Pedagogical changes and new models of delivering educational content should be considered in the effort to address the recommendations of the 2001 Institute of Medicine report and Benner’s recommendations on the radical transformation of nursing. Transition to the nurse anesthesia practice doctorate addresses the importance of these recommendations, but educational models and specific strategies on how to implement changes in educational models and systems are still emerging. The flipped classroom (FC) is generating a considerable amount of buzz in academic circles. The FC is a pedagogical model that employs asynchronous video lectures, reading assignments, practice problems, and other digital, technology-based resources outside the classroom, and interactive, group-based, problem-solving activities in the classroom. This FC represents a unique combination of constructivist ideology and behaviorist principles, which can be used to address the gap between didactic education and clinical practice performance. This article reviews recent evidence supporting use of the FC in health profession education and suggests ways to implement the FC in nurse anesthesia educational programs.

Keywords: Flipped classroom, inverted learning, nurse anesthesia, nursing.

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The Flipped Classroom: Now or Never?

In 2001, the Institute of Medicine (IOM) report, *Crossing the Quality Chasm*, described the current healthcare workforce as inadequately prepared to meet the needs of a growing and increasingly diverse patient population. The report identified acquisition of new types of knowledge, development of different provider skills, and the creation of new health profession educational models as essential to preparing the healthcare workforce of the future. Fundamental competencies required of all healthcare professionals were identified in the report and included: the ability to translate evidence into practice; proficient utilization of technological innovations to improve patient care; membership in and collaboration on multidisciplinary teams; and recognition of complex care delivery arrangements and changing patient-clinician relationships. Supporting these recommendations, Benner et al. in a multi-year collaboration with The Carnegie Foundation called for the radical transformation of nursing and recommended nurses be prepared for the myriad of contexts in which they will work—not only a hospital setting. While the importance of these recommendations and competencies is evident, identification of specific educational strategies and models needed to bring about change in nursing education have not been clearly defined. Specific to nurse anesthesia education, pedagogical changes and new models of delivering educational content should be considered in the effort to address the IOM and Benner’s recommendations. Transition to the nurse anesthesia practice doctorate addresses the importance of the IOM competencies, but educational models and teaching strategies for obtaining these competencies are still emerging.

One educational model generating a considerable amount of buzz in academic circles at all levels is the flipped classroom (FC). The flipped classroom is a pedagogical model that employs asynchronous video lectures, reading assignments, practice problems, and other digital, technology-based resources outside the classroom, and interactive, group-based, problem-solving activities in the classroom. This FC represents a unique combination of constructivist ideology and behaviorist principles which can be used to address the gap between didactic education and clinical practice performance. This article reviews recent evidence supporting use of the FC in health profession education and suggests ways to implement the FC in nurse anesthesia educational programs.

Flipped Classroom: Overview

In 2007, 2 high school chemistry teachers, Jonathan Bergmann and Aaron Sams, developed the FC as a means of providing athletes...
who missed class due to attending athletic competitions with an alternative means of obtaining class content. The flipped or inverted classroom provides students opportunities for advanced preparation and time to identify knowledge gaps needing clarification. Instead of spending the class time lecturing about topics covered in preclass reading assignments, faculty interact with students by discussing points of confusion, providing real-life examples relevant to course content, challenging students to think more deeply about complex processes, and monitoring peer-to-peer, team-based learning activities.

Constructivist and Behavioral Theories and the Flipped Classroom

The FC model is consistent with both behavioral and constructivist learning theories. Behavioral learning theory, the foundational principle supporting traditional classroom instruction, places priority on learning facts and skills that academic, accreditation, and credentialing authorities have decided are important. Unlike constructivism, behaviorism focuses on the teacher as the center of instruction and content includes lectures, tutorials, drills, demonstrations, and other forms of teacher-controlled instruction. In the FC, the student typically receives this foundational content ahead of class time in order to facilitate beneficial in-class active learning activities.

Constructivism is based on the primary tenet that individuals use personal experience to construct and understand knowledge and reflection to create meaning. Students take responsibility for their learning and are actively engaged rather than passive recipients of lecture content. Faculty are not the “sage on the stage,” but instead collaborate with students to ensure mastery of essential course concepts. Students learn in a social environment with classmates and are exposed to many viewpoints and perspectives. Because students collaborate with peers, accountability is reinforced by both faculty and peer feedback. Constructivism supports shorter, more frequent assessments to assess progressive increases in knowledge retention and critical thinking ability rather than fewer, more comprehensive exams. As a result, faculty have increased opportunities to identify errors in student thinking and provide helpful feedback. The FC utilizes both learning theories by adhering to behaviorist principles outside the classroom and constructivist tenets within it (Table 1).

