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Abstract

Faculty seek methods that efficiently use their time, facilitate deep learning, and acquire competencies through the curriculum. The flipped classroom, a pedagogical approach, is proposed to be one solution to these issues. This study is a scoping review of how health care professional courses apply the flipped classroom model. The specific aims of this scoping review are: (a) determine the health care disciplines using and researching flipped classrooms, (b) identify and categorize instructional/course design and teaching and learning strategies used in flipped classroom literature, and (c) classify the levels of evidence-based education and trustworthiness in the studies as defined by Kirkpatrick's hierarchy. Following the PRISMA guidelines for sectioning the study, twenty studies were included in this scoping review. This scoping review identified various health care professions that have implemented the flipped classroom model at multiple levels of courses and curriculum to enhance student learning experiences. The flipped classroom design model provides different ways of improving learning environments, which could benefit student learning outcomes in academic performance and satisfaction. Pre-class and in-class active learning is the most common teaching and learning strategies; although less common, there is value identified in the after-class learning activities. Research suggests that blended learning and flipped classrooms can be effective in health care professional education to learn, retain, apply, and think critically compared to traditional teaching. Occupational therapy educators can use various learning strategies discussed in this study as an alternative or supplement to enhance or replace the traditional lecture-based teaching style.

Keywords

Flipped Classroom, Kirkpatrick Levels, Teaching and Learning Strategies, Blended Learning Design

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Flip to Learn & Learn to Flip in Occupational Therapy Education: A Scoping Review

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ABSTRACT

Faculty seek methods that efficiently use their time, facilitate deep learning, and acquire competencies through the curriculum. The flipped classroom, a pedagogical approach, is proposed to be one solution to these issues. This study is a scoping review of how health care professional courses apply the flipped classroom model. The specific aims of this scoping review are: (a) determine the health care disciplines using and researching flipped classrooms, (b) identify and categorize instructional/course design and teaching and learning strategies used in flipped classroom literature, and (c) classify the levels of evidence-based education and trustworthiness in the studies as defined by Kirkpatrick's hierarchy. Following the PRISMA guidelines for sectioning the study, twenty studies were included in this scoping review. This scoping review identified various health care professions that have implemented the flipped classroom model at multiple levels of courses and curriculum to enhance student learning experiences. The flipped classroom design model provides different ways of improving learning environments, which could benefit student learning outcomes in academic performance and satisfaction. Pre-class and in-class active learning is the most common teaching and learning strategies; although less common, there is value identified in the after-class learning activities. Research suggests that blended learning and flipped classrooms can be effective in health care professional education to learn, retain, apply, and think critically compared to traditional teaching. Occupational therapy educators can use various learning strategies discussed in this study as an alternative or supplement to enhance or replace the traditional lecture-based teaching style.

Introduction

Given the ever-expanding body of knowledge in the profession, occupational therapy and occupational therapy assistant program educators look for evidence-based teaching-learning methods. Faculty seek ways to efficiently use their time, facilitate deep learning, and acquire competencies through curriculum design (Zakaria, 2017). The flipped classroom, a pedagogical approach, is proposed to be one solution to these issues. The flipped classroom is an innovative approach to blended learning where there is a hybrid approach to learning; the rote lectures are homework before class and the in-person time is now spent in active learning (Bristol, 2019; Geist et al., 2015). The goal of the in-person time is to be active, interactive, and applied; therefore, achieving higher-ordered learning (van Vliet et al., 2015). The use of the flipped classroom model in health professions education is known; however, the extent of its use, design strategies, or effectiveness remains to be examined (Critz & Knight, 2013; Pierce & Fox, 2012; Prober & Khan, 2013).

There is growing debate among educators if the traditional lecture-based classroom teaching is the best way to help students learn (Anderson, 2017; Prober & Heath, 2012; Tan et al., 2017). The lecture-based instructional approach refers to a traditional classroom teaching model; this model is teacher-centric, focused on content delivery and applying questions and answers (Shi et al., 2018). In contrast, in a flipped classroom, the aim is to move the charge of learning from the teacher to the students (Limniou et al., 2018). Another feature of the flipped classroom in higher education is the classroom learning space can vary from traditional lecture classrooms, computer labs, laboratories, or technology-enabled learning spaces such as active learning classrooms (Long et al., 2017). A recent review of the literature in various disciplines (e.g., engineering, mathematics, sciences, health care, humanities, and education) shows the flipped classroom promoted “students’ engagement, metacognition, attitude, performance, understanding, and achievement” (Al-Samarraie et al., 2020, p.1).

