

# Flipping the Classroom in Health Care Higher Education

## A Systematic Review

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### ABSTRACT

**Background:** The flipped classroom is an approach to teaching with independent and asynchronous study of content by students and active learning during scheduled class times.

**Purpose:** The purpose of this review was to systematically examine research on the use of the flipped classroom approach in health professions education.

**Methods:** Eleven electronic databases were searched for peer-reviewed literature from 2005 through September 2017. Inclusion criteria for studies addressed health professions students and quantitative outcomes (quizzes, examinations, course grades).

**Results:** Of the 49 articles identified, 24 met the inclusion criteria. The majority of studies ( $n = 17$ ) noted a significant improvement in at least 1 student academic outcome using the flipped classroom compared with the traditional lecture.

**Conclusions:** This systematic review of the effects of the flipped classroom approach for the education of health professions students did not reveal compelling evidence for the effectiveness of the method in improving academic outcomes above that of traditional classroom approaches.

**Keywords:** academic achievement outcomes, flipped classroom, flipped learning, health professions students, systematic review

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As higher education undergoes intense scrutiny, a formidable challenge for faculty is to adequately prepare students, especially those entering a dynamic and complex health care arena. Newly graduated health care professionals must be equipped with the skill of clinical reasoning to assess and understand client problems, implement a plan, and evaluate outcomes. The characteristics of today's millennials, abundance of information in the knowledge domains, and necessity for advanced reasoning skills endorse the incorporation of active learning strategies in the classroom. Two Institute of Medicine reports and the Carnegie Foundation recognized the requisites for unique instructional design.<sup>1-3</sup> These recommendations include teaching for a sense of salience by using contextual and

integrated clinical reasoning. In search of strategies to meet these demands, educators give considerable attention to the flipped classroom approach.<sup>4,6</sup>

The flipped classroom considers students as adult learners by emphasizing and valuing student accountability and self-determination. This model of design is described as an independent and asynchronous study of class content by students and active learning during scheduled class times.<sup>7</sup> Active learning and unique instructional design describe the main concepts of a flipped classroom. As the student-student interactions increase the individualization of education, actual instruction parallels more adeptly with the skills of our digital natives.<sup>6</sup> Currently, rigorous research is limited on the effectiveness of a flipped classroom in the context of health professions education.

The purpose of this review was to comprehensively and systematically examine relevant research concerned with the use of the flipped classroom approach in health professions education. This review was guided by the question: Among health professions students, what are the quantitative academic achievement outcomes for those taught in a flipped classroom compared with those in a traditional lecture format?

### Methods

The review methods were derived from the World Health Organization systematic review template protocol at

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<http://www.who.int/hrh/education/planning/en/>.<sup>8</sup> Specifically, as illustrated in section 1 of the template protocol (p3), a working definition of *flipped learning* was adopted, and this guided development of the purpose (objective) for the review (template section 2). The review question was developed using the PICO (population, intervention, comparison, and outcomes) format outlined in the template (section 3), and 4 sources of data were used to gather evidence (section 4) including databases, hand searching, gray literature, and reference lists from articles already collected.

To guide the search, flipped learning was defined as a set of pedagogical approaches that include relocating information transmission to outside the classroom, implementing active learning activities into the classroom, and requiring some element of preclass and postclass assessments to appreciate the achievements of in-class activities.<sup>9</sup> English-language peer-reviewed original research published in peer-reviewed journals from 2005 through September 2017 was included. The search dates were based on the exponential growth of literature about the flipped classroom during this time frame.<sup>10</sup> Keywords for the electronic search included “flipped classroom” and “flipped learning.” Other search terms were “health professions students” and “quantitative academic achievement/performance.” A university health professions librarian was consulted for search term refinement and assistance in identifying appropriate databases.

Eleven electronic databases were searched through EBSCOhost for peer-reviewed literature including Cumulative Index for Nursing and Allied Health Literature, PubMed/MEDLINE, Cochrane Library, Academic Search Premier, Education Research Complete, Education Resources Information Center, Education Abstracts and Retrospective, ProQuest, Journal Storage, Science Direct, and Psychological Information. An additional electronic search for gray literature was conducted using New York Academy of Grey Literature, FADE Library, BioMed Central, Harvard DSpace Archive, NIH Public Access Project, OALster, Web of Science, and Google Scholar. A hand search was conducted of reference lists in selected articles.

