Virtual Lecture Hall For In-Class And Online Sections: A Comparison Of Utilization, Perceptions, And Benefits

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Abstract

We further evaluated the Virtual Lecture Hall (VLH) (Cramer, Collins, Snider, & Fawcett, in press), an instructional computer-based platform to deliver PowerPoint slides threaded with audio clips for later review. Students from either an in-class or online section (ns = 810 and 74 respectively) of introductory psychology had access to live recorded lectures via the VLH, made available through the course Web site. Approximately 45% of in-class and 78% of online students used the resource prior to each of two course midterms; 32% of in-class and 50% of online students completed a five-item survey assessing student perceptions of whether the VLH enhanced learning or increased grades, and whether they wanted the resource in other courses. Number of VLH accesses and total duration were calculated. Results showed that regardless of course section, greater VLH use was linked to higher midterm scores, and student perceptions of the VLH were highly favorable. Curiously, whereas in-class students' VLH use and duration were negatively related to expected grade, that same link was positive for online students. Directions for future research in resource development and implications for educators are discussed. (Keywords: PowerPoint-audio recorded lectures.)

The face of the classroom has changed dramatically in recent years, and continues to do so in higher education (Carswell, Thomas, Petre, Price, & Richards, 2000; Clark & Mayer, 2002; Comeaux, 2005; Mayer, 2004; Nicolaou, Nicolaidou, & Constantinou, 2005; Zhang, 1998). Bransford, Brown, and Cocking (2000) noted that "new developments in the science of learning raise important questions about the design of learning environments – questions that suggest the value of rethinking what is taught, how it is taught, and how it is assessed" (p. 131). As Alonso, López, Manrique, and Viñes (2005) observed, "Computer-assisted teaching using the Internet has radically changed the teaching paradigm" (p. 217). In fact, more students than ever are taking distance education courses, and more instructors are utilizing technology in the classroom (Kekkonen-Moneta & Moneta, 2002).

Whereas instructors routinely entertain the introduction of novel technologies in the classroom in order to stimulate student interest, focus attention, and foster learning, there remain many unique challenges (Barrie, Ginns, & Prosser, 2005; Comeaux, 2005; Finley, 2005; Palloff & Pratt, 1999). Although often confronted by practical student constraints, including time, finances, geography, and technology, online instructors have successfully revamped their online learning environment (a) to increase learning availability to those who cannot or choose not to attend traditional in-class offerings, (b) to cost-effectively de-

sign and disseminate course content, and (c) to handle larger student numbers. For example, various online tools such as course-relevant newsgroups, threaded discussion boards, even student self-assessment strategies help to encourage critical thinking and effective writing skills.

However, the question remains as to whether the advent of educational technologies, including PowerPoint slides, online discussions, and computerized demonstrations, live up to students' expectation of truly enhanced learning for which they were intended (Barrie et al., 2005; Bork, 2001; Frear & Hirschbuhl, 1999; Herson, Sosabowski, & Lloyd, 1999; Sosabowski, Herson, Lloyd, & Bell, 1998). Indeed, the advent of the Internet in recent years has brought with it new possibilities for instructors to creatively deliver effective course instruction to students (Carswell et al., 2000). For instance, Kekkonen-Moneta and Moneta (2002; see also Xie & Zhang, 1999) compared students' learning outcomes in the lecture to an online version of an introductory computing course. Whereas both lecture and online-learning students achieved comparable factual learning outcomes, the online students outperformed the lecture students in applied-conceptual learning. Among others, these findings suggest that the use of carefully designed interactive learning modules can effectively foster higher-order learning outcomes. Indeed, Martin and Taylor (1997) have regarded a virtual classroom as the next step in the development of educational technology.

THE VIRTUAL LECTURE HALL

As a bridge between these educational trends, we further extend our previous research on the Virtual Lecture Hall (VLH) (Cramer et al., in press), a computer-based instructional delivery platform that marries PowerPoint slides with live-recorded audio clips that students may review later. It was our hope that students equipped with this pedagogical tool would show greater retention of course material and enhanced course satisfaction. Specifically, we sought to compare the utilization rates and performance levels between students enrolled in the same course, taken either traditionally in the classroom or delivered entirely online through the VLH.

The VLH began as a platform to deliver previously presented lectures (recorded either live or otherwise) so that students could review material (a) that they had missed, or (b) for study purposes. Compiled lectures that unite audio clips with PowerPoint slides are made available to students on the campus network and over the Internet, although lectures can be similarly saved and delivered on a CD-ROM. The main Internet page includes both a media player and vertical menu bar that lists the titles of slides in the lecture. Students can navigate directly to any slide in the lecture that they wish to review by merely selecting a slide title that then displays the slide and plays the audio of the associated slide.