As Wiggins and McTighe (2011) described in their book, *The Understanding by Design Guide to Creating High-Quality Units*, instructional/course design begins with clear goals of the course and then designing the course to achieve those goals. In the flipped classroom the overarching course structure and related teaching and learning strategies are essential for success. Teaching and learning strategies include a variety of activities and methods that are organized and arranged for optimal student engagement, learning, and achievement of desired outcomes (Hughes, 2011). An example of the relationship between instructional design and teaching and learning strategies can be illustrated in the flipped classroom. The design may include three-credit hours, live in-person design, and pre-class, in-class, and/or after-class required student activities. Teaching/learning strategies are what the instructor embeds in the pre-class, in-class, and after-class activities. The pre-class learning phase may include reading, knowledge check quizzes, or watching a prerecorded lecture, the in-class time is now spent engaged in active and applied to learn activities, and the after-class activity may be a written reflection (Al-Samarraie et al., 2020; Long et al., 2017; McLaughlin et al., 2017).

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Educators also need to evaluate curriculum, curricular design, teaching and learning, and student learning outcomes (Belfield et al., 2001). Best Evidence Medical Education (BEME) Collaboration (https://www.bemecollaboration.org/) is an international organization akin to the Cochrane Collaboration. Still, the only goal is developing evidence-informed health care education by classifying educational outcomes (Yardley & Dornan, 2012). The Kirkpatrick's scale, which evaluates various medical education research (Yardley & Dornan, 2012), was adopted by BEME. Unlike Cochrane's positivist approach of reviewing articles using controlled trials analysis, the Kirkpatrick level is intended to take a constructionist approach and seek clarification of what pedagogical approach is used, under what circumstance, when, with whom, and how. Kirkpatrick's hierarchy levels use a grading standard for health education-related articles and a five-point trustworthiness scale. There is value in the Kirkpatrick model health care education because the scale assesses educational experiences based on the transfer of "knowledge, skills and attitudes learned in the classroom into the workplace" and the health care organization to develop competent health care professionals (Hammick et al., 2010, p. 28).

With the increased interest and use of the flipped classroom model, it is time to determine to what extent the flipped classroom is used in health care education and the effectiveness. In this scoping review, the intent was to identify the general size and scope of available research literature and the characteristics of that research (Grant & Booth, 2009). The specific aims of this scoping review were to: (a) determine the health care disciplines using and researching flipped classrooms, (b) identify and categorize instructional/course design and teaching and learning strategies used in flipped classroom literature, and (c) classify the levels of evidence-based education and trustworthiness in the studies as defined by Kirkpatrick's hierarchy.

Method

Scoping review methodology was used based on the process outlined by Arksey and O'Malley (2005). Consistent with the scoping review, initial protocols were established and refined the search process through an iterative process as we proceeded through the Arksey and O'Malley five stages (Arksey & O'Malley, 2005; Levac et al., 2010). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Moher et al., 2009) was used during stages two and three, identifying relevant studies and selecting the studies.

Stage 1: Identifying the Research Question

Stage one includes identifying the aim of the study (research question). This scoping review's primary purpose was to determine who was using flipped classroom design in health care education, the types of instructional design and teaching and learning strategies used and identify the levels of evidence-based education used in flipped classroom design as defined by the Kirkpatrick hierarchy.

Stage 2: Identifying Relevant Studies
Identifying relevant studies includes identifying applicable research terms and databases. The search terms included (flipped classroom OR flipped learning OR blended learning OR inverted classroom OR inverted learning) AND (health care professionals OR allied health OR occupational therapy OR physical therapy OR nursing OR pharmacy OR nursing education OR medical education OR pharmacy education).

The data search included PubMed, EBSCO, CINAHL; consistent with other scoping reviews (Juckett & Robinson, 2018), a targeted hand search of discipline-specific journals was also applied. Those journals included: *American Journal of Occupational Therapy, Open Journal of Occupational Therapy, Journal of Physical Therapy Education, British Medical Journal Education, Health Professions Education, Nurse Educator, Journal of Occupational Therapy Education, Nursing Education, Journal of Interprofessional Education and Practice,* and *Journal of Allied Health*.

Stage 3: Selecting the Studies
Before selecting the studies for review, the three reviewing authors agreed upon both inclusion and exclusion criteria. The inclusion criteria included studies that flipped classroom was for undergraduate and graduate health care profession students, empirical study design, full-text articles were available, English language, and published articles published from 2007 to 2019. Exclusion criteria were expert opinion studies, protocol studies, all non-health care professions, and studies of grades K – 12. Two reviewers reviewed all studies titles and abstracts and read the full text for selection. A third author resolved conflicts. The three reviewing authors agreed to include only studies explicitly using flipped classroom design in this scoping review through the iterative review process at the time of full-text review.

Stage 4: Charting the Data
Three reviewers applied descriptive analytics to chart the data using two forms of data extraction. The Kirkpatrick hierarchy levels (Lovato & Peterson, 2019; Wall, 2010) were used to determine the level of evidence-based education of each study, and the appraisal of the strength of medical education research, as described by Yardley and Dornan (2010), was applied to determine the trustworthiness of each study. The Kirkpatrick hierarchy levels assess outcomes specific to participation, attitudes, knowledge or skills, behaviors, organizational practice, and benefits to patients/clients (see Table 1).

