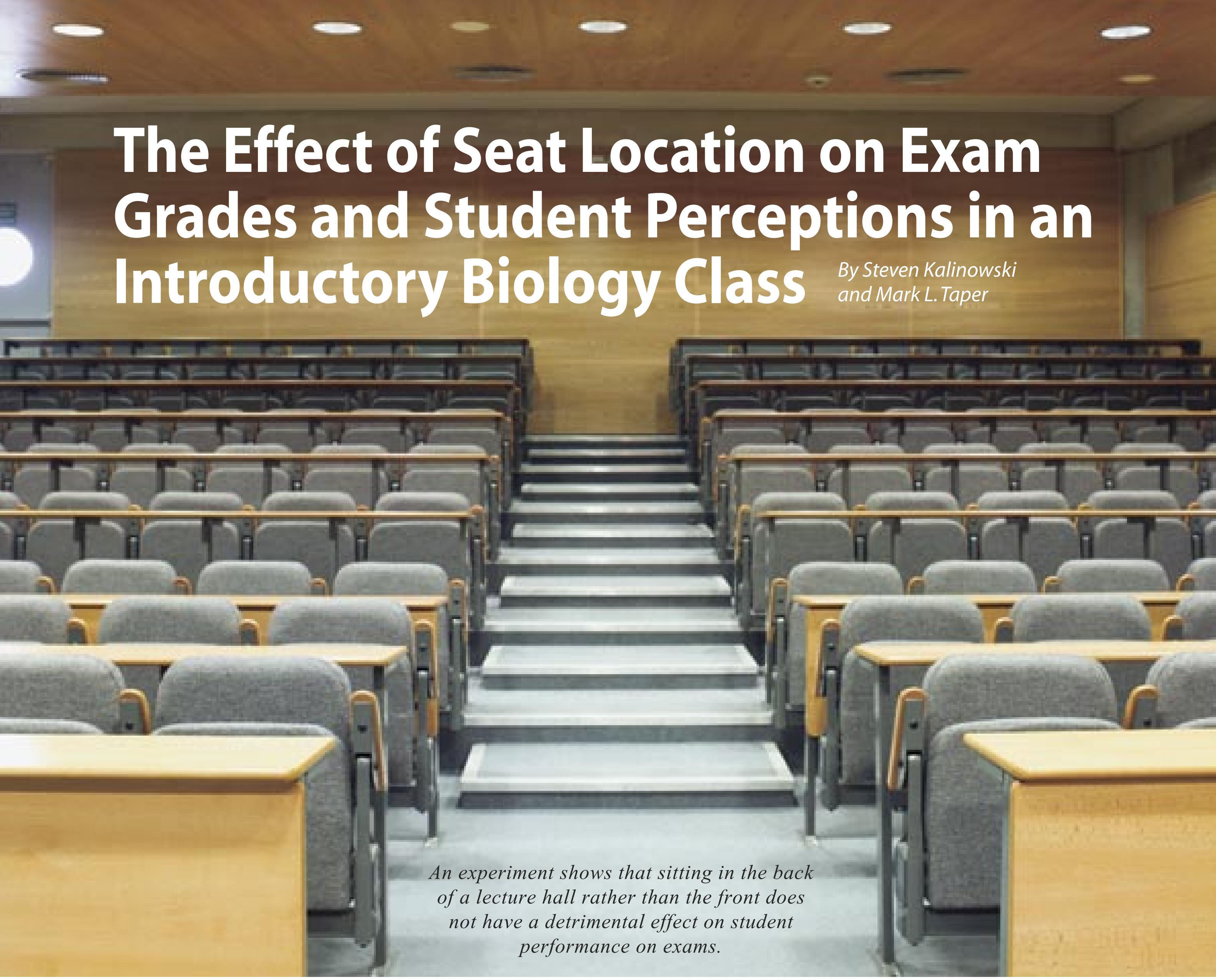
The Effect of Seat Location on Exam Grades and Student Perceptions in an Introductory Biology Class

By Steven Kalinowski and Mark L. Taper



An experiment shows that sitting in the back of a lecture hall rather than the front does not have a detrimental effect on student performance on exams.

The effect of seat location on learning has received surprisingly little attention in education literature (Weinstein 1979). Classroom experience and education literature suggest that students who sit in the front of a lecture hall are more likely to get As than students in the back (Benedict and Hoag 2004; Holliman and Anderson 1986; Pedersen 1994). The explanation may seem obvious—front-row students get better grades because they are better students. Perkins and Wieman (2005) recently challenged this dogma by showing that students sitting in the front rows of a high-enrollment introductory physics class (Physics 1010, Physics of Everyday Life) received better grades than students in the back—even though seats were randomly assigned at the beginning of the course. This suggests that conventional wisdom has ignored an alternative explanation for why grades decrease toward the back. Sitting in the back may be a disadvantage. Perkins and Wieman did not identify why sitting in the front led to better grades, but they did show that students assigned to sit in the back also had poorer attendance during the course and poorer attitudes regarding physics than students in the front.

