

**Flipped Classroom Method Compared to Traditional Classroom Method for Nurse
Anesthesia Education**

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Abstract

Purpose: The purpose of this scholarly project was to investigate outcomes of the flipped classroom teaching technique for student registered nurse anesthetists by assessing differences in performance and satisfaction compared to a traditional classroom method.

Methods: A retrospective review was conducted to examine efficacy of the flipped classroom teaching technique compared to traditional classroom method for nurse anesthesia doctoral students. Course performance and satisfaction results were compared.

Results: Course satisfaction results showed no statistical differences in survey responses to questions in the Student Evaluation of Educational Quality categories of learning, enthusiasm, organization, individual rapport, breadth, and preparation. Only the category group interaction showed statistically significant improvement in the flipped classroom cohort. Course performance showed no significant difference between the flipped and traditional cohorts.

Conclusion: The flipped classroom is a promising teaching technique that deserves attention from educators to modernize the traditional classroom with a student-centered education approach. Instructors attempting to improve classroom time utilization for students to engage in active learning, critical thinking, analysis, and communication skills should feel confident that the flipped classroom method is a viable option to create a contemporary and effective education atmosphere while maintaining, or potentially improving, student performance and satisfaction.

Data Sources: CINAHL, PubMed, DARE, ACP Journal Club, Cochrane Controlled Trials Register, and Cochrane Database of Systematic Reviews.

Keywords: Flipped classroom, nurse anesthesia education, graduate level didactic education.

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Introduction

The 2011 Institute of Medicine (IOM) report *The Future of Nursing: Leading Change, Advancing Health* provided recommendations to graduate level nursing education with its key message on education: nurses should achieve higher levels of education and training through an improved education system that promotes seamless academic progression. The report mandated radical change in current instructional design to narrow the gap between competent nursing practice and educational preparation.¹

New approaches and educational models must be developed to respond to burgeoning information in the field. An improved education system is necessary to ensure that the current and future generations of graduate level nurses can deliver safe patient-centered care across all settings. Institutions of higher education are facing increased scrutiny to improve student learning and demonstrate program effectiveness.² The challenges that educators face is an expanding load of required information for graduate students in an environment of coinciding increased clinical responsibilities. As curriculum requirements grow, instructors in graduate education programs are pressured to make more efficient use of class time.³

Anesthesia education has undergone major changes while trying to keep pace with the ongoing trends.⁴ Nurse anesthesia programs are currently undergoing a significant change in curriculum as the Council on Accreditation of Nurse Anesthesia Educational Programs requires that, effective January 1, 2022, all newly enrolled nurse anesthesia students programs must matriculate into a doctoral degree program.⁵ This standard is adding increased pressure on instructors and requires additional resources to educate students. The IOM strongly recommends the adequately preparing the healthcare workforce to meet the needs of a growing and increasingly diverse population.⁶ Specific to nurse anesthesia education, pedagogical changes

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and new models of delivering education content should be considered in the effort to address the IOM recommendations. It is time to examine existing teaching strategies of nurse anesthesia programs to ensure they are evidence-based and producing quality results.⁷

The rapid increase in internet access and advances in online technology over the last decade present an opportunity to rethink how teaching and learning occurs in the context of higher education.⁸ A growing body of literature points to the use of digital education technologies as an effective method to improve student performance and satisfaction.⁹ In an effort to improve the quality of education with the use of technology, consideration has been given to the flipped classroom teaching strategy. Flipped classroom evolved out of a history of experimentation with the concept of a hybrid, or problem based learning, using active techniques and new technologies to engage students.³ With this teaching method, the lectures that would traditionally be given during class time are provided to the students in advance via online videos, education modules, and/or quizzes and tests. Flipped classroom lectures are recorded, so students can view them before class and at their own pace.² The face-to-face classroom time is used for interactive instructor-facilitated learning that includes discussion, case scenario analysis, and application of content acquired in pre-class work.^{10,11} With this teaching technique the classroom work and out-of-class work is literally “flipped”.

Nurse anesthesia educational programs need to analyze their current educational practices to ensure they are evidence-based and consider if flipped classroom would be an effective alternative to traditional lectures.⁷ The purpose of this scholarly project was to investigate outcomes of the flipped classroom teaching technique for student registered nurse anesthetists (SRNAs) by assessing differences in student content comprehension and satisfaction compared to a traditional lecture-based classroom approach. It was hypothesized that course performance

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and satisfaction would be greater with the group that participated in the course structured with the flipped classroom model. The research question for the project was: do student registered nurse anesthetists benefit from a flipped classroom teaching method compared to a traditional classroom method determined by improved course satisfaction and performance?

Literature Review

Flipped classroom is a relatively new teaching method, therefore there is a paucity of empirical data specifically studying flipped classroom and nurse anesthesia programs. That is not to say that research into this topic has not occurred or that flipped classroom is not currently being used as an educational tool in nurse anesthesia programs, but there exists a real gap in research into this topic. To acquire sufficient evidence to answer the research question an extensive search was performed of multiple scientific journal databases including CINAHL, EMBASE, LISTA, PubMed, DARE, ACP Journal Club, Cochrane Controlled Trials Register, Cochrane Database of Systematic Reviews, Cochrane Methodology Register, MetaRegister of Controlled Trials, and Trip Database. The database search was limited to articles written in English published between January 1997 and September 2017. The literature search was expanded beyond nurse anesthesia education and included closely related areas of health care education that would be able to be used to measure the study group. Search terms included the following keywords: flipped classroom; inverted education; higher education; graduate education; nursing education; and/or medical education. Two prevailing themes emerged from the review of literature: student performance and student satisfaction related to flipped classroom.

