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# The Impact of Blended Learning on Retention, Performance and Persistence in an Allied Health Gateway Lab/Lecture Course in an Urban Community College

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## Abstract

The purpose of this study was to compare blended and face-to-face (FTF) teaching in student learning outcomes, retention, likelihood of repeating the course, likelihood of taking the subsequent course in a sequence, and performance in the subsequent course. We tested the null hypotheses that all of the above mentioned variables were independent of the teaching format by comparing eight semesters of blended and FTF sections of Human Anatomy and Physiology I. We found no difference in retention, student learning outcomes, nor the likelihood of repeating the course. Completing a blended section of the first semester of Anatomy and Physiology did not have an impact on performance (grade distribution) in the second semester of Anatomy and Physiology relative to students in FTF sections. A large majority of students in a blended section answered that they would take a blended course again, and that they would recommend it to a friend. However, fewer students completing a blended section went on to the second semester of the course.

*Keywords*: gateway course, blended learning, hybrid learning, distance learning, anatomy and physiology, urban community college, course sequence, longitudinal study, Bronx Community College

## Introduction

In the 2016 fall semester, more than 6.3 million students took at least one online course, and the percentage of students enrolled in online courses expanded for at least the 14th consecutive year (Allen & Seaman, 2017). The increasing popularity of internet- and computer-aided education demands an analysis of its usefulness to the various members of the learning community. For administrators, the benefit is clear: greater cost-effectiveness in terms of faculty labor (especially when considering MOOCs) and facilities usage, and the promise of greater student enrollment, tuition and fees. For faculty, there are potential benefits and pitfalls. Technology can free faculty from the classroom, allow more time for research and also be part of a robust curriculum, leading to positive learning outcomes (discussed below). On the other hand, many faculty value personal interaction with students and may view the loss of time in the classroom as negative. Furthermore, there is the continuous hazard of prioritizing or fetishizing the technology over pedagogy.

There are many terms, and just as many pedagogical strategies, for the inclusion of computer- or internet- based tools in higher education. In general, they are categorized along a spectrum, ranked by the percent of instruction that is done in a face-to-face (FTF) setting. “Web-enhanced” or “web-facilitated” instruction typically refers to a traditional

FTF lecture in which the instructor makes available various online tools and resources for students' use (typically 1-29% delivered online). Meanwhile, "blended" or "hybrid" learning replaces a certain percentage of FTF instruction with online interaction (typically 30-79%) and "online" courses are conducted via the internet (typically 80+%) (Allen & Seaman, 2017).

Of course the primary question researchers in pedagogy are obliged to ask (and attempt to answer) is how the inclusion of technology in education is affecting students. Are they leaving these classes with a greater understanding of the material? How do grades, for better or worse, the standard metric we have for determining learning, compare between the technology-enhanced and traditional classrooms? Is student perception of learning equivalent across settings? While there is a great deal of existing research about the impact of computers and the internet on educational outcomes, a consensus has been hard to reach. Meta-analyses have found similar student performance between online and FTF courses (Bernard, et al., 2014; Means et al., 2013), students in e-learning (Shachar & Neumann, 2010) or blended (Means, et al., 2013) environments outperforming students in FTF sections. Meanwhile, a poll of both administrators and faculty found that 74% of higher education leaders see learning outcomes as the same or superior in online versus traditional courses (Allen & Seaman, 2013).

Blended learning is a quite broad term that describes an array of pedagogical approaches, course designs, assessment tools, media employed, percentages of online material, etc. (Bernard et al., 2014; Driscoll & Carliner, 2005). The extant research on blended learning is quite varied: Some studies find some improvement in student learning (McFarlin, 2008; Melton, Bland, & Chopak-Foss, 2009; Pereira et al., 2007; White &

Sykes, 2012), some show no statistical difference (Abdullahi, 2011; Carbonaro et al., 2008; Dantas & Kemm, 2008) and some even find lower mastery of concepts delivered in a blended environment (Vamosi, Pierce, & Slotkin, 2004). Al-Qahtani & Higgins, (2013) found that students in a blended environment outperformed students in both traditional and fully online settings. (See Zhao, Y & Breslow, L, (2013) for a meta-analysis.) The lack of general agreement in the research community can most likely be traced to the large degree of variation in the construction and delivery of course material in these studies.

