

INTRODUCTION

Student retention, defined as first-time, full-time college students returning to the institution for their second year, is associated with greater student persistence and graduation rates. According to the U.S. Department of Education, National Center for Education Statistics, retention rates of first-year, full-time college students at public 4-yr institutions of higher education averaged 81% as of 2019 (13). Nationwide, nearly one-third of first-year freshmen do not return for their sophomore year, and undergraduate 5-yr graduation rates are ~40%. There are many factors associated with retention, some are fixed [e.g., socioeconomic, minority, or first-generation status, high school grade point average (GPA), etc.], whereas others are more easily influenced by university programming efforts (e.g., student perceptions). Indeed, students’ perceptions of institutional quality and overall satisfaction with college experience are suggested to be predominant predictors of persistence and student success (12).

Students’ perceptions of support for student learning and responsiveness of faculty and staff affect their decisions to persist in a program (12). Improving student perceptions can be achieved by academic support programs that help students succeed in college (11, 12, 20). When advising provides knowledge about successfully navigating higher education, it can promote student persistence and positively affect retention (18). Furthermore, purposeful student-faculty interaction, both formal and informal, is associated with student retention (12, 18). Students’ perception of accessibility to faculty for help and support was one of the most important factors that significantly reduced students’ likelihood of leaving a major (specialized area of study, e.g., chemistry) or institution early (20). Clearly, positive student perceptions of support programs, advising, and faculty availability improve student retention. However, while much research has focused on addressing student perceptions at the university level, for retention efforts to be successful at large, public institutions, it could be argued that they would be more effective on a smaller scale, for instance at the level of individual programs, since both student-faculty interactions and advising occur within majors. Furthermore, while all students benefit from academic support programs and responsive faculty and advisors, those students most at risk for attrition might be most positively affected, especially regarding retention.

Despite the President’s Council of Advisors on Science and Technology entreaty to colleges and universities to produce more science, technology, engineering, and mathematics (STEM) graduates (8), more than one-half of freshmen who declared STEM majors at the start of college left these fields before graduation (5, 10), and many of those who left STEM were actually high-performing students (17). In STEM majors, the graduation rate of students is roughly 20% below their counterparts in non-STEM majors (10). Clearly, STEM-specific retention initiatives are warranted, and, while exercise physiology could be classified as a non-STEM field (health sciences), the required progression through math, physics, and chemistry courses categorizes this particular program as a STEM major. However, little work has directly investigated freshman retention in physiology in particular.

Due to the rigorous scientific course work that begins the first semester of freshman year, undergraduate physiology programs are especially vulnerable to retention-related issues. One proven method of addressing freshman student retention is through first-year courses (e.g., first-year seminar, or FYS),
which aid students in navigating their first year of college, including developing life skills, improving academic strategies, and increasing a sense of belonging (3). These courses have been shown to improve retention and graduation rates, as well as academic self-efficacy and self-regulated learning (3). When held within a major, a first-year course offers the opportunity to address retention-related issues (e.g., improving perceptions of student learning, responsiveness of faculty, and accessible advising) on a manageable scale.

Therefore, this study aimed to systematically examine the effects of a targeted intervention to address retention in at-risk freshmen within an undergraduate exercise physiology program by comparing a retention intervention against a control group. The primary outcome of this study was to investigate whether the semester intervention would elicit positive student perceptions of factors related to retention (e.g., academic advising and FYS courses) in students at risk for attrition, compared with a control group (not at-risk freshmen). The secondary outcome was to determine whether this intervention would elicit higher retention rates into the second year, both at the institution and within the major, as assessed by longitudinal follow up. Additionally, this study sought to better understand the program’s freshman population, specifically at-risk compared with not-at-risk students, through exploratory methods, with the goal of informing the development of potential avenues for improving program retention moving forward. To better understand the impact of the intervention, a Scholarship of Teaching and Learning (SoTL) lens was used to systematically examine the programmatic intervention to reflect on and improve teaching.

METHODS

This project was approved by the internal review board at West Virginia University (IRB no. 1807211250).

Theoretical Framework

To better understand the impact of the intervention, programmatic interventions were closely examined through a SoTL lens. Specifically, SoTL uses a systematic approach to reflect on and improve teaching and then disseminate the findings of the work. Bronnimann, et al. (2) stated that, “the goal of SoTL is the improvement of the student experience and improvement in learning and teaching” (see p. 356). This SoTL work was aligned with the data focused questions of Prosser and Trigwell (16) to better understand and explain what they were trying to explore, how they were going to explore the intervention, what data they would collect, and how they would collect, analyze, and interpret the data. Given that this investigation focused on improving student success and retention at the program level, as well as the institution, this research was guided by Trigwell’s (19) six stages of SoTL.

First, the theoretical perspectives that guided this investigation focused on student perceptions of support for student learning and responsiveness of faculty and how that impacts retention in an undergraduate physiology program. In addition to the primary focus, this investigation also looked at how student perceptions can be positively impacted by academic supports provided by the program (12). Second, this research team developed an intervention for the program retention issue they were addressing. Third, they developed a research question to be able to adequately address the data questions presented by Prosser and Trigwell (16). The fourth stage of SoTL involved implementing a systematic intervention that targeted the research question and provided the necessary data to examine the question. Next, the team worked collaboratively to prepare a product for public review. Finally, the investigators worked through multiple pathways (e.g., presentations, articles, etc.) to disseminate this SoTL information.