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Table 1

Kirkpatrick's Levels as Represented on the Best Evidence Medical Education Collaborations

Kirkpatrick Hierarchy
Level 1:
Participation feedback: covers learners' views on the learning experience, its organization, presentation, content, teaching methods, and aspects of the instructional organization, materials, quality of instruction
Level 2a:
Modification of attitudes/perceptions: outcomes relate to changes in the reciprocal attitudes or perceptions between participant groups towards the intervention/ simulation
Level 2b:
Modification of knowledge/skills: for knowledge, this relates to the acquisition of concepts, procedures and principles; for skills this relates to the acquisition of thinking/problem-solving, psychomotor and social skills
Level 3:
Behavioral change: documents the transfer of learning to the workplace or willingness of learners to apply new knowledge and skills
Level 4a:
Change in organizational practice: wider changes in the organization or delivery of care, attributable to an educational program
Level 4b:
Benefits to patient/clients: any improvement in the health and well-being of patients/ clients as a direct result of an educational program

Note. Descriptions of each level of Kirkpatrick Scale (Yardley & Dornan, 2012).

Medical education research strengths were appraised using a scale of 1-5 (Yardley & Dornan, 2012). Table 2 includes the descriptions of the scale to measure strength of the studies included in the scoping review.

Stage 5: Collating, Summarizing, and Reporting the Results

The selected studies were represented in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (see Figure 1).

Table 2

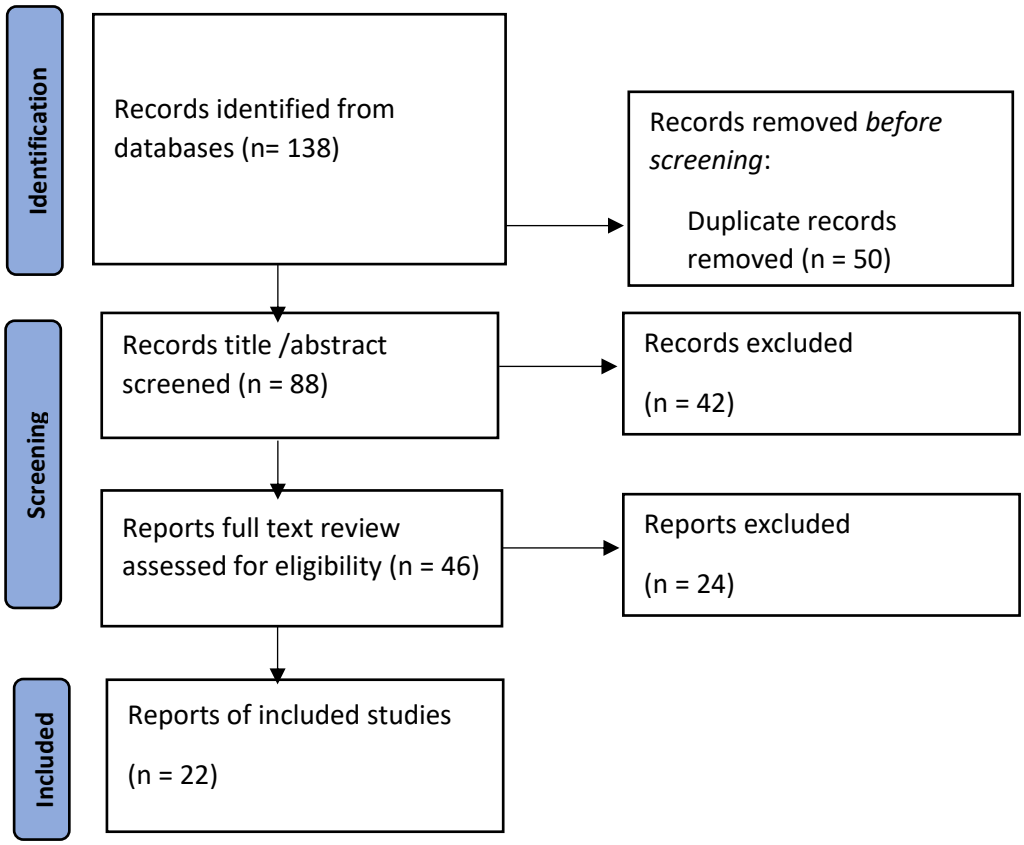
Yardley and Dornan Scale

1.	No clear conclusions can be drawn; not significant
2.	Results ambiguous, but there appears to be a trend
3.	Conclusions can probably be based on the results
4.	Results are clear and very likely to be true unequivocal
5.	Results are unequivocal

Note. Description of Yardley and Dornan Scale used for appraisal of the strength of medical education research (Yardley & Dornan, 2012)

Figure 1

Data Search PRISMA Flow Diagram



Note. Flow diagram shows what articles were included in the scoping review

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The authors' descriptive analytics, year, Kirkpatrick hierarchy levels, and the appraisal of the strength were placed in ranked order. Thematic construction was used to understand better the scope of the finding from the selected studies (Colquhoun et al., 2010). Thematic analysis was applied to describe and differentiate what teaching strategies were used and when these strategies occurred.

