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Pedagogical Approaches Utilized in Nutrition Education 2010-2020: A Scoping Review

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Abstract: Background: Scoping reviews are used to provide a wide range of evidence on a given topic, which serves as a useful methodological approach in the Scholarship of Teaching and Learning (SoTL). The purpose of this study is to examine nutrition and dietetics programs specifically. In current practices, active learning strategies are recommended to maximize student learning, but many instructors still default to a lecture-based teaching approach. Since instructors are trained as disciplinary experts, not pedagogical experts, an overview of pedagogical methods currently utilized in the discipline will allow instructors an introduction to this body of knowledge and provide SoTL scholars with a way to identify gaps for future work.
Objective: To explore the current literature on pedagogical strategies utilized within nutrition and dietetics undergraduate programs in the USA and Canada, using the Joanna Briggs Institute guidance for systematic and scoping reviews.

Keywords: Dietetics education, Scholarship of teaching and learning, Evidence synthesis, Undergraduate coursework, Scoping Review.

Systematic reviews are one type of evidence synthesis that can be used to conduct stand-alone reviews of existing literature. These reviews serve to describe the state of the field (i.e. narrative review, textual narrative synthesis, meta-summary, meta-narrative, and scoping review), test a hypothesis using the literature (i.e. meta-analysis, realist review, and ecological triangulation), extend the literature to create something new (i.e. meta-ethnography, thematic synthesis, meta-interpretation, meta-study, critical interpretive synthesis, and framework synthesis) or critique the current literature base (i.e. systematic review) (Grant & Booth, 2009; Xiao & Watson, 2019). Scoping reviews (with the purpose of describing) are often a precursor to a systematic review (with the purpose of critiquing).

Scoping reviews are recommended to document the breadth and depth of coverage of a body of literature (Munn et al., 2018), being chosen over other types of reviews when the evidence is new enough to prevent posing precise research questions (Armstrong et al., 2011). The purpose of such a review is to identify gaps in knowledge on a specific topic and avoid repeating previous research efforts by fully understanding the current state of the literature (Arksey & O'Malley, 2005; Lo, 2020; M. D. J. Peters et al., 2015). Like systematic reviews, scoping reviews are also useful as an introduction to a new field (Newman & Gough, 2020).

Scoping reviews are common in clinical health disciplines including nutrition sciences and dietetics (Baranowski et al., 2019; Juckett et al., 2020; Potter et al., 2018). While they are less common in the Scholarship of Teaching and Learning (SoTL) literature, scholars have been advocating for their use for over a decade (Chick et al., 2019; Divan et al., 2017). A key characteristic of SoTL is the emphasis on epistemologies and methodologies of the researcher's discipline, which can be difficult to determine without taking a rigorous inventory and analysis of current practice. Recent calls for scoping reviews in SoTL move research forward by taking stock of questions, topics, methods, and areas where more work needs to be done, as well as who is doing the work. (Chick et al., 2019). Therefore, applying a systematic or scoping review approach to study the pedagogical approaches in nutrition and dietetics appears to be a natural fit for providing an overview of current practices in this particular field; however, this approach can be used in any discipline and can serve as a precursor to robust evaluations of the success of pedagogical methods in the form of a systematic review. The focus of this scoping review on nutrition science and dietetics is specifically due to the disciplinary expertise and make-up of this review's research team. To date, we have been unable to identify any published systematic or scoping reviews focused on pedagogical approaches within nutrition science and dietetics programs.

Although systematic and scoping reviews are used for different purposes, the methods for completing both are similar and structured in nature. Both types of reviews require a research team to ensure reviews are not conducted by a single individual. Teams typically consist of disciplinary experts as well as searching experts. A research question is developed and tested with a preliminary search to ensure the question is not too broad or narrow in scope; sufficient literature should be able to be gathered based on the research question. Next, librarians create a robust search strategy to gather relevant literature based on the research team's inclusion and exclusion criteria; inclusion and exclusion criteria help put parameters on the types of information gathered, the population the research is focused on, and methods used to conduct the research. Once information is gathered and duplicate articles are removed, disciplinary experts begin screening for relevant articles and removing irrelevant studies from the pool. Two steps of screening are involved, the first focuses on the title and abstract, while the second phase looks at the full text of the article. Finally, the subset of articles that make it through screening will have all data extracted; this includes gathering details from the study in order to synthesize commonalities or differences. Unlike systematic reviews, scoping reviews do not measure the success of specific interventions, but instead identify emerging evidence for current practice or disparities in research.

The aim of dietetics and nutrition education is to prepare students to become skilled and competent practitioners (Molaison et al., 2009). Hence, institutions of higher education are facing increased scrutiny to improve student learning and demonstrate program effectiveness (Monaco & Martin, 2007). Despite research showing that student-centered active learning techniques improve student performance (Freeman et al., 2014; González-Sancho et al., 2013; Michel et al., 2009; Newton et al., 2015; Santos et al., 2020), the predominant pedagogical method for presenting course material is via lecture, a teacher-centered method where students are passive recipients (Lammers & Murphy, 2002; Prober & Heath, 2012). The disadvantages of lectures include failing to provide instructors with feedback about student learning and assuming that all students learn at the same pace. Further, students' attention wanes quickly during lectures and information tends to be forgotten easily when students are passively listening (Hartley & Cameron, 1967; MacManaway, 1970). Teacher-driven instructional methods continue to have a place in the classroom, but it is recommended to combine lectures with other instructional methods (Perrin, 2014).

Faculty and instructors often lack formal training on how to implement and assess pedagogical approaches in the classroom. Campus teaching centers provide programming to address this gap through workshops, learning communities, teaching observations, individual consultations, and suggested readings (Beach et al., 2016). Systematic reviews are an often-underutilized approach to helping novices better understand, evaluate, and potentially implement new teaching methods (Leung et al., 2017).

Following preliminary research on instructional strategies used in nutrition-dietetics courses, it became apparent that evidence on the recommendation on instructional strategies for nutrition-dietetics courses was insufficient for understanding best practices, thus illustrating an evidence gap. Considering this deficiency, the review's research question, "What are the pedagogical approaches currently used in dietetics, nutrition, and food science undergraduate programs in the USA and Canada?" was developed. The main objective of this review is to provide a comprehensive overview of original research published between 2010-2020 that include references in the abstract or keywords to SoTL and nutrition education, nutrition instruction, or dietetics.

Methods

Developing and Validating the Review Protocol

In systematic reviews in clinical fields, the first step is registration of the proposed topic and approval of a protocol for the review as dictated in the Cochrane guidelines (Cochrane, n.d.). This is done to gain peer feedback and validation of the methodology before the review is conducted (Sieving, 2007). A similar step is required in the Joanna Briggs Institute (JBI) approach to scoping reviews. Scoping review protocols should be shared for transparency, reduced reporting bias, and validation, but unlike systematic reviews are ineligible for registration (M. Peters et al., 2020). The protocol for this study is available in an institutional repository.

