What is the optimum duration of an asynchronous distance learning course?

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Cognitive learning theory maintains that new information enters working memory, where it is organized and transferred to long-term memory (10). During this learning transfer, links are created between new and established knowledge so that information is placed in context for retrieval at a later date. If this theory is correct, it seems reasonable to assume that in the classroom setting, new material must be presented over a sufficiently long period to allow students enough time to process the new information and integrate it into existing memory. This indicates that there must be a minimum duration for a college course; otherwise, students would not have sufficient time to learn at an optimum level. This report addresses the question of course length by outlining the results of a 5-yr study on the outcomes and perceptions of students enrolled in two sections of an online summer course. Each year, the content, assignments, and assessments for the two sections were identical; they differed only in duration, as one section was 1 mo long, whereas the other lasted 2 mo.

A study of a traditional, face-to-face business course revealed that students performed equally well in a 5-wk (summer) course and 12-wk (standard) course (5). Students seemed to enjoy the more intensive summer course and showed a higher level of motivation, which may be indicative of a willingness to spend more time and energy in the process of acquiring, absorbing, and learning the new information. To date, there have been no reports on the effect of course duration on online student performance and perceptions. This is interesting because, since the year 2000, the enrollment in online courses has increased by almost 20% per year, which is greater than the increase in the number of students attending institutes of higher learning in the United States over the same time period (8). More than 20% of graduating students have taken at least one online class and, in fall 2007, >3.9 million students were enrolled in at least one online course (1). These data indicate that online education is both established and growing, and studies have shown that there is no significant difference between the achievement of online students and those who have been given face-to-face instruction (6).

Course management software promotes the notion that it is no longer necessary for online students and instructors to come together at the same time. Rather, individuals can work independently and within their own timeframes in a class that is run asynchronously. In this scheme, class scheduling need not be confined to the standard college semester, and there is no requirement for students to travel to campus for class. In fact, all that is needed is a computer and a robust internet connection. Under these conditions, students can study anywhere and at any time. But what is the best duration for an online course to promote optimum learning? This study aims to provide some answers to this question by providing data from an asynchronous online course taught within two time frames over five consecutive summers.

Materials and Methods

The Biology Department of Villanova University offers an undergraduate distance learning course in Human Physiology for liberal arts and business majors. In each of the past five summers, this online lecture/laboratory course has been run in two sections, which were identical in content, exams, and assignments. Students either elected to take the 1-mo section, which ran in July, or the 2-mo section, which ran in June and July. The course grading scheme was the same for the 2 sections and was derived from 3 sources: 4 lecture exams (60%), 12 laboratory reports (20%), and 2 term papers (20%).

The course was divided into four quarters; each quarter lasted 1 wk in the shorter (1 mo) section and 2 wk in the longer (2 mo) section. The assignments for each quarter consisted of 10 lectures and 3 laboratory simulations. Each lecture began with a web-based article, a brief case, or a short video clip selected to introduce a particular topic. Initial versions of the lecture used narrated Microsoft PowerPoint presentations and then Adobe Camtasia files. In both cases, the files were large and took a long time to download, and students stated that the environment was passive; they did not enjoy watching lecture presentations. The final lecture format consisted of a prerecorded mp3 file played through an Adobe Flash player, which was integrated into an interactive HTML webpage. Students did not simply watch the lecture; rather, the player allowed students to play, stop, and rewind the prerecorded voice recording, and the numerous text links forced them to interact with the web content. Each lecture was principle based and covered sufficient physiology to explain the topic at hand. The lecture ended with a summary aimed to tie the presented material to the introductory topic and to previous lectures. The amount of memorization was kept to a minimum, and the principles introduced in one lecture were often revisited later in the course, so that students could appreciate that certain processes are used in different organ systems to achieve a similar goal.
How We Teach

THE OPTIMUM DURATION OF AN ASYNCHRONOUS DL COURSE

Table 1. Numbers of students who completed (or dropped) the two sections of the course in five summers

<table>
<thead>
<tr>
<th>Year</th>
<th>1-mo Course</th>
<th>2-mo Course</th>
<th>%Female/%Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number of students who completed the course</td>
<td>Number of female students who completed the course</td>
<td>Number of male students who completed the course</td>
</tr>
<tr>
<td>2007</td>
<td>23</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>2008</td>
<td>17</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>2009</td>
<td>23</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>2010</td>
<td>23</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>2011</td>
<td>26</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>81</td>
<td>31</td>
</tr>
</tbody>
</table>

%Female/%Male values are expressed as a percentage of the total number of students who completed the course in that year.