Participants

Undergraduate exercise physiology freshmen considered at risk for attrition were enrolled in a first-year course focused on improving retention. To identify at-risk students, an expert panel within the program identified incoming math scores as the best metric to predict student success within the major based on previous findings (4, 9, 17). In the late summer 2018, incoming freshmen were sorted into at-risk for retention (retention) (n = 82) and non-retention (non-retention) (n = 165) FYS courses based on incoming math placement. Those that placed into college algebra (math ACT ≥ 22, math SAT ≥ 570) or higher were placed in the non-retention course, and all others were placed into the retention course. The retention specialist faculty (an assistant professor) taught the retention section of the FYS course and was the faculty advisor for all retention freshmen (n = 77), except for those students who were honors student (one), student athletes (three), or student veterans (one) (these students were assigned different faculty advisors as stipulated by the university). An assistant professor who had previously taught the FYS course taught the non-retention section of the FYS course following standard university practice (described below). Non-retention freshman students were randomly assigned to faculty academic advisors within the department.

Course Overview

The FYS course is taught university wide and overseen by the centralized Center for Learning Advising and Student Success (CLASS). The general curriculum and expected learning outcomes for the course are the same throughout the university, but the specifics and methods of teaching are left to the individual instructor. In exercise physiology, the first 8 wk were typically spent preparing students to achieve academic success (e.g., time management, finding campus resources, etc.), whereas the last 8 wk were allocated for invited guest lectures to share with students various careers available in exercise physiology. While both the retention and non-retention sections of the exercise physiology FYS followed this structure, the retention section addressed retention-specific issues, as determined from an Initial Survey.

Initial Survey

The Initial Survey served two purposes: to better understand the program’s freshman population, specifically at-risk compared with not-at-risk students, as well as to inform the development of specific content for the retention FYS. The Initial Survey was a 43-item questionnaire administered online via Qualtrics (LLC Qualtrics, Provo, UT) in the first week of the semester. Both sections of the FYS were given class credit for completion of the survey. The survey assessed demographic characteristics, as well as factors related to retention, including university fit, attitudes toward and perceptions of college, academic preparedness, high school experience, and current and future goals (Table 1). Likert questions were on 5-point scale; lower values were associated with more favorable responses.

Intervention

The intervention spanned the fall 2018 semester, with outcomes evaluated near the end of the semester. The two primary components of this intervention were delivery of the FYS course curriculum and academic advising that promoted accessibility to faculty for help and support; both the FYS curriculum and advising approach were developed from the Initial Survey findings (Table 1).

Course curriculum. Much of the curriculum for FYS was outlined by the university to ensure all incoming freshmen throughout the university received similar content. However, the curriculum in the retention FYS specifically addressed the primary concerns (e.g.,
Table 1. *Initial survey responses*