Results

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was followed to obtain the final selected studies. Upon initial databases, 138 studies were identified; 88 remained for the title and abstract review once duplicates were removed. Following the title and abstract review, 46 studies were moved forward to the full-text review, resulting in 22 studies in this scoping review. Six overarching professional categories represented in the studies included pharmacy (n=11), medical school (n= 4), nursing (n= 2), social work (n=1), and other health professional programs (n = 4). Most of the studies (n=16) used flipped classroom for the entire course, and six selectively used flipped classroom as a portion of the overall course. Most studies (n=15) measured significant positive outcomes measured by final exam scores, grades, and adaptive scales testing knowledge and skills, leaving five studies with mixed results and two with no significant results.

Kirkpatrick's hierarchy levels for appraising medical education interventions were applied to assess the impact of the studies (see Table 3). Level 1 describes what learners experienced or their reaction to the learning (Yardley & Dornan, 2012). Level 1, Participation, was reached in 31.8% of the reviews. Consistent with Yardley and Dornan's (2012) study, the most significant percentage of the reviews was Level 2, 50% of the studies. Further analysis of the data showed only one study represented Level 2a, which meant a modification of attitude or perception, whereas 45% of the studies were Level 2b representing a modification of knowledge or skills, including problem-solving. Approximately 18.1% of the studies represented a behavioral change where the learners applied the new knowledge or skill - Level 3 (Yardley & Dornan, 2012). The highest level of Kirkpatrick's hierarchy, Level 4, organizational change or patient improvement, was not present in the studies.

Table 3

Appraised Studies Ranked on Levels of Kirkpatrick Hierarchy and Yardley and Dornan Scale

Study	Kirkpatrick Scale	Yardley & Dornan Scale
Mc Laughlin et al., 2013	3	4
Pierce & Fox, 2012	3	4
Munson & Pierce, 2015	3	3
Roopashree et al., 2017	3	3
McLaughlin et al., 2017	2b	4
Belfi et al., 2015	2b	4
Harrington et al., 2015	2b	4
Koo, 2016	2b	4
Ferreri & O'Connor, 2013	2b	3
Bohaty, 2016	2b	3
Bossaer et al., 2016	2b	3
Camiel et al., 2016	2b	3
Anderson et al., 2017	2b	3
Chen & Chang, 2017	2b	3

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Khanova, McLaughlin et al., 2015	2a	3
Young et al., 2014	1	3
Khanova, Roth et al., 2015	1	2
Sage & Sele, 2015	1	2
Sajid et al., 2016	1	2
Simpson & Richards, 2015	1	2
Telford & Senior, 2017	1	2
Wong et al., 2014	1	2

Note. This table demonstrates the levels for each research study included in the scoping review on the Kirkpatrick hierarchy and strength on the Yardley and Dornan Scale.

Both themes and sub-themes for the types of instructional design and/or teaching and learning strategies were identified (see Table 4). The primary themes were related to course design; specifically, pre-class preparation, in-class activities, and class follow-up. Within these primary themes, sub-themes emerged: learning strategy focused; those include but are not limited to knowledge attainment and retention, reflective learning, active learning, discussion, assignments/homework, and feedback.

Table 4

Teaching and Learning Strategies

Authors	Article Title (Aim)	Pre-Class	In-Class	After-Class
Anderson et al., 2017	Comparison of pharmaceutical calculations learning outcomes achieved within a traditional lecture or flipped classroom andragogy	Recorded lecture Reading Group activities Assignments	Quiz: group & individual Brief lecture CBL - group Instructor modeling Discussion Guided note taking Problem sets Simulations TPS	Reflection
Belfi et al., 2015	"Flipping" the introductory clerkship in radiology: Impact on medical student performance and perceptions	Recorded lecture e-learning modules RadCast (podcast)	CBL - discussion ARS Games (jeopardy)	Not Discussed
Bohaty, 2016	Flipping the classroom: Assessment of strategies to promote student-centered, self-directed learning in a dental school course in pediatric dentistry	Tegrity lecture capture Readings Handouts	Interactive applied class activities & discussions	Case based questions in exams

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Bossaer et al., 2016	Student performance in a pharmacotherapy oncology module before and after flipping the classroom	Vodcasts (video podcasts) Quiz	CBL – instruction & discussion	Case study Self-assessment
Camiel et al., 2016	Students' attitudes, academic performance and preferences for content delivery in a very large self-care course redesign	Recorded lecture Readings Study guides Faculty-student Q&A	iRAT/tRAT CBL - discussion Review of Q&A Peer team member assessments	Not Discussed
Chen & Chang, 2017	Integrating the self-study, online discussion, and double-stage presentations (SOP^2) model into the flipped classroom to foster cognitive presence and learning achievements.	Recorded lecture Quiz	Faculty summary Peer feedback Clinical activity Faculty assessment of learning	Discussion forum Self-reflection Wiki Homework Peer assessment
Ferreri & O'Connor, 2013	Redesign of a large lecture course into a small group learning course	Readings	CBL – group & discussion CBL - In-class assignment Q&A on readings Discussion	Review of class material
Harrington et al., 2015	Quantitative outcomes for the nursing students in a flipped classroom	Preparation prior to class	In class activities	Not Discussed