Eligibility Criteria

Knowledge syntheses are strengthened by well-defined inclusion and exclusion criteria. Reviews with defined restrictions on publication period are the most transparent- especially if it is stated at what point in the review process this time period was defined. However, many reviews are published without publication period or other criteria being clearly defined (Helbach et al., 2022). As the purpose and methods of scoping reviews become more codified, there is a need for increased transparency of their methodological reporting. Thus, the authors selected inclusion criteria before searching began.

Inclusion criteria were comprised of; (i) Studies focused on pedagogical methods within undergraduate education in dietetics and nutrition, (ii) full-text articles, (iii) research articles published in the USA and Canada, (iv) articles including in the abstract or keywords either nutrition education, nutrition instruction or dietetics, (v) studies dated between 2010-2020. Articles were excluded if they were not published in English, published before 2010, or conducted outside of the USA and Canada.

These years were chosen to include current pedagogical publications while excluding pedagogical publications during the height of the COVID-19 pandemic (spring 2020), as these may not represent common pedagogical approaches in the field. Based on the length of time for a study to result in publication, we were confident the majority (if not all) of studies published in 2020 were completed prior to the shift to pandemic teaching; this study provides a snapshot in time of teaching practices before COVID-19, which inevitably drastically shifted teaching practices. The selection of these dates is a purposeful sample to identify pedagogical methods and gaps before the pandemic became an impetus for virtual and hybrid learning.

Information Sources

The authors selected databases based upon relevance to the two focal areas of this study: the Scholarship of Teaching and Learning, and the fields of Nutrition and Dietetics. Two librarians conducted a systematic search of PubMed via NCBI, Scopus via Elsevier, ERIC via EBSCOhost (1966-), CINAHL Complete via EBSCOhost (1937-), Embase (1947-) via Elsevier, and ProQuest Dissertations & Theses Global. Searches were conducted in January and February of 2022.

Search Strategy

The research team used a combination of keywords that covered topics related to pedagogical methods, undergraduate education, and nutrition and dietetics, as well as a controlled vocabulary. Specific identified Medical Subject Heading (MeSH) terms included: 1. "nutritional science", 2. "dietetics", 3. "teaching", 4. "education, medical undergraduate", and 5. "models, educational." Full search strategies can be found in Supplemental 1. Limiters were applied based on inclusion and exclusion criteria to facilitate narrowing down the literature: publication status, publication date, and language; additionally, searches were restricted to papers published in English between 2010 and 2020. All the searches resulted in a combined 2,779 articles, of which 119 duplicates were removed. 2,660 articles were included in the title and abstract screening.

Selection of Sources of Evidence

Results of the online database searches were imported to Zotero, a citation management software, and deduplicated. Once articles were deduplicated, the resources were exported to Covidence software to begin the title/abstract review. Articles generated from the above criteria were manually checked by reading through the abstract. Covidence facilitates the screening process to ensure articles meet the inclusion criteria and will be extracted based on exclusion criteria. Two researchers (a faculty member and a graduate student) who were well-versed in the field of nutrition and dietetics screened the titles and abstracts, using a blinded process to eliminate bias. Ineligible papers were eliminated.

Titles and abstracts that appeared to meet the review's eligibility criteria were subjected to full-text reading. A full-text screen was conducted by 2 independent reviewers based on inclusion and exclusion criteria. Conflict resolution was provided by a third reviewer with extensive expertise in the Scholarship of Teaching and Learning and pedagogical methods. Once the full-text screening was complete, the researchers moved into the extraction process.

Data Charting Process

Covidence was used to retrieve data from the included papers. Extracted data included title of paper, author(s), publication year, country of origin, location of publication, funding sources, study aims, research question/topic, inclusion criteria (type of study, participants -undergraduate students enrolled in nutrition/dietetics course, intervention details – pedagogical approaches, outcome), details of the study population (undergraduate students, program focus, course name/content, course level, class size, type of school), details of pedagogical approach(es) (intervention mode and delivery, pedagogical methods).

The review maps the instructional approaches used between 2010 and 2020 in nutrition-dietetics courses in the USA and Canada. Data extraction was conducted independently by two reviewers before comparing through Covidence software. Differences were discussed (if necessary, with a third reviewer) before producing a single form containing the selected data.

Synthesis of Results

Selection of Studies

A total of 2662 articles were imported into Covidence for screening. After removing two duplicate articles, 2660 articles were screened by their title and abstract. Based on the review's predetermined inclusion and exclusion criteria, titles and abstracts of papers were independently screened by two reviewers, to ensure no bias occurred. Titles and abstracts that appeared to meet the review's eligibility criteria were subjected to full-text reading. A total of 157 articles were reviewed as a full text and assessed for eligibility. A third reviewer assisted in the selection process if the two primary reviewers could not reach a consensus on the eligibility of articles. Of these articles, 38 met the criteria and were included in the scoping review (See Figure 1). Results are reported per the PRISMA-ScR guidelines.

Reasons for excluding articles reviewed as full-text included wrong population (47), not relevant (15), no full text available (14), studies conducted outside of the USA and Canada (13), not a pedagogic methodology (10), not a pedagogical research study (8), poster (6), not in English (1), wrong intervention (1), wrong setting (1), and wrong study design (1).

The study team collaboratively designed the charting table and defined variables in Covidence. Variables included in data charting were authors, title of paper, publication year, country of origin, location of publication, funding agency if applicable, study aims, and research question. Most articles were published in the USA (29), then Canada (9). Of the 38 articles, 10 articles were published in 2020 (see Figure 2). One study was a student thesis and was published in ProQuest Dissertations and Theses, and all the other articles were published in peer-reviewed journals. Out of 38 articles, only 14 studies were funded, mostly by university internal grants. The articles were presented in alphabetical order in Table 1. In the 38 studies, a range of pedagogical methods were used: experiential learning/service learning (7), incorporating research (7), Interprofessional education (6), blogging (4), measuring critical thinking (2), case-based learning (2), Flipped classroom (2) and one article each from problem-based learning and other pedagogical methods (see Figure 3). Some of the studies utilized more than one pedagogical method. Some of the pedagogical methods used in the studies are discussed below.

