American Journal of Pharmaceutical Education **2013; 77 (9) Article 196.**

INSTRUCTIONAL DESIGN AND ASSESSMENT

Pharmacy Student Engagement, Performance, and Perception in a Flipped Satellite Classroom

Jacqueline E. McLaughlin, PhD, MS,[a] LaToya M. Griffin, PhD,[a] Denise A. Esserman, PhD,[b] Christopher A. Davidson, ME,[a] Dylan M. Glatt,[a] Mary T. Roth, PharmD,[a] Nastaran Gharkholonarehe, PharmD[a] and Russell J. Mumper, PhD[a]

[a]UNC Eshelman School of Pharmacy, UNC Chapel Hill, Chapel Hill, North Carolina
[b]Departments of Medicine and Biostatistics, UNC Chapel Hill, Chapel Hill, North Carolina

Submitted December 10, 2012; accepted May 29, 2013; published November 12, 2013.

Objective. To determine whether "flipping" a traditional basic pharmaceutics course delivered synchronously to 2 satellite campuses would improve student academic performance, engagement, and perception.

Design. In 2012, the basic pharmaceutics course was flipped and delivered to 22 satellite students on 2 different campuses. Twenty-five condensed, recorded course lectures were placed on the course Web site for students to watch prior to class. Scheduled class periods were dedicated to participating in active-learning exercises. Students also completed 2 course projects, 3 midterm examinations, 8 graded quizzes, and a cumulative and comprehensive final examination.

Assessment. Results of a survey administered at the beginning and end of the flipped course in 2012 revealed an increase in students' support for learning content prior to class and using class time for more applied learning ($p=0.01$) and in the belief that learning key foundational content prior to coming to class greatly enhanced in-class learning ($p=0.001$). Significantly more students preferred the flipped classroom format after completing the course (89.5%) than before completing the course (34.6%). Course evaluation responses and final examination performance did not differ significantly for 2011 when the course was taught using a traditional format and the 2012 flipped-course format. Qualitative findings suggested that the flipped classroom promoted student empowerment, development, and engagement.

Conclusion. The flipped pharmacy classroom can enhance the quality of satellite students' experiences in a basic pharmaceutics course through thoughtful course design, enriched dialogue, and promotion of learner autonomy.

Keywords: pharmaceutics, flipped classroom, distance learning

INTRODUCTION

The subset of students who attend courses at a site distant from the main campus is growing. An increasing number of pharmacy colleges and schools use satellite campuses as a space- and cost-effective means to expand and diversify their student body. Of the 127 degree programs with accreditation status from the Accreditation Council of Pharmacy Education, 31 have a branch or distance education campus.[1] While the effectiveness of distance education relative to traditional education in pharmacy colleges and schools is well-established,[2-6] distance education presents unique challenges for students and instructors. In general, student isolation and attrition in distance education is associated with a lack of interaction between instructors, learners, and learning material.[7,8] Students perceive interaction as a critical factor in distance education and report enhanced learning and higher satisfaction in more interactive courses.[9,10] Furthermore, engagement in the distance education environment may be positively related to student performance, satisfaction, participation, motivation, and critical thinking.[11-14]

The perceived difficulties associated with distance learning are articulated by the *transactional distance theory*, which defines transactional distance as a psychological and

Corresponding Author: Russell J. Mumper, PhD, Vice Dean and John A. McNeill Distinguished Professor, UNC Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, CB 7355, 100G Beard Hall, Chapel Hill, NC 27599-7355. Tel: 919-966-1271. Fax: 919-966-6919.
E-mail: mumper@email.unc.edu

communication gap between the instructor and learner formed by physical distance. Transactional distance is a function of the interplay between 3 key variables: program structure, dialogue, and self-directedness.[15] While content delivery and pedagogy vary widely in satellite courses, active learning can enhance the experiences of these students by facilitating interaction and reducing the transactional distance between the learner and the educational environment.[16]

Strategic course design, enriched dialogue, and promotion of learner autonomy can minimize obstacles associated with distance learning.[15] The "flipped" classroom is a blended learning model in which foundational content is moved outside of the scheduled class time for students to learn on their own, allowing the instructor to engage students in group discussions and interactive-learning activities during the scheduled class to promote higher-level thinking.[17] By deliberately delivering basic content outside of class for students to learn at their own pace and replacing unidirectional communication (ie, lectures) with interactive-learning activities during class, the flipped classroom emphasizes the 3 main elements of the transactional distance theory. While this methodology has proven successful for traditional classroom settings in higher education,[18-20] it has remained unclear how distance instructors can use the flipped classroom to foster student-centered learning while overcoming the geographical and situational barriers of distance education. Addressing this question was the general research objective of this paper.