Khanova, McLaughlin et al., 2015	Student perceptions of a flipped pharmacotherapy course	Self-paced online learning modules w/ Knowledge-Checks	Mini-lectures	Not Discussed
		Homework	CBL – group & discussion	
			Review sessions with content experts	
			ARS	
			TPS	
			Video discussion	
Khanova, Roth et al., 2015	Student experiences across multiple flipped courses in a single curriculum	Recorded lecture	Micro-lectures	Not Discussed
		Readings	CBL – group & discussion	
		Summary Notes	CBL - Instructor led	
		Interactive on-line activities	ARS	
			Discussion (student led)	
			Problem-solving	
Koo, 2016	Impact of flipped classroom design on student performance and perceptions in a pharmacotherapy course	Recorded lecture	Quiz	Not Discussed
		Self-assessment Questionnaires	CBL - Instructor led with ARS	
			CBL - group	

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Mc Laughlin et al., 2013	Pharmacy student engagement, performance, and perception in a flipped satellite classroom	Self-paced online interactive learning modules	Quiz	Not Discussed
		Readings	ARS	
			Student presentations	
			TPS	
			Micro-lectures	
			Active learning activities	
McLaughlin et al., 2017	Design, implementation, and outcomes of a three-week pharmacy bridging course	Recorded lecture	Quiz	Not Discussed
		Readings	Micro lectures	
		Assessments	Discussion	
		Pre-knowledge check	Problem based learning	
			Group – problem-based learning activities	
			ARS	
			Student directed inquiry	
Munson & Pierce, 2015	Flipping content to improve student examination performance in a pharmacogenomics course	Recorded lecture	Knowledge Check	Post test
			Micro-lecture	
			Problem solving	

Pierce & Fox, 2012	Vodcasts and active-learning exercises in a "flipped classroom" model of a renal pharmacotherapy module	Recorded lecture	CBL Discussions (Student centered) Problem solving Applied simulation	Not Discussed
Roopashree et al., 2017	Effectiveness of flipped classroom as a teaching tool: A pilot study	Recorded lecture	2 tests (basic knowledge and applied comprehension) CBL - essay CBL – group & discussion	Not Discussed
Sage & Sele, 2015	Reflective journaling as a flipped classroom technique to increase reading and participation with social work students	Reading paired with reflective reading journal	Discussion (lacked details)	Not Discussed
Sajid et al., 2016	Can blended learning and the flipped classroom improve student learning and satisfaction in Saudi Arabia?	Recorded lecture Asynchronous discussion board Knowledge Check Application exercises	Not Discussed	Not Discussed

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Simpson & Richards, 2015	Flipping the classroom to teach population health: Increasing the relevance	Recorded lecture Readings Interactive online modules Knowledge Checks	CBL Web quests Videos Group – presentations Faculty led summary	Reflective journaling
Telford & Senior, 2017	Health care students' experiences when integrating e-learning and flipped classroom instructional approaches	Quizzes Videos Web links Various on-line learning tools	Not Discussed	Not Discussed
Wong et al., 2014	Pharmacy students' performance and perceptions in a flipped teaching pilot on cardiac arrhythmias	Recorded lecture Power Point Slides Readings	Quiz CBL – group & discussion Q&A Problem solving and calculations	Not Discussed
Young et al., 2014	The flipped classroom: A modality for mixed asynchronous and synchronous learning in a residency program	Recorded lecture	Group – discussion and worksheet Problem solving	Not Discussed

Note: This table includes the pre-class, in-class, and after-class activities identified by each research study included in the scoping review. Key: ARS =Audience response system; CBL – case-based learning; TPS – Think Pair Share

Discussion

The research on flipped classrooms in health professions education and the Kirkpatrick hierarchy was limited. Therefore, a scoping review design was applied to examine the current educational state. Both themes and sub-themes for the types of instructional design and/or teaching and learning strategies were identified from this scoping review. The primary themes were related to course design, specifically pre-class preparation, in-class activities, and class follow-up. Within these primary themes, sub-themes emerged: learning strategy focused; those include but are not limited to knowledge attainment and retention, reflective learning, active learning, discussion, assignments/homework, and feedback.

