Hybrid lecture-online format increases student grades in an undergraduate exercise physiology course at a large urban university

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McFarlin BK. Hybrid lecture-online format increases student grades in an undergraduate exercise physiology course at a large urban university. Adv Physiol Educ 32: 86–91, 2008; doi:10.1152/advan.00066.2007.—Hybrid courses allow students additional exposure to course content that is not possible in a traditional classroom environment. This exposure may lead to an improvement in academic performance. In this report, I describe the transition of an undergraduate exercise physiology course from a traditional lecture format to a hybrid lecture-online format. A total of 658 final grades (traditional = 346, hybrid = 312) was used to evaluate the effect of course format on academic performance. The hybrid online portion was delivered using WebCT Vista, enhanced with various instructional technologies. The hybrid lecture portion was enhanced with an in-class response system. PowerPoint files were used to distribute in-class lectures in both formats of the course. Final student grades were 9.9% higher (83% of the increase due to an increase in the exam grade) when the course was administered in a hybrid format (P = 0.01), which translated to a one letter grade increase on a standard grading scale. Transition from a traditional lecture format to a hybrid format significantly enhanced student learning; presumably, this increase is due to the fact that students were able to increase their exposure to course content via access to material on WebCT.

Program Description

Course data utilized. To prepare the present report, student grade data were used from the following six semesters of KIN 3306 (Physiology of Human Performance): Fall 2004 (traditional format, n = 117 students), Spring 2005 (traditional format, n = 94), Summer 2005 (traditional format, n = 41), Fall 2005 (traditional format, n = 94), Summer 2006 (transition format, n = 48), Fall 2006 (hybrid format, n = 191), and Summer 2007 (hybrid format, n = 73). The sample included 346 students who took the course in a traditional face-to-face lecture format and 312 students who took the course in a hybrid lecture-online format. The hybrid design used included 1.5 h/wk online and an additional 1.5 h/wk in a traditional classroom setting. The details of the two course formats are described in detail below (Fig. 1). All exams used the same question bank in each format of the course. The lead instructor for all course sections included in this sample was the author (B. K. McFarlin).

Traditional class format. In this course format, students attended two 1.5-h lectures/wk in a traditional classroom designed to hold between 100 and 200 students. Lectures were formatted such that two to three lectures were dedicated to each topic and broken down as follows: one lecture for general, introductory material and the remaining lectures for advanced material related to the particular exercise physiology topic. Course lectures were administered using PowerPoint slides (Microsoft, Redmond, WA) and Flash (Macromedia, San Jose, CA) media-based animations whenever possible. Common Flash animations included those of skeletal muscle contraction, nerve conduction, heart contraction, etc. These animations were also employed in the hybrid format. As is common in a course with a large number of students enrolled, there was minimal interaction (in terms of questions being asked) between the lead professor and students. The course was scheduled at a similar time each semester (typically between 1000 and 1200 hours). The course grade was determined using a norm-referenced system based on the student’s final point total. In this course, the grade distribution was typically skewed to the left. Skewness was removed by centering the grades on a normal scale, using the average point total and SD. Points were accumulated as follows: exam 1 (120 points), exam 2 (120 points), exam 3 (120 points), and attendance (50 points) for a total of 410 points.
Hybrid course format. One reason that we chose to transition from a traditional format to a hybrid format was to respond to previous comments given by students during formal course evaluations. Students frequently reported that the course did not take advantage of current instructional technologies, which may allow additional access to course content. To address these concerns, KIN 3306 was transitioned to a hybrid format during the Summer 2006 session. A hybrid course is considered to offer 50% of the instruction in a traditional manner and 50% in an online manner. For the transition, the introductory, general lectures for each topic (described above) were moved to WebCT for delivery. The first stage of this process was to identify which technologies would be included in the first hybrid offering. It was decided that the online portion of the course would be administered via WebCT Vista (Washington, DC) because this is the software standardized for our campus. The WebCT environment was customized for this class using course-specific banners (Fig. 2A) and an interactive SitePal avatar on the homepage to provide course announcements (Fig. 2B). The SitePal character was created by OddCast (New York, NY) from a digital picture of the author. I acknowledge that course announcements could have been easily provided as only text announcements; however, the objective of using the Site-Pal interface was to better engage the students when they loaded the WebCT homepage by providing a face to go with the class. Once the basic WebCT site was created, the next objective was to create, produce, and organize course material. It was determined that it would be ideal to offer students access to online lectures that provided basic material in support of advanced topics, which would be covered during the in-class lectures. To accomplish this task, PowerPoint files similar to what would be presented during the in-class lectures were created and voice narrated using Articulate Studio (New York, NY) (Fig. 3). The process of creating the online lectures was as follows: 1) develop the rough storyboard, 2) make the slides, 3) write the spoken script, 4) record the audio dialogue, 5) link the audio portion to PowerPoint animations using Articulate Studio, 6) incorporate the learning games, 7) build the practice SCORM (industry standard term for web-based learning module) module, 8) test in the product in WebCT, 9) correct any issues noted during the test in WebCT, 10) rebuild the package into a corrected SCORM module, and 11) load the final module onto WebCT. The module was also produced into a downloadable storyboard that was also uploaded to WebCT in MS Word format. One major advantage of the Articulate software is that it enhances the appearance of standard PowerPoint files by allowing the course designer to add self-test questions, provide a search function, and provide a navigable menu. A conservative estimate is that it took between 16 and 20 h to create, narrate, and publish each online lecture for this course. Once students completed the online lecture, they were required to take a WebCT quiz over the topic. They were allowed two attempts to take each quiz, and thus the majority of students got between 90% and 100% of the points on these assignments. The purpose of allowing two attempts was to make sure that the students learned and understood all the material that was covered in the online lecture.

