collaborative work (Rodrigues da Silva Noll Gonçalves et al., 2021) and provide diverse perspectives from which could draw knowledge (Hinderer & Joyner, 2014). Reitsma et al. (2019) suggested that in including different professions/disciplines in an ID team, one should consider the availability of students, the scope of their practice at the undergraduate level, and specific and appropriate case studies — the latter points being about emphasizing IDE's relevance to learners (LaDuca et al., 2019; Pumar Méndez et al., 2008). Further, studies highlighted the need for IDE to be included in all curricula and integrated into and mapped onto it, rather than being viewed as an add-on (Parker et al., 2022; Reitsma et al., 2019; Waggie & Laattoe, 2014).

In designing IDE, one paper suggested using a constructive perspective — i.e., one where students discover and adapt complex information to internalize new knowledge (Scrooby et al., 2019), and employ causal thinking and reflective skepticism (Rango, 1981). Within the context of sustainability learning, Noy et al. (2017) put together a framework for developing curricula that promote ID knowledge and skills. The framework includes group work, challenging existing worldviews, peer learning, and personal engagement (e.g., developing new skills for working toward ID solutions and linking class experiences to real life) (Noy et al., 2017). The incorporation of team projects in ID training programs was also suggested by Misra et al. (2019). Marx et al. (2021) suggested a generalizable model for the successful integration of ID service-learning involving the following: finding a community partner with tangible needs; identifying courses and learning outcomes that can address those needs; having instructors collaborate to determine how to integrate ID service learning; finding overlapping class times and shared meeting spaces; grouping students and setting processes and project outcomes; fostering joint project ownership among students; and determining assessment strategies.

Recommendations for changes to an ID course embedded within a campus-community partnership were provided by Valaitis et al. (2016), although they were not focused specifically on the ID aspect. Karuguti et al. (2017) suggested using the Depth of Knowledge (DOK) framework to measure cognitive rigor. Cognitive rigor refers to the complexity of content, the level of cognitive engagement with that content, and the scope of planned instructional activities (Hess et al., 2009). Karuguti et al. (2017) specifically suggest the DOK framework can help ID educators align the quality of the learning outcomes with the rigor of the learning activities and assessments.

In terms of format, Waggie & Laattoe (2014) suggested ID programs be four to seven weeks long to optimize collaboration, while Gilbert et al. (2000) recommended a modular format to facilitate knowledge and skill development. When ID experiences are held in a large space, educators should ensure that there are also distraction-free spaces available to student teams (LaDuca et al., 2019).

One study referred to the need for creative approaches in IDE teaching to deliver complex material in a relevant way to the disciplines involved (Hinderer & Joyner, 2014). Clark & Hoffman (2019) recommended using a systems approach in place of a reductionist approach, and using theories such as self-directed and peer-to-peer learning. To support student collaborations, Cleak & Williamson (2007) made an adaptation to their initiative, adding theoretical content about group dynamics and prompts for teams to produce group contracts. Finally,



Parker et al. (2022) discouraged those in the field of IDE from assuming that educators understand how to implement it; on a similar note, another study suggested designing train-the-trainer programs for IDE facilitators (Kerry et al., 2021).

Finally, in evaluating the effectiveness of IPE, studies recommended more rigorous methods beyond learner satisfaction (Pumar Méndez et al., 2008). These might include the development of instruments with appropriate psychometric properties, and combining validated quantitative instruments with qualitative data (Rodrigues da Silva Noll Gonçalves et al., 2021), or using objective measures (such as the Kirkpatrick model) for gauging impact (Hawley, 2021).

DISCUSSION

This scoping review focused on IDE interventions implemented for undergraduate students majoring in health sciences-related programs. We identified 35 articles published between 1981 and 2022 that discussed IDE across various academic contexts and learning environments. Our findings indicate that (a) structures at the micro, meso, and macro levels play a pivotal role in the impetus for IDE, supporting IDE, or presenting challenges; (b) the process of IDE varies considerably across interventions in the disciplines involved and their grouping, as well as type of intervention, duration, and format; (c) positive outcomes of IDE are related to knowledge, skills, attitudes and beliefs, behaviors, applicability and relevance; and (d) challenges for IDE are related to support for the method; resources and logistics; facilitation; case studies; group dynamics; and attitudes and beliefs. This review also highlighted the ambiguous use of the term “interdisciplinary”; the dual nature of structure as a facilitator and as a barrier; the way in which particular outcomes can sometimes appear as positive or negative; and significant gaps in the literature, which are related to the way that authors report process, outcomes, and limitations in scholarly work on IDE.