| Question                                                                 | All Freshmen | Non-Retention | Retention |
|--------------------------------------------------------------------------|--------------|---------------|-----------|
| Do you identify as a minority? (yes)                                    | 13           | 7             | 18        |
| Are you from Appalachia? (yes)                                          | 51           | 60            | 35        |
| Are you a student veteran? (yes)                                        | 1            | 2             | 1         |
| Is English your first (native) language? (no)                           | 98           | 99            | 97        |
| How likely are you to go home during your first month of school? (somewhat or extremely likely) | 63           | 66            | 56        |
| What are your plans after you graduate?                                 |              |               |           |
| Medical school                                                          | 38           | 43            | 27        |
| Dental school                                                           | 8            | 9             | 4         |
| Occupational therapy                                                    | 2            | 1             | 1         |
| Physical therapy                                                        | 34           | 31            | 44        |
| Chiropractic school                                                     | 3            | 2             | 5         |
| Physician’s assistant program                                           | 16           | 16            | 18        |
| Graduate school                                                         | 1            | 1             | 3         |
| Start working                                                           | 2            | 1             | 3         |
| Other                                                                   | 5            | 5             | 3         |
| Compared with other seniors in your graduating high school class, how would you rank yourself? |              |               |           |
| Far above average                                                       | 31           | 42            | 13        |
| Somewhat above average                                                  | 57           | 54            | 64        |
| Average                                                                 | 12           | 4             | 23        |
| Somewhat below average                                                  | 0            | 0             | 0         |
| Far below average                                                       | 0            | 0             | 0         |
| Are you a first-generation college student? (yes)                       | 20           | 15            | 26        |
| How well do you expect to do in college?                                |              |               |           |
| Mostly A’s                                                              | 35           | 41            | 30        |
| Mix of A’s and B’s                                                      | 60           | 57            | 69        |
| Mostly B’s                                                              | 3            | 1             | 1         |
| Mix of B’s and C’s                                                      | 1            | 1             | 0         |
| Mostly C’s                                                              | 0            | 0             | 0         |
| Mix of C’s and D’s                                                      | 0            | 0             | 0         |
| Mostly D’s                                                              | 0            | 0             | 0         |
| Which of the following do you feel you are well prepared for? Select all that apply. |              |               |           |
| Time management                                                         | 50           | 60            | 39        |
| Study skills                                                            | 27           | 35            | 12        |
| Note taking                                                             | 66           | 74            | 55        |
| Reading comprehension                                                   | 45           | 54            | 29        |
| Critical thinking                                                       | 47           | 55            | 30        |
| Meeting deadlines                                                       | 73           | 83            | 62        |
| Which of the following do you feel you are underprepared for? Select all that apply. |              |               |           |
| Time management                                                         | 41           | 38            | 44        |
| Study skills                                                            | 61           | 62            | 62        |
| Note taking                                                             | 23           | 27            | 19        |
| Reading comprehension                                                   | 30           | 32            | 30        |
| Critical thinking                                                       | 30           | 33            | 29        |
| Meeting deadlines                                                       | 13           | 13            | 8         |
| Which of the following do you feel you are well prepared for? Select all that apply. |              |               |           |
| Math                                                                    | 58           | 75            | 40        |
| Biology                                                                 | 55           | 56            | 53        |
| Chemistry                                                               | 29           | 41            | 13        |
| Writing                                                                 | 47           | 51            | 43        |
| English                                                                 | 60           | 71            | 47        |
| Physics                                                                 | 13           | 15            | 5         |
| Which of the following do you feel you are underprepared for? Select all that apply. |              |               |           |
| Math                                                                    | 34           | 22            | 44        |
| Biology                                                                 | 31           | 33            | 26        |
| Chemistry                                                               | 55           | 50            | 57        |
| Writing                                                                 | 26           | 29            | 22        |
| English                                                                 | 16           | 18            | 12        |
| Physics                                                                 | 62           | 74            | 44        |
| Which of the following do you feel might be a challenge for you during your freshman year? |              |               |           |
| Select all that apply                                                   |              |               |           |
| Finding campus resources                                                | 15           | 18            | 14        |
| Making friends/fitting in                                               | 21           | 21            | 18        |
| Finding time to study                                                   | 22           | 27            | 18        |
| Efficient/effective studying                                           | 68           | 78            | 51        |
| Getting good grades                                                     | 44           | 51            | 27        |
| Enough sleep                                                            | 60           | 66            | 53        |
| Healthy habits                                                          | 38           | 47            | 27        |
| Mental health                                                           | 40           | 46            | 31        |
| Resisting peer pressure                                                 | 5            | 9             | 1         |
efficient/effective studying, getting enough sleep) of students as identified by the Initial Survey. For example, the university expected FYS to cover time management. According to the Initial Survey, the retention students expected “studying enough” and “getting enough sleep” to be challenging, so the time management lecture and in-class activity focused on allocating sufficient study and sleep time into students’ daily and weekly schedules. Other lectures and activities focused on study skills (e.g., reading comprehension, note taking) and benefits and ease of using campus academic resources (e.g., library, math laboratory tutoring, and professors’ office hours). Given the smaller size of the retention FYS section, the setting was more engaging for students because it was delivered in a small amphitheater-style classroom, compared with the larger non-retention section, which was held in a large audience lecture hall that required a more traditional class.

Midterm grades and semester advising. In October 2018, midsemester grades were released. All undergraduate students in the retention and non-retention groups with a D or F at midterm received a generic e-mail encouraging students to seek academic assistance as needed, citing a list of campus and departmental resources, and including a statement of encouragement on behalf of the department. The non-retention freshman students may have also received counsel from their faculty advisor during their semester advising meeting, but this was not documented. Retention freshman students were required to submit their midterm grades in FYS, and those who had a D/F on their midterm grades included a written plan of action for improving grades by the end of the semester. The retention freshmen brought their midterm grades and written plan of action for improvement to their advising appointment with the retention specialist faculty with whom they had a targeted conversation for addressing study habits, time management, and use of academic resources. Those students were also instructed to attend free tutoring offered by the department; however, this was not compulsory, and attendance was not tracked. By the end of the semester, the retention freshmen had face-to-face interaction with their faculty advisor/retention specialist faculty at least 18 times (at least weekly).

Outcomes

End-of-Semester Survey. During the last 3 wk of classes, all retention and non-retention students were invited to complete the End-of-Semester Survey, a 92-item questionnaire administered online via Qualtrics (LLC Qualtrics, Provo, UT). This survey was different from the Initial Survey to capture students’ impressions of their first semester. Course credit was given again for completing the survey. The survey was adapted from the College Persistence Questionnaire (6) that predicts student attrition based on academic integration, social integration, supportive services satisfaction, degree commitment, institutional commitment, and academic conscientiousness. While the College Persistence Questionnaire is validated at the university level, 36 questions were amended to be specific to the program (e.g., “How confident are you that exercise physiology is the right major for you?”). Additional questions were included to evaluate