Evidence for the Flipped Classroom

The concept of the FC is not new; however, the resurgence in its relevance has been driven by the convergence of and recognition by scholars, policy makers, and patient care advocates that improved models of healthcare education must be developed to ensure provider competency. Because mounting evidence suggests that active learning is as effective, or more effective, than the traditional classroom, faculty should consider reviewing the effectiveness of their current instructional methods.

Foundational to the FC are in-class learning activities that emphasize problem solving and cooperative learning. When students work together to solve real-world problems, engagement, attention, and knowledge retention increase dramatically. Hake found that students enrolled in active learning courses (N = 2,084) outperformed students in traditional courses by 2 standard deviations. Peer-to-peer learning also facilitates communication, conflict resolution, and team building, and promotes collaboration—a central tenet of the IOM report. Evidence from nursing literature supports Hake’s findings as nursing students reported learning more from having active-learning activities in the classroom rather than lecture-only. In addition, nursing students who had active learning activities in the classroom scored significantly higher on a standardized assessment test than students who only received lectures.

Nursing Education and the Flipped Classroom

Nursing students and faculty have described positive experiences when using the FC in graduate nursing education. Students come to class ready to actively engage in collaborative learning through the use of case scenarios, small group

<table>
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<tr>
<th>Table 1. Tenets of the Flipped Classroom</th>
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<tr>
<td>Draws on such concepts as active learning, student engagement, hybrid course design, and course podcasting</td>
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<td>Provides opportunity for interactive, personalized time between students and faculty</td>
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<td>Requires that students take ownership of their learning</td>
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<tr>
<td>Blends direct instruction with constructivist learning</td>
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<td>Archives content permanently for review or remediation</td>
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<td>Personalizes student learning</td>
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<td>Promotes deep learning</td>
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<tr>
<td>Describes almost any class structure that provides prerecorded lectures followed by in-class exercises</td>
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<tr>
<td>Addresses student questions as content is being studied</td>
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<tr>
<td>Builds on what students already know</td>
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<tr>
<td>Supports collaboration, team-work, and peer-to-peer mentoring</td>
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<tr>
<td>Uses instructor role to connect concepts</td>
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<tr>
<td>Assesses students frequently for knowledge gaps</td>
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<td>Identifies low performing students</td>
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discussions, and other interactive activities. Because faculty do not spend the entire class period lecturing, they have more time to facilitate in-depth discussions of class content and other active learning strategies. Missildine et al15 examined the effects of flipping the classroom and the use of innovative in-class learning activities on academic success and nursing student satisfaction. Three approaches to learning were compared: traditional lecture only, lecture plus recorded lecture capture backup, and the FC approach of preclass viewing of recorded lectures combined with innovative classroom activities. Examination scores were higher for the FC group (M = 81.89, SD = 5.02) than for both the lecture capture group (M = 80.70, SD = 4.25, P = .003) and the traditional lecture group (M = 79.79, SD = 4.51, P < .001). However, students were less satisfied with the FC than with either of the other methods (P < .001).

Critz and Knight16 used the FC to facilitate delivery of course content to family nurse practitioner (FNP) students. When evaluations from two classes of FNP students (N = 20) indicated that students were disengaged and uninvolved in their traditionally taught pediatric course, faculty questioned their teaching strategies and changed the course to the FC model. Didactic content was delivered online as 11 preclass modules, which included prerecorded PowerPoint lectures and videos (typically 20-40 min long), assigned reading (textbook materials and evidence-based journal articles), and an online quiz (quizzes composed 60% of the total grade). Students were expected to spend 8-10 hours/week completing preclass modules. In-class sessions included intensive case studies, role-playing, and problem-solving exercises, and (for some content) in-class lectures. Course evaluations after implementation of the FC showed that 60% felt the course covered “extremely worthwhile” content, whereas 40% reported content was “very worthwhile.” Students rated the reading assignments and short narrated recorded lectures as particularly useful and appreciated the opportunity to access preclass content on their own schedules and to identify content areas requiring in-class clarification. Most students rated the in-class case study scenarios as “extremely worthwhile” (70%) or “very worthwhile” (15%). The amount of assigned preclass work was rated as “just right” by 75% of students, while 25% indicated that there were “slightly too many” assignments. One student found the format useful but thought it was more work than the traditional classroom setting. Other students found listening online just as useful as the traditional in-class lecture and in-class application of course content helpful in making clinically based decisions.16

Medical Education and the Flipped Classroom
In the 2010 publication, Educating Physicians: A Call for Reform of Medical School and Residency, Cooke et al17 called for a radical change in the direction of medical education. For all its traditional successes, the current model of medical education in the United States and Canada is being challenged on issues of quality, access, and cost.18 While the FC can be viewed as disrupting higher education, it should also be considered a pedagogical innovation that promotes learner-centered medical education.