Specifically, the goal of the current research design, referred to as Project 4-1-1 Flip, was to use mixed methods to examine the engagement, performance, and perceptions of first-year pharmacy students enrolled in a flipped basic pharmaceutics course delivered synchronously to the University of North Carolina (UNC) Eshelman School of Pharmacy's 2 satellite campuses in Asheville and Elizabeth City, North Carolina. Within the scope of Project 4-1-1 Flip, engagement is defined as the extent of participation, on behalf of the instructor and the learner, in educationally purposeful activities.[21] In general, engagement is positively related to academic performance and commonly measured via class attendance, contributions to group discussions, completion of assigned readings, and frequency of electronic medium access.[22-24] While engagement emphasizes behavior, student perception measures receptivity towards course design, content delivery, teaching practices, and instructor performance.[25] Student perceptions of instruction and learning materials can affect student attitudes toward learning and consequently influence their performance.[26] Given the relationship of engagement and perceptions to academic performance, these constructs warrant careful consideration during course redesign and should be measured to fully understand the impact of curricular revision on the educational experience of students.

DESIGN

Basic Pharmaceutics II was a required 3-credit hour course for all first-year pharmacy students enrolled in the UNC Eshelman School of Pharmacy in the spring semester. The course covered the science of drug delivery to the body via complex, specialized, and novel dosage forms, with a strong emphasis on the principles of physical diffusion through synthetic and biological barriers. The class met twice per week over the semester (approximately 13 weeks), with each class lasting 75 minutes. Classes were conducted by faculty members located in Chapel Hill the majority of the time (n=23), with 1 class session conducted from Asheville and 1 from Elizabeth City. For both years (2011 and 2012) of this study, the course was delivered synchronously via video teleconferencing to satellite classrooms. Student desks at all sites were equipped with remote touch-sensitive microphones that engaged a video camera when activated. All students could view each other at each campus when asking questions or engaging in discussion. During each class period, at least 1 staff member was present in a linked command-and-control center on each campus to ensure equipment was working properly.

Two concurrent years of data in which 2 different delivery styles were used to teach the course were collected for the study. In 2011, the course was delivered in a traditional lecture-based format to all 153 students, including 13 satellite students. Content was delivered in 75-minute lectures during class time that occasionally included a 15-minute active-learning exercise. Assessment of student learning consisted largely of multiple-choice examinations with limited short-answer and essay questions. In 2012, the course was delivered with a flipped format as depicted in Figure 1 to all 162 students, including 22 students on 2 different satellite campuses. All 25 course lectures were condensed and prerecorded using Echo360 Classroom Capture (Echo360 Inc, Dulles, VA) and downloaded to a Web site embedded within Sakai (Sakai Foundation), the course Web site. Students could access the lectures, called Integrated Learning Accelerator Modules (iLAMs), which contained the fundamental content necessary for each class session at any time with any Internet-enabled device. Users had the ability to pause, rewind, fast forward, and re-watch the videos, each lasting an average of 35 minutes (range 21-55 minutes). Watching iLAMs prior to class was highly encouraged but not mandatory.

