Does sex (female versus male) influence the impact of class attendance on examination performance?

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There is limited evidence that female students miss class more frequently than male students, perhaps because the classroom environment is somehow less hospitable to female students (40). Furthermore, we documented sex (male vs. female) differences in learning style preferences among undergraduate physiology students (37) as well as first-year medical students (31). Importantly, learning style preference impacts class attendance (40). Accordingly, sex may influence the impact of attendance on examination performance.

This is an important question because policies on class attendance vary markedly (20). Many faculty members require class attendance and count attendance positively in grade determination or count the lack of attendance against the student’s grade. Even when attendance is not required, many faculty members encourage attendance in a variety of ways because they believe that attendance is important in student success. Faculty members may believe this because there is strong support for the benefits of attendance. For example, Schmidt (29) reported that the most valuable and important time commitment in a course was the time actually spent in the classroom. Specifically, the time actually spent in the classroom had the greatest positive impact on overall student performance (29). Similarly, Park and Kerr (27) documented that each absence from class lowered a student’s grade by 0.06 in a 4.00 grading system. Accordingly, a student with 10 absences would lower his/her grade by 0.6, which would be the difference between a C+ and a B. Finally, Romer (28) reported that the mean grade point average for students with strong attendance was, on average, one entire letter grade higher than that of students with poorer attendance. Similar results, i.e., frequently missed classes are associated with lower grades, have also been reported (20). Taken together, these studies suggest that class attendance is a better predictor of college grades than any other predictor, including SAT scores, studying skills, and the amount of time spent studying (6, 15, 20, 25a).

However, “So far as the mere imparting of information is concerned, no university has had any justification for existence since the popularization of printing in the fifteenth century” (38). This quote, from British mathematician, logician, and philosopher Alfred North Whitehead, has challenged our assumptions about the importance of class attendance in lecture-based classes. Our assumption was that grades are related to class attendance, i.e., students who attend classes more frequently obtain better grades and class attendance dramatically contributes to enhanced learning. However, with printed materials, electronic resources, the internet, and other technologies (25), is there any reason for students, female or male, to attend lecture-based classes, i.e., is regular attendance associated with performance on examinations, for female or male students, in a lecture-based course (1, 39)?

These questions are particularly relevant because the imparting of information through lecturing remains the predominant form of teaching in postsecondary and healthcare professional education (7, 17, 26). This may be due, in part, to the fact that lecturing is effective in transmitting and sharing factual information with a large number of students (11, 21, 30). However, do students need to hear the content from the teacher or can they master the content by other means? Specifically, if the students do not hear the content in class, can the content still be mastered (22)?

To address these issues, we determined the effect of class attendance on examination scores for female and male students enrolled in our undergraduate exercise physiology class of 51 students (20 female students and 31 male students). The experiment was designed not to interfere with the normal conduct of the course. Attendance was recorded in each class, and, although regular attendance was encouraged, it was not
required and did not factor into the final grades. Examinations consisted of multiple-choice questions derived from the lecture material. Grades were calculated on four 1-h examinations and one 2-h cumulative final examination. The final grade reflected the average days of attendance for female students only. Thus, the influence of regular attendance on examination performance is more important for female students than male students.