Pre-Class Preparation

In this scoping review, the subthemes for pre-class preparation were knowledge attainment and retention, multimedia activities, reflective learning, and assignments. Knowledge attainment and retention pre-class preparation included readings, questions/quizzes, and study guides. Pre-readings were essentially required in many of the studies. During pre-class work, individual activities, and interactive tasks (Bohaty, 2016) included completing assigned pre-readings and related assignments. Eight studies explicitly reported using quizzes or knowledge checks in the pre-class preparation (Bossaer et al., 2016; Chen & Chang, 2017; Harrington et al., 2015; Khanova, McLaughlin et al., 2015; McLaughlin et al., 2017; Sajid et al., 2016; Simpson & Richards, 2015; Telford & Senior, 2017).

Ferreri and O'Connor (2013) exclusively used pre-readings and study guides in their pharmacy course redesign. Khanova, McLaughlin et al. (2015) found that when they solicited student feedback on a flipped classroom redesign of a pharmacotherapy course, the professors developed study guides or drug tables for each educational module to support student's self-directed learning of the material.

Multimedia preparation varied from recorded lectures, videos, and both primary and interactive online modules. Seventeen of the twenty-two studies used some form of recorded lectures. Some of the other ways the course content was shared with students included Vodcasts (Bossaer et al., 2016; Pierce & Fox, 2012), Tegrity Lecture Capture (Bohaty, 2016), RadCast (podcast; Belfi et al., 2015), voiced-over PowerPoint (Roopashree et al., 2017; Sajid et al., 2016; Simpson & Richards, 2015), self-paced online interactive modules (Khanova, McLaughlin et al., 2015; McLaughlin et al., 2013; McLaughlin et al., 2017), and the remaining studies did not specify (Anderson et al., 2017; Camiel et al., 2016; Chen & Chang, 2017; Khanova, Roth et al., 2015; Koo, 2016; Munson & Pierce, 2015; Pierce & Fox, 2012; Telford & Senior, 2017; Wong et al., 2014). The use of multimedia strategies promoted student learning at their own pace, treating students as self-directed learners.

Reflective learning occurred most often through reflective journaling (Sage & Sele, 2015). Koo (2016) combined multimedia and reflection using short online videos for foundational concepts followed by self-assessment questions. Pre-class assignments were both individual and group; one found students preferred group assignments

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(Ferreri & O'Connor, 2013). Assignments included case studies, preparation for in-class presentations, posting online answers to questions, reflecting on a topic, or a peer review of reflections. Studies have found significant improvement in student experiences by adapting a course design to the flipped model. The foundational class content is moved out of class, and discussions and other higher-order thinking activities are part of in-class activities (Koo, 2013; McLaughlin et al., 2013).

Anderson (2017) provided a comparison of traditional lecture and flipped classroom models. The flipped model emphasis on pre-class preparation to foster readiness to learn in class. The flipped classroom requires the students to engage in specific tasks to understand its core concepts actively. Leveraging these pre-classroom activities was germane in the studies in this scoping review. van Vliet and colleagues (2015) conducted an RCT on the flipped classroom and metacognition, and they compared traditional classrooms to the flipped classroom. The findings suggest the pre-class preparation for the flipped classroom plays a "very important role in the stimulation of deep learning processes" (van Vliet et al., 2015, p 8).

In-Class Learning

In-class learning is the next phase of the flipped classroom model. The in-class activities are designed to further the information gained in the pre-class activities. The student continues to carry the responsibility of learning for the in-class activities. In-class activities can include a brief lecture, readiness quiz at the beginning of the class (McLaughlin et al., 2017), clinical case-based learning, demonstration, and group-based discussion (Roopashree et al., 2017). Just as in the pre-class preparation, the in-class learning had subthemes. In-class learning subthemes were knowledge attainment and retention, group presentations, discussion-based activities, and other active learning activities.

Knowledge Attainment and Retention

Knowledge attainment and retention were represented in several ways, including knowledge check quizzes, audience response systems (ARS), and brief mini-lectures. Short in-class quizzes were frequently used in flipped classrooms for both readiness assessment and quick lecture knowledge checks (McLaughlin et al., 2013, McLaughlin et al., 2017; Wong et al., 2014). Roopashree et al. (2017), in addition to the beginning of the class knowledge check quiz, also used an end-of-class clinical case-based essay quiz. Audience response systems, such as clickers or Kahoot, were explicitly used in six studies (Belfi et al., 2015; Khanova, McLaughlin et al., 2015; Khanova, Roth et al., 2015; Koo, 2016; McLaughlin et al., 2013; McLaughlin et al., 2017).

The use of quizzes or some form of knowledge checks are consistent with the literature; when quizzes occurred at the beginning of a class, students can reflect on their knowledge gaps, and the in-class learning activities can be adjusted, whereas others use quizzes at the end of class to assess learning of the in-class content (Bristol, 2019; Roopashree et al., 2017). Some used knowledge check quizzes at the beginning of the class (Koo, 2016; McLaughlin et al., 2013; McLaughlin et al., 2017;

Munson & Pierce, 2015; Roopashree et al., 2017; Wong et al., 2014); while others added the Individual Readiness Assurance Testing (iRAT) and Team Readiness Assurance Testing (tRAT) method (Anderson et al., 2017; Camiel et al., 2016), mid-class instructor-led knowledge checks (Munson & Pierce, 2015) or the end of class clinical case-based essay quiz (Roopashree et al., 2017).