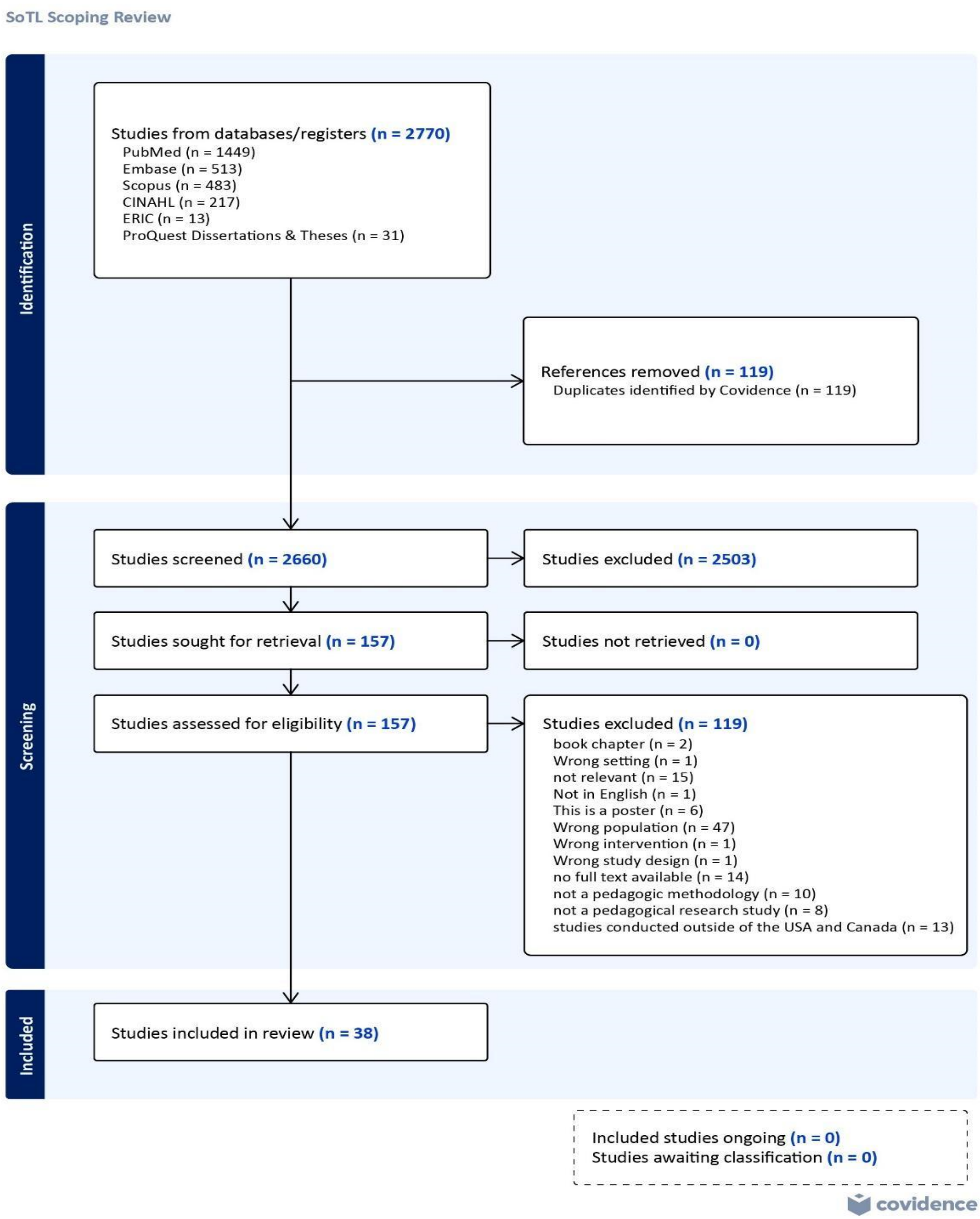

Figure 1: Flow diagram of the literature search (2010 -2020) and filtering results for a scoping review of pedagogical methods used in nutrition and dietetics.

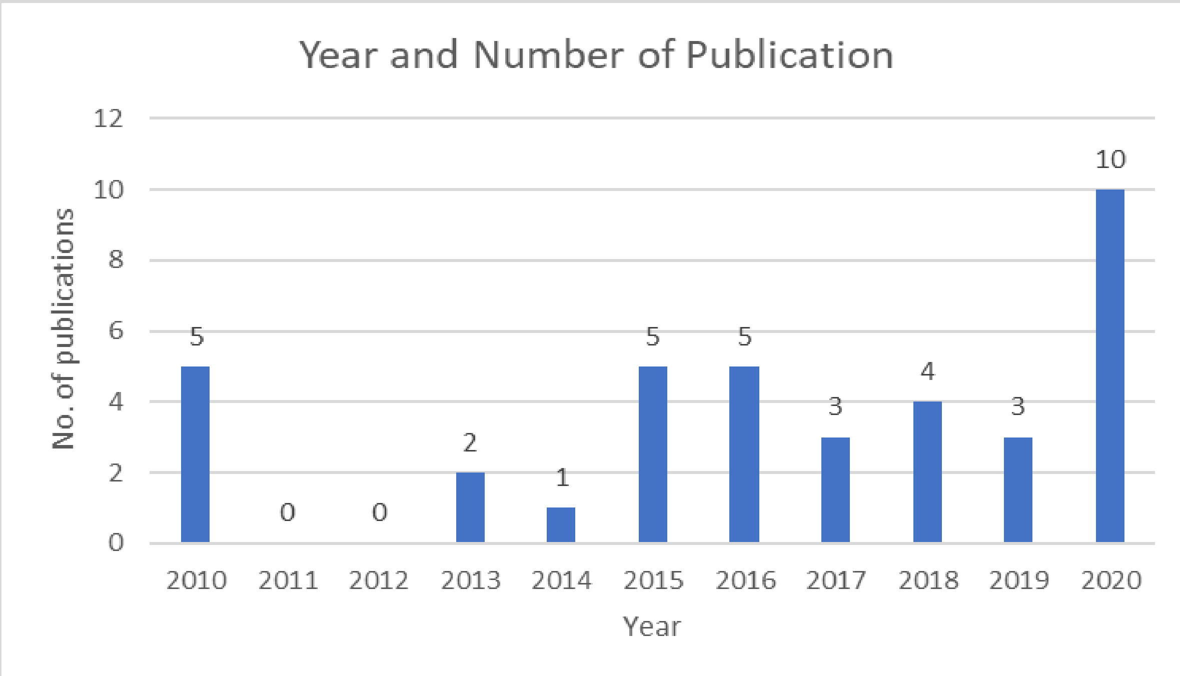

Figure 2: Number of Publications on Pedagogy in Nutrition and Dietetics by Year between 2010-2020