### Eligibility Criteria

Inclusion criteria for the studies were as follows: (a) health professions students comprised the sample, and (b) quantitative outcomes (quizzes, examinations, course grades) were reported. The process of article selection is illustrated in Figure 1, Supplemental Digital Content (<http://links.lww.com/NE/A487>). Studies using only subjective measures such as student engagement, satisfaction, and perception of academic achievement were excluded from the review. Studies were also excluded if the faculty used methodologies inconsistent with the flipped classroom method, such as when in-class time was replaced by online activities rather than used to supplement learning. Twenty-four studies were eliminated based on exclusion factors. One study was excluded because a more recent publication used the same data.

Electronic searches of titles and keywords yielded 1948 articles. A large number of duplicates were eliminated. The reference lists of systematic reviews of the flipped classroom and an integrative review of 13 nursing studies were also assessed to find relevant literature.<sup>4,11,12</sup> Forty-nine studies were identified as relevant to the topic. Full-text articles were obtained. To avoid selection bias, 2 team members independently reviewed each relevant article to initially assess its relevancy, and then all reviewers made the final decision whether the inclusion and exclusion criteria were met. An iterative process was used to reach consensus about which articles to include.

### Assignment of Quality Ratings

To ascertain the quality of the selected studies, a rating scale was developed and assigned to each study by the review team (Table 1, Supplemental Digital Content, <http://links.lww.com/NE/A488>). The items of the scale were modeled after a published scoring instrument.<sup>13</sup> The reviewers further clarified the initial criteria in this scale. Revised items included scoring for sample sizes, clarity of the methods used, and specificity in outcomes measured.

### Results

Of the 49 articles identified, 24 met the inclusion criteria. Table 2, Supplemental Digital Content, <http://links.lww.com/NE/A489>, describes each selected study by the design and quality score, course, duration, and description of intervention. Table 3, Supplemental Digital Content, <http://links.lww.com/NE/A490>, describes the sample size, student academic outcome measured, and study statistics.

### Study Characteristics

As detailed in Table 2, Supplemental Digital Content, <http://links.lww.com/NE/A489>, the researchers used various methods. Methods included 7 mixed, 12 quasi-experimental, 4 experimental, and 1 descriptive designs. Only 2 of the experimental studies were randomized controlled trials.<sup>14,15</sup> Three studies lacked a methods section.<sup>15-17</sup> The study quality varied from a score of 3 to 6 on the rating scale, with a potential range of 0 to 7. Reviewers assigned scores of 0 to 3, considered low quality, to 4 studies. Scores of 4 to 5, considered to be of moderate quality, were assigned to 18 studies. Scores of 6 to 7, considered to be of high quality, were assigned to 2 studies. While the majority of reviewer scores were in agreement, an occasional discrepancy occurred in ratings of outcome definitions and methods. Discrepancies were resolved by discussion within the entire team.

As noted in Table 2, Supplemental Digital Content, <http://links.lww.com/NE/A489>, the majority of studies ( $n = 18$ ) involved graduate students. One study involved both undergraduate- and graduate-level students.<sup>18</sup> Six studies involved only undergraduate students.<sup>14,19-23</sup> Courses from a variety of disciplines were involved in the study including 2 chiropractic health, 11 medical, 5 nursing, 5 pharmacology, and 1 public health. The majority of studies

(n = 13) were of 1 semester duration, ranging from 1 hour to 1 semester of content repeated over 2 years. Ten studies conducted over consecutive semesters evaluated different cohorts of students on the same subject content.

Because of the various terms used for flipped, such as active or blended, it was often difficult for reviewers to determine if the methods used were similar. There was great variability in the way faculty described the flipped and traditional methods. Table 2, Supplemental Digital Content, <http://links.lww.com/NE/A489>, describes how the active learning was implemented and, when reported, the content taught.