Prober and Khan18 have proposed a new model for medical education based on the FC design. Inadequacies in the current medical education model, including lack of flexibility and sensitivity to the skills and aspirations of individual learners, were identified as the primary impetus for necessitating changes. They assert that it is neither possible nor desirable for all students to deeply explore all aspects of biomedical knowledge because of the exponential increase in the rate of accrual of such knowledge. Their proposed model defines a core curriculum essential to safe medical practice, while simultaneously recognizing an ever-changing, digitally oriented world. Primary goals of this revised educational model are to enhance the relevance and retention of knowledge through rich interactive exercises and to facilitate in-depth learning fueled by individual students’ aptitude and passion. Their plan is for students to access brief (~10 min) online videos before class to learn new concepts on their own time. The video lecture content can be viewed by students as many times as necessary to master the essential knowledge needed to participate in in-class activities. Expert faculty facilitate in-class discussions and learning activities such as case studies and provide interactive sessions in which students can apply newly mastered knowledge.

Pharmacy Education and the Flipped Classroom
Changes in pharmacy education have also brought attention to use of the FC as an instructional model to replace instructor-dominated traditional lectures. Pierce and Fox19 used the FC model to deliver a renal pharmacotherapy module in a pharmacy-integrated therapeutics course. Class time, normally used for student note-taking, was replaced with highly interactive student-instructor activities. Prior to class, students independently accessed prerecorded video podcasts of lectures and completed quizzes to measure knowledge retention. In-class, active learning exercises provided students with opportunities to analyze and synthesize information within the context of an unfolding case scenario, which was followed by patient care simulations. Student performance on the
Table 2. Flipped Classroom Guidance and Recommendations

| Do not allow the flipped classroom online work to replace all lectures or direct interaction. | Provide students with rationale and evidence for why the flipped classroom is being used. |
| Use the online work to introduce, support, review, reinforce, and supplement class instruction | Track and verify students use of the flipped classroom. |
| Use the online work to provide more class time for the following: Demonstration, discussion, individual assistance, meaningful group activities, and project-based learning. | Create regular assessments to measure student progress and mastery of concepts. Weekly in-class quizzes and team-based learning activities will achieve this goal. |
| Seek student feedback, ideas, and products to improve the class. | Consider course evaluation feedback in context by using for course improvement and not as an absolute directive. |
| Hold students accountable by setting expectations, measuring and grading students on their use of the flipped classroom. | Using the flipped classroom model takes practice so, stick with it. |

Final examination questions relating to the renal module was significantly higher when this content was delivered using the FC model than in the previous year, when it was delivered in the traditional lecture format. Students' evaluations after completion of the FC module were highly favorable; most expressed a desire for more student-faculty interaction in class and for adoption of the FC model by more instructors in the program. Pierce and Fox concluded that this test of the FC model underscores the importance of quality rather than quantity of student-teacher interaction in improving student performance. By affirming students' proclivity for active learning and by demonstrating the efficacy of active learning using the FC model to improve student outcomes, these results support a growing body of educational research concerning how people learn and the developments in modern cognitive science.

The Flipped Nurse Anesthesia Classroom

Evidence from nursing, medicine, and pharmacy education research suggests that learning and critical thinking improve when students are accountable and engage in the FC. Although student evaluations of the FC are largely positive, one source indicated that the average score on student evaluations of a flipped course was approximately 50% lower than for a comparable course delivered in traditional classroom format. This fact alone may pose a barrier to faculty confidence in adopting the FC teaching method, especially in an institution that uses student ratings to evaluate faculty teaching effectiveness. When nurse anesthesia students are stressed and feeling negative about a particular course, the FC may not seem like the best teaching model. However, experienced educators will rely on student assessment and performance data in lieu of student course satisfaction to determine the best teaching methods and strategies.

Preparing Students for the Flipped Classroom

It is important to spend time explaining how the FC works and to present evidence supporting why it is being used. Students typically accept change once they understand the rationale behind the decision. Initially, students may resist the FC; however, when they come to understand that application, analysis, and synthesis of course content is the desired outcome, rather than rote memorization, their confidence in the FC increases.

Preclass Preparation

Although there is no “gold standard” for implementing the FC, the following are the author's general guidelines for “flipping” a classroom (Table 2).