Six studies reported brief mini-lectures were used (Anderson et al., 2017; Khanova, McLaughlin et al., 2015; Khanova, Roth et al., 2015; McLaughlin et al., 2013; McLaughlin et al., 2017; Munson & Pierce, 2015) whereas Chen and Chang (2017) provided feedback on discussion board questions and a summary at the beginning of class. Ferreri and O'Connor (2013) opened the class with a question-and-answer discussion on the readings. Simpson and Richards (2015) reported the instructor provided a summary at the end of the in-class session. These strategies were all consistent with Day et al.'s (2018) literature review of the characteristics of intermediate assessment and their relationship with student grades. They suggested periodic knowledge checks and individual corrective feedback through lectures or summaries were useful and all positively influenced student grades.

Discussion Based Activities

Discussion-based group activities were reported in seven studies (Anderson et al., 2017; Ferreri & O'Connor, 2013; Khanova, McLaughlin et al., 2015; Khanova, Roth et al., 2015; McLaughlin et al., 2017; Pierce & Fox, 2012; Young et al., 2014). Some discussions were student-led or student-centered (Khanova, Roth et al., 2015; Pierce & Fox, 2012), where other discussions were focused on homework or readings (Ferreri & O'Connor, 2013), to complete a worksheet (Young et al., 2014) or discuss in-class videos (Khanova, McLaughlin et al., 2015; Simpson & Richards, 2015) and other studies did not specify what occurred in groups (Sage & Sele, 2015).

Groups

Group work is a commonly used teaching and learning strategy in flipped classroom design- this allows for group presentations, discussions, and problem-based activities to occur. The primary use of groups was through case-based learning activities. Twelve of the studies explicitly reported the use of case-based learning activities. In some studies, the faculty or content experts facilitated the case discussion (Bossaer et al., 2016; Khanova, Roth et al., 2015). However, in most instances, students work on the cases in groups as faculty walked around the room meeting with the student groups.

Simpson and Richards (2015) reported a unique use of groups to keep students on track and avoid deviating from the assigned task. They randomly placed students in three to five separate groups throughout the class session. Initially, the students wanted to sit with their friends; however, the study reports the students readily became engaged in their randomly assigned groups. Group presentations, either for that day or for a culminating term project, were an everyday in-class activity (McLaughlin et al., 2013; Simpson & Richards, 2015). In general, presentations were either case-based or assigned topics.

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Another type of group-based activity was problem-based activities such as group work on pharmacy problem sets (Anderson et al., 2017; McLaughlin et al., 2013). Think-pair-share (TPS) is a commonly used collaborative technique to increase student participation, improve academic achievement and critical thinking (Kaddoura, 2013). TPS group work was also used to examine further a topic or case study (Anderson et al., 2017; Khanova, McLaughlin et al., 2015; McLaughlin et al., 2013). These studies use group work as consistent with the ICAP (interactive, constructive, active, passive) framework of student engagement. According to the ICAP framework and related research, active learning group work is iterative and engages students to interact in a way that results in higher-order cognitive learning outcomes (Hodges, 2018).

Other Active Learning Activities

The remaining in-class activities varied from simulations or clinical activities (Anderson et al., 2017; Chen & Chang, 2017; Pierce & Fox, 2012), problem-solving work or problem sets (Munson & Pierce, 2015; Pierce & Fox, 2012; Young et al., 2014), web quests and games (Belfi et al., 2015; Simpson & Richards, 2015), instructor modeling and guided notetaking (Anderson et al., 2017). Three studies only addressed the pre-class activities and did not examine or report on in-class learning design (Geist et al., 2015; Sajid et al., 2016; Telford & Senior, 2017).

Active learning activities are linked to metacognition. At its core, metacognition is a self-assessment process and self-reflection, allowing learners to recognize what they know and do not know (Kane et al., 2014). Referring to Bloom's Taxonomy, higher-order thinking is more closely related to metacognition. Bristol (2019) suggested that pre-class preparation is left for the lower levels of cognitive learning (remembering, knowledge, and comprehension). In contrast, the in-class activities incorporate higher levels of cognitive learning, engaging clinically relevant activities addressing application, analysis, synthesis, and evaluation (Bristol, 2019). Hodge's (2018) research on ICAP (interactive, constructive, active, passive) framework of student engagement further supports the higher order during active learning activities as demonstrated in this review's studies. Following the in-class activities, the content can be further reinforced through after-class activities.

After-Class Activities

The final phase in the flipped class design is the after-class follow-up and reflection. After-class activities are essential to further the course objectives and the previously learned in-class activities (e.g., problem-solving exercises) or foster self-assessment and reflection. The after-class activities can capitalize on metacognitive strategies of self-assessment and self-reflection, deepening the learning experience (Kane et al., 2014; van Vliet, 2015). Researchers suggest the after-class activities are an essential part of the flipped-classroom model (Persky & McLaughlin, 2017).