| Question | All Freshmen | Non-Retention | Retention |
|----------|-------------|---------------|-----------|
| Do you have any fears about coming to college? Select all that apply. | | | |
| Not getting along with my roommate | 12 | 17 | 9 |
| Not making friends | 24 | 31 | 21 |
| Not spending enough time studying | 52 | 59 | 45 |
| Getting homesick | 25 | 27 | 26 |
| Missing my girlfriend/boyfriend/partner/spouse | 12 | 14 | 13 |
| Feeling left out | 16 | 21 | 12 |
| Feeling like the faculty don’t know me or don’t have time for me | 26 | 33 | 16 |
| Figuring out where to go if I need help with something | 33 | 41 | 23 |
| Other | 13 | 11 | 14 |
| How many hours a week do you plan to study? | | | |
| 0–5 | 8 | 8 | 5 |
| 6–10 | 46 | 44 | 48 |
| 11–15 | 30 | 35 | 25 |
| 16–20 | 10 | 9 | 12 |
| 21–25 | 8 | 9 | 5 |
| 26+ | 3 | 4 | 7 |
| Which of the following on-campus resources do you plan to use once or more this term? Select all that apply. | | | |
| Library | 65 | 79 | 53 |
| Math laboratory | 35 | 50 | 16 |
| Tutoring | 55 | 59 | 52 |
| Student success center | 10 | 10 | 10 |
| Computer laboratories | 19 | 26 | 10 |
| Office hours | 59 | 74 | 40 |
| Student organizations | 38 | 44 | 34 |
| EXPH club | 53 | 62 | 44 |
| Others | 11 | 10 | 9 |
| How many hours a week do you plan to socialize, hang out with friends, and/or party? | | | |
| 0–5 | 19 | 15 | 21 |
| 6–10 | 35 | 38 | 38 |
| 11–15 | 25 | 23 | 27 |
| 16–20 | 12 | 13 | 12 |
| 21–25 | 5 | 5 | 3 |
| 26+ | 4 | 7 | 0 |
| How useful do you think your education in exercise physiology at WVU will be for getting work after college that you would really like? (extremely, very useful) | 93 | 92 | 97 |

Values are the percentage of students who responded.
expected performance outcomes and repeat/replicate Initial Survey questions to assess changes in outcomes across the intervention (e.g., the Initial Survey asked “How many hours a week do you plan to study?” and the End-of-Semester Survey asked “How many hours a week do you typically study?”). Likert questions were on 5-point scale; lower values were associated with more favorable responses.

Qualitative data. Responses from the university-issued student evaluations of instructions were compiled. Individual students’ statements were reviewed and are included as support of data captured from surveys.

Quantitative data. Cumulative student GPAs for the fall 2018 semester, collected from the university registrar, were included. Retention rates were calculated from university registrar data of freshmen returning to the program and institution at the start of the fall 2019 semester.

Analysis

Where appropriate, data are presented in percentages. Descriptive statistics summarizing numerical questionnaire data were analyzed using Microsoft Excel and reported as medians (maximum–minimum). Differences between retention and non-retention groups were compared using two-tailed, unpaired t tests. P values < 0.05 were considered significant.

RESULTS

Initial Survey Results

There was a 97% response rate on the initial survey (240 of the enrolled 247 completed the survey). The complete survey responses for the entire exercise physiology (EXPH) freshman class, as well as for the non-retention and retention groups, are presented in Table 1. Compared with the non-retention group, the retention group self-reported higher relative numbers of minorities (non-retention 7%, retention 18%), but fewer self-identified as from Appalachia (non-retention 60%, retention 35%). More retention students were pursuing physical therapy school (44%) than medical school (27%) compared with non-retention students (physical therapy school 31%, medical school 43%).

More retention students self-identified as average or somewhat above average (87%) in high school compared with the non-retention group, which was more likely to report somewhat and far above average (96%). Both groups had similar academic achievement expectations: 98% of the non-retention group and 99% of the retention group expected “mostly grades of A” or a “mix of A and B grades” in college. Compared with retention students, more non-retention students felt well prepared in areas of academic readiness (time management, study skills, note taking, reading comprehension, critical thinking), but feeling underprepared was equally reported between groups for these same outcomes. More retention students felt unprepared for math compared with the non-retention group. Despite math being a prerequisite for chemistry, there were no differences in feelings of preparedness for chemistry.

At least one-half of the retention group expected challenges when it came to efficient/effective studying, not studying enough, and getting enough sleep. Fewer retention students (27%) expected getting good grades to be a challenge compared with non-retention students (55%). About one-half of students in both groups planned to study between 6 and 10 h/wk and participate in social activities between 6 and 15 h/wk. The non-retention group reported planning to use campus-wide academic resources more than the retention group, especially the library, math tutoring laboratory, and office hours.

Most students agreed that graduating from the university with their undergraduate degree was important (non-retention 76%, retention 82%). Almost all agreed that pursuing a degree in exercise physiology would be very or extremely useful for finding work after college that they would really like (non-retention 92%, retention 97%).

Midterm Grades

Of the 247 freshmen enrolled at the start of the fall 2018 semester, 106 (42% of freshmen) had a D or F grade at midterms, and 51% of those had two or more D/F grades. In the non-retention group, 40% had a D or F grade at midterms, and 44% of those had two or more D/F grades. In the retention group, 48% of students had a D or F grade at midterms and 63% of those had two or more D/F grades.