METHODS

Design. All procedures were reviewed and approved by the Institutional Review Board, and informed consent was obtained from all students before the study began. This experiment was implemented during the Exercise Physiology class at East Carolina University during the summers of 2010 and 2011 (EXSS 3805). The class in 2010 consisted of 30 students (13 female students and 17 male students). The class in 2011 consisted of 21 students (7 female students and 14 male students). The course, offered through the Department of Kinesiology, must be completed in the third or fourth year in order for majors to meet the graduation requirements in 1) Health Fitness Specialist (BS), 2) Physical Education (BS), 3) Sport Studies (BS), or 4) Exercise Physiology (BS). Students from other basic science departments could also enroll. The class was lecture based and presented using Microsoft PowerPoint slides provided ahead of lecture by the instructor of record. The students could also supplement the lecture content by reading and consulting their recommended textbook. Many slides used in class were directly from the textbook, but these were supplemented by slides designed by the instructor to address current literature. As such, the students were informed and reminded periodically that attending lecture was important because a significant amount of course content was not addressed by the textbook due to scientific advances in various aspects of subdisciplines in the field of exercise physiology (e.g., mitochondrial bioenergetics). The instructor has taught this and similar classes at East Carolina University for >12 years. Didactic classroom engagement occurred 4 times/wk for a period of 120 min/class over the 5-wk summer session. The course content was specifically constructed to build on the student’s core requirements of foundational anatomy and physiology. As such, the beginning semester lectures included a thorough review of basic skeletal and cardiac muscle architecture, which was followed by an expansion of details on the cellular/molecular aspects of the sliding filament and excitation-contraction coupling processes for muscle tension development. Afterward, a comprehensive view of cellular bioenergetics and cardiopulmonary physiology was provided. These topics were presented in a backdrop of exercise performance and training principles. Finally, the course ended with “special topics” on environmental physiology, the use and efficacy of ergogenic supplements, and finally content on cardiovascular, pulmonary, and metabolic (obesity and cardiovascular) pathologies and the use of exercise as a prevention and intervention strategy. In all, 16 chapters were addressed from the textbook. Supplemental materials were provided by the textbook in the form of a CD, and animations of important concepts and principles were provided by the instructor on the BlackBoard website at East Carolina University. All students were provided with detailed exam outlines at least 1 wk ahead of each test. Questions were exclusively multiple choice. The final exam was comprehensive but contained ~20% of the questions from materials after the third exam. Semester exam grades were provided within 24 h of the exam on Blackboard, and the students were coached on how to compute their performance/grades after each exam. Questions and advice on performance and study approaches were provided during office hours.

The experiment was designed not to interfere with the normal conduct of the course. Attendance was recorded anonymously in each class, and, although regular attendance was encouraged, it was not required and did not factor into the final grades. The maximum possible score was 922 points based on four (summer 2010) or three (summer 2011) 1-h examinations and one 2-h cumulative final examination (each summer session). Examinations consisted of multiple-choice questions derived from the lecture material. Each of the examinations and the final exam were weighted equally. Final grades were determined by dividing the total points accrued for the five exams by the total possible points. Letter grades were determined as follows: A = 100 – 85%, B = 84.99 – 75%, C = 74.99 – 65%, D = 64.99 – 55%, and F = 54.99% or lower.

Analysis. Descriptive statistics are presented as means ± SE. In addition, a linear regression analysis between the percentage of points scored and absences for each student was performed to determine the relationship between class attendance and scores on examinations (Fig. 1, A and B).

A nonparametric Mann-Whitney rank-sum test was used to compare the percentage of the classes attended for students earning a grade above and below the class average grade for both female and male students (Fig. 2). Significance was set a priori at P < 0.05.

RESULTS

Daily attendance for female and male students combined averaged 81 ± 2%. There was no difference in daily attendance between female and male students (female students: 78 ± 4% and male students: 81 ± 3%). Examination scores for female and male students combined averaged 74 ± 2%. There was no difference in examination scores between female and male students (female students: 73 ± 2% and male students: 74 ± 2%). However, attendance and examination scores varied...
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Fig. 2. Class attendance (percentage of attended classes) for both female and male students who earned a grade above or below the class average in an undergraduate Exercise Physiology course in which attendance was not mandatory. The final grade reflected the average days of attendance for female students only. Specifically, female students earning a grade above the average class grade attended 89 ± 4% of the classes; however, female students earning a grade below the average class grade attended only 64 ± 6% of the classes. These results for female students contrast sharply with the results for male students. Specifically, there was no difference in the number of classes attended for males earning grades above or below the class average (84 ± 3% vs. 79 ± 5%). Thus, some male students were absent frequently but scored above the class average, whereas other male students attended many classes but scored below the class average. *P < 0.05.

widely for both female and males students (Fig. 1). The class average for the present course was typical of previous class averages, based on instructor records (data not shown).

As shown in Fig. 1, there was a small decrease in score with an increase in the number of absences when female and male students were combined. Based on the maximum possible score of 922 points, the average student with perfect attendance scored 747 points (81%, the intercept), and each absence was associated with an average decrease of 16.8 points (1.82%, the slope). Although the score obtained by the average female and male student with perfect attendance (female student: 83% and male student: 79%) was not different, each absence was associated with a greater decrease of points for female students (21.6 points or 2.3%) compared with male students (15.0 points or 1.6%).