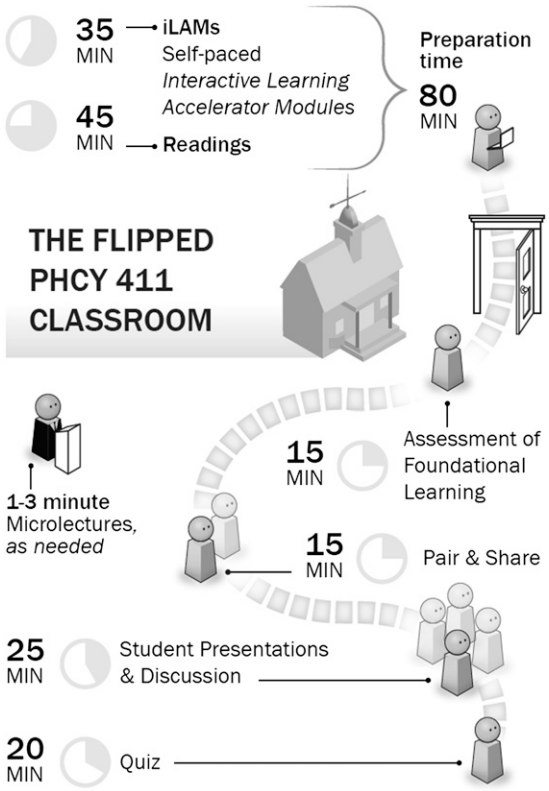

Figure 1. The Flipped PHCY 411 Classroom. Two core elements of The Flipped Classroom were offloading content, and creating a learner-centered classroom.

Because course lectures were offloaded to self-paced online videos, scheduled class periods were organized into 4 active-learning exercises that each used a different assessment method[27,28]: clicker questions (approximately 15 minutes); think-pair-shares (approximately 15 minutes); student presentations (approximately 25 minutes); and a quiz (approximately 20 minutes). These activities enabled instructors to make real-time formative assessments during class and provide prompt microlectures[29] to address misconceptions or gaps in student knowledge.

Additionally, 2 course projects designed to encourage higher-order thinking and assess student ability to analyze, synthesize, and evaluate consistent with the top of Bloom's Taxonomy of Learning,[30,31] were assigned at the beginning of the semester: (1) a package insert analysis assignment requiring students to apply class concepts to a Food and Drug Administration registered dosage form; and (2) a clinical pharmaceutics proposal outline asking students to identify a clinical shortcoming, design a dosage form for treatment, and write a 3-page research proposal outline. Three midterm examinations, 8 graded quizzes, and a cumulative and comprehensive final examination also provided insight into student learning over the course of the semester.

EVALUATION AND ASSESSMENT

Data Collection

In 2012, following exemption of the study by the university's Institutional Review Board, a survey was administered to students prior to the start of the course to collect demographic information, perceptions of active-learning activities, preference for delivery format, and typical academic engagement behavior. A post-course survey instrument examining the same constructs was administered at the end of the course. Online activity measures, such as the number of times a student logged into the course Web site in Sakai, the number of times a student accessed online course videos, and the number of lectures the student reported watching, were also collected.

The post-course survey instrument and course evaluation provided opportunities for students to provide open-ended responses specifically addressing learning materials, course structure, classroom activities, graded assignments, instructor effectiveness, and course strengths and weaknesses. Because identifiers and demographic information were not collected on the course evaluation, student responses could not be linked to survey responses or any other collected data. Participation in the pre- and post-course surveys was voluntary; completion of the

course evaluation was required in order to receive a grade in the course.

To compare performance and perceptions in the 2011 and 2012 offerings of the course, performance indicators as well as course evaluation responses from both years were collected. Performance indicators included the same final cumulative examination from both years, which measured the same content in the same basic format.

Data Analysis

Because the instruments implemented in Project 4-1-1 Flip provided both quantitative and qualitative data, a mixed methods study design was used. All quantitative data analysis was conducted in SPSS for Windows, Version 20 (IBM Corp., Armonk, NY). Because of the small sample size and use of short Likert scales, nonparametric tests were conducted to analyze all data associated with the pre-course survey, post-course survey, and course evaluation instruments. The Wilcoxon signed rank test was used to compare pre- and post-course survey responses, the Mann-Whitney U test was used to examine 2011 and 2012 course evaluation responses, and Spearman rho was used to investigate correlations between variables. Exact methods were used when appropriate because exact methods do not make any distributional assumptions and are valid for any sample size. Because course grades tend to follow a normal distribution and that appeared true here, an independent *t* test was used to compare final examination grades for the 2011 and 2012 classes. Significance was established at $\alpha=0.05$. Given the lack of power to detect anything but large differences due to small sample sizes, any *p* value less than 0.20 was used to generate hypotheses (ie, suggested a potential relationship may exist) for future research, which would be needed to test these hypotheses.