Interdisciplinary education as a construct

Despite our search strategy including only the term “interdisciplinary,” the studies in this review used a variety of terms to refer to collaborative learning. Although some authors provided definitions or descriptions (Table 2), others used terms such as “cross-disciplinary,” “interdisciplinary,” “interprofessional,” “multidisciplinary,” and “transdisciplinary education” interchangeably or indiscriminately. Ambiguity and lack of consensus around this terminology have been emphasized previously (Choi & Pak, 2006; Flores-Sandoval et al., 2020). Flores-Sandoval et al. (2020)

cautioned that the ambiguous use of these terms may lead to difficulties in assessing studies related to healthcare teams; they suggested authors address the rationale or philosophical underpinnings behind their selection of a particular term. An exemplar from the included studies is Mulligan et al. (2011), in which the authors defined and contrasted the terms “interdisciplinary” and “cross-disciplinary,” while also offering a rationale for the term chosen to describe their intervention.


A further nuance we identified was that “interdisciplinary” may describe the collaboration of students from more than one discipline (Noy et al., 2017); the collaboration of instructors from more than one discipline to develop and/or offer an initiative to one discipline group of students (e.g., Dame et al., 2019), or both (e.g., Karsten et al., 2015; Malachowski, 1990). “Interdisciplinary” may also refer to the tasks and learning outcomes of an initiative — for example, Gouvea et al. (2013) described the integration of physics and biology in a physics course. In order to accomplish collaborative learning between disciplines and professions, a universal consensus must be made on the meanings of all terms involved.

Structure: Supporting interdisciplinary education

In applying the Donabedian model to the studies in our review, we identified structural factors at the macro, meso, and micro levels that directly or indirectly facilitated, or created challenges for, IDE. At the macro level, calls from national organizations justified the need for the development of IDE within specific contexts. Another element that supported IDE was policy at the level of academic units or of the higher education institution itself, as well as structures that positioned the academic setting as a champion of IDE. Although the studies in this review may not have directly focused on supportive environments for IDE, our analysis indicates that a “sponsor” type of environment is conducive to IDE, with IDE designers and implementers expressing a need for funding, faculty development, and existing centers or curricula. These findings are consistent with a similar review of health professional education by Lawlis et al. (2014) that identified facilitating factors at the government and professional (e.g., funding), institution (e.g., faculty training), and individual levels (e.g., enthusiasm, shared interprofessional vision).

Dual nature of contributing factors

With respect to the structure, many of the factors appeared to be both facilitating factors or factors that posed barriers. For example, at the micro level, IDE benefitted from faculty members recognizing the need for change and collaboration, as well as from the availability of physical



spaces for conducting interventions. Conversely, lack of buy-in from faculty members posed a challenge.

Similar findings were identified with the outcomes. For example, both positive (e.g., Avrech Bar et al., 2018; Kenaszchuk et al., 2012; Misra et al., 2009) and negative (Rodrigues da Silva Noll Gonçalves et al., 2021; Scrooby et al., 2019) attitudes and beliefs towards IDE were reported. Some studies also reported benefits related to students working with others (e.g., improved ability to work with others in Noy et al., 2017), while others reported conflicts in ID groups (e.g., Cleak & Williamson, 2007). The dual nature of barriers and enablers has been described by Lawlis et al. (2014) and highlights the context-dependent character of IDE.

Gaps in the existing literature

Several gaps were identified in the literature on IDE initiatives at the undergraduate level for students in health-related programs. Many of these related to the level of detail provided in the studies themselves on the IDE initiative — particularly its process, its outcomes, and study design and limitations.

Reporting of the process

When reporting on the process, there was often limited information on the educational initiative, the disciplines involved, and student collaboration, as well as its duration and modality. While we were able to classify most initiatives as course-based, curricular, extracurricular, or clinical, there were studies that did not include certain details of the intervention and thus made this challenging — for example, Kerry et al. (2021)'s study when it examined student perceptions of valued facilitator competencies after students completed an IPE course.

Although studies generally listed the disciplines involved, some lacked such information (Misra et al., 2019). Regarding ID collaboration among students, we were not able to qualify the extent to which students were interacting, as the authors of the included studies did not always describe their collaboration in detail. For example, Cleak and Williamson (2007) provided descriptions of ID student grouping, with a minimum of three disciplines working as a team to complete modular tasks and assignments, but in Snyder et al. (2017), the ID groupings of students working on scenarios was not made explicit.