Clearly defining the variables that make up the learning environment is important in making statements about the efficacy of blended learning. For example, the overall academic setting (community college versus four-year college, or public versus private) can be an important variable in the study of the efficacy of online learning. For example, students at community colleges comprise a different population base than that of 4-year institutions. In addition to students seeking professional certification or job training, community colleges also serve a larger portion of English language learners, as well as those with poor academic records and greater financial hardship (Grubb, 2002). For these students, the rigors of college life that more prepared students may find inconsequential can be substantial, to say nothing of the challenges associated with taking a blended course. During the Spring 2019 semester at our institution (Bronx Community College), for example, 55% of students identified as the first member of their family to attend college. The educational setting may be especially important if faculty perceptions and motivating factors across institution types are different. (Windes & Lesht, 2014).

As noted above, research indicates that in a lecture or survey course setting, blended learning strategies can lead to improved student outcomes. While the strategy for blending these types of courses is fairly standard (replacing some percentage of lectures with on-line or computer-aided activities), the ways to blend laboratory science courses show more variability. Some studies have examined replacing lab sessions with "virtual" labs (Brinson, 2015), at-home lab sessions (Lyall & Patti, 2010), or both (Brewer, Cinel, Harrison, & Mohr, 2013). In fact, there is relatively little data on blending lab sciences in general, and even less on combining online lectures with hands-on labs in particular (see Abdullahi (2011) for one example).

In this study we report our findings comparing blended and face-to-face (FTF) sections of the first semester of Anatomy and Physiology (A&P I). This course, populated almost exclusively by students in Allied Health majors, consists of a lecture and lab component. While the in-class lab component was consistent between section types, the lectures were entirely online in the blended sections. In particular we asked the following questions:

1. Does retention differ between blended and FTF sections?
2. Do student-learning outcomes, as measured by summative assessment, differ between blended and FTF sections?
3. Does the number of repeating students differ between blended and FTF sections?
4. Does taking a blended section correlate with continuation in the program of study?
5. Does completing a blended section of the first semester of Anatomy and Physiology have an impact on performance in the second semester, relative to students in FTF sections?

6. Would a student who took a A&P I blended section take another blended course, and would s/he recommend a friend to take a blended course?

## Methods

This study was conducted over eight semesters at Bronx Community College, a campus of the City University of New York, in multiple sections of Human Anatomy and Physiology I (hereafter "A&P I"), a gateway course for the Allied Health careers (Nursing, Radiologic Technology, Nuclear Medicine Technology, Dietetics and Nutrition Science, and Therapeutic Recreation).

### Section Formats

Two teaching formats of A&P I course were selected for this study: a blended course format and an FTF course format. Learning objectives and course content were the same for all sections. Different instructors taught each one of the FTF sections ($N_{FTF\ sections}$=151), whereas the same instructor taught blended sections ($N_{B\ sections}$=8). Each section consisted of lab and lecture sessions: Lab sessions were the same across all sections while lecture sessions were completely web-based in the blended sections. In these sections students followed a weekly assignment schedule that consisted of 1) reading course content from the textbook and from instructor's notes, 2) completing a crossword puzzle with new terms and concepts, 3) watching videos and/or online tutorials, and finally, 4) taking an online quiz about the week's content. Students in the blended sections also had review sessions available before each one of the lecture exams. Review sessions

emphasized important facts and concepts, and integrated those facts and concepts. Students in both FTF and blended sections had the Biology Study Center available with tutors, but blended students had a teaching assistant (tutor) assigned to the course, so the tutor-to-student ratio was much higher than in FTF sections. Students in both section types took four fifty-question multiple choice lecture exams (blended students took these exams online while FTF students took them in class) and an in-person seventy-five question, cumulative, multiple-choice common final exam.

**Description of Resources for Blended Sections**

- **Professor lecture notes** were provided as PowerPoint presentations via BlackBoard. Slides were built using images from the textbook and open education resources and included a summary of important facts and concepts. Each slide included just the minimum information necessary to understand a fact or concept.
- **Textbook** was purchased by students and readings from it were assigned weekly.
- **Crosswords** were built by the instructor using EclipseCrossword™, and were available to be completed online. The crosswords included vocabulary and key concepts associated with the course learning objectives.
- YouTube based **short videos** focused on one or a few concepts associated with the course learning objectives and were typically a few minutes in length.
- **Animations and tutorials** online**,** similar to the videos, were generally of short duration and reviewed important concepts.