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Although flipped classroom originated with middle school education, there are an increasing number of published studies demonstrating flipped classroom as an effective method to disseminate key concepts to medical and graduate nursing students.¹²⁻¹⁴ Flipped classroom has become increasingly popular in nursing, medical, and other healthcare related fields.¹⁵ Nursing education has seen positive results with implementation of flipped classroom into the curriculum.¹⁶⁻¹⁹ Pharmacy schools have published multiple studies with their experiences with flipped classroom.^{15,20,21} In addition, anesthesia residency programs have examined the effectiveness of asynchronous learning tools consisting of web-based lectures for trainees.^{22,23} Student examination scores often showed statistically significant improvements in student academic performance when participating in a flipped classroom method compared to a traditional classroom approach.^{9,14,19,24,25}

Students in an upper-level lecture course designed primarily for biochemistry majors showed improved performance by nearly 12% in a flipped-format course, due in part to students interacting with course material in a more timely and accurate manner.⁹ Interestingly, positive effects of flipped classroom in this study were most pronounced for students with lower grade point averages and for female students.⁹ In a study with public health graduate students, performance was higher in the flipped classroom semester relative to the baseline semester. When the course exams were individually evaluated, exam scores for flipped classroom were significantly higher than for the baseline semester.²⁴ Observed flipped classroom and innovative learning activities on academic success of graduate nursing students has been shown to result in significantly higher average examination scores for the students with a flipped classroom approach of lecture capture with innovative classroom activities.¹⁹

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In 2015, a pilot study was conducted to examine the efficacy of flipped classroom on learning outcomes for residents rotating in the surgical intensive care unit at Massachusetts General Hospital. There was a statistically significant improvement in residents' perceptions of confidence with the content areas within each module and examination scores improved with for all modules.²⁵ The flipped classroom model has been shown to be a highly effective means in which to disseminate key physiological and medical concepts to graduate students medical students, residents, and graduate level nursing students.^{19,22,24,26}

Two of the studies showed no significant difference in student learning when flipped classroom was used.^{8,23} A group of 11 masters of public health students participated in a 'flipped' environmental and occupational health course in which there was no statistically significant difference found between examination scores across the two groups.⁸ A multicenter study in which separate institutions were assigned to either flipped classroom or traditional lecture on pharmacology for anesthesia for second year anesthesia residents resulted no difference between groups on benchmark (pretest), acquisition (posttest) or retention (4-month post) test scoring.²³

No studies found that student learning outcomes were worse in the flipped classroom versus traditional lecture-based classroom.^{8,9,19,23,24,26} Second year residents that participated in a study examining teaching methods reported barriers to implementation of flipped classroom include resistance to changing the time-honored traditions of medical education, cost and time requirements for implementation, resistance to completing the pre-class assignments, resistance to active learning, and fear of loss of control of learning environment.²⁵

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Students in flipped classrooms have rated their overall course experience more highly than students within lecture-based models. A group of graduate public health students gave overall higher ratings for a flipped course compared to prior years' traditional class ratings.⁸ Secondly, the instructor had positive experiences regarding the design, implementation, and overall outcomes of the course.⁸

Course evaluation rating and open-ended comments were used by a study at the completion of two courses to weigh satisfaction with flipped and traditional models.²⁴ Closed-ended ratings from student evaluations demonstrated no differences in numerical ratings of either the course or the instructor across the two semesters.²⁴ Seventy-three percent of students mentioned an aspect of the blended learning experience as an effective element of the course and overall the blended course was preferred.²⁴

Anesthesiology residents have described a preference for the flipped classroom, which suggests that residents found the flexibility of watching prerecorded lectures on their own time helpful, believed they would retain more information, and felt the flipped classroom better prepared them for board examinations and clinical practice.²³ One study's survey results measured students' perceived effectiveness of the flipped classroom at three distinct time points in the term. Survey variable scores for students enrolled in the flipped classroom were significantly higher than the survey variable scores for students enrolled prior to the implementation of the flipped classroom.²⁶

Two of the studies in the review showed either decreased student satisfaction with the flipped classroom model or no difference in perceptions between study groups.^{9,19} Graduate nursing students compared between three approaches to learning; traditional lecture only, lecture

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and lecture capture back-up, and the flipped classroom approach of lecture capture with innovative classroom activities.¹⁹ The findings showed students were more satisfied with the lecture only and lecture capture back-up methods than the flipped classroom approach.¹⁹ Student satisfaction with the course modeling resulted in students not feeling they learned more in the flipped course version compared with the standard course.⁹ This outcome was also present in the setting when authors reported significant improvements in performance.⁹