For the most recent incarnation of the VLH, a PowerPoint add-in was developed that provided easy-to-use controls for voice recording and synchronization with slides on the computer as the lecture was presented. The add-in both handled post-lecture production chores and published the finished lecture to a streaming RealNetworks media server. Two versions of each lecture were created, as most students had telephone dial-up connections of 33.3 or 56.6 kB/s.

One version was created using D-HTML for students with fast Internet connectivity (DSL or cable). The D-HTML version allowed VLH users to adjust the size of the on-screen slides for easier viewing while still maintaining slide animations and correct audio timings. The other version accommodated students with slower telephone modem connectivity. In this version, audio was synchronized with a JPEG image of each lecture slide. This new system also preserved the capability of hyperlinking to any slide in the presentation.

In the first empirical study of this technology, Cramer et al. (in press) made the VLH available (after an initial baseline of student performance) to more than 800 undergraduates enrolled in either Introductory or Personality Psychology, and both utilization and duration statistics were collected. With test performance assessed on the first midterm prior to availability of the VLH, students served as their own control group so any initial differences could be covaried or partialled out of subsequent test performance (i.e., the second midterm). In addition to utilization data, students elected to complete a brief survey assessing whether they believed the VLH enhanced learning or increased grades, and whether students wanted the VLH in other university classes, how many classes they have missed to date, and their expected grade. Results showed a positive relation between subsequent test performance and both the number and duration of VLH accesses, even after accounting for students' initial midterm scores. In addition, there was a significant difference between high- and low-users of the VLH. In other words, students who used the VLH a total of 100 minutes or more scored approximately 15% higher on their second midterm than students who used it less. Analysis of the student survey showed a highly favorable evaluation of the VLH, wherein a majority of students believed it would enhance learning and improve grades. More than 90% agreed the VLH should be offered in other courses. Results failed to find a relationship between VLH utilization and the number of classes missed, or between expected grade and either VLH access or duration of use.

PRESENT STUDY AND HYPOTHESES

At present, the VLH has been evaluated on students who attend in-class lectures and may revisit recorded lectures for review for a later time. That is, it remains unknown how effective would be the VLH when delivered to students registered for the same course with lectures delivered entirely online. As such, we evaluated the performance of students participating in an in-class section of Introductory Psychology (given the option of using the VLH), and compared them to students enrolled in an online section of the same course whose VLH access to course lectures was necessary. This permitted the evaluation of two important hypotheses.

Based on earlier work by Herson et al. (1999), who tracked student utilization rates, it would prove worthwhile to monitor who uses the VLH according to how often they use the feature and for how long. Thus, both a measure of number and duration of accesses were calculated. Upon entry to the VLH on the course Web site, the server recorded each time a student accessed a lecture, logging the date and time of each entry as well as the duration of each access.

Students were also asked to complete a survey delineating their thoughts and feelings about the VLH, including their perceptions of its effectiveness, whether they believed it would increase their grade, and whether they would like to see the VLH employed in other classes (cf. Carswell et al., 2000; Cramer et al., in press; Johnson, Aragon, Shaik, & Palma-Rivas, 2000). We hypothesized that compared to their performance assessed before access to the VLH, students who use the VLH more often or for a greater duration will show significant improvements in their subsequent test scores. We further hypothesized that because this is the only means by which online students can receive the lecture materials (unlike in-class students receiving a live lecture), the aforementioned improvements should be significantly stronger for students enrolled in the online section.

METHOD

Participants

There were 884 students from an introductory psychology class (71% female) at the University of Windsor in southwestern Ontario, Canada, who participated in the study for no compensation. Seventy-four of these students (8.4%) were registered in an online section without on-site classes; the remaining students were registered in two relatively evenly populated on-site in-class sections of the same course with the same instructor, materials, and evaluation.

Materials and the VLH Platform

The VLH lectures were created using PowerPoint slides to deliver the static lecture material. The audio component was recorded simultaneously during their presentation to the in-class sections. The compiled lectures were uploaded and made available to students through a course Web site open only to students registered in the introductory course. Prior to gaining access to the resource, students provided informed consent (by endorsing through a mouse click an online agreement) in their use of this educational tool, and received a disclaimer (with each VLH access) that their activity—as tracked through a student number—would be monitored for research purposes.