- **Weekly online lecture quizzes** consisted primarily of multiple-choice and true/false questions, which covered all content from the week's assignment, including vocabulary and concepts.

## Statistical Analysis

Contingency tables were used to compare blended and FTF grade distributions. Significance was set at 95% confidence level (P value <0.05) using chi square tests. 2 x 2 tables were used to compare blended and FTF retention, likelihood of repeating the course, and likelihood of taking A&P II after A&P I. Calculations were carried out using VassarStats© (Lowry 2019).

## Results

**Retention and grade distribution.:** In the eight semesters analyzed for this report, retention and final grade were independent of whether a student took a FTF or blended section. The withdrawal rate (30%, $N_{FTF}$=3582, and 31%, $N_B$=167; $\chi^2$ = 0.0507, P= 0.83) is indicated by the "W" column in Figure 1. There was no significant difference in A-F grade distribution between A&P I blended and FTF sections (Figure 1) ($\chi^2$=2.9, P=0.57, df=4).

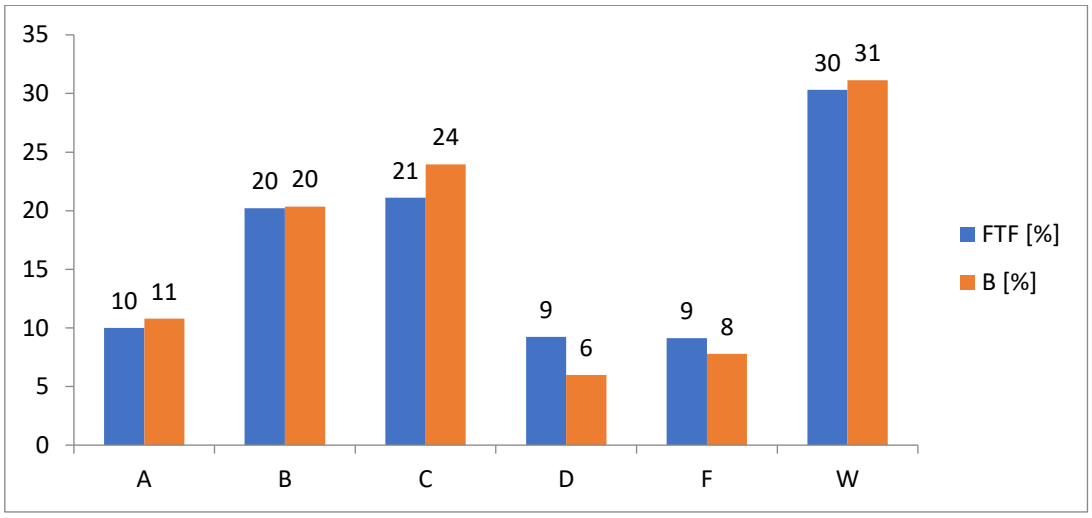


**Figure 1.** A&P I Blended vs. FTF Grade Distribution Comparison. Numbers on bars show percentages ($N_{FTF}$= 3582, $N_B$=167)

**Repeating A&P I:** The likelihood of repeating the course within at least two semesters was independent of section type. (Figure 2) ($\chi^2$ = 0.1486, p= 0.70).