Table 3, Supplemental Digital Content, <http://links.lww.com/NE/A490>, provides findings extracted from the studies. Sample size in individual studies ranged from 17 to 449 students. Course enrollment included students from chiropractic health (n = 122), medicine (n = 1646), nursing (n = 944), pharmacy (n = 992), and public health (n = 33). Table 3 Supplemental Digital Content, <http://links.lww.com/NE/A490>, lists the results of statistical analysis for student academic outcomes. Types of academic outcomes varied by study. Academic improvements were significantly higher for the flipped classrooms compared with the traditional groups in 17 studies (n = 2589).<sup>15-22,24-32</sup> Pierce and Fox<sup>18</sup> and Tune et al<sup>32</sup> found significant differences in favor of the flipped classroom between years 2011 and 2012, with increases of 4% and 10%, respectively. In 2 other studies, effect sizes were small to medium (0.03 to 0.57) in favor of the flipped classroom.<sup>19,28</sup>

In 8 studies, no significant differences were found in academic performance between the traditional method and the flipped classroom (n = 966).<sup>14,23,30,33-37</sup> Harrington et al<sup>14</sup> reported a small effect size of 0.04. None of the studies contained evidence that the students in the flipped classroom had adverse academic outcomes compared with those in the traditional method. Also, no studies provided longitudinal data to allow assessment of change over time.

### Pretest-Posttest Comparisons

In any educational endeavor, the goal is to improve the scores from pretest to posttest. Significant differences between the flipped classroom and traditional approaches were noted in 4 studies by comparing pretest-posttest knowledge scores.<sup>18,24,25,31</sup> However, without comparisons to equivalent pretest and posttest scores for traditional classroom groups, it is difficult to assess whether the change could be attributed to teaching methodology.

### Examination Scores

In 7 studies, examination scores were significantly greater for students in the flipped classrooms.<sup>15,19-22,26,27</sup> In 2 studies, significant differences were reported in favor of the flipped classroom for some outcomes but not for others.<sup>28,32</sup> In 4 studies, no significant differences were reported in examination scores of students experiencing flipped versus traditional classrooms.<sup>14,33,34,37</sup>

### Final Examinations and Final Grades

In comparing students' final examination scores in a traditional lecture group to those in a flipped classroom, Pierce and Fox<sup>18</sup> (n = 71) observed that the latter scored significantly higher. Everly<sup>19</sup> (n = 139) and Geist et al<sup>20</sup> (n = 86) found no significant differences in final examination scores between the 2 methods. In a 2013 pilot study of 35 students, there were no significant differences between traditional and flipped classrooms in final examination scores; however, with the addition of 71 more participants, significant differences were obtained.<sup>17</sup>

Kiviniemi<sup>28</sup> found significant differences between the traditional lecture and flipped classroom students on the final course grades. Ferreri and O'Connor<sup>16</sup> found significant changes in the grade distribution, with more A and fewer B, C, and F grades given in the flipped classroom than a traditional lecture group. Harrington et al<sup>14</sup> and Whillier and Lystad<sup>23</sup> found no significant differences between traditional and flipped groups in the final course grade.

### Discussion

This systematic review examined research investigating use of the flipped classroom approach in health care education. Students and faculty from a variety of health disciplines were represented in the sampled investigations, and studies were quite diverse in terms of courses, content, and size. The review team was struck by the proportion of studies that met the selection criteria, yet revealed mixed results or no significant differences in student academic achievement between the flipped classrooms and the comparison groups. Possible explanations for these findings include overall study quality and student and faculty factors.

The quality of the included research is an important consideration. A rating scale was developed as an objective method of reviewing studies (see Methods). Using the rating scale, the reviewers noted that overall quality ratings were low to moderate. No studies received the highest score of 7 points. Only 1 study rated a score of 6, and most rated a score of 3 to 4. Most study designs were pre-experimental or quasi-experimental rather than true experimental.