There were no required student meetings, although the instructor was available through e-mail and on the course chatline from 9 PM through midnight, Monday through Friday; feedback from a post-course survey indicated that this time was convenient for most students. While some students interacted with one another on the chatline, most of the interactions were one on one with the instructor. The asynchronous nature of the course allowed students to work within their own schedules, with the understanding that they completed the timed exam and submitted their laboratory reports and term paper (if appropriate) before the Sunday midnight (EST) deadline at the end of the quarter.

RESULTS

Course data. Data were collected over five summers, between 2007 and 2011, and postcourse attitudinal surveys were administered in the last 3 yr. Feedback from the surveys revealed that this was the first distance learning course for 58% (SD ±2) of students in the shorter section and 61% (SD ±6) of students in the longer section. Table 1 shows data for the number of students who completed the two sections of the course, the sex distribution, and the number of students who dropped the course. The data show that ~70% of the student population was female and that more students (62%) elected to take the shorter course. Furthermore, 12.3% of registered students dropped out of the shorter section, whereas only 5.6% dropped out of the longer section, and 85% of the students who dropped out of the class did so during, or immediately after, the first quarter.

A Student’s t-test revealed no significant difference between the final numerical grades earned by students in the two groups of students in any one year (Table 2). Similarly, data from the courses conducted during summer 2011 showed no significant difference between the scores for the four exams, the combined laboratory grade, and the two term papers. Grade analysis based on sex was performed on data from 2007 and 2011, the two years when the male-to-female ratio was closest to 1 (Table 1). A Student’s t-test revealed no significant difference between the final numerical grades earned by female and male students.

Postcourse survey. Students in both sections of the class were asked to answer an online postcourse survey at the end of the fourth quarter, before the final exam. This attitudinal survey was composed of 25 questions and used a Likert-type rating scale. Very few students (<10%) voluntarily completed this attitudinal survey in the first 2 yr of the study. However, in the last 3 yr, when students were awarded one bonus point for carrying out the survey, the completion rate rose to >90% for all sections. Table 3 shows the answers (expressed as a percentage of the total number of responders in each section) to four survey questions. The data show that the majority of students in the shorter section would have liked more time to study and felt that they would have earned a better grade had they taken the longer section; this latter perception is interesting because there was no statistical difference between the final grades earned by students in the two sections of the course in any one year (Table 2). Students in the longer section, in contrast, did not feel that they needed more time to study and believed that, had they taken the shorter class, they would have been more stressed and would not have earned a better grade. Interestingly, all students who completed the longer section and a majority of students in the shorter section stated that they would recommend the longer 2-mo class to a friend who was committed to taking this online course (Table 3, question D).

DISCUSSION

Students in the two sections of the online Human Physiology course were self-selected groups. While the criteria used by students to select their class are not available, it does not appear to be connected to prior experience with online learning because the same percentage (~40%) of students had prior experience with an online course. No attempt was made to determine student activity outside of the course. However, the website log-on times, positive feedback from questions on the asynchronous nature of the course, and the timing of the chat sessions and e-mails indicate that most students did their course work at night and on weekends. Attempts, both during and after the course, to convene focus groups to discuss the course objectives and evaluate the curriculum were unsuccessful, even though students were asked to meet online. A similar low rate of response was observed during the first 2 yr of the study, when students were asked to voluntarily complete the postcourse survey.
Mayer’s cognitive theory of multimedia learning maintains that new information is processed through auditory and visual channels and that each of these channels has a finite capacity (9). This information is then organized and transferred from working memory to long-term memory, placing it in context with existing knowledge or building new schemata. This theory had a profound effect on the design of this online course in Human Physiology. The asynchronous nature of the course allowed students to acquire new knowledge at their own pace and time, and the ability to stop and replay the voice track facilitated student learning. It is interesting that a study (3) published after the course format had been established showed that 50% of students learning physiology prefer the visual sensory modality, whereas the second most preferred modality for learning is sex specific (aural for females and read/write for males). Data from 2007 and 2011 showed no statistical difference between the final grades earned by males and females, which indicates that the modes of presentation used in this study did not favor either sex.