1. For each class session, provide students with class topics, learning objectives, and preclass preparation activities at least 7 days in advance of class time. Significant precourse planning is needed to identify course content, create assignments, and develop “in-class” activities.

2. Preclass preparation activities: Preclass activities include recorded video lectures and required readings.

   a. Recorded video lectures: Three to four short lecture videos highlighting major concepts relating to the content area being studied (maximum length of each should be 10-15 minutes) are distributed to students (Table 3).

   b. Required readings: Book chapters and evidence-based journal articles of varying complexity are presented to support and expand upon the content of the recorded lecture video.

   c. Online videos and web links: While students can easily access a variety of YouTube videos demonstrating machine checks and peripheral block placement, course videos have the advantage of being vetted by faculty for content and procedural accuracy.

   d. Open book quizzes: Students take short quizzes and are responsible for viewing other students answers posted to the course website prior to class. This exercise demonstrates accountability and ensures students focus on specific content areas.

In-class Activities

1. Question and answer session: At the beginning of each in-class
Table 3. Flipped Classroom Video Resources

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<tr>
<th>Tool</th>
<th>Description</th>
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<tbody>
<tr>
<td>Jing</td>
<td>Allows sharing images and short videos of your computer screen (Free).</td>
</tr>
<tr>
<td>Vimeo</td>
<td>Web-based video storage; Allows privacy setting, generates link to video, browse videos, and upload videos (Free).</td>
</tr>
<tr>
<td>Camtasia</td>
<td>Web-based screen recording; turns PowerPoint into video, uses call outs, transitions, hotspots, quizzing features, titles, picture-in-picture ($$).</td>
</tr>
<tr>
<td>Screenr</td>
<td>Records audio and provides an embed code for your course Web page (Free).</td>
</tr>
<tr>
<td>Screencast</td>
<td>Web-based video recording that gives full license to the product you just created (Free).</td>
</tr>
<tr>
<td>YouTube</td>
<td>Faculty directs students to previously vetted recordings (Free).</td>
</tr>
<tr>
<td>Mediasite</td>
<td>Video presentation tool that allows creation of live digital recordings of lectures or presentations; Students view presentations over the internet in real-time and access for viewing at a later date ($$).</td>
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Discussion

With positive results from nursing, medicine, and pharmacy, the FC is supported as a sound pedagogical model. The FC format supports creativity and charges the student with taking responsibility for his/her own learning. While the focus of the FC is no longer the faculty as the “sage on the stage” but rather the “guide on the side,” it provides a setting where students receive personal attention still held accountable for actions and academic performance.

Students, at least to some degree, are initially resistant to new teaching methods. The FC requires students to access content at home before class, instead of first being exposed to it in class, and this is definitely a paradigm shift. As a result, students may come to class unprepared to participate in class activities and lacking foundational content delivered in preclass recorded video lectures and required readings. There are strategies for dealing with this issue. Because videos are the primary method of choice for delivering preclass content, faculty who are inexperienced with lecture recording may not be pleased with the quality of their prerecorded lectures. To assess video tutorial and course effectiveness, student feedback in a FC course can be compared with feedback from courses taught by the same instructor in the traditional format. Most students provide sincere, constructive course evaluation feedback, which, when used constructively by faculty, greatly improves many aspects of a given course. However, it is important for faculty to resist modifying a flipped class based solely on student satisfaction data. In the end, primary attention should be given to objective evidence, such as student exam performance and engagement in active learning exercises.

With the FC, additional time is needed to develop lectures and record preclass lectures, and initially may increase faculty time commitment. Faculty must have a comprehensive plan for all preclass and in-class assignments and learning activities. Because most faculty time will be used to answer student questions, facilitate in-class discussions, administer quizzes, and provide feedback on student assignments, insufficient time will be available to plan FC activities on a week-to-week basis.

Conclusion

The current model of nurse anesthesia education produces highly competent nurse anesthetists. However, it is time to examine existing teaching methods and strategies to ensure they are evidence-based and likely to produce the desired results. In the FC, students learn foundational concepts outside of the classroom so they can apply that information to collaborative, real-world projects inside the classroom. Because students become involved in and responsible for their own learning, the driving force for learning becomes intrinsic rather than extrinsic. With the FC, traditional lecture as the gold standard for disseminating information...
takes a back seat to interactive class activities and out of class student preparation. While the FC model may not transform nurse anesthesia education, it does provide an alternative to be considered. At a minimum, it challenges each nurse anesthesia educational program to examine their current educational practices to ensure they are evidence-based.

REFERENCES

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