The results of Perkins and Wieman (2005) are troubling because there are at least three reasons to expect their back-row students to do well. First, Wieman is one of America's most distinguished teachers (e.g., he won a 2001 National Science Foundation Director Award for Distinguished Teaching Scholars), and his class is popular enough to require a waiting list. Second, Wieman and Perkins used active-learning exercises to engage all of their students (Ebert-May and Brewer 1997; Handelsman et al. 2004). Third, Perkins and Wieman reassigned seats halfway through the semester, so that students initially sitting in the front were moved to the

Steven Kalinowski *(skalinowski@montana.edu) is an assistant professor of conservation genetics and* ***Mark L. Taper*** *is an associate professor of quantitative ecology at Montana State University in Bozeman, Montana.*

back and vice versa. This switch did not compensate for the effects of the first half of the semester; students that sat in the back during the first half of the semester did poorly in the second half of the semester, even though they had been moved toward the front.

We present results from an experiment that tested the effect of seat location on student performance and attitudes in an undergraduate biology class. Like Perkins and Wieman (2005), we randomly assigned seat locations on the first day of class. However, unlike Perkins and Wieman, we did not find that students sitting in the front did any better than students sitting in the back.

Methods

We conducted our experiment with students enrolled in Biology 215, Introductory Biology: Individuals to Populations at Montana State University. Biology 215 is a sophomore-level course on ecology and evolution for biology majors. Of 45 students enrolled in the class, 43 finished the semester. All students were majoring in biology and the great majority identified themselves as preparing for medical school. In addition to teaching the basic concepts of ecology and evolution, Biology 215 emphasized four general scientific-thinking skills: quantitative reasoning, argument analysis, experimental design, and evidence evaluation. The class met three times per week for a 50-minute lecture and had a laboratory that met once a week for two and a half hours. Lectures were designed as inquiries seeking to answer a question (e.g., "How old is the earth?"). We used PowerPoint slides during lectures. PowerPoint presentations can encourage students to remain passive; we attempted to avoid this problem by encouraging active learning (Doumont 2005; Tufte 2006). Some of each class period was used for small-group discussions and Socratic dialogue, and students were frequently called on at random during these discussions.

We taught Biology 215 in a modest-sized lecture hall. The screen at the front of the hall was approximately 2.5 meters wide and 2 meters from the first row. There were 11 rows of 11 seats in the gently sloping hall. Students in the last-occupied row (row 9) were approximately 12 meters from the screen.

On the first day of class, we randomly divided students into groups of three, and assigned each group to a row. Two groups were assigned per row—except for the front row, which we left empty (because we believed some students might be uncomfortable sitting in the very front). We did not tell the class that we were studying the effect of seat location on their learning. Two weeks into the semester we checked whether students were sitting in their assigned seats. By then we had learned everyone's name, so checking their seat assignments was easy.

We used exam scores to measure student learning during lectures. Five exams were given to the class: four midterms and a final. Each exam was composed of definitions, short essay questions, and mathematical problems. There were no matching, multiple-choice, or true/false questions. Almost all of the questions on the exams pertained to topics discussed during lecture. The average raw score on the exams ranged from 65% to 70% of the total. These raw scores were adjusted so that the average score on each exam was 80% (B–).

On the last day of the semester, we gave the class a survey (Table 1) asking students to rate the effectiveness of the textbook, lectures, homework, and class discussions. In addition, it asked students to rate the course by workload and level of interest. The survey was voluntary, but was not anonymous because it was intended to measure the relationship between seat assignment and student perceptions. It was administered by an assessment specialist who retained the survey until after we assigned final grades for the course.

Linear multiple regression was used to examine how assigned-seat location affected grades and student perceptions. In each regression, row number and cumulative GPA were independent variables. Exam scores and student perceptions were dependent variables. Systat 10.2 was used for all statistical analysis (see References).

Our original intention for this experiment was to document the effect of seating on learning, and then attempt to mitigate it. However, when we analyzed exam scores for exams 1 and 2, we did not find a statistically significant relationship. Therefore, we modified the experimental design and left students in the same seats all semester.

In addition to the experiment described above, we investigated whether students with higher grades are likely to choose to sit toward the front of the lecture hall. We did this by recording the seats students selected at the start of the first lecture (before we assigned seats). This was done by taking digital photographs of the class as they entered the lecture hall. Linear regression determined whether there was an association between GPA and seat location.