Evidence supports the use of flipped classroom in a variety of graduate level science courses. The articles reviewed showed that flipped classroom is a more effective education delivery method than the traditional classroom.^{9,14,19,23-26} Flipped classroom encourages students to become more engaged with course material, persist in their learning through more timely and accurate preparation, and ultimately perform better measured by improved exam scores.⁹ The format provides opportunities for students to engage in critical thinking, independently facilitate their own learning, and increase peer-to-peer interactions and learning.²⁶

Educators should purposefully reflect about course design, develop effective learning activities that engage learners, complement online content, and take maximal advantage of face-to-face class time. To accomplish these tasks, it is important to think creatively about how to leverage emerging educational technologies in the flipped classroom approach.²⁵ It is advocated that the flipped classroom model could be adapted fairly easily at institutions with sufficient technical support to facilitate delivery of prerecorded lectures to students.¹⁴

Flipped classroom is a promising and potentially superior teaching technique that is worthy of consideration from educators. It is a topic with significant potential that could provide an opportunity for cost-cutting and modernizing the traditional classroom while providing

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student-centered education models. It is recommended in the literature that further research should investigate whether the positive effect of the flipped classroom can be replicated in other specialties and to understand the specific characteristic of flipped courses that lead to positive impacts.^{8,23}

Educators are obligated to give the best possible education to future health care providers. Sufficient evidence exists to show that SRNAs may benefit from approaching education with the flipped classroom method. Anesthesia instructors generally keep pace with the ongoing education trends by staying at the forefront of incorporating new technology in clinical practice and promoting patient safety initiatives.²⁷ Often students engage in collaborative learning through the use of case scenarios, small group discussions, and other interactive activities.⁷ This model of instruction and learning makes SRNAs strong candidates for success in coursework utilizing the flipped classroom model. Advancing the use and research of flipped classroom in the arena of nurse anesthesia education is likely to result in positive outcomes as long as limitations of current research discussed in this review are considered.

Theoretical Framework

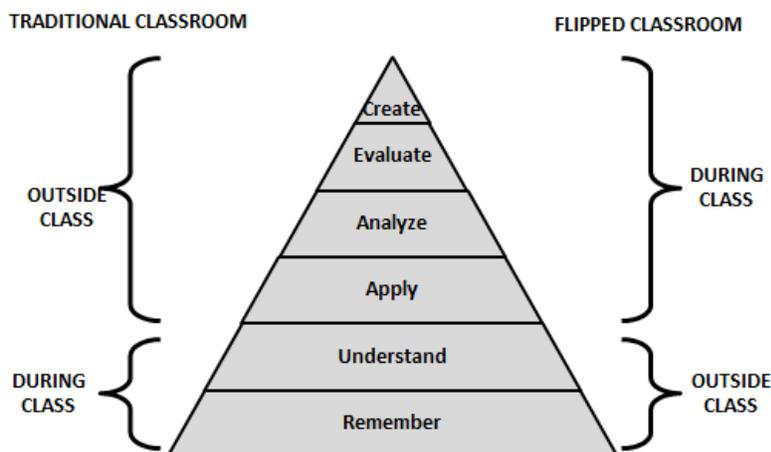
Flipped classroom involves more than shifting content delivery outside of class time. It represents a broader shift in how educators think about the learning process.⁸ Bloom's taxonomy is a widely accepted framework used to define and distinguish different levels of human cognition.²⁸ The framework classifies thinking and learning according to six levels of complexity, often depicted as a pyramid, leading many instructors to encourage their students to climb to higher order thinking.²⁹ The lower three cognitive levels are knowledge, comprehension, and application. The highest three cognitive levels are analysis, synthesis, and

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evaluation.²⁹ Bloom's original taxonomy was later revised that resulted in the Revised Bloom Taxonomy (RBT) where the categories were redefined as follows: remember, understand, apply, analyze, evaluate, and create. (*Figure 1*)³⁰

The relationship of the RBT and flipped classroom method have been described in the literature.³¹ The flipped classroom focuses on progressive exposure to lower, then to higher levels of cognitive performance.⁸ Online-based lectures viewed before the class allow for more basic cognitive work and knowledge acquisition to be completed on the students' own time and pace. The classroom time is reserved for more complex tasks of learning where students have the support of instructors and peers. This type of instruction enables the professor to be more thoughtful and strategic in their course design to achieve all levels of learning, especially engaging in higher levels cognition, namely application, analysis, evaluation, and creation.³¹

Figure 1. Connection between Traditional and Flipped Classroom to Bloom's Taxonomy³¹



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Methodology

This retrospective study examined efficacy of the flipped classroom teaching technique compared to traditional classroom method for nurse anesthesia doctoral students. All components were completed entirely within the Mayo Clinic Doctor of Nurse Anesthesia Program with the full support of the Program Director and faculty, including the instructor for the course involved in this study. The study design involved research on established or commonly accepted educational models and no risk to participants, exempting it from ongoing review according to the University of Michigan-Flint (*Appendix A*) and Mayo Clinic (*Appendix B*) Institutional Review Boards. All subjects were consented and enrolled on a voluntary basis and all data was protected on a password protected server or a locked cabinet. Student data provided by the course instructor was de-identified. All data was kept confidential and no one other than the primary investigator and course instructor had access to the results.