Thematic coding was used to analyze text data collected by the post-course survey instrument and end-of-course evaluation in 2012. This qualitative approach uses iterative coding to develop and interconnect categories that guide the development of theoretical propositions.[32] Following data collection, text was consolidated into a single file and all identifiers were removed prior to analysis. In the open coding phase of analysis, a constant comparative approach was used independently by 2 researchers to identify categories that characterized the experiences of students in the flipped classroom. Axial and selective coding was then used to explore the interrelationship of categories and identify overarching categories of interest.[32] Select quotes from student responses are reported to reflect findings from the qualitative analysis.

Quantitative Findings

In the 2012 offering of the course, 19 of the 22 students at satellite campuses completed the pre-course and post-course survey instruments. Of the 19 survey participants, 13 were female, 17 were white, 13 held at least a bachelor's degree, and 15 came from a science, technology, engineering, or mathematics background. The mean ± standard deviation (SD) participant age was 25.1±5.8 years. All students completed the required course evaluations (13 in 2011 and 22 in 2012).

To better understand student experiences in the flipped classroom, results were analyzed from pre- and post-course surveys. As shown in Table 1, there was a significant increase in students' belief that learning key foundational content prior to coming to class greatly enhanced their learning of course material in class ($p=0.001$). Similarly, there was a significant increase in students' support for learning content prior to class and using class time for more applied learning ($p=0.01$). Future work should be powered to test the hypotheses that there is a positive relationship in the ability of in-class discussions of course concepts with peers ($p=0.08$) and lectures ($p=0.08$) to greatly enhance learning in the flipped format and a negative relationship in reading the assigned texts prior to coming to class ($p=0.10$). In the post-course survey, 16 students reported watching all 25 of the lectures throughout the semester, while the other 3 reported watching 20 to 24 of the lectures. All students reported viewing lectures weekly, with 1 student viewing lectures daily and 14 viewing lectures multiple times per week. Student preferences for overall course delivery method demonstrated a significant difference between pre-course and post-course preference. In the pre-course survey, 13 students (68.4%) said they preferred a traditional lecture format. After the flipped course was completed, 17 (or 89.5%) said they preferred the flipped classroom structure ($p=0.001$).

Examination performance, online engagement measures, and course evaluations were collected for all students. Student academic performance, based on the final examination, was not significantly different ($p=0.31$) in 2012 (152.1±15.6 out of 200 points) when compared with 2011 (154.1±16.2 out of 200 points). On average, students logged into the Sakai Web site 192.2±76.1 times (range: 96 to 351 times) throughout the semester and accessed the iLAMs online 45.5±20.0 times (range: 17 to 94 times). Course evaluation responses did not differ significantly between the 2011 and 2012 classes. Specifically, items measuring class attendance, weekly course preparation, course materials, active student engagement, course relevance, and the overall rating for the course did not significantly change with the new course format. In addition, all correlations examining relationships

Table 1. Student Perceptions of Learning Enhancement and Engagement Activities Following Participation in the 2012 Flipped Classroom (N=19)

Pre-Course and Post-Course Survey Questions[a]	Pre-course, Median, Range	Post-course, Median, Range	*P*
Lectures greatly enhance my learning./Prerecorded lectures greatly enhanced my learning.	3, (2-4)	4, (3-4)	0.08
Learning key foundational content prior to coming to class greatly enhances(d) my learning of course material in class.	3, (2-4)	4, (3-4)	0.001
Interactive, applied in-class activities greatly enhance(d) my learning.	3, (1-4)	4, (2-4)	0.01
I participate(d) and engage(d) in discussions in class.	3, (1-4)	3, (2-4)	0.25
In-class discussions of course concepts with my peers greatly enhance(d) my learning.	3, (1-4)	3, (2-4)	0.08
I read assigned readings prior to coming to class.[b]	3, (3-5)	2, (2-5)	0.10
Assigned readings from textbooks/articles enhance(d) my learning.	3, (2-4)	3, (2-4)	1.00
How often would you say you generally go(went) to class?[c]	1, (1-3)	1, (1-3)	1.00

[a] Likert scale items measured on a 4-point scale ranging from 1=strongly disagree to 4=strongly agree, unless otherwise noted.
[b] Five-item Likert scale measured as 1=never, 2=rarely, 3=some of the time, 4=most of the time, 5=all of the time.
[c] Five-item Likert scale measured as 1=100%, 2=90-99%, 3=80-89%, 4=50-79%, 5=1-49%.

between measures of online engagement and final examination performance in 2012 were weak.