Results

The experiment went smoothly; students did not seem to mind being told where to sit, and worked well in their assigned groups. When we checked whether students were sitting in their assigned groups, all students except one were in the correct group (and this student moved back to her original group on her own accord).

We obtained two noteworthy results. First, we found no evidence that grades or student attitudes were affected by seat location (Figure 1). Nor was there a suggestion of any such relationship. In the multiple regression of average exam score and seating row, the coefficient for row was 0.53 (where a positive sign indicates grades increased toward the back), with a 95% confidence interval of [–0.17, 1.23]. If the low end of this confidence interval was correct (exam scores decreased by 0.17% per row), this would result in a decrease of 1.53 points (out of 100) over nine rows—an almost negligible effect.

Our second noteworthy result was that students who chose to sit in the front of the lecture hall on the first class had significantly higher GPAs than students in the back ($P = 0.009$, $R^2 = 0.18$) (Figure 2). The slope of the regression line was –0.10, indicating that, on average, GPAs decreased by 0.1 point (on a 4-point scale) per row. This represents a substantial difference in GPA between students in the front and back (the regression line dropped from 3.9 in the front of the lecture hall to 2.7 in the back).

Discussion

Our main finding was that there was no effect of seat location on exam scores in our classroom. This contrasts with the results of Perkins and Wieman (2005). There are at least three general categories of explanations for why seat location might have affected grades in Physics 1010 but not Biology 215. The first category of explanations is directed at the lecture hall. Perhaps seat location only affects grades in large lecture halls, and our lecture hall was not large enough for this effect to be relevant. This explanation seems unlikely though, because the most-distant student in our lecture hall sat 12 meters from the projector screen, which is only slightly less than the most-distant students in Perkins and Wieman's classroom (13 m), and because the lecture hall used by Wieman and Perkins was designed to give all students a clear view of the instructor (Bartlett 1973). One potentially important difference between lecture halls, however, is that ours was relatively narrow (11 seats wide), which may help keep students' attention directed forward. Alternatively, the size of the lecture hall may be less important than the number of students in it. Perkins and Wieman had over four times as many students in their class as ours, which may have given their students a sense of anonymity that facilitated distracting thoughts. The small size of our class allowed us to learn everyone's names and to call on them personally, which might have reduced anonymity in the back of the classroom.

Differences between students in each student body constitute a second category of explanations. Perkins and Wieman's students were nonmajors, and therefore may not have been highly motivated to learn physics. In contrast, all of our students were biology majors, and may have been more motivated (either because they were interested in biology or because they were interested in getting good grades). Alternatively, our students may have come to class with a strong background in science, and this may have been helpful.

A third category of explanations points to course design and content. Both classes met for 150 minutes per week. However, Physics 1010 met twice a week for 75 minutes while Biology 215 met three times a week for 50 minutes. Perhaps the longer lectures in Physics 1010 made it harder for students in the back of the lecture hall to remain engaged (see Bligh 2000 for a review of student attention span). Alternatively, our laboratory investigations may have benefited students. We made an effort to follow each laboratory with a lecture

FIGURE 1

The average exam score (including final exam) of each student in the class plotted against the row that each student was assigned to.

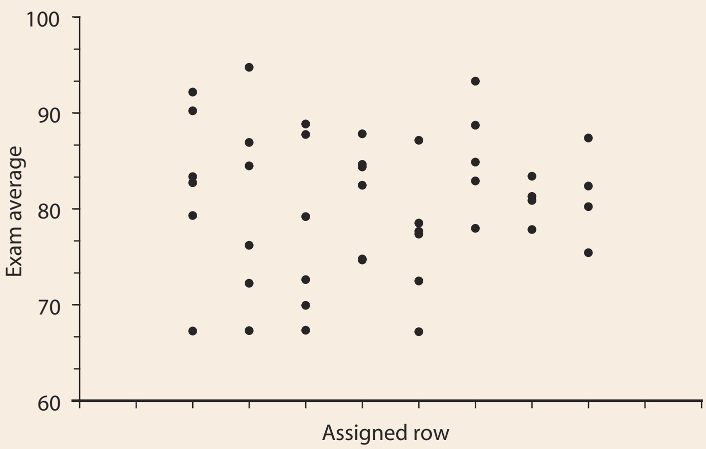


FIGURE 2

The cumulative GPA (not including Biology 215) of each student in Biology 215, and the row that they chose to sit in at the beginning of the first day of class. The line shows the linear regression for the data.