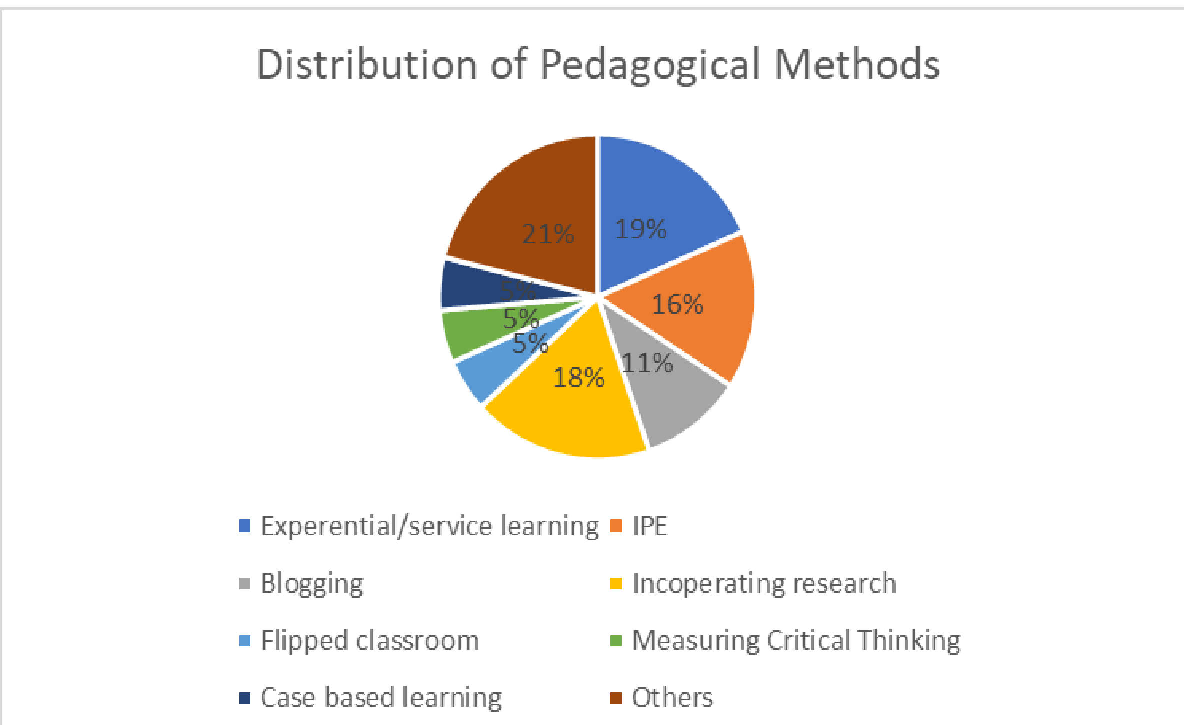

Figure 3: Distribution of Pedagogical Methods used in Nutrition and Dietetics between 2010 to 2020

Characteristics of Sources of Evidence

Experiential/Service Learning

In experiential learning, the following strategies were used: service learning to enhance public service motivation (Dinour & Kuscin, 2020); using standardized patients or real patients to improve communication and behavior change skills (Schwartz et al., 2015); working as a camp counselor at a weeklong kids' cooking camp (Young, 2017); conducting food system assessments of local neighborhoods (Matthews, 2013); training in social media communication (Twynstra & Dworatzek, 2016); food insecurity experience and reflection (Harmon et al., 2017); and community-engaged learning (Allsopp & Buys, 2020).

Dinour and Kuscin found small but significant increases in students' public service motivation (PSM) after project or charity-based service learning. Service learning could enhance students' motivation for public service and understanding of community-based roles for Registered Dietitian Nutritionists (RDNs) (2020). In addition, patient simulation was studied as an effective experimental teaching strategy in nutrition counseling and clinical nutrition courses (Schwartz et al., 2015; Buchholz et al., 2020). Patient simulation enhances learning outcomes through safe environments to learn from mistakes, authentic and concrete learning experiences, and the application of theoretical knowledge. Schwartz and fellows found both real patients and standardized patients (SPs) improve students' communication and behavior change skills with no statistically significant difference, so SPs can be an ideal method for teaching nutrition counseling when real patients are inaccessible. Additionally, reflective observation following patient stimulation may further benefit the learning where students discuss the simulation with classmates and instructors and apply new knowledge and skills in subsequent simulations (Buchholz et al., 2020).

For undergraduate students, hands-on learning or experiential learning is important to practice and develop skills that cannot be learned from class lectures or reading a book. For example, dietetics students worked in a camp as counselors and a post-camp survey showed that students reported working as a counselor reinforced knowledge learned in the classroom as well as the development of soft skills such as problem solving and time management (Young, 2017). Therefore, experiential learning provides opportunities for students to apply their knowledge in real life situations while gaining skills.

Interprofessional Education (IPE)

According to the World Health Organization (WHO), Interprofessional Education (IPE) occurs when "students from two or more professions learn about, from, and with each other to enable effective collaboration and improve health outcomes" (World Health Organization, 2010). Professional standards for accredited programs call for assessment of students' competency in interprofessional skills. Therefore, it is not a surprise to find several articles were based on IPE. In IPE: using simulation experience, and team-based learning were commonly used and nursing, medical, pharmacy and other health professional students were part of the team.

In IPE training, Clauser et al., incorporated asynchronous SBIRT (screening, brief intervention, and referral for treatment) training, in-person student roleplays, and standardized patient interaction. Students and faculty viewed this IPE experience did improve students' overall learning experience (2020). In another qualitative study on student experiences of IPE using simulation, employing an exploratory case study design that measured student perception with open-ended reflective questions indicated that students felt a sense of comfort working as a team (Costello et al., 2018). In other studies (Schug et al., 2018; van Schaik et al., 2016), Team-based learning (TBL) was used in IPE training and the outcomes indicated TBL provides an opportunity for students to acquire and refine the competencies needed for interprofessional practice. Kutt et al., developed a course that combines IPE and basic complementary therapies for undergraduate health science students, including dietetic students. The researchers then implemented the course and evaluated whether the learning objectives for both IPE and complementary therapies could be met in this same course using a mixed method. The researchers concluded based on the qualitative analysis, that it is possible to combine IPE and complementary therapy to teach undergraduate health science students' competencies.

Incorporating Research

Higher education is requiring more undergraduate students to have research experience and that is reflected by the number of pedagogical methods focused on incorporating research or information literacy into the curriculum. Further, ACEND Accreditation Standards for Nutrition and Dietetics Didactic Programs (DPD), require that the program's curricula must include "Research methodology, interpretation of research literature and integration of research principles into evidence-based practice" (Accreditation Council for Education in Nutrition and Dietetics, 2021). Four of the articles (Antunez & Schupp, 2020; Horsman, 2015; Ingalls, 2018; Smith & Penumetcha, 2010) focused on collaborating with librarians in different capacities to improve students' information literacy skills. The other three studies (Crist et al., 2017; Lee & Burnett, 2019; Lieffers et al., 2020) focused on students participating in research projects.

Blogging

Social media pervades the everyday lives of students, including for many how they study and learn or communicate, more specifically blogs are used to engage students more fully with learning. Therefore, this is another emerging pedagogical method used in the nutrition and dietetics area of study to enhance students' learning. It is a useful tool for instructors as a source of information on student understandings and misconceptions of course topics (T. Paulus & Spence, 2010).
A survey research study investigated students' perceptions and experiences of weekly blog posts and peer comments on nutrition topics (Halic et al., 2010). They found blog experience helped students think about topics outside of the class and share knowledge with others. A sense of community where students feel connected to their peers and part of the learning community was positively correlated with perceived learning outcomes. Also, blogging works better coupled with compatible pedagogical conceptions, and structured prompts and facilitation by teaching assistants facilitated content-specific blogging.

Another benefit of blogging is to develop online written communication skills which are essential for future healthcare professionals and should be provided during their academic training (Halliday & Frisard, 2020). However, they found although technical knowledge may have increased from blogging, students' perceived improvement in the sense of community from blogging was low. Another study indicated the difficulty of incorporating computer-mediated communication conversations into academic environments (T. M. Paulus & Lester, 2013).