The key objective of the online component of this course was to provide students the opportunity to prepare for in-class lectures by watching online lectures in a self-paced format. Once a baseline level of knowledge was established, the students were prepared for advanced material that would be
covered during the in-class lectures. To enhance the traditional classroom experience, we employed a radio frequency (RF) in-class response system (Higher Ed Generation 2, e-Instruction, Denton, TX). This system was used to track both student comprehension and attendance. At the beginning of each class meeting, students were asked to answer advanced application questions from the previous lecture (these questions were similar in structure to the exam questions). At the conclusion of each lecture, students were asked to answer basic knowledge questions that pertained to the lecture that they had just heard. Even though the students in the hybrid format did not complete clicker questions, which were on the examinations, the nature of the clicker questions may have biased them toward performing better on exams. In addition to use of the in-class response system, all lecture audio was uploaded to WebCT for download in either a .WMA or .MP3 format. Lecture audio was available to students who attended in-class meetings as an incentive to attend class. It is important to note that both course formats received the same information; however, the students in the hybrid format were provided the content in a technologically rich way. The course grade was determined using the same norm-referenced system described above in the traditional class format. Points were accumulated as follows: exam 1 (120 points), exam 2 (120 points), online quizzes (60 points), in-class responses (60 points), and attendance (50 points) for a total of 410 points.

Fig. 3. Screenshot of an introductory, online lecture for the hybrid version of KIN 3306 (Physiology of Human Performance). This lecture was produced using PowerPoint (Washington, DC), voiceover narration, and Articulate Studio (New York, NY). Self-test questions (not shown) were embedded in the lectures to allow students to review as they proceeded.

Statistical analysis of course effectiveness. The key outcome measures were the grade on exam 1, the grade on exam 2, and the final grade for each semester the course was taught. We chose not to use the grade for exam 3 because only the traditional format had three exam grades. Prior to formal statistical testing, data were checked for normality and constant error variance using residual-predicted and quantile-quantile plotting. Grade data were analyzed using a 2 (delivery format: traditional or hybrid) × 3 (semester: Fall, Spring, or Summer) ANOVA. Significance was set at $P < 0.05$. The location of significant effects was determined using multiple Student $t$-tests with a Bonferroni correction for multiple comparisons. All data are reported as means ± SE.

Program Evaluation

Descriptives. Grades from a total of 658 students who took KIN 3306 (Physiology of Human Performance) between August 2004 and August 2007 were used in the present investigation. All of these semesters were taught by the same instructor (B. K. McFarlin). For the present investigation, there were 346 students who took the traditional course format and 312 students who took the hybrid course format. A breakdown by semester revealed that 402 students took the course in the Fall, 94 students in the Spring, and 162 students in the Summer. Basic descriptive statistics for each semester are presented in Table 1.

Exam grade comparisons. A significant semester × format interaction was found for exam 1 grades ($P < 0.01$). Exam 1 grades for the hybrid format were 10.5% (12.6 points) higher than for the traditional format. For exam 2 grades, significant main effects were found for semester ($P < 0.01$) and format ($P < 0.01$). Exam 2 grades for the hybrid format were 17.6% (21.2 points) higher than for the traditional format. Exam 2 grades in the Summer were significant greater than those in the Fall (−20.0) or Spring (−18.1). Summing the two exam grades
together shows that, on average, students in the hybrid format earned exam grades that were 14.0% (33.8 points) higher than students that took the traditional format.

Final Grade (Point Total)

A significant semester × format interaction was found for final course grades \((P = 0.01; \text{Fig. 4})\). On average, students in the hybrid format of the course earned final grades that were 9.9% (40.7 points) higher than students in the traditional format (Fig. 3B). Neither Fall-hybrid nor Summer-hybrid was different than each other. The SD for the HYBD course was 38.8; thus, an increase in the final grade total of 40.7 points was equivalent to a one letter grade improvement.