End-of-Semester Survey

Of the 247 freshmen enrolled in the FYS at the start of the fall 2018 semester, 194 (79%) completed the End-of-Semester Survey. There was a greater relative response rate in the retention group (n = 77, 93%) compared with the non-retention group (n = 118, 75%).

From the adapted College Persistence Questionnaire, freshmen generally responded favorably to questions regarding their perceptions of the exercise physiology program. The significant findings between groups are presented in Table 2. Overall, the retention group reported more favorable responses compared with the non-retention group on questions related to Academic Integration and Support Services Satisfaction in the exercise physiology program.

Students in the retention group also reported more favorable responses to questions pertaining to the FYS course and advising (lower values indicate more favorable responses): “Do you feel your EXPH 191 (e.g., FYS) course helped you prepare for the rigors of college?” (non-retention 2.4 ± 1.0, retention 2.0 ± 0.8; P < 0.01); “Do you feel your EXPH 191 (e.g., FYS) course helped you transition and adjust to college?” (non-retention 2.3 ± 1.1, retention 2.0 ± 0.9; P < 0.01); “Please rate your satisfaction with your advisor” (non-retention 1.8 ± 1.2, retention 1.3 ± 0.6; P < 0.001). Generally, the responses to the university-administered student evaluation of instruction supported these findings: “This class was extremely helpful for my first semester in college.... I enjoyed learning about the on-campus resources and where to get help”; “I really enjoy...my advisor and I enjoyed her class a great deal!”; “[My advisor] was very friendly, and connected well with the class. It was obvious that she cared about everyone in the class and wanted us to succeed. She gave us a lot of opportunities to learn and brought in a lot of good resources that benefited our future and thought process.”

Students in the retention group reported improvements in academic preparedness (e.g., time management, study skills, note taking, critical thinking, and meeting deadlines) with the least improvements in reading comprehension (Table 3). Many retention students reported finding campus resources (47%), making friends and fitting in (44%), and finding time to study (39%) were easier than expected, but studying efficiently and effectively (53%), getting good grades (38%), and maintaining...
Table 2. Adapted college persistence questionnaire

| Question                                                                 | Non-Retention | Retention | P Value |
|--------------------------------------------------------------------------|---------------|-----------|---------|
| **Academic integration**                                                 |               |           |         |
| In general, how satisfied are you with the quality of instruction you are receiving in exercise physiology? | 1 (1–5)       | 1 (1–3)   | 0.01*   |
| (1 = extremely satisfied, 5 = extremely dissatisfied)                    |               |           |         |
| Students differ widely in how much interaction they want to have with exercise physiology faculty. How satisfied are you in the amount of interaction you have? | 2 (1–4)       | 2 (1–4)   | 0.01*   |
| (1 = extremely satisfied, 5 = extremely dissatisfied)                    |               |           |         |
| **Social integration**                                                   |               |           |         |
| How much do you think you have in common with other students in exercise physiology? | 2 (1–5)       | 3 (1–4)   | 0.01*   |
| (1 = a great deal, 5 = none at all)                                     |               |           |         |
| How many of your closest friends are here in exercise physiology with you rather than elsewhere? | 3 (1–5)       | 4 (1–5)   | 0.03*   |
| (1 = all, 5 = none)                                                     |               |           |         |
| **Supportive services satisfactions**                                    |               |           |         |
| How satisfied are you with the academic advisement you receive in exercise physiology? | 1 (1–5)       | 1 (1–4)   | 0.03*   |
| (1 = extremely satisfied, 5 = extremely dissatisfied)                    |               |           |         |
| How easy is it to get answers to your questions about things related to your education here in exercise physiology? | 2 (1–4)       | 1 (1–4)   | 0.01*   |
| (1 = extremely easy, 5 = extremely difficult)                           |               |           |         |

Values are median (minimum–maximum).

DISCUSSION

This SoTL study aimed to better understand the freshman population within an undergraduate exercise physiology program and to investigate the effects of a targeted intervention to address retention for at-risk freshmen within this cohort. Students were considered at risk based on incoming math scores (4, 9, 17). Previous work has shown STEM attrition occurs more frequently among students with weaker academic backgrounds in STEM-required introductory mathematics courses (17). For example, in students who did not take algebra II/trigonometry or higher math courses in high school and started their first year of college in a STEM program, 41% left STEM fields by dropping out of college, and, of those who did take the prerequisite math, one-third switched majors (4).

The primary outcome of this SoTL study was to determine whether the semester intervention would elicit positive student perceptions of factors related to retention (e.g., academic advising and FYS course) compared with a control group. The secondary outcome was to determine whether this intervention elicited higher retention rates into the second year, within both the program and the institution, as assessed by longitudinal follow up. Additionally, this study sought to better understand the program’s freshman population, specifically at-risk compared with not at-risk students, through exploratory methods with the goal of informing the development of potential avenues for improving program retention moving forward. The focus of this work aligns with the SoTL work of Bronnimann et al. (2), which goes beyond small-scale instructor/class SoTL to have a broader impact at the program level.