Many of the studies in this review, 17 of 20, did not mention any after-class activities or reflections. The limited information on the after-class activities is consistent with Lo and Hew's (2017) critical review of the flipped classroom literature. Of the 15 studies in their review, only one included after-class activities. Persky and McLaughlin (2017) also found research activities predominately examined pre-class and in-class activities. The after-class activities are used inconsistently in flipped classroom design and related research.

The remaining six studies that integrated after-class activities were in the sub-themes of reflection, knowledge attainment and retention, assignments, peer review, and discussion. Four of the studies listed only one type of after-class activity, whereas two studies had more variety. Chen and Chang (2017) had distinct activities (discussion, self-assessment of learning, and homework assignments). Examining the subthemes further, Simpson and Richards (2015) discussed reflective journaling. They used this strategy to foster critical thinking specific to complex issues. The reflective journal activity also used a rubric to guide the students to a deeper targeted reflection. Knowledge attainment and retention were through reading, reviewing class material, and post-tests (Chen & Chang, 2017; Ferreri & O'Connor, 2013; Munson & Pierce, 2015). One study of medical students used homework assignments to understand the content further (Chen & Chang, 2017). In the same study, students participated in a prompted discussion as an after-class activity (Chen & Chang, 2017).

Kirkpatrick Hierarchy

This scoping review used the evidence-informed education outcome measure, Kirkpatrick hierarchy levels (levels 1 through 4; Lovato & Peterson, 2019; Yardley & Dornan, 2012), to assess flipped classroom outcomes specific to participation, attitudes, knowledge and skills, behaviors, organizational practice, and benefits to patients/clients. The studies in this review were at the lower levels of student learning; all the studies were below Kirkpatrick hierarchy level 4. None of the level 2 studies analyzed the student changes at the organizational level or actual transfer of knowledge to practice. The findings are consistent with a study by Belfield et al. (2001), who found only 1.6% of health education studies reported an impact on health outcomes.

Limitations

Chang (2018) suggested that a scoping review is limited by what is known on a subject. The purpose is to get a general idea and understand the current state of research in a given area; in this case, the flipped classroom. The search strategy and exclusion criteria may have resulted in the omission of pertinent articles. Twenty-two studies reviewed had mixed measures, e.g., final exam scores, grades, and adaptive scales testing knowledge, skills, and attitudes; therefore, the consensus of overall outcomes was not possible. Of those studies, six studies included subjective measures of student perceptions and satisfaction and not the effectiveness of the flipped classroom design.

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Future Research

There are several opportunities for future research. Considering the flipped classroom design, more research is needed on the benefits of the after-class activities and what activities are most effective for higher-order learning. More consistent and accurate ways to measure outcomes could help determine a pedagogical teaching model's effectiveness. Discipline-specific research, specifically occupational therapy, is warranted to explore if the flipped classroom model teaches students to think critically, apply the knowledge learned during the coursework, and translate it into practice later. When considering translation to practice, we need to research how the courses are carried into practice by measuring the Kirkpatrick Levels, including Level 3 (behavioral change), Level 4a (organizational practice), and ultimately Level 4b (benefits to patients).

Implications for Occupational Therapy Education

Occupational therapy educators can benefit from the knowledge acquired by other health care professions on the flipped classroom model's use to improve the student learning outcomes. Course design presented in the flipped format could help students' achievement, skills, knowledge, and self-learning abilities (Tan et al., 2017). The flipped classroom model provides different ways of improving learning environments, which could benefit student learning outcomes in student academic performance and satisfaction (Betihavas et al., 2016). The experience can augment the current learning and teaching methods. Occupational therapy educators can use various learning strategies discussed in this study as an alternative or supplement to enhance or replace the traditional lecture-based teaching style as needed.

Conclusion

This scoping review identified various health care professions that have implemented the flipped classroom model at multiple levels of courses and curriculum to enhance student learning experiences. The flipped classroom design model provides different ways of improving learning environments, which could benefit student learning outcomes in academic performance and satisfaction (Betihavas et al., 2016). Pre-class and in-class active learning are the most common teaching and learning strategies; although less common, there is value identified in the after-class learning activities (Persky & McLaughlin, 2017). Research suggests that blended learning and flipped classrooms can be effective in health care professional education to learn, retain, apply, and think critically compared to traditional teaching (Sajid et al., 2016).

Kirkpatrick's hierarchy levels, an evidence-based grading standard of medical education research, utilized in the scoping review, demonstrated the students' engagement through participation, modifications of attitude or perception, and modifications of knowledge or skill and behaviors. But the studies did not identify the transfer of these skills and abilities to real-world settings or direct patient care. Health care educators need to address this gap of classroom education translating to the health care practice environment.

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