The duration of IDE interventions ranged from one-off occurrences (e.g., Roberts & Forman, 2015; Williams et al., 2008) to semester-long initiatives (e.g., Marx et al., 2021; Wingert et al., 2011) — again, with some studies lacking specifics (e.g., Scrooby et al., 2019), making it difficult for the reader to contextualize their outcomes.

Finally, there were gaps in the reporting of modality, with some studies (e.g., Avrech Bar et al., 2018; Hoffman & Cowdery, 2022) not providing specific information as to how students interacted. In consulting literature published after our study's search date, we did identify one article that provided a robust description of the IPE process (Beebe et al., 2025).

Reporting of the outcomes

With respect to outcomes, there was a lack of evidence (quantitative or qualitative) across the studies on the effectiveness of the initiatives, with author statements being presented as findings. For example, based on course evaluations, Robeva (2009) reported that students were able to grasp concepts more efficiently in the ID intervention. Along the same lines, the included study by Marx et al. (2009) reported an IDE intervention's impact on student learning without describing methods for data collection and analysis. We caution that for initiatives to be adapted and enhanced by other scholars, evidence of their effectiveness is integral. This evidence may be qualitative and/or quantitative; as an example, in consulting literature published after our study's search date, we identified a randomized trial that measured the effectiveness of video-assisted debriefing versus oral debriefing in simulation-based interdisciplinary health-professions education (Rueda-Medina et al., 2024).

Reporting of limitations in IDE research

This scoping review was conducted to provide an overview of the existing evidence around undergraduate IDE in health sciences, irrespective of methodological quality or risk of bias in the sources of evidence. As such, included studies were not critically appraised (Tricco et al., 2018). Notwithstanding, we identified the following limitations cited within the studies: small sample size (Cino et al., 2018; Parker et al., 2022; Reitsma et al., 2019; Scrooby et al., 2019); single-institution study (Avrech Bar et al., 2018); lack of longitudinal results (Avrech Bar et al., 2018; Karuguti et al., 2017; Kenaszchuk et al., 2012; Roberts & Forman, 2015); and voluntary participation or self-selection into groups, resulting in bias (Hawley et al., 2021; Kenaszchuk et al., 2012), with many studies not stating their limitations.

Ross and Zaidi (2019) caution that generic limitations (e.g., sample size or one institution) or the omission of limitations may result in researchers failing to “communicate the relevance of their work, illustrate how their work advances a larger field under study, and suggest potential areas for further investigation” (p. 261). One of the limitations (lack of longitudinal studies)



indeed presents an opportunity to improve scholarly inquiry into IDE.

Ross and Zaidi (2019) add that presenting limitations (implications, steps taken to minimize limitations, and possible alternative approaches and explanations) provides transparency, as well as reproducibility and transferability of methods. We believe that gaps in the presentation of limitations combined with the previously mentioned gaps in the reporting of processes and outcomes create challenges for reproducibility and transferability in IDE research. We urge the IDE community to consider the development of checklists or reporting guidelines to support reproducibility and transparency in education research (National Science Foundation and The Institute of Education Sciences, 2018; Keijser et al., 2020 preprint).

Recommendations for key groups

In light of our findings, we provide the following recommendations for education researchers:

- Clearly define the term “interdisciplinary” (or related terminology from Table 2) by referencing scholarly definitions and situating it within the research context.
- Employ rigorous methods beyond just learner satisfaction to evaluate the effectiveness of IDE, such as the development of instruments with appropriate psychometric properties; combining validated quantitative instruments with qualitative data pre- and post-assessment; or using objective measures (e.g., the Kirkpatrick model).
- Report the process of IDE and the limitations of the research in ways that support transferability and reproducibility.

For educational developers:

- Design IDE to start early upon entry to post-secondary education and be integrated throughout and mapped onto the curriculum across learners’ academic journey, instead of just being an add-on.
- Include more disciplines in IDE to represent programs that are typically excluded; take into account the availability of students, their scope of practice at their respective education levels, and a potential lack of student enthusiasm to design an intervention that is relevant to learners.
- Design initiatives where students discover and adapt complex information, challenge existing worldviews, use causal thinking and reflective skepticism, participate in peer learning; engage in group projects that provide real-life, practical experiences that are applicable to learners’ future training and careers and helpful for internalizing new ID knowledge and skills.
- Align the learning outcomes with the rigor of the learning activities and the assessments, using similar weighting of assessments for students from all

disciplines taking part in the intervention. Highlight to students the importance of IDE in professional standards and program accreditation. Include content on group dynamics. Consider the amount of workload required from students, provide timely and sufficient information for activities, and allow for discussion.