Qualitative Findings

The following 3 major themes were identified in the open-ended text comments included on the survey instruments.

Engagement. Students frequently commented on the quality of engagement encountered in the flipped classroom. The offloaded lectures prompted student engagement with course content, which was further reinforced through active-learning exercises during class time. Active-learning exercises also helped facilitate engagement with other learners and the instructor with the content, as well as application of the content to address or solve real-life problems. One student stated, "I felt like I could be more engaged in deeper discussions because I came to class with a basis of knowledge about the topic. It made me more engaged and interested in the material, and it made me more prepared to think critically and apply the things that I had learned." While comments frequently highlighted benefits of engagement in the flipped classroom, some students noted barriers to engagement. For example, one student noted, "I did not think the student [pair and share] enhanced my learning. They brought up interesting topics, but I didn't feel like I could ask course relevant questions because I wasn't confident that they would know the answer."

Empowerment. For most students in Project 4-1-1 Flip, the flipped classroom created an environment that facilitated enhanced learning and increased confidence. The new format afforded students autonomy by enabling them to proceed at their own pace through lectures, guide themselves to additional content, and assess their own learning gains. As one student stated, "I felt like if I watched the prerecorded lectures, it was impossible for me to get behind in the class, which is not true of many other classes. I was always current with the material which gave me confidence in quizzes and discussion." In addition, students reported feeling equipped to find information and inspired by the ability to connect course content to the workplace and future practice.

Development. Students in this study reported that the format and active-learning opportunities provided by the flipped classroom contributed to the development of skills involving critical thinking, problem solving, professionalism, and studying. In this sense, the flipped classroom generated perceptions of growth in content acquisition and higher-order thinking. As one student noted, "I wish all classes were designed like this. I was able to truly learn what being an independent student meant and I learned *how* to study, a skill that is actually pretty difficult to develop."

Quality and Efficiency. Axial and selective coding was used to explore the interrelationship of categories and identify overarching categories of interest.[32] The themes described above were further grouped into the overarching categories of quality and efficiency. The idea of quality emerged from students' consistent uses of words like *clarity, organization,* and *worth*. The other overarching

category, efficiency, emerged from words like *time, workload,* and *reinforce.* Coding of the data suggests that these 2 overarching categories shaped student perceptions of empowerment, development, and engagement. Reinforcement of information through high-quality videos often led to student perceptions of efficient learning and reduced stress. One component of active learning, student presentations, was perceived negatively by some students because of lack of content mastery, redundancy, and presentation quality.

DISCUSSION

An increasing number of pharmacy colleges and schools are establishing satellite campuses as a space- and cost-effective means to expand and diversify their student body, to address regional manpower shortages, and/or to emphasize and address rural health. Understanding how these students experience the educational environment is imperative for improving outcomes and preparing aspiring pharmacists to meet the needs of 21st century health care. In Project 4-1-1 Flip, the impact of a flipped satellite class delivered synchronously to 2 satellite campuses was demonstrated. Although performance in the flipped classroom was not significantly higher than performance in the traditional lecture course, survey responses measuring perceived learning enhancement coupled with qualitative analysis of student comments reveal a compelling picture of engagement, development, and empowerment.

The findings from this study support other pharmacy education studies that reflect positive student perceptions associated with active learning.[33-35] Namely, the analysis revealed: (1) an increase in favor of learning content prior to class and using class time for more applied learning; and (2) an increase in the notion that learning key foundational content prior to coming to class greatly enhances in-class learning. The qualitative findings triangulate these results, suggesting that learning key material prior to class enabled students to engage in active-learning exercises with more focus, confidence, and enthusiasm.