Discussion

To our knowledge, this is one of the first investigations to report the structure utilized to transition a large undergraduate exercise physiology course from a traditional format to a

Table 1. Student breakdown by academic classification

<table>
<thead>
<tr>
<th>Academic Classification</th>
<th>Traditional</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fall 2004</td>
<td>Spring 2005</td>
</tr>
<tr>
<td>Total number of students</td>
<td>117</td>
<td>94</td>
</tr>
<tr>
<td>Number of seniors</td>
<td>38</td>
<td>30</td>
</tr>
<tr>
<td>Number of juniors</td>
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<td>56</td>
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<td>Number of sophomores</td>
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<td>Number of freshmen</td>
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<td>0</td>
</tr>
<tr>
<td>Number of other students</td>
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<td>1</td>
</tr>
</tbody>
</table>

Total sample size was 658 students (traditional = 346 and hybrid = 312).
hybrid format. The results also demonstrate that the hybrid format was associated with a significant improvement in student grade performance. In this investigation, students who took the hybrid format earned final grades that were an average of 9.9% (40.7 points) higher than those in the traditional format. Taking this finding in combination with the average grade for exams 1 and 2 suggests that 83% of the improvement in final grades can be directly attributed to higher exam scores of students who took the hybrid format. Since the final letter grade was established using the class average and SD, the point total increase in the hybrid format was consistent with a full letter grade (i.e., an “A” instead of a “B”).

It is reasonable to speculate that the instructional technology played a large role in the improvement of both exam grades and final grades. It has been previously demonstrated (1, 5) that courses that effectively use instructional technology improve student grades due to an interaction that is typically not possible in a large classroom setting. For instance, during the online component of our course, students were able to choose a content delivery method that matched their learning style. It is possible that they were able to better understand and comprehend the advanced material, due to an improved learning of the introductory material. Despite the apparent increase in learning that was observed, it is possible that the results may have been confounded by the longitudinal nature of this study or the presence of the Hawthorne effect.

In addition to statistically analyzing student grades, I also reviewed informal student feedback from course evaluations and found that students who took the hybrid format of the course preferred its self-paced nature and ability to review course content as often as they liked. This antitotal account appears to support the speculation regarding why the final grades improved. Beyond the improvement of student grades, hybrid courses may be useful to large college campuses because they help with space management issues (7, 9). For instance, in the present hybrid course, I only needed to have access to a classroom for 1.5 h/wk, which effectively meant that two courses could be taught in a classroom that would normally be dedicated to one traditional lecture course.

While the hybrid environment does appear to provide numerous benefits to the student learners and instructors, it is not without its own shortcomings. For instance, a major drawback of online instruction is an inability to confirm the identity of a student who is completing an assignment. Another drawback for the instructor is the amount of time that is required to author online course materials. I was willing to commit the time to this cause because I knew that it helped to advance the University of Houston mission of learning and leading; however, at other universities that lack instructional development support, this may be an issue. Despite the initial time requirement to create new online course material, over several semesters an instructor would be able to utilize the same content with slight modifications/updates; thus, this may actually represent a time savings. Another weakness of the present approach is that while the final point total was the same between the two course versions, the manner in which the points were allocated was different. Thus, it is possible that individual grades may have been higher because the points were easier to earn in the hybrid course. Based on the increase in exam 1 and 2 scores, only ~17% of the improvement in the final point total was due to other points; thus, the majority of improvement in the final point total was due to exams. One of the main reasons that I selected to use WebCT to deliver the online component is that it is the standard at my university and at other universities across the nation. I also enjoyed using WebCT because you do not have to have extensive experience writing HTML code but can take advantage of HTML code using the built-in Java interface. Throughout the process of transitioning this course, I experienced a number of setbacks with the implementation of the technology; however, in the end, I expanded my own instructional capacities and provided a better learning experience to my students. As a result of my experiences and improvement in student grades, I now only offer KIN 3306 in a hybrid format.

In the present evaluation, it has been demonstrated that a hybrid formatted course significantly improved student grades. One key to the effective use of instruction technology is to always remain on the cutting edge. To address this, two areas of focus have been developed to be implemented in future semesters of this course. First, the current use of the SitePal interface will be expanded so that it is more than just an announcement tool. I am presently working with the SitePal support team to develop an online, interactive question assistant that students can query to get answers to basic course structure as well as content-related questions. It is envisioned that the development of this technology will allow the creation of “virtual teaching assistants” whose knowledge can be expanded as necessary in the future. Second, the use of podcasting will be expanded. Specifically, two new iTunes RSS streams will be developed. One stream will be devoted to the dissemination of course lecture audio (in addition to the WebCT download). The second stream will be used to relay weekly course announcements. It is anticipated that the addition of these technologies in addition to the current hybrid structure will further improve student learning and translate to an improvement in academic performance.

In today’s learning environment, the effective use of instructional technology provides a means to provide students with immediate, on-demand access to course content. In large, traditional lecture courses, customization is not possible because of the time burden that it places on the instructor. Hybrid and online courses are useful because they eliminate this burden. The key to effective implementation and utilization of instructional technology is to keep the focus on student-related outcomes and learning. This was the objective of the present investigation and will continue to be a focus in the future.

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REFERENCES