Low ratings for studies often reflected a lack of clarity in describing the flipped classroom method. The lack of clarity interfered with reviewers' abilities to discern whether other issues such as the difficulty of the topics or faculty or student factors were more influential in the outcomes than the flipped classroom approach. Faculty factors include experience or inexperience with the pedagogy; actions, such as the overt or covert display of enthusiasm or indifference to the use of the flipped classroom; and consistency in approach during team teaching. Most of the research reports failed to describe the preparation of the faculty for the flipped classroom approach. Only 1 study detailed the processes used to train faculty for consistent content delivery. Student factors included potential baseline differences between cohorts and use of retrospective cohorts for the comparison groups.

The length of time of flipped classroom use varied greatly by study. In some, the approach was used only for the content of 1 unit in a semester, whereas in others, it was studied for a full semester, or longer. Significant differences favoring the flipped classroom groups at the beginning of the semester, which were not sustained through the semester, may have resulted from the traditional lecture students lagging behind at first but catching up developmentally by the end of the course.

### Limitations

The varying lengths of implementation of the flipped classroom approach affected the inferences that could be made from this review. Some academic outcomes were measured after a single topical unit, and others used the content from entire semesters. The variability in these measures circumvented the possibility of conducting a meta-analysis. Clearly, this review would be strengthened by the statistical evidence a meta-analysis would yield.

This review shares a limitation of other research syntheses in that publication bias confined the literature available to the team. The amount of gray literature available to the search was limited. Also, the scale used to rate the quality of the reviewed studies was created by the research team and requires further development as a measure of study merit.

### Implications and Recommendations

Inconsistency of terminology is an issue in the literature. Blended learning and other terms have been used to describe flipped classroom approaches, and this complicated the search process. As well as being used to describe the flipped classroom, blended learning refers to online teaching with sessions held in the traditional classroom. A commonly accepted definition for the terms is needed. In the absence of this, faculty should clarify the conceptual definitions they have used for research audiences.

Although the team confined the review to health professions students, some differences in baseline characteristics of students may still have been present among study samples. For example, the academic backgrounds of nursing students differ from many other health professions students because they are undergraduate, may have had a greater number of science courses before their nursing courses, and may have higher grade point averages compared with students in health programs with less competitive admissions. Insufficient information about these background factors was reported in studies to ascertain their contributions to study outcomes.

Another important issue impacting the research on effects of the flipped classroom approach is one that arises from the ways in which “flipping” occurs. Overall, evidence supports active learning strategies as effective approaches for maximizing learning.<sup>38</sup> In this review, only Belfi et al<sup>24</sup> attempted to isolate the effects of active learning from those of the flipped classroom. Much work is yet to be done to differentiate the effects of the flipped classroom approach from other active learning modalities.

### Conclusion

This systematic review of the academic outcomes of the flipped classroom approach for the education of health professions students did not reveal compelling evidence of the effectiveness of the method above that of traditional classroom approaches. However, many studies had methodological weaknesses that were possible reasons that few studies yielded significant differences between study groups. From this systematic review, it can be concluded that the flipped classroom has either a positive or equal effect on academic outcomes as the traditional lecture method. As much as possible, future research should emphasize strong experimental designs and control of variables through study procedures as well as statistical techniques to improve the credibility and merit of the evidence underlying the flipped classroom approach.

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## TEACHING TIP

### Increasing Cognitive Thinking Skills With Edpuzzle

Students may enter a nursing program without knowing how to decipher pertinent information within a learning activity. This deficit may cause students to feel overwhelmed by the content to be learned. Learning how to learn takes practice. Edpuzzle is a free online application that instructors can use to allow students to practice learning. This application gives students the opportunity to engage with content by answering questions (multiple-choice or open-ended), listening to audio, and/or viewing text boxes throughout a given video lesson. By answering questions throughout the video, students are able to evaluate their knowledge. Students can then self-identify content that has not been mastered. Text boxes can be used to highlight aspects of the lesson and model how to focus on the most pertinent information within a given lesson. Once completed, instructors can view students' progress and determine areas that may need to be readdressed. As an example, Edpuzzle ([www.edpuzzle.com](http://www.edpuzzle.com)) can be used to review content before an examination. This allows students the opportunity to evaluate their knowledge and refer back to content that they may need to review before a high-stakes exam. This application can potentially assist with many outcomes.

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