The importance of quality and efficiency in successful implementation of the flipped classroom cannot be overstated. Student comments clearly articulated a desire for high-quality engagement with content, peers, and instructors. As a result, the course textbook and student presentations will be replaced with more engaging, contemporary, and applied literature reading and in-class discussion in the next offering of the course. In addition, students voiced concerns about the burden that flipping could potentially create if faculty members did not give careful consideration to student workloads. Although iLAMs were condensed to an average of 35 minutes each to minimize the amount of out-of-class time required to complete them, class progress was closely monitored and adjustments were made as necessary within the course at mid-semester to help students balance the course workload. Specifically, 1 of the 2 required projects was converted to a bonus project.

The satellite students in this study responded positively to their experiences in the flipped classroom. However, there are several components of this instructional approach that warrant consideration for satellite students and larger cohorts. In addition to being mindful of student workload, faculty members must consider their own time and resources. With an emphasis on critical thinking and other higher-level thinking skills described by Bloom's Taxonomy,[30,31] assessments in the flipped classroom should provide more opportunities for students to analyze and synthesize information in the form of short answer, essays, and course projects – all of which can require additional time to evaluate. Designing and implementing offloaded content and in-class activities also requires thoughtful planning and preparatory work. Furthermore, an underlying premise of this particular model of the flipped classroom is that instructors and students have personal access to the appropriate technology and technological support.

Despite these limitations, the flexibility of this model makes the flipped classroom highly translatable. A growing body of research across a wide range of disciplines, including pharmacy,[36] economics,[19] engineering,[20] and physics,[18] report improved outcomes using various approaches to flipping. As other colleges and schools consider implementing this instructional delivery model, the authors believe the practice of offloading content and engaging satellite students in the classroom is far more important than adopting the specific strategies used in this study. While the format for this course was designed to optimize learning in basic pharmaceutics, a wide array of offloading and active-learning strategies have been shown to improve learning. Animated e-books, captured videos, and annotated handouts, for example, can all be used to effectively offload content.[18-20,36] Similarly, numerous active-learning strategies are available for engaging students in the classroom, including case-based discussions, team-based learning, panel discussions, and student debates.[29,30]

This study demonstrates enhanced learning experiences for satellite students, despite no significant improvement in examination performance. While a comparison of examination scores provided a glimpse into the impact of the flipped classroom on examination performance, this metric alone does not adequately capture the educational experience of students. For this reason, we collected

data from numerous instruments to provide insight into the impact of the flipped format, not just on grades but also on engagement, preferences, and perceptions. As such, our qualitative and pre-post results reflect the ability of the flipped classroom to transform the educational experience of satellite students through enhanced engagement, a metric that is simply not captured on a final examination.

Complex constructs like empowerment, engagement, and development are not always easily reduced to measurable items on survey instruments or examinations and, given the findings from this study, warrant further investigation within the context of the flipped classroom. In this study, for example, the quantitative measures of student engagement were limited to online activity. While these metrics are important for understanding the relationship between student engagement and performance, they are a small subset of engagement measures known to impact student development.[21] As such, future studies should consider the relationship of other indicators of student engagement with satellite student learning in the flipped classroom. Future research should also further examine how flipping impacts additional dimensions of academic performance or learning outcomes for satellite students as our results did not support previous findings for main-campus students.[18-20] Research should focus on the longitudinal impact of the flipped satellite classroom on knowledge and skill retention along with the ability of the flipped classroom to develop self-regulated learning skills. As this is one of the first studies to research a remotely taught flipped classroom, it is also important to further determine how flipping impacts satellite students in other disciplines, grade levels, courses, and institutions.

The flipped classroom effectively reduces the transactional distance created by the satellite location and can enhance the quality of student learning through thoughtful course design, enriched dialogue, and promotion of learner autonomy. The experience in this flipped class has raised awareness in the school regarding strategies that are valued and important for satellite students. Although the generalizability of the results is limited because of the research design used, these experiences led us to conclude that the flipped classroom is both feasible and necessary for pharmacy education. We hope that more satellite programs will adopt the underlying principles of the flipped classroom to foster learning, enhance student experiences, and prepare aspiring pharmacists for success.

CONCLUSIONS

While lecture-based content delivery remains an enduring tradition in higher education, the need for more dynamic methods that enable students to take an active role in the learning process is apparent. In this study, a Basic Pharmaceutics II course was flipped to meet student requests for enhanced active learning in class and improve the teaching and learning methodologies taught remotely, which consisted mainly of traditional lectures.[37,38] Most of the students at the satellite campuses preferred the flipped format, reporting that learning foundational content prior to class and engaging in active-learning exercises during class time significantly enhanced their learning. In addition, the quality and efficiency of interactions in the flipped satellite classroom shaped student perceptions of the educational environment. Although performance on the final examination did not change significantly with the new format, the flipped classroom clearly impacted the academic experiences of these satellite students.