The intervention was successful in eliciting positive student perceptions of factors related to retention (e.g., academic advising and FYS course) in students at risk for attrition. Students in the retention group reported positive perceptions of the FYS course in helping them prepare for, as well as transition and adjust to, college. These findings are in agreement with previous literature that has found academic support programs that help students succeed in college improve student perceptions (11, 12, 20). Additionally, the retention group included favorable qualitative responses to the instructor evaluation and rated their academic advising more highly than the non-retention group. Since both advising and faculty accessibility promote student persistence and are associated with student retention, it was expected that the positive outcomes in the present study would improve retention rates within the major at longitudinal follow up (the secondary objective of this study) (12, 18, 20).

Healthy habits (43%) and mental health (45%) were harder than expected. Results showed similar trends for the non-retention group (Table 3). Both groups reported primarily using the library (non-retention 79%, retention 78%). Fewer retention students reported using the math laboratory (non-retention 40%, retention 13%) and office hours (non-retention 62%, retention 42%) (Table 3).

Self-reported expectations for fall 2018 final grades were lower for retention students than non-retention students (Table 3). For the fall 2018 term, the average GPA for all EXPH freshmen was 3.139 ± 0.844, but the retention group had a significantly lower GPA than the non-retention group (non-retention GPA 3.333 ± 0.715, retention GPA 2.771 ± 0.947; P < 0.001). By the spring 2019 semester, 48 freshmen transferred out of the program (20%) with little relative difference between groups (non-retention: n = 30, 19%; retention: n = 18, 22%). The majority of the students who transferred out of the department were retained within the university (99%). By summer 2019, 65% of the non-retention group and 57% of the retention group were retained. At the start of fall 2019 term, 55% of the 2018 freshman class was retained within the program (non-retention 66%; retention 39%), and 85% was retained within the university (non-retention 91%, retention 74%).
Retention within the exercise physiology program into the spring semester showed similar rates between groups: 81% and 78% for the non-retention group and retention group, respectively. If math scores are predictive of success in college, and those with lower math scores are less likely to be retained, fewer retention students would be retained into the spring semester. Since this retention intervention achieved similar retention rates between groups, we believe the intervention was successful for the semester during which the intervention was implemented. However, student retention is typically defined as first-time, full-time college students returning to the institution for their second year. Retention of all freshman within the university was 85%, which is above the national averages (61.6% in 2017) and above the average for the institution (80.0–81.6% for 2014–2016) (14). National data reported in 2017 found that, for students starting their freshman year in a STEM major, 20% dropped out from public 4-yr colleges. Bachelor of Science degree-seeking STEM entrants who first attended institutions that were among the least selective (public, nonprofit 4-yr institutions) had a higher probability of leaving due to dropping out than students who first attended highly selective institutions (4). Despite being at a public, nonprofit 4-yr university with relatively low acceptance standards, the retention rate of our physiology program (85%) more closely reflects retention rates typically seen among more selective, private, nonprofit 4-yr colleges (retain 82.5% to graduation) (4).

Non-retention students exhibited retention within the major (66%) and university (91%) that was comparable to data from the previous 5 yr (2013–2018) (2013–2018) (2013–2018) (2013–2018) (2013–2018) (2013–2018). However, fewer retention students were retained within the major (39%) and university (74%) compared with the previous 5 yr (51% major, 78% university). Despite the intervention and positive student perceptions, these numbers suggest the inter-

Table 3. End-of-semester survey responses for academic experience

| Question                                                                 | Non-Retention | Retention |
|-------------------------------------------------------------------------|---------------|-----------|
| Since you started at WVU do you think you’ve improved on any of the following? Select all that apply. |               |           |
| Time management                                                         | 73            | 62        |
| Study skills                                                            | 64            | 51        |
| Note taking                                                             | 58            | 62        |
| Reading comprehension                                                   | 24            | 30        |
| Critical thinking                                                       | 60            | 51        |
| Meeting deadlines                                                       | 62            | 65        |
| Which of the following were EASIER than expected during your first semester of college? Select all that apply. |               |           |
| Finding campus resources                                                | 44            | 47        |
| Making new friends and fitting in                                      | 48            | 44        |
| Finding time to study                                                   | 38            | 39        |
| Studying efficiently and effectively                                    | 30            | 26        |
| Getting good grades                                                     | 27            | 30        |
| Getting enough sleep                                                    | 34            | 17        |
| Practicing healthy habits                                               | 30            | 29        |
| Maintaining mental health                                               | 15            | 21        |
| Resisting peer pressure for drugs/alcohol                               | 48            | 45        |
| Which of the following were HARDER than expected during your first semester of college? Select all that apply. |               |           |
| Finding campus resources                                                | 22            | 13        |
| Making new friends and fitting in                                      | 25            | 27        |
| Finding time to study                                                   | 38            | 35        |
| Studying efficiently and effectively                                    | 43            | 53        |
| Getting good grades                                                     | 44            | 38        |
| Getting enough sleep                                                    | 57            | 68        |
| Practicing healthy habits                                               | 44            | 43        |
| Maintaining mental health                                               | 44            | 45        |
| Resisting peer pressure for drugs/alcohol                               | 9             | 6         |
| Which of the following on-campus resources have you used this term? Select all that apply. |               |           |
| Library                                                                 | 79            | 78        |
| Math laboratory                                                         | 40            | 13        |
| Tutoring library                                                        | 23            | 18        |
| Student success coaching                                                | 6             | 8         |
| Computer laboratories                                                   | 15            | 10        |
| Office hours                                                            | 62            | 42        |
| Departmental tutoring                                                   | 3             | 10        |
| Other                                                                   | 20            | 23        |
| How well are you currently doing in college?                            |               |           |
| A                                                                       | 38            | 16        |
| A/B                                                                     | 43            | 26        |
| B                                                                       | 7             | 18        |
| B/C                                                                     | 9             | 29        |
| C                                                                       | 2             | 3         |
| C/D                                                                     | 1             | 8         |
| D                                                                       | 0             | 0         |
| D/F                                                                     | 0             | 0         |
| F                                                                       | 0             | 1         |