Participants

Subjects in this study included two cohorts of SRNAs enrolled in the course Clinical Orientation and Competencies during the academic years 2016 and 2017. Both cohorts were enrolled in the course during the second year of a 42-month Doctor of Nurse Anesthesia Practice program. Neither cohort was aware of the differences in course design format for the two subsequent semesters. All students enrolled in the two semesters were eligible for inclusion in the study. Participation for the study required voluntarily consent (*Appendix C*).

The traditional classroom and flipped classroom student cohorts each consisted of 26 SRNAs for a total of 52 eligible participants (n=52). Consent to participate was obtained by all 52 eligible students; both cohorts were at the same academic level at the time of the study, since

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the program curriculum sequence did not vary. At the time of the course, all of the subjects had been introduced to the virtual learning environment and course management system Blackboard Learn, which housed the course platform for both semesters.

Course Overview: Clinical Orientation and Competencies

Clinical Orientation and Competencies is an introductory course that provides entry level instruction and training to SRNAs as they begin clinical education. Students are introduced to the inter-professional collaborative approach of the anesthesia care team. Objectives of the course are to develop a foundation in the basic technical abilities, learn and incorporate required organizational skills, integrate acquired academic knowledge within the clinical focus, provide supervised instruction during the acquisition of requisite skills, emphasize the importance of continuous vigilance, recognize the importance of interpersonal skills, demonstrate participation as member of the surgical team, and acquire the expected level of excellence for patient care. The course is a requirement of the program's curriculum and occurs during the fall semester in correlation with entry into clinical practice. Students in both semesters were provided identical course objectives and topics of focus. The course was organized over 8 weeks with a specific topic of focus scheduled for each week (*Table 1*).

Table 1. Clinical Orientation and Competencies Course Topics

Week 1	Orientation to the OR Suite
Week 2	Electronic Records
Week 3	Intra-Provider Communication
Week 4	IV Insertion
Week 5	Airway Management
Week 6	Arterial Line Insertion
Week 7	Medication Preparation
Week 8	Fluid Management

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Teaching Methods

Traditional classroom method. Students enrolled in the fall 2016 Clinical Orientation and Competencies course comprised the control group (n=26) and were instructed with the traditional classroom lecture-based curriculum for the 8-week course. Each of the 8 weeks had a 1-hour in class lecture provided by program faculty using a similar teaching style of classroom slide-presentations. Corresponding checklist were assigned for each topic requiring the SRNA to apply the competency in the clinical setting in the presence of a CRNA preceptor. After successful demonstration of the competency, deemed by the CRNA preceptor, the checklist was signed by both student and preceptor.

Flipped classroom method. Students enrolled in the fall 2017 Clinical Orientation and Competencies course comprised the study group (n=26). The course utilized the same objectives and course content as the previous year. A flipped classroom method was implemented during the 8-week course in place of the traditional in-class lectures. Flipped classroom modules were created by the primary investigator and administered to the students with the collaboration of the course instructor. Course topics were presented via online modules made available on Blackboard Learn. The modules consisted of voiced-over slide presentations, video recorded lectures and demonstrations, web-based modules, and online quizzes. Each module required an estimated 20-40 minutes to complete lecture material outside of the classroom. A primary difference in content delivery for the flipped classroom group was that content for modules 1-4 was posted on Blackboard during the first week and modules 5-8 were posted on the fourth week allowing the SRNAs to complete them at an individualized pace. Posted modules remained open and available for student review during the entire 8 week course allowing for unlimited repeat

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viewings. Classroom time was utilized for topic discussions, case study review, and hands-on activities between SRNAs and CRNA preceptors.

Course Evaluations

Student perceptions and satisfaction with the course was measured with the use of a modified Student Evaluation of Educational Quality (SEEQ) survey administered by the course instructor (*Appendix D*). SEEQ is a standard course evaluation tool used in educational research first published in 1982³². The survey evaluated educational quality and was utilized in a recent study by Moraros et al²⁶ that evaluated effectiveness of flipped classroom in a graduate level setting. The modified SEEQ survey was administered by the course instructor at the conclusion of Clinical Orientation of Competencies to both cohorts. The survey consisted of 26 Likert-scale questions that were grouped into seven categories. Students rated questions on a 1-5 scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). The purpose of the survey was to rate the effectiveness of implemented teaching methods and describe student perceptions. Surveys were provided to each student by the course instructor at the end of the 8-week course. Survey participation for course evaluation was voluntary and without incentive.

Course Performance

Students completed a single end-of-course exam. The course exam consisted of 50 multiple-choice questions administered on campus, proctored by the course instructor, and was closed book. Examination questions were identical for both the study group and control group. Course grades and examination data were shared with the primary investigator and course instructor for consented participants. Course data provided by the instructor was de-identified and reported as de-identified individual exam scores and total course scores.

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Results

Fifty-two SRNAs volunteered to participate in the study and consented to review of course grading and evaluation. A demographic survey (*Appendix E*) was provided to both groups to evaluate demographic characteristics. Participation in the demographic survey occurred in January 2018. Response was voluntary and results remained confidential. De-identified examination scores and final course grades were provided by the instructor for all students enrolled the two groups.

The sample-size for this investigation was fixed based on the number of students per class (n=26 per class). The predetermined number of students (n=26 per group) provided a statistical power of 80% to detect a difference between groups of 0.8 standard deviations. In all cases, two-tailed tests were performed with p-values < 0.05 considered statistically significant.