ACKNOWLEDGEMENTS

The authors would like to thank the class of 2015 of the UNC Eshelman School of Pharmacy for their willingness to participate and engage in Project 4-1-1 Flip. The class of 2015 proved to be trailblazers and epitomized the attributes that we seek for professional students. We also thank the other PHCY 411 instructors including Professors Michael Jay, Leaf Huang, and Richard Kowalsky, as well as Anthony Emekalam and Mollie Scott for their efforts facilitating the course at Elizabeth City and Asheville, respectively. The authors thank Jason Whitley, Creative Lead for Instructional Innovation in the Educational Technology Research and Development Group at the UNC Eshelman School of Pharmacy, for his creation of Figure 1. Finally, we thank Casey Emerson and other educational technology staff members for providing critical technology and expertise.

The authors acknowledge and thank Echo360 Inc for the grant to support Project 4-1-1 Flip. The UNC Eshelman School of Pharmacy thanks Carolina Partnership and The Pharmacy Network Foundation, Inc. for their generous support through the Educational Renaissance initiative. In addition, we thank the UNC's CTSA for supporting the time of Dr. Esserman on this project.

REFERENCES

1. Vlasses PH. ACPE and pharmacy schools: quality assurance versus quantity assurance. https://www.acpe-accredit.org/pdf/PharmacyFoundationf.pdf. Accessed November 15, 2012.
2. Kidd RS, Stamatakis MK. Comparison of students' performance and satisfaction of a clinical pharmacokinetics course delivered live and by interactive videoconferencing. *Am J Pharm Educ.* 2006;70(1): Article 10.
3. Lenz TL, Monaghan MS, Wilson AF, Tilleman JA, Jones RM, Hayes MM. Using performance-based assessments to evaluate parity between a campus and distance education pathway. *Am J Pharm Educ.* 2006;70(4):Article 90.