Measuring Critical Thinking Skills

Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics (ACEND), 2022 Standards for Didactic Programs require students to be able to apply critical thinking skills after graduation. In these studies, authors tried to increase critical thinking and find the best way to assess students' critical thinking skills (Iwaoka et al., 2010; McNamara et al., 2020). Further, McNamara et al. employed an evidence-based framework using nutrition topics to encourage college students' critical thinking decision making skills (2020). At the same time, Iwaoka et al. reported using take-home exams with open-ended questions, writing detailed laboratory reports, and documenting unsolicited student reflections in journal entries may be a better indication of actual gain in critical thinking skills rather than using a multiple-choice questionnaire to measure critical thinking ability (2010).

Flipped Classroom

The flipped classroom is an innovative pedagogical method that focuses on learner-centered teaching. In flipped classrooms, the activities traditionally done during class time become home activities, and activities that were done as homework assignments become classroom activities (Sohrabi & Iraj, 2016). The benefit of using flipped classroom pedagogy is to increase student engagement with content, improve faculty contact time with students, and improve student learning (Milman, 2012). Gilboy et al., focused on how to implement a flipped classroom and assess the students' perception of this approach in two nutrition/dietetics majors-only classes (2015). The authors reported redesigning the traditional class to a flipped classroom was a rewarding experience while upfront time to digitize lectures and developing appropriate active learning materials to use in class was cumbersome. In another study, researchers used the flipped methodology to teach library research skills to upper-level undergraduate nutrition students. The study outcome indicated that flipped classroom pedagogy provides a method to improve upper-level college students' research skills (Pannabecker et al., 2014). Further, emphasizes the importance of faculty/librarian collaboration in teaching library research skills.

Case-Based Learning

Case-based learning (CBL) engages students in discussion of specific scenarios or events that resemble or typically are real-world examples. This type of learning requires students to recall previously covered materials to solve cases (Garvey et al., 2000). This method is learner-centered with intense interaction between participants as they build their knowledge and work together as a group to examine the case (Williams, 2005). In a study, Harman et al. indicated that the skills students acquired through CBL are consistent with those identified as essential to professional practice (2015). Further, CBL prepares students for multifaceted problems that they are likely to encounter in professional practice. Monk & Newton reported that case-based learning assignments can promote students' perceived scientific literacy skills capabilities in both traditional lecture and distance education course formats (2018).

Other pedagogical methods used include; students' participation in an art module to understand the relationship of art to dietetic practice (Lordly, 2014); Using the interteaching approach (Goto & Schneider, 2010); Comparing student perceptions and final grades of online vs face-to-face nutrition courses (Miller et al., 2020); Online Interactive Learning Assessments in nutrition care process (McKay et al., 2016); Comparison of three instructional strategies and their learning outcomes (Darabi et al., 2016); a scripted role assignment as an effective instructional strategy to promote the development of cognitive presence among students (Olesova et al., 2016); specifications grading (Pope et al., 2020) and team-based active learning (Bailey et al., 2020).

Discussion

Summary of Evidence

The pedagogical practices described in this scoping review used approaches that departed from a traditional lecture-based format. We looked at pedagogical interventions based on 38 studies published between 2010 and 2020. Most of these pedagogical research studies were not funded. Still, faculty members are interested in conducting this type of studies that show their interest in conducting pedagogical research and improving students' learning. Further, most of those that were funded came from institutional internal grants. The most commonly utilized pedagogical methods were experiential/service learning, Interprofessional education, incorporating research methods, and blogging. This reflects the current requirements of the Accreditation Council for Education in Nutrition and Dietetics of the Academy of Nutrition and Dietetics (ACEND) (Accreditation Council for Education in Nutrition and Dietetics, 2021). In some studies, more than one pedagogical method was used. For example, in one article interprofessional education was delivered through a simulation (Costello et al., 2018). Further, fifteen studies clearly indicated that these studies were conducted with upper-level classes (juniors/seniors) and some of these studies included grad students. Eleven studies were conducted in introductory or fundamental nutrition classes. Most of these classes were taken by any level of undergraduate students, sophomores to seniors. IPE studies did not describe the class level of the students, but most of these students would have been enrolled in upper-level classes. Some studies did not mention the class level of students but described the course, for example, an undergraduate community nutrition course. These studies were conducted from a single semester to multiple years.

Limitations

The main limitation of this study is the disconnect between the JBI guidelines and the academic publication industry. JBI guidelines require authors to submit a protocol of the scoping review for peer review and publication before the actual review is conducted; this ensures that the scoping review criteria are well defined in order to minimize bias. Despite following these procedures with three different academic journals, the editorial feedback received stated the journal did not publish protocols but would be interested in the final scoping review manuscript. The authors reflected on this message, deciding the intention of peer review was met and ultimately submitted the protocol to an open access institutional repository. Registered protocols also prevent multiple researchers from conducting lengthy reviews in similar areas, resulting in duplication of research. If we, as an academic community, want to see more rigorous pedagogical publications (particularly in interdisciplinary areas such as SoTL), then this disconnect needs reconciled.

Secondly, a scoping review provides a snapshot of current practices and identifies gaps in research. Scoping reviews do not assess or evaluate the interventions or methods. Thus, the methodological quality and possible bias of the studies were not assessed. Future research should aim to evaluate pedagogical methods addressed in this review by conducting a systematic review; further investigative evidence could be gathered on the overall effectiveness and impact of different teaching methods. For clinical health sciences, including nutrition and dietetics, quality assessment of studies improves the incorporation of evidence-based decision making into teaching and learning. Additionally, a systematic review can synthesize evidence from pedagogical approaches that work across different institutions and settings. Even though these critical aspects were not considered, this review provides insights into the breadth of current pedagogical methods utilized in nutrition and dietetics undergraduate programs in North America.

Another consideration is the deliberate choice in the timeline of research occurring between 2010 and 2020; this scoping review synthesized the breadth of literature as well as key trends and gaps with a particular discipline and time frame in mind. After five years of teaching and learning alongside COVID-19, it could also be useful to build upon this initial work to see how practices shifted and if new methods emerged.

One final limitation is the initial focus of this scoping review, which prioritizes the educational methods used in nutrition and dietetics programs. The Scholarship of Teaching and Learning draws on a rich history of borrowing insights and methodologies from other disciplines to enhance educational practices; with that lens in mind, one goal of this research is to provide practical guidance for other disciplines to conduct their own inventory of pedagogical approaches or systematically gathering information on any given SoTL topic. This data driven approach moves research forward in various areas by reducing duplication in reviews as well as targeting any knowledge gaps in current practice.

Conclusions

This review identifies and describes pedagogical practices utilized in dietetics and nutrition in the USA and Canada in the past decade (2010 to 2020). Specifically, it outlines methods used to teach dietetics and nutrition undergraduate students. The most common pedagogical methods used were experiential/service learning, IPE, incorporating research, and blogging. These contribute to nearly two-thirds of the in-scope pieces on nutrition and dietetics-related pedagogy. These pedagogical methods reflect the current skills and training required by the nutrition/dietetics standards and programs in higher education.

Scoping reviews focus on describing the literature base rather than evaluating its quality. Future studies should extend the current work to a systematic review aimed at evaluating the quality and impact of pedagogical methods. As we continue to expand our global connectedness, future work may also wish to include studies on pedagogical methods used in nutrition and dietetics programs outside of North America.