Participant Characteristics

The demographic survey response for the traditional classroom cohort and flipped classroom cohort was n=26 and n=25 respectively. Participant characteristics responses were compared between groups using the chi-square test for categorical variables reported as counts and percentages, and Wilcoxon rank-sum test reported as median (25th, 75th) for the continuous variables.

Participant characteristics of the two groups are shown in Table 2. Demographic data of gender, age, and education level showed similar distributions among the study and control groups. Both groups previously had statically similar backgrounds in education that utilized individual learning space via online modules. There was no significant difference between types of technologies owned, comfort level with computers/internet, and frequency accessing social

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media platforms. The demographic data showed that there was a significant difference between two areas. Frequency of accessing online video services for educational media and comfort levels with using Blackboard Learn management system were statistically different with the flipped classroom group utilizing the two technologies at a higher rate.

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Table 2. Demographic Data

	Traditional Classroom (n=24)	Flipped Classroom (n=25)	p-value
Gender †			
Male	10(42.6%)	8(32%)	0.48
Female	14(58.3%)	17(68%)	
Age (Years) †			
<25	0	0	0.55
25-29	10(41%)	9(36%)	
30-34	9(37.5%)	11(44%)	
35-39	4(16.7)	4(16%)	
40-44	1(4.2%)	0	
45+	0	1(4%)	
Highest level of education completed prior to admission to Mayo's anesthesia program †			
Bachelor's	22(91.7%)	24(96%)	0.53
Master's	2(8.3%)	1(4%)	
Prior to enrollment in NA6300 Clinical Orientation and Competencies, have you participated in education in which direct instruction was moved from the group learning space (classroom) to the individual learning space via online modules? †			
Yes	18(75%)	20(80%)	0.8
No	4(16.7%)	4(16%)	
I'm not sure	2(8.3%)	1(4%)	
Type of technology you own †			
Windows PC/Laptop	23(95.8%)	25(100%)	0.23
Apple PC/Laptop	14(58.3)	11(44%)	0.32
iPad	12(50%)	16(64%)	0.32
Android Tablet	2(8.3%)	1(4%)	0.53
iPhone	22(91.7%)	24(96%)	0.4
Android Smart Phone	4(16.6%)	5(20%)	0.52
How frequently do you access social media platforms †			
5+ times/day	11(47.8%)	7(29.2%)	0.12
1-4 times/day	6(26%)	15(62.5%)	
1-6 times/week	5(21.7%)	2(8.3%)	
1-4 times/month	1(4.4%)	0	
How frequently do you access video services for educational media †			
5+ times/day	2(9%)	0	0.008*
1-4 times/day	4(18.2%)	4(16%)	
1-6 times/week	1(4.6%)	10(40%)	
1-4 times/month	15(68.2%)	11(44%)	
I have a high level of comfort with using computers and the Internet ‡			
1-5 Likert Scale	4.5(4-5)	5(4-5)	0.23
1=Unfavorable - 5=Favorable			
I have a high level of comfort with using Blackboard learning management system ‡			
1-5 Likert Scale	4(4-5)	5(4-5)	0.046*
1=Unfavorable - 5=Favorable			

† : ChiSq test

‡ : Wilcoxon test

Participant characteristics response rate = 94.2% (49/52)

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Student Course Evaluation

Course satisfaction surveys had a response of n=26 and n=25 for the traditional classroom and flipped classroom groups respectively. The course evaluation survey questions were analyzed according to the aggregate of the questions in each of the seven SEEQ categories. Student satisfaction results were summarized using median (25th, 75th) for the continuous variables (*Table 3*).

The analysis of the survey data demonstrated an overall positive evaluation of both the traditional classroom and flipped classroom models with median results ranging from 4-5 (4 = agree, 5 = strongly agree) in all seven categories. The category group interaction had the only statistically significant difference between the two groups with the flipped classroom group reporting a more positive response to the category's questions. There were no statistical differences in survey questions in the SEEQ categories of learning, enthusiasm, organization, individual rapport, breadth, and preparation.

Table 3. Modified SEEQ Course Evaluation

	Traditional Classroom (n=26)	Flipped Classroom (n=25)	p-value
Learning	4.8(4.4-5)	4.5(4-5)	0.38
Enthusiasm	4.5(3.8-5)	5(4-5)	0.16
Organization	4.5(4-4.8)	4.5(4-5)	0.46
Group Interaction	4(4-4.75)	5(4-5)	0.009*
Individual Rapport	4.5(4-5)	4.7(4-5)	0.45
Breadth	4(3.9-4.5)	4.5(4-5)	0.17
Preparation	4.2(4-4.8)	4(3.7-4.8)	0.7

Wilcoxon test

Course Evaluation response rate = 98% (51/52)

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Student Course Performance

The final grade and test scores outcomes were treated as ratio-level variables and compared between classes using a two-sample t-test. Test and course grading information were analyzed for all 26 students in each group. Analysis of course performance data showed no significant difference between the study and control groups (*Table 4*). Both the traditional classroom and flipped classroom groups performed extremely well in the course with an average test score of 90.2% and 91.5% respectively and an equal median course grade of 96.2% for both groups.