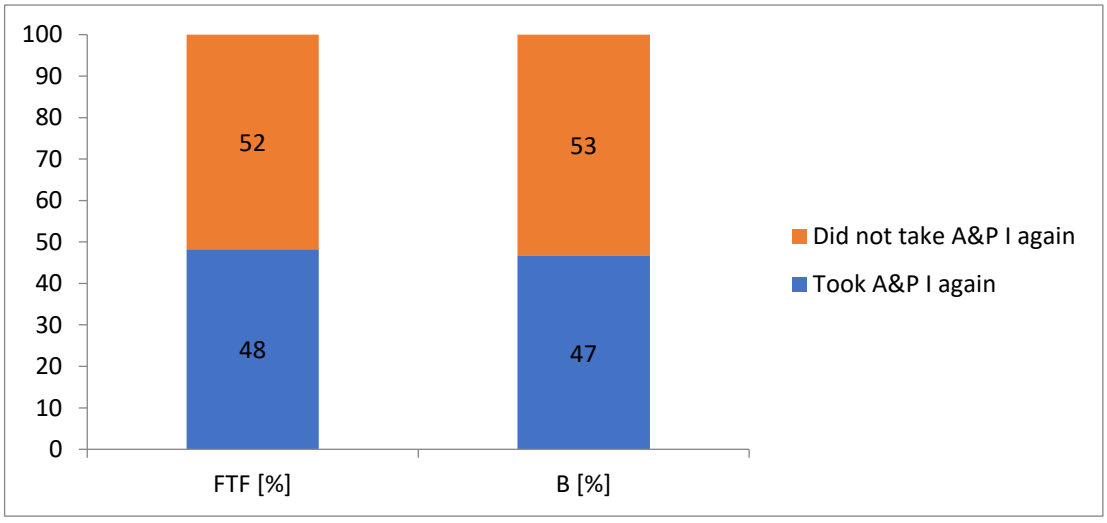


**Figure 2.** FTF vs. Blended Students retaking A&P I. Numbers in bars show percentage ($N_{FTF}$= 3624, $N_B$=169)

**Taking A&P II after A&P I:** Taking the second semester of A&P was significantly correlated with whether a student took a FTF or blended section (Figure 3). 46% of blended students and 55% of FTF students took A&P II ($\chi^2 = 5.2274$, $p = 0.02$) within at least two semesters of taking A&P I.

Students who do not take A&P II after A&P I include a mix of those whose curricula did not require A&P II, those who had not taken it (but planned to) when the analysis was completed, and those who did or intended to take the course, but transferred to another institution before doing so.

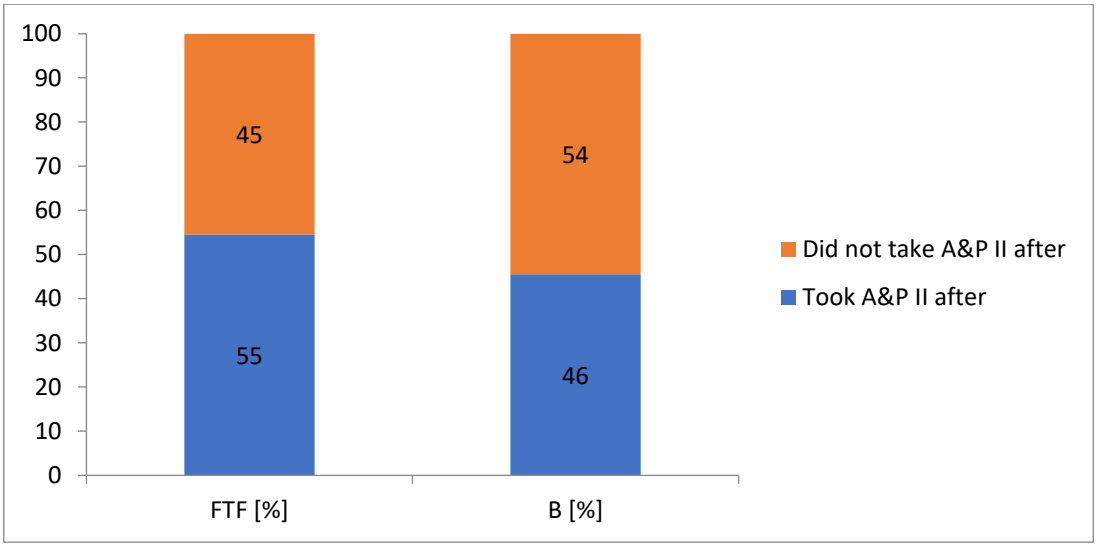


**Figure 3.** FTF vs. Blended students follow-up into A&P II. Numbers in bars show percentage ($N_{FTF}$=3589, $N_B$=167)

**Performance in A&P II.** There was no significant difference in A-F grade distribution between FTF and blended students ($\chi^2$=1.78, p=0.78, df=4). (Figure 4).