Acknowledgments

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Appendix

Appendix 1. Full Search Strategies.

Topic	Pedagogical strategies utilized within nutrition and dietetics undergraduate programs in the United States and Canada
Search Concepts	Nutrition/dietetics AND Pedagogical methods AND Undergraduate education AND United States/Canada
Limits	Years: 2010-2020 Language: English Countries: USA and Canada
Reference Management	Zotero and Covidence
Databases	PubMed, Scopus, ERIC, CINAHL, Embase, and ProQuest Dissertations & Theses
Created by	Amy Minix and Alyssa Denneler, IU Libraries
Dates run	January & February 2022
Total results	2779
Duplicates removed	119
Remaining results	2660

PubMed
((((Dietetics / education*) OR (("nutrition* science*" or "Nutritional Science" or dietetic* or "nutrition stud*"))) AND (((exp Teaching/) OR (exp Education/)) OR (("coordinated program" or "didactic program" or "teach* method*" or "learn* environment*" or pedgog* or "learning method*" or "instruction* method*" or "teaching strateg*" or "learning strateg*" or curricul* or "blended learn*" or "hybrid learn*" or "team based learn*" or "team-based learn*" or educat* or learn*)))) AND (university or undergraduate* or "post secondary" or "post-secondary" or "postsecondary" or "college student*" or "university student*") AND (2010:2020[pdat])) AND ((("united states"[MeSH Terms]) OR ("united states"[All Fields]) OR ("america"[All Fields]) OR ("united states of america"[All Fields])) OR (("canada"[MeSH Terms] OR "canada"[All Fields] OR "canada s"[All Fields] OR "canadas"[All Fields]))) Filters: English

Scopus
TITLE-ABS-KEY ("undergraduate education" OR "university teaching" OR "undergraduate students" OR "undergraduate program" OR "undergraduate curricula" OR "undergraduate courses" OR undergraduate OR "postsecondary education" OR "post-secondary education" OR "college students" OR "university students" OR postsecondary) AND (nutrition OR dietetics OR "nutrition AND dietetics" OR “coordinated program” OR “didactic program”) AND ("teaching methods" OR

"teaching method" OR "learning method*" OR "instructional method*" OR "teaching/learning strateg*" OR curricula OR "teaching practices" OR "learning environments" OR “blended learn*”) AND (LIMIT-TO (AFFILCOUNTRY , "United States") OR LIMIT-TO (AFFILCOUNTRY , "Canada")) AND (LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010))

ERIC

("undergraduate education" OR "university teaching" OR "undergraduate students" OR "undergraduate program" OR "undergraduate curricula" OR "undergraduate courses" OR undergraduate OR "postsecondary education" OR "post-secondary education" OR "college students" OR "university students" OR postsecondary) AND (nutrition OR dietetics OR "nutrition AND dietetics" OR “coordinated program” OR “didactic program”) AND ("teaching methods" OR "teaching method" OR "learning methods" OR "instructional methods" OR "teaching/learning strategies" OR curricula OR "teaching practices" OR "learning environments") AND ("United states" OR Canada)
Limiters: 2010-2020 years

CINAHL

(Dietetics OR Nutrition OR “nutrition* science” OR dietetic* OR nutrition* stud*) AND (Students, dietetics OR Education OR teach* OR pedagog* OR “learning method*” OR curricul* OR “blended learn*” OR “hybrid learn*” OR “team based learn*” OR “team-based learn*” OR “SoTL” OR “scholarship of teaching and learning”) AND (students, undergraduate OR university OR undergraduate* OR “university student*” OR “post secondary” OR “post-secondary” OR “postsecondary” OR “college student”) AND (united states or america or usa or u.s. or united states of america or u.s.a. or us OR Canada)
Limiters: 2010-2020 years

Embase

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AND dietetics" OR “coordinated program” OR “didactic program”) AND ("teaching methods" OR "teaching method" OR "learning methods" OR "instructional methods" OR "teaching/learning strategies" OR curricula OR "teaching practices" OR "learning environments"))
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Limiters: 2010-2020 years

Appendix 2. Learning contexts and pedagogical practice descriptions for extracted studies, n = 38.

Authors	Year/Country	Pedagogical practice	Study Population	Methodology	Outcomes
Allsopp MAK, Buys DR.	2020/USA	Community-Engaged Learning:	Juniors and seniors (n19) with nutrition concentrations in the Department of Food Science, Nutrition, and Health Promotion	Pre- to post-assessment of community-engaged learning experiences and changes in attitudes after students delivered an educational presentation to underserved communities	Demonstrated the feasibility of converting a traditional didactic community nutrition course into one that uses a community-engaged framework. Findings from the student surveys and their retrospective reflections suggested the success of this endeavor.
Antunez MY, Schupp K.	2020/USA	Designing a Journal Club by a nutrition faculty and a librarian	23 undergraduate nutrition and dietetics student volunteers	Pre- and post-session online surveys; Optional written formative assessment for ongoing feedback	The journal club was effective in introducing the review of articles to improve critical reading skills among undergraduate students.
Bailey RL, Kiesel VA, Lobene AJ, Zou P.	2020/USA	Team-Based Active Learning:	Undergraduate 300-level nutrition class pre- (n32) and post- (n43) intervention	Comparison of student exam scores and course evaluations pre-and post-implementation of the intervention - replacing individual homework assignments with team-based learning activities during classroom time.	Incorporating team-based active learning improved content knowledge in undergraduate nutrition students as assessed by performance on exams overall and in some but not all content domains. Course and instructor ratings were improved slightly from evaluations, but negative comments such as unequal

					participation of group mates were revealed.
Buchholz AC, Vanderleest K, MacMartin C, Prescod A, Wilson A.	2019/Canada	Patient Simulations	Dietetic undergraduates (n18) enrolled in Applied Clinical Skills class; Graduates/interns (n33) enrolled in Applied Nutrition II class	A pre-post observational study in which students' communication and nutrition-care competence were evaluated during the first and final clinical nutrition simulations.	Simulated patients incorporated into clinical nutrition courses increased dietetics students' and interns' communication and nutrition-care competence.
Clauser J, Richardson BB, Odom-Maryon T, Mann D, Willson MN, Hahn PL, Purath J, Tuell E, Schwartz CR., DePriest D.	2020/USA	IPE - Screening, Brief Intervention, and Referral for Treatment (SBIRT) educational module	A total of 1,255 Students from nursing, pharmacy, medicine, physician assistant, social work, dietetics, and occupational therapy programs participated.	Students completed a survey at the end of IPE.	Utilizing SBIRT as an interprofessional learning experience enhanced students' overall educational experience and assisted with developing interprofessional relationships.
Costello M, Prelack K, Faller J, Huddleston J, Adly S, Doolin J.	2018/USA	IPE - using simulation	Nursing, physical therapy, nutrition, and social work students (n123) participated.	Using post-simulation open-ended interview questions to collect student's perceptions of the experience.	Using simulation in IPE provides students with an opportunity to practice interprofessional collaboration and develop increased confidence and perceived ability to meet their patients' needs more efficiently.
Crist CA, Duncan SE, Bianchi LM.	2017/USA	Wiki research project and cross-	Students in Functional Foods for Health: experimental class	Pre-post tests administered to both classes	The Wiki research project has engaged students and provided opportunities to