Table 4. Course Performance

	Traditional Classroom (n=26)	Flipped Classroom (n=26)	p-value
Test Results	90.2(84-94.5)	91.5(84.8-94.3)	0.9
Course Grades	96.2(94.6-98.6)	96.2(95-98)	0.85

t Test

Discussion

The objective of the research question was to examine if SRNAs enrolled in the class Clinical Orientation and Competencies would benefit from the flipped classroom teaching method compared to a traditional classroom method as determined by improved course performance and course satisfaction survey results. The study results demonstrated that there was no overall significant difference in course performance or course perception between the flipped classroom and traditional classroom study groups. Although the flipped classroom group did report a more positive result with questions in the group interaction SEEQ category, this factor alone is not enough to make a determination that flipped classroom had overall higher student satisfaction. The median test results demonstrate that course performance between the groups was equal and the students that completed the course during this study performed at a very high level regardless of being taught with the flipped or traditional method.

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The significant finding with this project shows that, in the setting of teaching SRNAs introductory principles of clinical practice, both the traditional classroom and flipped classroom methods were shown to be effective modalities of education demonstrated by equally high levels of course performance and student satisfaction between the two groups. Traditional classroom lecture-based education has long been used as the primary technique for teaching across all levels of education. In addition to this, recent studies report that the traditional classroom approach is still deemed by students to be effective for content delivery, involving students in the learning process, and engaging in independent thinking and problem solving.^{33,34} Validating flipped classroom as an equally effective method of teaching graduate level students is a key outcome of this study as flipped classroom additionally offers benefits of greater access to education via on-line modules, option of distant enrollment, and students learning at an individual pace.³⁵

Although the study was not designed to compare differences in actual class time hours between the traditional and flipped classroom models, an accounting of total course hours demonstrated that there were equal numbers of time spent in the clinical setting but there was a 45% decrease, 17 compared to 31 respectively, in the number of classroom hours needed for each group (*Table 5*). Time of both students and instructors is exceedingly valuable and review of this project shows potential to significantly decrease the required number of classroom hours by using the flipped classroom method. This benefit is also extended to the fact that physical classroom spaces are inherently expensive and availability of access to instructors is valuable and can be limited.

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Table 5. Total Course Hours

	Traditional Classroom	Flipped Classroom
Classroom Hours	31	17
Clinical Hours	96	96
Total Course Hours	127	113

Limitations

There are several limitations to this scholarly project. The study's small sample size was predetermined by the enrollment of the two class groups and the fact that a single course was studied. This project only investigated flipped classroom for the specific course Clinical Orientation and Competencies. In order to evaluate effectiveness of this teaching technique for nurse anesthesia education as a whole, other topics and courses need to be included in projects of this nature. Results of student perceptions and performances would bear greater reliability if teaching methods were evaluated broadly across an entire nurse anesthesia curriculum. Only test results and course grades were available to evaluate course performance between the two groups. This provided a small sample of variables for comparison and the power of a study to detect differences in outcome is primarily determined by the number of events. Timing of the delivery of the course content and course evaluation was separated by a full academic year.

Use of technology in education is increasing at a dramatic rate, especially in graduate level education.³⁶ This study did not control the methods of education that the groups were exposed to during their respective curricula. Differences in exposure to blended learning technologies due to its increasing popularity among program faculty could have altered the students' reported perceptions. The evaluation instruments were developed by modifying the SEEQ evaluation. The modifications were newly designed and specifically tailored to the course without validity and reliability resting. Finally, the findings of this study are specific to its

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design and may not be generalizability to other curriculum topics, institutional settings, and graduate level programs.

Future Research

Applications of flipped classroom methods are continuing to demonstrate a number of fruitful directions for research into this topic. Although there is a foundation building of current research implicating the positive impact of this model on teaching with higher education^{9,14,19,24,25}, more research is needed to evaluate how the principles of flipped classroom influence higher education for graduate level students and specifically for nurse anesthesia training. The results of this scholarly project reveal that flipped classroom is equally effective as compared to traditional classroom. This leads the author to recommend that well designed implementation and evaluation projects with flipped courses are unlikely to cause risk to the education of graduate level students. The limitations of this study show that future research with flipped classroom and nurse anesthesia education needs to include an expansion of coursework and involve larger cohorts at different educational experience levels. Decreased required numbers of in-class hours for the flipped classroom cohort was an incidental finding of this study. Future studies should examine the effect of the flipped classroom on in-class time. Instructors should be encouraged to explore emerging educational technologies for content delivery and share their experiences with flipped classroom to collectively benefit educators considering this path.

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Conclusion

The current model of nurse anesthesia education, although effective in producing highly competent providers, continues to be dominated by traditional lecture-based models despite massive advances in online technology and developments in pedagogical theory.^{7,8} Credence needs to be given to the 2011 IOM report that educators are obligated to give the best possible education to future health care providers through improved education systems that promotes seamless academic progression.¹ The results of this study suggest that flipped classroom education is a promising and potentially superior teaching technique that deserves attention from educators to modernizing the traditional classroom with a student-centered education model. Instructors pursuing a focus for increased classroom time utilization for students to engage in active learning, critical thinking, analysis and communication skills should feel confident that a flipped classroom method is a viable option to deliver a contemporary and effective education while maintaining, or potentially improving, high quality student performance and satisfaction in the graduate level setting.