In addition to utilization data, students were invited to complete a brief five-item survey to assess their thoughts and feelings about the VLH, including questions concerning whether they believed the VLH enhanced learning or increased grades, and whether students wanted the VLH in other university classes (each question was assessed on a five-point Likert scale: 1="not at all" to 5="to a great extent"), how many classes they have missed to date (0, 1–3, 4–6, 7–9, or 10 or more), and finally their expected grade in the class (A, B, C, D, or F).

Procedure

Beginning in the Fall 2003 semester, two 50-minute lectures were recorded live each week throughout the semester and made available online approximately 15 minutes after each class. As delivered with chiefly PowerPoint slides and video clips, the class lectures only moderately overlapped with textbook information, so that the former reinforced (rather than substituted for) the latter. Five weeks after the start of classes, all students completed their first midterm,

followed four weeks later by completion of their second midterm. At the course conclusion, all students were debriefed on the study in a written memo that outlined all the details on why and how the study was conducted, what the researchers expected to find, and the implications for higher education.

RESULTS

In-Class vs. Online VLH Utilization

In addition to utilization rates and duration measures, the analysis to follow tested the two hypotheses in a comparison of in-class and online students' performance scores for the two midterms. Of the 810 in-class students, 357 (45% of in-class enrollment) utilized the VLH a total of 1,499 times (at five minutes minimum per access). There were on average 4.08 (SD = 3.91) accesses per in-class student, which ranged from one to 32 in total accesses. VLH duration for in-class students ranged from five to 299 minutes, with a median of 16 minutes. Comparatively, there were 58 of 74 online students (78% of enrollment) who utilized the VLH a total of 467 times. There were on average 8.05 (SD = 7.30) accesses per online student, which ranged from one to 37 in total accesses. VLH duration for online students ranged from five to 365 minutes, with a median of 61.2 minutes.

Tracking Midterm Test Scores

Students in both in-class and online sections were simultaneously tested on their mastery of course material based on two midterms; we compared whether midterm scores varied by section, but more important, we explored the extent to which students had used the VLH in their preparation. An analysis of variance (ANOVA) was conducted with the first midterm as the dependent variable and both course section (in-class vs. online) and VLH use (use vs. no use) as the independent variables. Results showed two significant main effects by (1) section, $F(1, 880) = 30.62$, $p < .001$, MSE=308, so that in-class students outperformed online students (Ms = 63.0 vs. 51.9, SDs = 16.2 vs. 20.5, respectively); and (2) VLH use, $F(1, 880) = 4.05$, $p = .045$, $MSE = 308$, so that students who used the VLH outperformed students who did not (Ms = 62.8 vs. 61.4, SDs = 17.0 vs. 16.7, respectively). There was no significant interaction.

A similar ANOVA utilized the second midterm scores. As before, results showed two significant main effects by (1) section, $F(1, 880) = 5.07$, $p = .025$, $MSE = 409$, so that in-class students outperformed online students (Ms = 60.2 vs. 57.4, SDs = 20.4 vs. 20.0, respectively); and (2) VLH use, $F(1, 880) = 8.77$, $p = .003$, $MSE = 409$, so that students who used the VLH outperformed students who did not (Ms = 62.5 vs. 57.7, SDs = 20.5 vs. 20.0, respectively). Once again, there was no significant interaction.

To further delineate the relation between midterm performance and VLH access, we designated VLH access into five groups: no accesses (n = 459), 1–2 accesses (n = 184), 3–4 accesses (n = 80), 5–6 accesses (n = 68), and 7 or more accesses (n = 93). An ANOVA of second midterm scores by section and VLH access showed a significant main effect by section (as previously reported), but also a significant main effect for access, $F(4, 874) = 3.51$, $p = .007$, $MSE = 408$.

Tukey follow-up multiple comparison procedures showed that students who accessed the VLH either 1–2 times or not at all (*M*s = 55.8 and 52.8, respectively) had significantly lower midterm scores than students who accessed the VLH 3–4, 5–6, or 7 or more times (*M*s = 62.5, 61.5, and 64.4, respectively), whose means did not significantly differ. That is, moderate use of the VLH corresponded to a roughly 9% increase in midterm score, regardless of enrollment in an in-class or online section.