Values are the percentage of students who responded.
vention was unsuccessful at improving retention rates of at-risk students within the program (down from 51% to 39%) and university (down from 78% to 74%) into the second year. Intensity of the STEM course taken in the first year, the type of math courses taken in the first year, and the level of success in STEM courses bore stronger associations with switching to non-STEM fields than many other factors. These findings highlight the importance of proceeding through math courses and could explain why the at-risk retention group exhibited greater attrition to other majors. National data reported in 2017 found that, for students starting their freshman year in a STEM major at a public, nonprofit 4-yr college, 30% switched to a non-STEM major (4). Indeed, poor grades in STEM courses and better grades in non-STEM courses may push students out of STEM majors. Aside from courses, one possible explanation is that the targeted advising and/or guest lecturing of various careers in exercise physiology helped students focus on their passions and interests, leading them to pursue other majors. Alternatively, the intervention might have allowed at-risk students to sooner recognize the magnitude of academic challenges facing them in a 4-yr STEM-based exercise physiology degree, causing them to transfer out of the major sooner than they might have otherwise. Perhaps continuing a targeted intervention throughout the entire freshman year (e.g., into the spring semester) might have improved retention rates. Regardless, these findings highlight the need to investigate why students elect to transfer out of a major to develop data-driven, rather than literature-guided, interventions for retention.

In addition to the primary and secondary outcomes, this SoTL study sought to better understand the program’s freshman population, specifically at-risk compared with not at-risk students, through exploratory methods. On the Initial Survey, the retention group self-reported lower ranking in high school compared with the non-retention group, and fewer felt well prepared in areas of academic readiness and more felt under-prepared in math. Given that allocation into the retention group was based on math scores, it is not surprising that the students perceived themselves to be unprepared in math. In addition, the fact that fewer reported feeling well prepared in academic readiness outcomes, as well as more having a lower self-ranking in high school, indicates that these students recognize that they are not the highest achieving students. Admitted with higher ACT or SAT scores, non-retention students were placed into higher level math and chemistry courses compared with retention students. Despite this, the non-retention group achieved a higher cumulative first-semester GPA. This highlights the potential difficulty retention students face entering a STEM program as well as the competition they will encounter when applying to postgraduate programs.

While medical school and physical therapy programs are the most popular postgraduate ambitions for the students in this study, those in the retention group were more likely to be pursuing physical therapy than medical school. Compared with medical school, physical therapy programs have less rigorous admissions requirements (e.g., introductory rather than higher level biology courses, reduced chemistry requirements, etc.) and typically accept a slightly lower GPA average (GPA for accepted physical therapy applicants for 2018–2019 was 3.57; GPA for accepted medical school applicants for 3018–2019 was 3.72) (1, 15). It appears the retention group, who perceived themselves to be less high achieving, self-selected the less competitive postgraduate program. Interestingly, despite perceiving themselves to be less high achieving, fewer retention students (27%) felt getting good grades would be a challenge compared with non-retention students (55%). This could be due to several reasons, including taking less challenging courses in and before college, or a misimpression of the rigor of the program. Perhaps the groups differ in what defines “good grades” and “challenging”; however, further research is needed to determine the reasoning for this discrepancy and to address this misperception about the challenging nature of an undergraduate exercise physiology program.

At midterms, a greater percentage of retention students had a D or F grade and were more likely to have multiple D or F grades compared with the non-retention group. These findings confirm what was self-reported in the Initial Survey: that retention students are less high achieving. By the end of the semester, the retention group had a significantly lower average GPA compared with the non-retention group. Whether the retention groups’ targeted conversation with the faculty advisor improved their academic readiness or success is unclear. However, the greater satisfaction with academic advising suggests that these conversations were a positive addition to the intervention.

Both groups gave generally favorable responses to the exercise physiology program in the End-of-Semester Survey. Difference between groups indicate less favorable responses from the retention group compared with the non-retention group in areas of academic integration, social integration, degree commitment, institutional commitment, and academic conscientiousness. Social integration showed the most differences between groups, suggesting that retention students have fewer friends at the institution and feel they have less in common with other students. While 44% felt making friends was easier than expected, more than one-fourth of students found it to be harder than expected. Social integration is critical to college student retention, and its role in student success cannot be overstated (7, 18). Establishing friendships with peers is on par with connecting with faculty and successful advising. Clearly, creating an inclusive environment that facilitates peer-to-peer interaction must be a central tenet of the FYS course moving forward, likely through smaller, more interactive sections. Indeed, one student’s suggestion for recommended changes to FYS was to “do more group projects or activities. By the end of the semester, I still didn’t really know anyone, and these are people I will be around for the next four years.” Importantly, since neither the retention nor the non-retention FYS incorporated a social integration component, this is an important retention-related factor to address moving forward.