		disciplinary lecture	(n29) and control class (n30)		explore and expand food content and research while improving information literacy, communication, and critical thinking skills.
Darabi A, Pourafshar S, Suryavanshi R, Arrington T.	2016/USA	Comparison of three instructional strategies: (1) peer discussion with just-in-time information (JIT information), (2) peer discussion without JIT information), and (3) independent performers	Participants (n 58) from an undergraduate program in food and nutrition	Students were divided into two groups based on their prior knowledge and were randomly assigned to the three conditions. Learners' performance was rated by the mean score of three ratings based on criteria set in advance.	The independent learners performing the task individually performed better than their counterparts in either of the discussion groups (groups with or without JIT).
Dinour L, Kuscin J.	2020/USA	Service Learning	Dietetic undergraduates in a community nutrition service learning (SL) course were placed in either charity (n59) or project (n52) SL.	A quasi-experimental study using pre-post tests to measure students' public service motivation (PSM)	Both groups showed enhanced PSM, with the charity group reporting a higher attraction to public policy, while the project group reported a higher self-sacrifice post-score.
Gilboy MB, Heinerichs S, Pazzaglia G.	2015/USA	Flipped classroom	Nutrition/dietetics majors (n148) from two 400-level undergraduate classes	In-class or online surveys assessed students' perception of flipped classroom	The majority of the students completing the evaluation preferred the flipped method compared with

				learning environments, including Five-point Likert scales and open-ended questions.	traditional pedagogical strategies.
Goto K, Schneider J.	2010/USA	Interteaching approach	37 undergraduate students in a junior-level course entitled Dietary Supplements and Functional Foods	Students participated in the end-of-semester evaluation.	The interteaching approach was overall well received by the students. They perceived that it fostered critical thinking, gave a sense of responsibility as a teacher, facilitated better focus during the clarifying lecture, and resulted in high perceived learning outcomes. Challenges identified by students included confusion generated from insufficient knowledge of student teachers.
Halic O, Lee D, Paulus T, Spence M.	2010/ USA	Blogging	67 Students in an undergraduate nutrition class	An online survey was administered at the end of the semester to investigate student perceptions of and experiences with blog integration	Blogging enhanced students' learning and led them to think about course concepts outside the classroom. However, fewer values were perceived in peer comments.
Halliday TM., Frisard MI.	2020/USA	Blogging	Grad (pre, n20; post, n17) and undergrad nutrition and exercise science students (pre, n78; post, n50) in a seminar course	A pre-post survey administered at the beginning and end of the semester assessed perceived learning, sense of community,	Blogging is generally viewed favorably by exercise and nutrition science students, but they were less likely to agree that it could enhance their learning or increase their sense of community in

				and technical knowledge.	the post-survey. However, Technical knowledge may have increased because of the blogging requirements.
Harman T, Bertrand B, Greer A, Pettus A, Jennings J, Wall-Bassett E, Babatunde OT.	2015/ USA	Case-based learning	85 Students from three upper-level undergraduate nutrition courses	Semi-structured audiotaped focus-group interviews to examine the student perspectives after immersion into case-based learning.	Students' perspectives were conceptualized through four themes: case-based learning, learning methods, problem-solving, and future practice. The skills acquired align with those essential to professional practice, such as problem-solving, critical thinking, self-evaluation, and interpersonal communication.
Harmon A, Landolfi K, Shanks CB, Hansen L, Iverson L, Anacker M,	2017/USA	Experiential learning- food insecurity experience	Quantitative data from surveys in years 1 and 2 (n58); qualitative data extracted from students' workbooks in years 2–5 (n119).	Mixed method: Empathy scores measured by Likert scales; participant responses and reflections recorded in workbook journals	Quantitative findings indicated that both classroom content and experiential exercises were important for enhancing empathy about food insecurity. Qualitative reflections showed guilt, empathy, and compassion, and raised consciousness about food insecurity.
Horsman A.	2015/Canada	Integration of librarian	Third-year undergraduate nutrition students taking a professional practice course	The librarian provided workshops on basic and advanced search strategies. A survey was	Integration of the librarian into the research aspects of the nutrition curriculum is an effective way for students to learn

				administered to obtain feedback.	competencies from which they will benefit throughout their careers.
Ingalls D	2018/Canada	Information literacy (IL) instruction by a librarian	Second-year undergraduate dietetic students (n48)	Pre-post survey after information literacy workshop	The workshop was successful in increasing students' knowledge of and ability to apply IL skills.
Iwaoka WT, Li Y, Rhee WY.	2010/USA	Measuring critical thinking	Food Science and Human Nutrition students in an Experimental Foods class taught every fall over an 8 y period (2001–2008, n154)	The class time is spent on discussing and solving ill-defined problems. To measure gains in critical thinking (CT), the Cornell Critical Thinking Test (CCTT) was administered as a pre- and post-test	Completing several take-home exams with many open-ended questions, writing detailed laboratory reports, and documenting unsolicited student reflections in journal entries that comment on apparent gains in CT skills may be a better indication of actual gains in CT skills compared to the actual CCTT test scores.
Kutt A, Mayan M, Bienko I, Davies J, Bhatt H, Vohra S.	2019/Canada	Combining IPE and education about complementary therapies	Undergraduate health sciences students - 2012 (n71), 2013 (n120) and 2014 (n140)	Pre-post mixed method with three groups: (1) Combined IPE-complementary therapies curriculum, and two control groups of (2) Non-specialized IPE curriculum, and (3) Combined IPE-continuing care curriculum	Combining IPE initiatives and basic complementary therapies education can save curricular time and develop healthcare professionals who appear to be more ready to provide team-based, patient-centered care.
Lee YM, Burnett D.	2019/USA	Engaging undergraduate	84 undergraduate students, mostly with a major in dietetics, in	Pre- and post-test questionnaires were administered to students	Students demonstrated positive attitudes and reported a gain in

		students in research	the Experimental Study of Foods class	before and after the food science research project.	confidence after the food science research project was completed. Also, enhanced student interest in research.
Lieffers JRL, Finch SL, Banow R, Loy K.	2020/Canada	Course-based first-year Research Experience (FYREs)	First-year undergraduate students (n265) in a nutrition professional practice course	Students worked in assigned groups of 3-4 to explore their community on a nutrition topic of their choice using survey questions. Students completed an evaluation using a paper-based questionnaire at the end of the semester.	A course-based research experience was successfully implemented into an undergraduate nutrition course with positive student feedback, despite most students having little previous research experience and limited knowledge of statistics.
Lordly D.	2014/ Canada	Arts-informed dietetic education	27 undergraduate students in a senior nutrition course	An exploratory, qualitative methodology informed by Schon's reflective framework was employed and a survey was used to collect information on students' participation in an art module.	This practice facilitated a transformation among students - in knowledge, perception, and attitude. The arts provide an alternative platform for an exploration of self and others, for improving practice.
Matthews J	2013/Canada	Experiential Learning - using a collaborative, problem-based learning and a photoactive approach	165 first-year undergraduate students of the Food and Nutritional Sciences program	Students worked collaboratively in conducting food system assessments of local neighborhoods as part of their first-year course; Informal feedback was received from students before and after class, during office hours, in-	Food system assessments provide an opportunity to promote positive student engagement and encourage students, particularly in Food and Nutrition programs, to think about food in its broader context. Furthermore, it contributes to deeper learning as