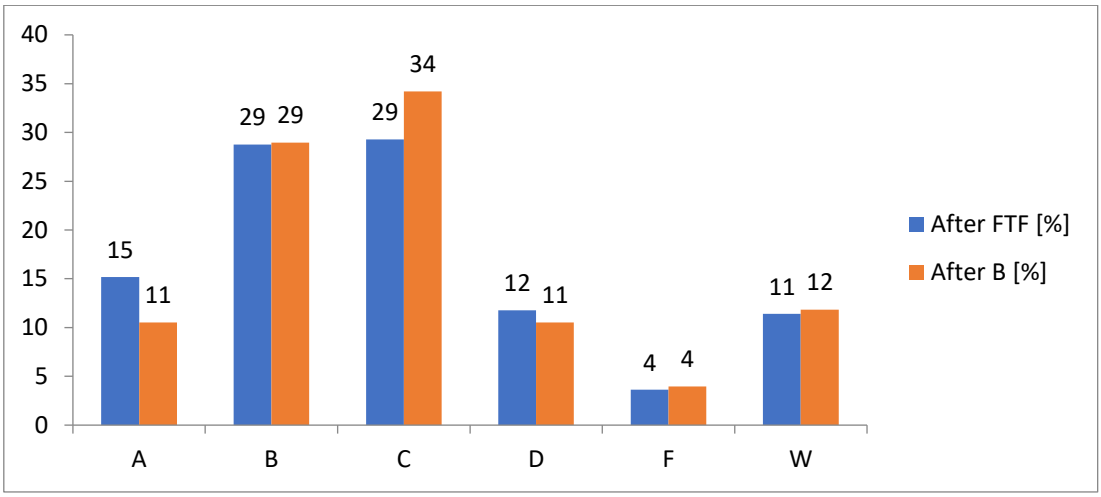


**Figure 4.** Grade distribution for A&P II of students after taking A&P I FTF vs. after taking A&P I Blended ($N_{FTF}$=1957, $N_B$=76)

**Student perception of blended course:** Among survey respondents (N=57), 88% indicated that they would take a blended course again and 86% would recommend taking a blended course to a friend (Figure 5).

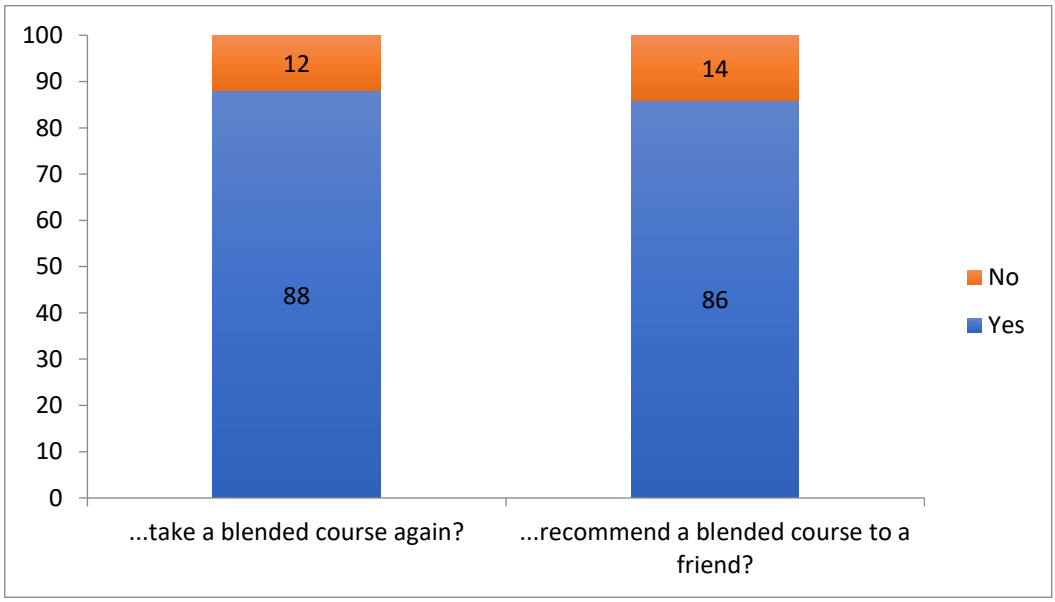


**Figure 5.** "Would you…" Data on five A&P I blended sections (N=57). Numbers in bars show percentage

## Discussion

Our data agree with a number of previous studies (Abdullahi, 2011; Carbonaro et al., 2008; Dantas & Kemm, 2008), though certainly not all, indicating that students in blended and FTF sections have similar learning outcomes. Given the disagreement in the field, it is perhaps important to ask whether equivalent outcomes between blended and FTF sections represent the best possible outcome or have we missed something in our course design that could have allowed our blended students to outperform their FTF counterparts? The most satisfactory answer to this question should involve comparing courses that are blended in the same way. Currently, the effectiveness of our course design, making lectures 100% asynchronous while maintaining a weekly in-class laboratory session, has been studied by relatively few researchers. One study that closely matched ours (Abdullahi, 2011) found similar outcomes among students in blended and FTF sections.