- Develop evidence-based train-the-trainer programs that build specific competencies for IDE facilitators.

For organizational structures at the meso and macro levels, such as academic program areas, higher education institutions, and policymakers:

- Provide structures that facilitate and support IDE, especially at the resource level (e.g., funding, administrative support, addressing classroom capacity).
- Provide structures at the logistical level (e.g., timetabling, curriculum approval, cross-listed courses, student recruitment, competing elective courses, IPE within competency-based education) and be mindful of faculty workload.
- Validate, acknowledge, and reward IDE activities (e.g., structures that foster collaboration across faculties or committees for staff development).

Limitations

Limitations of the review process

In selecting search terms, we excluded medical students, thus potentially impacting the final number of included studies. The reason for excluding the discipline of medicine was because of the variable categorization of medicine in different countries’ education systems, which sometimes treat it as an undergraduate/direct-entry degree and sometimes as a postgraduate degree.

We established early on in the review process that the body of literature was challenging to navigate due to a lack of information on students’ level of study. Although an alternative approach could have been to consult other resources to determine the undergraduate or postgraduate nature of the specific medical education system named in a study, this is beyond the reasonable scope for this project.

Also impacting the number of studies included in the review stems was the fact, due to resource limitations, there was no comprehensive search of grey literature or of citations. In future studies, one category of grey literature that could add to the body of knowledge around the IDE structure and process could be websites of higher education institutions featuring IDE initiatives. Finally, as this review focused on IDE at the undergraduate level and excluded studies that included health professionals, we may have missed studies that explored collaborative



learning initiatives across multiple higher education levels.

Limitations of the Donabedian model

When used to measure healthcare quality, two known flaws of the Donabedian model are that it does not consider healthcare as a system and that it lacks patient-centredness (Berwick and Fox, 2016). In our study, to mitigate this limitation, we viewed IDE as a system that includes structures at the micro, meso, and macro level, ranging from faculty buy-in to institutional support and embedded within a wide range of contexts (e.g., a single course versus the landscape of health science education in a country).

Within these systems, we considered primarily the student and the instructor. However, we recognize that IDE also operates within systems that were potentially not explicitly named in the included studies (e.g., legislation, hidden curricula, institutional or governmental agendas/priorities). With respect to the student-centeredness part of our model, our data was limited to the outcomes that were present in the studies. However, we also acknowledge this framework was used to analyze the results (instead of for inclusion/exclusion), and thus we included some studies that did not capture the responsiveness of IDE to student needs and interests. Moving forward, consideration should be given as to how quality/effectiveness of IDE should be measured; we recommend authors consider systems-level approaches to designing and reporting their initiatives and the explicit student needs they serve.

CONCLUSIONS

This scoping review identified 35 articles published between 1981 and 2022 that discussed undergraduate IDE across various academic contexts and learning environments. Our findings indicate that structures at the micro, meso, and macro levels played a pivotal role in the impetus for IDE, supporting IDE, or presenting challenges. We also observed that the process of IDE

varies considerably across interventions with regards to disciplines involved and grouping, type of intervention, duration, and format.

While there are several benefits to IDE in its ability to change in knowledge, skills, attitudes and beliefs and behaviors, there are also several challenges. In some cases, the same factor was identified as a benefit by one author and a challenge by another, highlighting the context-specificity of this work. With that in mind, it is critical that future studies provide details on what terminology is being used (and why); details on the interventions they are planning (who is involved, how are they learning collaboratively, etc.); explanation of how the intervention will be evaluated considering systems level and student-centered approaches; and details of any limitations or challenges encountered. By utilizing these recommendations, researchers, educators, and policymakers will be able to create structures that support IDE; to design, develop, and implement IDE initiatives that will lead to positive student outcomes related to knowledge, skills, attitudes and beliefs, and behaviors; and to continue to advance the body of literature on IDE.

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Conflicts of interest

The authors report there are no competing interests to declare.

Author Contributions

EL, LS, LD, SE, and NM collected the data, performed the analysis of the data, prepared figures and tables, wrote the original draft, and reviewed and edited the manuscript. EL and NM conceptualized the overarching research goals and coordinated the scoping review activities. WC and RvW reviewed and made suggestions for editing the manuscript.

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