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Appendix A. University of Michigan Flint IRB Approval

To: Jeffrey Oberhansley
From: Kazuko Hiramatsu
Cc: Cynthia Farina
 Gena Welch
 Jeffrey Oberhansley

Subject: Notice of Exemption for [HUM00137450]

SUBMISSION INFORMATION:

Title: The use of flipped classroom education method compared to traditional classroom education method for nurse anesthesia education

Full Study Title (if applicable): The use of flipped classroom education method compared to traditional classroom education method for nurse anesthesia education

Study eResearch ID: [HUM00137450](#)

Date of this Notification from IRB: 12/18/2017

Date of IRB Exempt Determination: 12/18/2017

UM Federalwide Assurance: FWA00004969 (For the current FWA expiration date, please visit the [UM HRPP Webpage](#))

OHRP IRB Registration Number(s): IRB00000248

IRB EXEMPTION STATUS:

The IRB Flint has reviewed the study referenced above and determined that, as currently described, it is exempt from ongoing IRB review, per the following federal exemption category:

EXEMPTION #1 of the 45 CFR 46.101.(b):

Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Note that the study is considered exempt as long as any changes to the use of human subjects (including their data) remain within the scope of the exemption category above. Any proposed changes that may exceed the scope of this category, or the approval conditions of any other non-IRB reviewing committees, must be submitted as an amendment through eResearch.

Although an exemption determination eliminates the need for ongoing IRB review and approval, you still have an obligation to understand and abide by generally accepted principles of responsible and ethical conduct of research. Examples of these principles can be found in the Belmont Report as well as in guidance from professional societies and scientific organizations.

SUBMITTING AMENDMENTS VIA eRESEARCH:

You can access the online forms for amendments in the eResearch workspace for this exempt study, referenced above.

ACCESSING EXEMPT STUDIES IN eRESEARCH:

Click the "Exempt and Not Regulated" tab in your eResearch home workspace to access this exempt study.

Kazuko Hiramatsu
 Chair, IRB Flint

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Appendix B. Mayo Clinic IRB Approval

Memo

Date: Monday, December 04, 2017

From: Mayo Clinic Institutional Review Board

Re: The use of flipped classroom education method versus traditional classroom education method for nurse anesthesia education

To: Jeff Oberhansley

The Mayo Clinic Institutional Review Board (IRB) acknowledges that based on the responses submitted for this new activity through the Mayo Clinic IRBe Human Subjects Research Wizard tool, and in accordance with the Code of Federal Regulations, 45 CFR 46.102, this research study is eligible for CATEGORY 1 EXEMPT status because: (1) This research activity does not involve Prisoners; (2) It does not involve an approved FDA regulated product, other than the use of an FDA approved product in the course of medical practice; (3) The research will be limited to procedures listed in the exempt-research categories as laid out by Mayo IRB; (4) The following category best describes the research that will be conducted: Research conducted in established or commonly ACCEPTED EDUCATIONAL SETTINGS, INVOLVING NORMAL EDUCATIONAL PRACTICES, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Other Federal, State and local laws and/or regulations may apply to the activity. This study must be reconsidered for submission to the IRB if any changes are made.

The Principal Investigator is responsible for the accuracy and reliability of the information submitted through the Human Subjects Research Wizard tool, for following all applicable Federal, State and local laws and/or regulations, and is also responsible for submitting research studies to the IRB when required.

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Appendix C. Consent to Participate in Research Study

Consent to Participate in a Research Study THE USE OF FLIPPED CLASSROOM EDUCATION METHOD VERSUS TRADITIONAL CLASSROOM EDUCATION METHOD FOR NURSE ANESTHESIA EDUCATION

The objective of this research is to investigate outcomes of implementation of the flipped classroom teaching technique for student registered nurse anesthetists (SRNAs) during NA6300 Clinical Orientation and Competencies by assessing differences in student content comprehension and satisfaction results compared to a traditional classroom approach.

Student perceptions of flipped classroom will be assessed by reviewing the student evaluation of educational quality (SEEQ) survey results administered by the course instructor for NA6300 Clinical Orientation and Curriculum for the Fall 2016 and 2017 semesters. SEEQ results were gathered anonymously so no student identifiers for the results are available.

Student performance of flipped classroom will be assessed by reviewing course grades, including quizzes, assignments, and examinations. All student information of participants in the study will be assigned a survey number by the course instructor to maintain student confidentiality of their coursework results.

A population demographic survey will be administered to the Class of 2019 and 2020 after completion of the Fall 2017 semester. Participation in the survey will be voluntary and results will remain anonymous as no identifying elements will be requested.

Risks are minimal for involvement in this study. There are no direct benefits for participants; it is hoped that through your participation, researchers will learn more about outcomes of a flipped classroom education method. There is no direct compensation.

All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All data will be concealed, and no one other than the primary investigator and faculty listed below will have access to them. The data collected will be securely stored on encrypted devices and/or in password protected databases until the primary investigator deletes it.

Participation in this research study is voluntary. You have the right to withdraw at any time or refuse to participate entirely without jeopardy to your academic status, GPA, or standing with the anesthesia program. If you desire to withdraw, please notify the principal investigator, Jeff Oberhansley at oberhansley.jeff@mayo.edu.