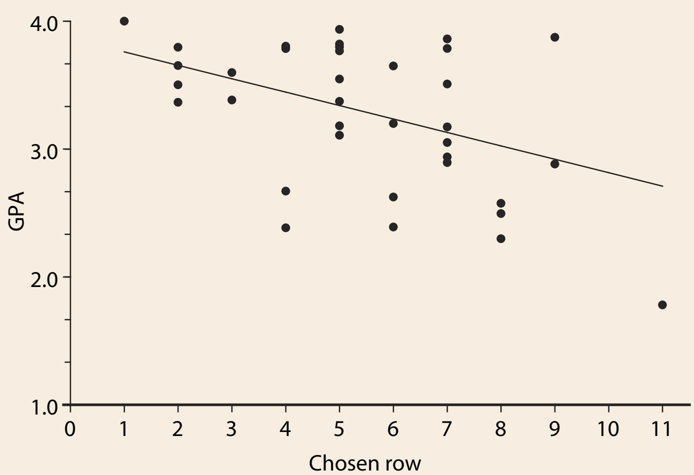


TABLE 1

Survey used to assess student perceptions regarding Biology 215.

Question	Average response
1. How useful was the text book? (1 to 5; 1 = not helpful, 5 = very helpful)	2.6
2. How helpful were class discussions for learning evolution and ecology? (1 to 5; 1 = not helpful, 5 = very helpful)	3.5
3. How effective were the instructors' PowerPoint presentations? (1 to 5; 1 = not effective, 5 = very effective)	3.6
4. How useful was the homework? (1 to 5; 1 = not useful, 5 = very useful)	2.9
5. On average, how many hours did you spend studying for each exam?	4.9
6. How did the workload in BIOL 215 compare to other science courses that you have taken at MSU? (1 to 5; 1 = much easier, 5 = much harder)	3.1
7. How interesting did you find the lectures? (1 to 5; 1 = not interesting, 5 = very interesting)	3.0

that reinforced the main concepts in the lab, and this may have better prepared students for learning. Lastly, there may be a difference between the type of questions asked in each course. Biology is notorious for requiring students to memorize facts, while physics requires mastery of concepts. Perhaps our students did more learning while they were studying than during lecture. Evaluating this hypothesis is difficult, but we made every effort to develop exam questions that required a thorough understanding of the material.

Given this uncertainty, the main implication of our results is that further work is needed to determine specifically how seat location affects learning. Four questions, in particular, deserve testing:

- Does seat location affect learning more in classes with many students than it does in classes with fewer students?
- Is seat location more important in classes for majors than nonmajors?
- Is 75 minutes too long of a lecture for students in the back to pay close attention?
- What can be done to mitigate the effects of seat location when they are relevant?

Large classes in large lecture halls are common in many universities, so answering these questions is important. At the very least, such research could be used to advise students sitting in the back of a lecture hall how they might benefit from moving up front.

Acknowledgments

We thank K. Aho, J. Ferguson, A. Metz, C. Morrison, and J. Van Andel for their assistance. We thank the National Science Foundation and the Howard Hughes Medical Institute for funding (NSF grant DEB-0415932 to MLT; HHMI Undergraduate Science Education Program grant to Montana State University).

References

Bartlett, A.A. 1973. The Frank C. Walz lecture halls: A new concept in the design of lecture auditoria. *American Journal of Physics* 41 (11): 1233–40.

Benedict, M.E., and J. Hoag. 2004. Seating location in large lectures: Are seating preferences or location related to course performance? *Journal of Economic Education* 35 (3): 215–31.

Bligh, D. A. 2000. *What's the use of lectures?* San Francisco: Jossey-Bass.

Doumont, J.L. 2005. The cognitive style of PowerPoint: Slides are not all evil. *Technical Communication* 52 (1): 64–70.

Ebert-May, D., and C. Brewer. 1997. Innovative in large lectures—teaching for active learning. *Bioscience* 47 (9): 601–08.

Handelsman, J., D. Ebert-May, R. Beichner, P. Bruns, A. Chang, R. DeHaan, J. Gentile, S. Lauffer, J. Stewart, S.M. Tilghman, and W.B. Wood. 2004. Scientific teaching. *Science* 304 (5670): 521–22.

Holliman, W.B., and H.N. Anderson. 1986. Proximity and student density as ecological variables in a college classroom. *Teaching of Psychology* 13 (4): 200–03.

Pedersen, D.M. 1994. Personality and classroom seating. *Perceptual and Motor Skills* 78 (33): 1355–60.

Perkins, K.K., and C. Wieman. 2005. The surprising impact of seat location on student performance. *The Physics Teacher* 43 (1): 30–33.

Tufte, E. 2006. *The cognitive style of PowerPoint*. Cheshire, CT: Graphics Press.

Weinstein, C.S. 1979. The physical environment of the school: A review of the research. *Review of Educational Research* 49 (4): 577–610.

Resources

Systat Software Inc.—*www.systat.com*