Student feedback revealed that they enjoyed interacting with the lectures and laboratory simulations, learning at their own speed and within their own time frame; a feature facilitated by the asynchronous nature of the course. Furthermore, many commented that they liked the format of the lectures and the laboratory simulations; they quickly understood and mastered the software, and this allowed them to spend their time transferring their learning and constructing new schemata. This decrease in extraneous cognitive load (12) coupled with the instructor’s conscious decision to “chunk” lecture material helped students with the intrinsic cognitive load, that is, students did not fight the software; rather, they spent their time confronting the inherent difficulty that many nonscience majors may encounter when faced with unfamiliar scientific principles (4). Certain concepts and principles were discussed several times during the course and were also reinforced in the laboratory simulations and in the term papers. This illustrated that many processes are used in different areas of the body to produce the same result and allowed students to transfer their learning to different areas of the course, which, students commented, gave them a feeling of accomplishment and mastery.

The lectures stressed concepts and principles, rather than memorization of facts, and revolved around a topic introduced as an online article, video clip, or case. The objective was to minimize fact memorization and concentrate on understanding, applying, and analyzing concepts. In other words, students were expected to acquire sufficient basic knowledge and then use their higher-order thinking skills (2) to understand the concepts and make sense of their newly acquired knowledge. The transfer of knowledge from working memory to long-term memory takes time (9). The restricted amount of time experienced by students in the shorter class suggests that they may have experienced more stress due to imposed time restrictions and wished that they had had more time to study (Table 3, question A). However, a comparison of the grades from the two sections revealed no significant difference in the grade for each question A). However, a comparison of the grades from the two sections revealed no significant difference in the grade for each assessment and between sections (Table 2). Similar results were obtained in a traditional face-to-face business course, where students performed equally well in a 5- and 12-wk course (5).

It is interesting that, in the past 5 yr, the shorter course always had a higher enrollment and a higher attrition rate (Table 1). In fact, when the data for 5 yr were combined, the attrition rate for the shorter section was more than twice that seen in the longer section of the course. While no feedback is available from the students who dropped the course, the observation that there was a higher attrition rate in the shorter course is consistent with other studies suggesting that students drop classes because of time constraints (13). Some students may have relied on last-minute memorization, rather than trying to learn consistently throughout the quarter, realized that they had fallen behind and dropped out of the class. The higher attrition rate for the shorter section was more than twice that seen in the longer section of the course. While no feedback is available from the students who dropped the course, the observation that there was a higher attrition rate in the shorter course is consistent with other studies suggesting that students drop classes because of time constraints (13). Some students may have relied on last-minute memorization, rather than trying to learn consistently throughout the quarter, realized that they had fallen behind and dropped out of the class.

### Table 3. Student feedback from four questions from a postcourse survey presented to both sections of the Human Physiology course during summer 2009 through 2011

<table>
<thead>
<tr>
<th>Year</th>
<th>1-mo Course</th>
<th>2-mo Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agreed</td>
<td>Neutral</td>
</tr>
<tr>
<td>2009</td>
<td>61</td>
<td>9</td>
</tr>
<tr>
<td>2010</td>
<td>71</td>
<td>24</td>
</tr>
<tr>
<td>2011</td>
<td>54</td>
<td>23</td>
</tr>
</tbody>
</table>

A. I wish that I had more time to study

B. I believe that I would have felt more stress had I taken the other section

C. I believe that I would have earned a higher grade had I taken the other section

D. I would recommend the 2-mo course (rather than the 1 mo) to a friend who was committed to taking the course

Values are percentages of students in each section that agreed with, were neutral to, or disagreed with the statements shown.
attrition rate in the shorter course coupled with the observation that most students who dropped the course did so during and immediately after the first quarter, when there was a hard deadline for students to complete their first exam and laboratory reports, indicates that the more compressed time frame may have exacerbated these problems.

The structure and discipline imposed on students by traditional, face-to-face instruction was absent in the asynchronous online course. Success in this distance learning course depended on some degree of self-motivation, and the lack of required class activities and meetings could have been responsible for the greater amount of stress reported by students in the shorter course (Table 3, question B). Online students can feel isolated and frustrated (7), and the asynchronous environment can facilitate procrastination. Under these circumstances, it is interesting that all of the students in the longer class and a majority of students in the shorter class would recommend the 2-mo section to a friend who wanted to take the course (Table 3, question D). This suggests that, in hindsight, most students would prefer the longer time frame for this asynchronous, online summer course.

DISCLOSURES

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

AUTHOR CONTRIBUTIONS

P.J.S. conception and design of research; P.J.S. performed experiments; P.J.S. analyzed data; P.J.S. interpreted results of experiments; P.J.S. drafted manuscript; P.J.S. edited and revised manuscript; P.J.S. approved final version of manuscript.

REFERENCES