If you have questions regarding this study, you may contact: Jeff Oberhansley at oberhansley.jeff@mayo.edu; Dr. Erin Martin at martin.erin17@mayo.edu; Jenna Steege at Steege.jenna@mayo.edu; Dr. Gena Welch at welchg@umflint.edu; Dr. Cindy Farina at cindyfarina@msn.com.

I, (print your name) _____, agree to participate in this research study.

Signature

Date

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Appendix D. Course Evaluation Survey (Modified SEEQ)

Mayo Clinic School of Health Sciences Nurse Anesthesia Graduate Programs							
NA6300 Clinical Orientation Course Evaluation							
This survey is designed to evaluate the course you have completed.							
Please help to improve the course by answering the following questions.							
When answering this survey apply your evaluation to your group of clinical preceptors as a whole and not individually.							
The results of this survey are confidential.							
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Learning:	1	I have found the course intellectually challenging and stimulating.	1	2	3	4	5
	2	I have learned something which I consider valuable.	1	2	3	4	5
	3	My interest in the subject has increased as a consequence of this course	1	2	3	4	5
	4	I have learned and understood the subject materials of this course.	1	2	3	4	5
Enthusiasm:	5	Clinical preceptors were enthusiastic about teaching the course.	1	2	3	4	5
	6	Clinical preceptors were dynamic and energetic in conducting the course.	1	2	3	4	5
	7	Clinical preceptors enhanced instruction with the use of humor.	1	2	3	4	5
	8	Clinical preceptors' style of instruction held my interest during the course.	1	2	3	4	5
Organization:	9	Course objectives were clear and accessible.	1	2	3	4	5
	10	Clinical Preceptors' explanations were clear.	1	2	3	4	5
	11	Course materials were well prepared and carefully explained.	1	2	3	4	5
	12	Proposed objectives agreed with those actually taught so I knew where clinical orientation was going.	1	2	3	4	5
	13	Course materials were accessible for review throughout the duration of the course.	1	2	3	4	5
	14	Course content developed my confidence with technical anesthesia skills.	1	2	3	4	5
Group Interaction:	15	Students were encouraged to participate in discussions of course content.	1	2	3	4	5
	16	Students were invited to share their ideas and knowledge.	1	2	3	4	5
	17	Students were encouraged to ask questions and were given meaningful answers.	1	2	3	4	5
	18	Students were encouraged to express their own ideas and/or question the clinical preceptor	1	2	3	4	5
Individual Rapport:	19	Clinical preceptors were friendly towards individual students.	1	2	3	4	5
	20	Clinical preceptors made students feel welcome in seeking help/advice in or outside of operating room.	1	2	3	4	5
	21	Clinical preceptors had a genuine interest in individual students.	1	2	3	4	5
Breadth:	22	Clinical preceptors contrasted the implications of various theories.	1	2	3	4	5
	23	Clinical preceptors' instruction style developed my confidence with technical anesthesia skills.	1	2	3	4	5
Preparedness:	24	Course format provided adequate instruction for me to be prepared for clinical orientation.	1	2	3	4	5
	25	Course format helped to manage my anxiety levels during clinical orientation.	1	2	3	4	5
	26	Course format gave me a sense of confidence during clinical orientation.	1	2	3	4	5

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Appendix E. Demographic Survey

THE USE OF FLIPPED CLASSROOM EDUCATION METHOD VERSUS TRADITIONAL CLASSROOM EDUCATION METHOD FOR NURSE ANESTHESIA EDUCATION									
Study Demographic Survey									
<p>The objective of this research is to investigate outcomes of implementation of the flipped classroom teaching technique for student registered nurse anesthetists (SRNAs) during NAG300 Clinical Orientation and Competencies by assessing differences in student content comprehension and satisfaction results compared to a traditional classroom approach</p> <p>Please read instructions/questions and circle the answer that most applies to you</p> <p>Participation in this survey is voluntary and results will remain confidential</p>									
1	Gender	Male	Female						
2	Age (Years)	<25	25-29	30-34	35-39	40-44	45+		
3	Highest level of education prior to anesthesia program	Bachelor's	Master's	Doctorate					
4	Post-secondary years of education completed	<4	4-5	5-6	6-7	>7			
5	Types of technology you own (Select all that apply)	Windows PC/Laptop	Yes	No					
		Apple PC/Laptop	Yes	No					
		iPad	Yes	No					
		Android Tablet	Yes	No					
		iPhone	Yes	No					
	Android Smart Phone	Yes	No						
6	Do you participate in social media?	Yes	No						
7	If you answered YES to question 6, how frequently do you login to social media platforms	N/A	5+ times/day	1-4 times/day	1-6 times/week	1-4 times/month	I prefer not to answer		
		Yes	No						
8	Do you use YouTube, or other video services, for educational media	Yes	No						
9		N/A	5+ times/day	1-4 times/day	1-6 times/week	1-4 times/month	I prefer not to answer		
6	I have a high level of comfort with using computers and the Internet	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree			
7		1	2	3	4	5			
	I have a high level of comfort with using Blackboard learning management system	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree			
		1	2	3	4	5			

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