At the start of the semester, at least one-half of the retention group expected challenges when it came to efficient/effective studying, not studying enough, and getting enough sleep, and they were less likely to use campus-wide academic resources (e.g., the library, math tutoring laboratory, office hours). These findings informed the development of the FYS curriculum and content related to time management, study skills (e.g., reading comprehension, note taking), and benefits and ease of using campus academic resources (e.g., library, math laboratory tutoring, and professors’ office hours) was included. At the end of the semester, students in the retention group reported improvements in academic preparedness (time management,
study skills, note taking, meeting deadlines) and academic experiences (finding campus resources, making friends and fitting in, finding time to study) were reported to be easier than expected. These findings suggest the curriculum in FYS was successful at eliciting positive retention-related outcomes, which is in agreement with previous literature showing FYS aids students in navigating their first year of college and improves retention (3). The inclusion of similar content in future retention-related programming is recommended.

Despite these positive findings, not all outcomes were favorable. At the end of the semester, factors central to academic and personal success in college (studying efficiently and effectively, getting good grades, maintaining healthy habits) were harder than expected for the retention group. These findings suggest that the retention group experienced improvements in skills development, such as time management or note taking, but that these skills may not have translated into better academic performance, such as studying efficiently or getting good grades (as confirmed with lower cumulative GPAs for the retention group). If so, interventions and support programs targeting at-risk students should focus on educating these students on how applying new or improved skills can be translated to higher achievement and academic performance. An alternative explanation is that, despite the lower GPAs, these improved skills allowed students to achieve higher grades than they would have otherwise. Clearly, further research is needed to tease apart the influence of skills development and academic achievement in this population to best develop support programs to aid at-risk students.

There were several limitations to this SoTL study. First, it was conducted on a specific cohort of exercise physiology freshmen at a large, 4-yr public institution in Appalachia. While the generalizability of these findings to other institutions or populations may be limited, the study and findings may help inform future research in this field. Additionally, incoming freshmen were identified as being “at risk” based on incoming math ACT or SAT scores, which may not be the most predictive measure of students’ attrition within the current major; however, no other measure has yet to be identified, as more predictive and previous work has shown that incoming math scores are predictive of college success (9). Not all of the surveys used for this study were validated. However, as described previously, this SoTL study was largely exploratory, and the findings are relevant to the development of future support programs within this major and will guide retention efforts moving forward. Many factors that contribute to retention that could account for observed differences were not evaluated in this study. Specifically, engagement with virtual learning environment, trips home, and university “welcome events” might have had an influence but were not included in the analyses. Additionally, since advisee-advisor conversations were not monitored or reviewed, the random allocation of advisors, including the quality of advising, could have impacted outcomes.

This SoTL retention intervention was successful in eliciting positive student perceptions of the major and retaining students at the university, but did not improve retention of at-risk students within the physiology program. Importantly, there are many factors that influence retention, many of which are fixed on matriculating to college (e.g., socioeconomic, minority, first-generation status, high school GPA, etc.). While this intervention specifically addressed those factors that can be influenced by university or major-level programming (e.g., student perceptions), the influence of fixed predictors could overshadow the role of student perceptions on retention.

This SoTL study successfully explored the undergraduate exercise physiology freshman population and evaluated the effects of a targeted intervention to address retention for at-risk freshmen. The findings from the present study, understanding the freshman population, as well as the efficacy of the intervention for improving student perceptions and retention rates, will inform the development of potential avenues for improving program retention moving forward. Specifically, this study has highlighted the importance of implementing peer-to-peer interactions in a FYS to improve social integration and possibly implementing curriculum in academic skills development. One possible avenue to explore is the role of peer mentoring, whereby upperclassmen mentor incoming freshman, helping them better navigate higher education while also cultivating social interaction. Future research should include a qualitative exploration for why students elect to transfer out of a major as well as research elucidating discrepancies in perceived abilities and academic expectations. Additionally, expanding this work to other universities or institutions with different student demographics and social/economic backgrounds is warranted and could provide valuable insight into STEM attrition. Specifically, this work could be replicated or expanded with community colleges, minority or first-generation students, and other demographic areas within and outside of the U.S.

The present study demonstrates the need for more systematic reflection through SoTL research to be conducted at the program level regarding student retention. As previously stated, the goal of SoTL is student success, which must be examined through multiple pathways, including working with individual students and broader scopes of success at the program level. Student success is central to every academic program, and this research demonstrates that, by using a SoTL approach to investigate a programmatic issue, changes can be made that directly impact students and programs.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

M.L. and R.W.B. conceived and designed research; M.L. performed experiments; M.L. analyzed data; M.L., A.M., and R.W.B. interpreted results of experiments; M.L. drafted manuscript; M.L., A.M., and R.W.B. edited and revised manuscript; M.L., A.M., and R.W.B. approved final version of manuscript.

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