The final grade reflected the average days of attendance for female students only (Fig. 2). Specifically, female students earning a grade above the average class grade attended 89 ± 4% of the classes; however, female students earning a grade below the average class grade attended only 64 ± 6% of the classes. These results for female students contrast sharply with the results for male students. Specifically, there was no difference in the number of classes attended for male students earning grades above or below the class average (84 ± 3% vs. 79 ± 5%; Fig. 2). Thus, some male students were absent frequently but scored above the class average, whereas other male students attended many classes but scored below the class average. This was not true for female students.

DISCUSSION

In this study, we determined the relationship between class attendance and scores on examinations for female and male students enrolled in our undergraduate exercise physiology class of 51 students (20 female students and 31 male students). A linear regression analysis between the percentage of points scored and absences for each student was calculated. There was a greater decrease in score with each absence for female students. Furthermore, the final grade reflected the average days of attendance for female students only. Accordingly, the influence of regular attendance on examination performance is more important for female students than male students.

Policies on class attendance vary markedly, with many faculty members requiring class attendance and counting attendance positively in grade determination and other faculty members not requiring class attendance. The results from this study document that the influence of regular attendance on examination performance is more important for female students than male students, which provokes the provocative thought that policies on class attendance should be based on the sex of our students. Although this thought may appear politically incorrect, it seems reasonable to suggest that women and men learn differently and have different preferred ways of learning (31, 37). It is even possible that female and male preferences in learning styles are rooted in evolutionary biology and/or overwhelming social differences (12). These differences have sparked an emotional debate regarding sex differences in learning (12). This debate is further inflamed by questions regarding “innate differences” between men and women and theories that claimed that women were biologically incapable of reason (12). However, despite the passions and political correctness encountered by former Harvard President Larry Summers (Summers suggested that the gender gap in math and science might be due to “issues of intrinsic aptitude”), these are important questions that must be addressed by the academic community if we are to provide quality education (37).

The results of the present study support previous findings of the limited impact of class attendance on exam performance when results from female and male students are combined (Fig. 1A). In addition, the results of the present study are novel in that they extend previous findings by documenting that the impact of attendance on exam performance is sex specific. The present data, therefore, challenge the conventional wisdom or beliefs held by many educators regarding the importance of attendance on class performance. The conventional wisdom is that grades are related to class attendance, i.e., students who attend classes more frequently obtain better grades and class attendance dramatically contributes to enhanced learning. The conventional wisdom appears to be correct for female students only.

The results from several previous investigations on the impact of attendance on course grades also challenge the conventional wisdom (5). For example, although most studies have reported a positive correlation between attendance and course grade and document that each day of absence costs students points in their final grade, the impact of attendance is rather modest (4, 13, 14, 16, 18, 32, 35, 36). Furthermore, because these are correlation studies, the direction of the relationship is unclear. That is, does attending class “cause” improved grades, or do students who earn better grades attend classes more? Although these questions cannot be answered by the present study, it is clear that students who do not attend classes also earn good grades. Furthermore, a study (36) has suggested that students who attend classes are often those who “regulate their own learning.” These students are intrinsically motivated and feel an obligation to attend class. These students
also complete assigned readings, pursue excellence in assignments, and accrue as much knowledge as possible from their college education (36). In this context, it seems obvious that for students to succeed academically, they must be motivated! A notable expression of student motivation is class attendance. Thus, highly motivated students attend more classes and succeed academically.

Accordingly, although studies have reported a positive correlation between attendance and course grade and document that each day of absence costs students points in their final grade, additional variables such as diligence, communication skills, and study habits are likely also required to fully understand the impact of attendance on grades. Thus, the results from this study suggest that although attendance is important for female students, it is not the only or even perhaps the major indicator of success on examinations. Future studies examining other important qualities, such as integrity, interpersonal skills, and willingness to commit to lifelong learning, merit further investigation.

To extend the above discussion, it seems likely that the true value of an educational activity, such as attendance, should not be determined solely by the content the student learns, nor by its ability to enhance content learning, but also by its ability to stimulate critical thinking, problem solving, communication, and interpersonal skills as well as the desire to learn. However, educational researchers have evaluated the effect of attendance on learning (performance on exams) in isolation as a singular variable with only a small emphasis on an evaluation of the effect of attendance on these additional goals. Furthermore, it could be argued that student performance on examinations is highly overrated because students forget much of the content that they memorize. Thus, attempts to evaluate the effect of attendance on student performance on examinations may be missing a bigger point. Rather, the value of attendance must be determined by behavioral parameters that are based on the observation of the student, the student’s work, and the student’s perspective as well as future effects on performance of learning novel tasks or even self-taught learning. This involves expanding the evaluation tools beyond content learning because the impact of educational interventions may be obscured if evaluated only by student’s performance on exams, i.e., all interventions will seem equal when based on student’s exam performance.