As we might expect from the reported variation, course design has been found to be a critical factor when analyzing the effectiveness of online education. Interactivity and student-instructor interaction is an important component of satisfaction and persistence for online learners (Croxton, 2014) and technologies which promote collaboration and mimic the interaction between student and professor had a significant positive impact on student performance (Levy, 2013). Our blended sections had an instructional design that made students cover learning objectives in multiple and repetitive ways (textbook, professor notes, videos, animations, tutor availability, and review sessions) and forced them to practice (quizzes with multiple attempts, crosswords). A portion of lab sessions were used to connect, discuss, and review lecture concepts assigned to them for the online session.

This created a situation where there was more congruity between lab and lecture in the blended sections than in the FTF sections (where lab and lecture topics are often out of sync). Using lab time to reinforce the online experience, and vice versa, may have worked as an advantage and influenced student satisfaction with the course. Young (2002) discussed this idea of using online tools to continue class time when blended learning started to become a widespread course format in U.S. colleges. It is also possible that students benefitted from a greater sense of community, which has been identified as a benefit to blended learning over both traditional and fully-online courses (Rovai & Jordan, 2004). In fact, the instructor teaching the blended sections observed students working more cohesively, and advising peers on the best strategies to succeed in the course more often (at least in class) than among students in other traditional FTF sections. Interaction with the instructor and active discussion are critical factors in determining student perception of their course (Swan, 2001).

Receiving support in the form of technical help is also a key factor in overall student satisfaction (Lee, et al., 2011) and so it is noteworthy that our blended students had access to a tutor. The tutor was a high performer in the class as well as someone well versed in dealing with the technological issues that students were expected to face. Especially at the beginning of the semester, students asked for assistance from both professor and tutor (e.g. how to access or retake a quiz, how to print PowerPoints, how to submit crosswords, how to play some of the online animations, etc.) and found a quick response. This not only contributed with overcoming technical issues, but may have also contributed with building the sense of community mentioned above.

The generally positive perception of the blended course is noteworthy, especially considering the high percentage of students who were unaware that they were enrolling in a blended course. These students might be expected to transfer their displeasure with the registration procedure to the course itself. However, greater than 85% of students expressed both that they would take a blended course again and recommend a blended course to their peers. Personal communication with students revealed that many of them struggled to make it to the end of the semester, meaning it is unlikely that they found the course easier from a content standpoint. Furthermore, reducing commuting time and money - often cited as an advantage of distance learning - was a defining reason for only a handful. In fact, most students came to review sessions before exams and to the Tutoring Center for help, as well as taking other FTF classes during the week.

Among the numerous studies analyzing various aspects of blended and online courses, there is a scarcity of longitudinal studies looking into the impact of blended courses on subsequent courses, or future studies. Burns, et al. (2013) found that among students taking an introductory information systems course, the blended and online students performed better than FTF students in the following course in the sequence. Dell (2012) found that an online elementary education cohort demonstrated the same proficiency as an FTF cohort.

The only area where we observed a significant difference between blended and FTF course takers was in the continuation of studies. 55% of FTF A&P I students went on to take A&P II, while only 46% of blended students did (Figure 3). The withdrawal and failure rates for FTF and blended sections were not significantly different, ruling out an

indirect effect. There are other potential explanations for the lack of progress through the course sequence, such as continuing to A&P II after our study period, or not needing A&P II for their major, or transferring schools in between A&P I and II, but these factors would not be expected to differ between FTF and blended sections.

It is possible that students in blended sections are more likely to have obligations outside of the classroom (which may drive them to enroll in the blended sections in the first place). A change in these obligations (family, employment, etc.) may cause a disruption in progress through the A&P sequence. A future study should survey students to explore this possibility. It is possible that there is bias introduced due to the fact that, while we offer multiple blended sections of A&P I, our blended offerings of A&P II were, at the time of the study, more limited. Students from blended sections, wishing to continue with that model, may have discontinued their studies, changed majors or transferred institutions before a seat in a blended A&P II section became available. Given the overall positive student perceptions of blended learning and the comparable performance to FTF sections, understanding the reasons behind the difference in persistence is of great interest.

Our findings that student outcomes were generally similar between blended and face-to-face sections align with the only other study (Abdullahi, 2011) that closely matches the learning environment that we created. While this congruence is promising, more studies need to be completed to build confidence in this particular model of blended learning.

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