4. MacLaughlin EJ, Supernaw RB, Howard KA. Impact of distance-learning using videoconferencing technology on student performance. *Am J Pharm Educ.* 2004;68(3):Article 58.
5. Reid LD, McKenzie M. A preliminary report on the academic performance of pharmacy students in a distance education program. *Am J Pharm Educ.* 2004;68(3):Article 65.
6. Mobley WC. Adaptation of a hypertext pharmaceutics course for videoconference-based distance education. *Am J Pharm Educ.* 2002;66(2):140-143.
7. Larreamendy-Joerns J, Leinhardt G. Going the distance with online education. *Rev Educ Res.* 2006;76(4):567-605.
8. Vrasidas C, McIsaac M. Factors influencing interaction in an online course. *Am J Distance Educ.* 1999;13(3):22-36.
9. Lee HJ, Rha I. Influence of structure and interaction on student achievement and satisfaction in web-based distance learning. *Educ Technol Soc.* 2009;12(4):372-382.
10. Stein DS, Wanstreet CE, Calvin J, Overtoom C, Wheaton JE. Bridging the transactional distance gap in online learning environments. *Am J Distance Educ.* 2005;19(2):105-118.
11. Alsharif NZ, Galt KA. Evaluation of an instructional model to teach clinically relevant medicinal chemistry in a campus and a distance pathway. *Am J Pharm Educ.* 2008;72(2):Article 31.
12. Henriksen B, Roche V. Creation of medicinal chemistry learning communities through enhanced technology and interdisciplinary collaboration. *Am J Pharm Educ.* 2012;76(8):Article 158.
13. Mehvar, R. A participation requirement to engage students in a pharmacokinetics course synchronously taught at a local and distant campus. *Am J Pharm Educ.* 2010;74(7):Article 118.
14. Steinberg M, Morin AK. Academic performance in a pharmacotherapeutics course sequence taught synchronously on two campuses using distance education technology. *Am J Pharm Educ.* 2011;75(8):Article 150.
15. Moore MG, Kearsley G. *Distance Education: A Systems View of Online Learning.* Belmont, CA: Cengage Learning; 2012.
16. Lear JL, Ansorge C, Steckelberg A. Interactivity/community process model for the online education environment. *J Online Learn Teach.* 2010:6(1). http://jolt.merlot.org/vol6no1/lear_0310.pdf. Accessed November 5, 2012.
17. Bergmann J, Sams A. *Flip Your Classroom: Reach Every Student in Every Class Every Day.* International Society for Technology in Education; 2012.
18. Deslauriers L, Schelew E, Wieman C. Improved learning in a large-enrollment physics class. *Science.* 2011;332(6031):862-864.
19. Lage MJ, Platt GJ, Treglia M. Inverting the classroom: a gateway to creating an inclusive learning environment. *J Econ Educ.* 2000;31 (1):30-43.
20. Foertsch J, Moses G, Strikwerda J, Litzkow M. Reversing the lecture/homework paradigm using eTEACH web-based streaming video software. *J Eng Educ.* 2002;91(3):267-274.
21. Kuh GD, Kinzie J, Buckley J, Bridges B, Hayek J C. *Piecing Together the Student Success Puzzle: Research, Propositions, and Recommendations.* ASHE Higher Education Report, 32(5). San Francisco: Jossey-Bass; 2007.
22. Carini RM, Kuh GD, Klein SP. Student engagement and student learning: testing the linkages. *Res High Educ.* 2006;47(1):1-32.
23. Yorke M. Retention, persistence and success in on-campus higher education, and their enhancement in open and distance learning. *Open Learn.* 2004;19(1).
24. Richard C, Rahman A, Kidd RS. Student pharmacists' use and perceived impact of educational technologies. *Am J Pharm Educ.* 2011;75(5):Article 92.
25. Culver S. Course grades, quality of student engagement, and students' evaluation of instructor. *Int J Teach Learn High Educ.* 2010;22(3):331-336.
26. Lizzio A, Wilson K, Simons R. University students' perceptions of the learning environment and academic outcomes: Implications for theory and practice. *Stud High Educ.* 2002;27(1):27-52. http://www.itl.usyd.edu.au/programs/P%26P/lizzio_wilson_simons.pdf. Accessed November 18, 2012.
27. Gleason BL, Peeters MJ, Resman-Targoff BH, et al. An active-learning strategies primer for achieving ability-based educational outcomes. *Am J Pharm Educ.* 2011;75(9):Article 186.
28. UNC Eshelman School of Pharmacy. Active learning techniques: alternatives to traditional lectures. https://learn.pharmacy.unc.edu/alt/. Accessed October 2, 2012.
29. Kee TP. The one minute lecture. *Educ Chem.* 1995;32:100-101.
30. Anderson LW, Krathwohl, DR, eds. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives.* New York: Longman; 2001.
31. Bloom BS, Engelhart MD, Furst EJ, Hill WH, Krathwohl DR. *Taxonomy of Educational Objectives: The Classification of Educational Goals; Handbook I: Cognitive Domain.* New York: Longmans, Green; 1956.
32. Strauss AL, Corbin JM. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques. University of Michigan*: Sage Publications; 1990.
33. Cain J, Black EP, Rohr J. An audience response system strategy to improve student motivation, attention, and feedback. *Am J Pharm Educ.* 2009;73(2):Article 21.
34. Ernst H, Colthorpe K. Expanding voluntary active-learning opportunities. *Am J Pharm Educ.* 2008;72(2):Article 28.
35. Persky A. Multi-faceted approach to improve learning in pharmacokinetics. *Am J Pharm Educ.* 2008;72(2):Article 36.
36. Pierce R, Cox J. Vodcasts and active-learning exercises in a "flipped classroom" model of a renal pharmacotherapy module. *Am J Pharm Educ.* 2012;76(10):Article 196.
37. Blouin RA, Joyner PU, Pollack GM. Preparing for a renaissance in pharmacy education: the need, opportunity, and capacity for change. *Am J Pharm Educ.* 2008;72(2):Article 42.
38. Blouin RA, Riffee WH, Robinson ET, et al. Roles of innovation in education delivery. *Am J Pharm Educ.* 2009;73(8): Article 154.