In this context, the lecture-then-test format may result in an abundance of memorized facts that are quickly forgotten; however, activities outside of the class structure may engage students more deeply. Specifically, students have rated internships, study-abroad programs, and senior thesis or other “capstone” projects, including undergraduate research, as the most valuable part of their learning experience (24). Importantly, none of these activities require classroom time, and all must be evaluated on criteria beyond student performance on examinations. Thus, the most profound learning experiences occur outside the classroom. This point was emphasized in a controversial book, Academically Adrift: Limited Learning on College Campuses (2), which documented that colleges fall short by requiring little of students in traditional courses and that students respond with small efforts outside the classroom.

The results from the present study also provoked the following question: does distance learning confirm the low impact of regular class attendance? Distance learning offers convenient alternatives to students who are unable to attend traditional classes. It is suggested that most distance learning courses have the same content and are equivalent to traditional courses. The interesting component of distance learning is that there are few, if any, regular class meetings. Rather than regular meetings, courses are offered in a variety of formats, including online, videotape, CD-ROM, and print. For many of these formats, the lecture portion of the course is viewed on a computer, and students use textbooks and other supplements to complete the course. These formats give students freedom and require motivation and an acceptance of responsibility. Because of the success of distance learning combined with the use of recording and disseminating classroom lectures and various computer-based educational technologies, students are less reliant than ever on classroom teaching (8). In this context, motivation, or the desire to learn, influences academic achievement (34). A component of motivation is the feeling of control over our environment. Having control requires making choices, one of which is whether to attend class or not. Making attendance mandatory may have the impact of reducing the feeling of control and thereby reducing motivation and negatively impacting achievement.

The academic value of class attendance may also depend on what students, as well as teachers, do in class (3, 9, 14, 23, 34) because learning is not a passive activity. Students do not learn by passively sitting in a classroom listening to the teacher. Rather, students learn when they are actively involved in learning. Therefore, students must do more than just passively listen: they must read, write, discuss, and be engaged in solving problems.

Achieving these goals should be easy because few students want to passively sit and listen to a lecturer. When this happens, the students and the lecturer are often bored, disengaged, and often fast asleep. Therefore, we must engage students, get them excited, and show them how to gather information and solve problems. In fact, we must show them how we learn rather than tell them what we know (10).

In this context, the United States ranks 12th globally in the percentage of young adults with college degrees (19). This disturbing reality is due, in part, to that fact that more than half of America’s college students fail to earn degrees. Students fail to complete college, mainly because students become uninspired and unchallenged by the content and drop out of school entirely (33). That is, they lack motivation and interest because, let’s face it, it is more often the rule than the exception that classes are boring and uninspiring. Thus, the teacher-oriented system relying on lecturing to passive students must be revised to a learner-centered process in which students become actively involved in their own learning. Otherwise, what’s the value of attending class (1, 39)?

**Limitations.** The conclusions and inferences regarding the relationship between sex, class attendance, and examination performance, based on results from this study, must be confirmed with other populations in other geographic locations. Specifically, this study used a relatively small sample obtained from a single geographic location with potentially unique characteristics. Accordingly, investigators are encouraged to extend these experiments to students in other geographic locations with their unique and idiosyncratic settings.

In this context, it is also important to consider that the specific type of class as well as the attitude and approach of the
students and instructor may impact the results. Specifically, it is expected that the results obtained in this lecture-based class may be different from results obtained with problem- or inquiry-based instruction.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

R.N.C. and S.E.D., conception and design of the research; R.N.C., performed the experiments; R.N.C., H.L.L., and S.E.D., interpreted the results of the experiments; R.N.C., H.L.L., and S.E.D., edited and revised the manuscript; R.N.C., H.L.L., and S.E.D., approved the final version of the manuscript; H.L.L., J.H.C., and S.E.D., analyzed the data; H.L.L. and S.E.D., prepared the figures; S.E.D., drafted the manuscript.

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