				class discussions, and anonymous course evaluation.	students reflect on both content and process.
McKay T, Jimenez EY, Svihla V, Castillo T, Cantarero A.	2016/USA	Online Interactive Learning Assessments (ILA)	30 of the 46 undergraduate juniors or seniors volunteered to participate in the study	25 students completed the survey after participating in online ILA cases.	Participating students were satisfied with the ILAs and reported that they provided the feel of authentic practical experience with the Nutrition Care Process
McNamara J, Sweetman S, Connors P, Lofgren I, Greene G.	2020/USA	Using Interactive Nutrition Modules to Increase Critical Thinking Skills	A total of 431 students participated from introductory nutrition course & agricultural science courses (intervention = 203; control = 228)	To understand how the addition of an evidence-based framework to an online nutrition module influences college students' critical thinking decision-making (CT-DM). Students were individually randomized into an intervention group or a control group. CT-DM was scored using a validated rubric.	CT-DM was scored using a validated rubric to assess the use of critical thinking skills when making a food-related decision. Green eating and critical thinking disposition were measured. Results show that CT-DM skills improved with intervention.
Miller ME, Newton K., Stover S, Miller B, Buttolph J.	2020/USA	Online vs face-to-face(F2F) nutrition courses	Students in 3 introductory nutrition courses (online (n24), traditional F2F (n59), and F2F with team-based learning (n60))	Students in three courses completed the Community of Inquiry (COI) questionnaire to assess perceptions, with final grades compared for academic performance evaluation.	Online courses may provide similar student perceptions of connection to the course content, peers, and the instructor similar to face-to-face courses, and may result in similar grades.

Monk JM, Newton G.	2018/Canada	Case-based learning assignments	Third-year nutritional science course- In-class traditional lecture (n179) and online distance education (n71) students	A pre-post survey was used to assess scientific literacy skills	Case-based learning assignments can promote students' perceived scientific literacy capabilities in both traditional lecture and distance education course formats
Olesova L, Slavin M, Lim J.	2016/USA	Scripted role assignments for asynchronous online discussion	Introductory nutrition course across three semesters: Fall (n=26), Spring (n=38), and Summer (n=76), totaling (n=139)	Quantitative content from students' discussion posts was analyzed.	Scripted roles can be an effective strategy to improve students' learning processes and outcomes. The majority of students' posts were at a higher level of cognitive presence based on course length.
Pannabecker V, Barroso CS, Lehmann J.	2014/USA	Flipped classroom - involvement of librarians to teach library research skills	Nutrition and health-related majors' students (n178) in two sessions of a 400-level nutrition class	The effectiveness of the flipped library research session was assessed by (1) optional student feedback for pre-class exercise and (2) pre- and post-quiz administered via the course site.	The flipped classroom method improved students' library research skills through interaction, engagement, and peer-to-peer learning.
Paulus TM, Lester JN.	2013/ USA	Blogging/Computer-mediated communication (CMC)	Students (n186) enrolled in a nutrition science course	Students' blog conversations were analyzed using the discursive psychology (DP) framework. The analytical approach involved (1) repeated readings; (2) selection, organization, and identification of patterns; (3) generation	Findings pointed to the difficulty of incorporating CMC conversations into academic environments in that there are no clear conversational norms for how this should be taken up by students.

				of explanations; and (4) reflexively and transparently documenting claims	
Paulus T, Spence M.	2013/USA	Blogging	Undergraduate lecture course in nutrition	Researchers described two iterations of the design, development, implementation, and evaluation of small online activity and reflection blogging groups into a large undergraduate lecture course	The blog conversations proved to be highly useful to the instructors as a source of data on student understandings and misconceptions of course topics
Pope L, Parker HB, Ultsch S.	2020/USA	Specifications grading	Upper-level dietetics course (n70)	Specifications grading effectiveness was assessed over two years using qualitative tools (focus groups, post-surveys) and tracking grade distribution, attendance, and revision attempts.	Specification grading may help to increase students' self-regulation, mastery learning, and instructor transparency. Drawbacks that emerged were inflexibility and grade socialization.
Schug V, Finch-Guthrie P, Benz J.	2018/USA	IPE & team-based learning (TBL)	Research methods course with students (n42) from nursing, exercise, and nutrition science	Pre-post survey and feedback were obtained.	TBL provides an opportunity for students to acquire and refine the competencies needed for interprofessional practice.
Schwartz VS, Rothpletz-Puglia P, Denmark R, Byham-Gray L.[31]	2015/USA	Experiential Teaching Strategy	75 dietetic students in a nutrition counseling class. Standardized patient (SP) group (n42) and	Ex post facto design comparing communication and behavior change skills in simulation lab with RP or SP using	Encounters with SPs and RPs are both effective strategies for dietetic students to demonstrate their communication and behavior change skills

			Real Patient (RP) Group (n33)	retrospective analysis of video recordings	
Smith SC, Penumetcha M.	2010/USA	Integration of librarians	Undergraduate introductory nutrition research course (n27)	Pre- and post-surveys were conducted at course onset and conclusion.	Students demonstrated enhanced comfort and confidence in utilizing library resources, leading to increased library usage. They also felt more adept at sourcing high-quality information on nutrition-related topics and evaluating different information sources, contributing to their educational and career goals.
Twynstra J, Dworatzek P.	2016/Canada	Experiential learning - social media assignment	Dietetic students in the Communications course (n48)	Students were instructed to make two posts 3 weeks apart. Students were evaluated on the hook, main points, professionalism, credibility, and effectiveness of inviting readers to the hyperlinked website.	Social media experiential education ensures that dietetics students receive a number of Foundational Knowledge and Practice Competencies required for entry-level practice.
van Schaik SM, Regehr G, Eva KW, Irby DM, O'Sullivan PS.	2016/USA	IPE	A total of 353 students from seven health professions schools (medicine, pharmacy, nursing, dentistry, physical therapy, dietetics, and social work)	Students provided anonymous feedback and completed an online survey to rate the usefulness and positivity of feedback received and guessed each comment's source.	Students have positive perceptions of interprofessional feedback without systematic bias against any specific group.

Young, C.	2017/USA	Experiential Learning	9 undergraduate nutrition students	Observations and surveys were used to determine the effects of the camp as an experiential learning scenario.	The experience provided academic benefits through reinforcing classroom knowledge, professional benefits through career discernment, and personal benefits through development of soft skills such as problem-solving and time management.

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