Student Perceptions

Of those who used the VLH at least once, 116 in-class and 29 online students (32% and 39%, respectively) completed the five-item survey. (See Table 1 for frequencies by section.) Overall, students from both in-class and online sections were especially favorable about the VLH, with students believing this tool enhances learning, improves grades, and should be an option in other courses. To see if VLH utilization varied as a function of expected grade and class section, an ANOVA used both number and duration of VLH accesses as the dependent variables. (See Table 2 for sectional means by expected grade.) For the number of accesses, results showed a main effect for section, $F(1, 138) = 11.69$, $p < .001$, $MSE = 27.1$, so that online students on average used the VLH more than in-class students; and a significant interaction between section and expected grade, $F(3, 138) = 2.86$, $p = .039$, $MSE = 27.1$, so that for in-class students VLH accesses increased as expected grades decreased; however for online students both VLH accesses and expected grades increased. For the duration of accesses, results similarly showed a main effect for section, $F(1, 138) = 14.08$, $p < .001$, $MSE = 4584$, so that online students used the VLH for longer periods of time than in-class students; and a significant interaction between section and expected grade, $F(3, 138) = 3.41$, $p = .019$, $MSE = 4584$; so that for in-class students duration increased as expected grade decreased, while for online students both duration and expected grade increased. Although the standard deviations were noteably disparate, a reanalysis using a nonparametric alternative revealed comparable results.

DISCUSSION

This study compared the relative utilization, midterm performance, and perceived benefits of the VLH for students enrolled in either an in-class or online section of introductory psychology. Overall, results showed relatively low VLH utilization in the in-class section, presumably because these students could derive the lecture material from merely attending class. However, for online students, the VLH was the only means toward acquiring lecture materials and so their utilization rates were understandably much higher. Although relatively few in-class students had used the VLH when available, it was admittedly a new technology to both the course and the university, and some students may have been unsure about how to access it. Indeed, educators should not be surprised that although this particular tool—among others offered in any given course (e.g., study guides, discussion groups, useful Web links)—was made available to improve student performance, most students failed to take advantage of its availability (Karabenick, 2004). Both medical and psychological health profes-

Table 1: In-Class and Online Student Perceptions of the Virtual Lecture Hall

Survey Item	Sec:	Mean	(SD)	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Does the VLH	IC:	4.35	(0.71)	0.0%	0.0%	13.8%	37.1%	49.1%
enhance learning?	OL:	3.87	(1.14)	6.7%	3.3%	20.0%	36.7%	33.3%
Will the VLH	IC:	3.93	(0.89)	0.9%	1.7%	32.8%	32.8%	1.9%
improve your grade?	OL:	3.80	(1.10)	6.7%	3.3%	20.0%	43.3%	6.7%
Should the VLH be	IC:	4.87	(0.39)	0.0%	0.0%	1.7%	9.5%	8.8%
in other classes?	OL:	4.27	(1.28)	6.7%	10.0%	0.0%	16.7%	6.7%
				A	B	C	D	F
Expected grade	IC:	----	----	14.7%	51.7%	30.2%	3.4%	0.0%
in the course	OL:	----	----	13.8%	55.2%	20.7%	10.3%	0.0%
				0	1-3	4-6	7-9	10+
Number of classes	IC:	----	----	47.4%	37.9%	11.2%	1.7%	1.7%
missed	OL:	----	----	n/a	n/a	n/a	n/a	n/a

Note. IC (in-class, n = 367); OL (on-line, n = 58).

Table 2: Mean (Standard Deviations) Number and Duration of VLH Accesses by Section and Expected Grade

Expected Grade	Number of Accesses In-Class	Number of Accesses Online	Duration of Access In-Class	Duration of Access Online
A	3.35 (2.87)	14.50 (15.6)	26.6 (26.4)	190.2 (134)
B	4.65 (4.83)	10.50 (7.81)	44.8 (63.2)	100.2 (100)
C	4.54 (3.12)	7.33 (3.67)	46.4 (61.7)	101.6 (67.9)
D	7.75 (4.92)	6.50 (7.23)	84.4 (92.1)	64.9 (31.3)

sionals refer to this as the service gap, wherein individuals fail to utilize the available resources shown to improve their situation (Cowling, Luk, Mileshkin, & Birleson, 2004).

In addition, the significantly higher midterm scores observed in the present study for in-class students was likely due to a selection bias, wherein students unable to enroll in the in-class section (based on enrollment limits) elected instead for the online alternative. More generally, for both in-class and online students, midterm scores were significantly higher (by almost 9%) with moderate (three or more) accesses of the VLH; in other words, students need not immerse themselves in this new resource in order to derive significant and sizeable benefits. This improvement was lower than what has been observed in earlier studies of the VLH (cf. 15%, Cramer et al., in press). It may be argued that the improvement in scores from one midterm to the next is an artifact and has little to do with the Virtual Lecture Hall; that is, those who performed well on the first midterm would have similarly performed well on the second midterm, regardless of access to this new technology. However, this explanation was discounted in initial studies of the VLH (Cramer et al., in press), wherein students acted as their own control groups in a pre- and post-VLH course setup that showed student motivation and study habits did not interact with VLH use.

Students in both sections were also keenly favorable toward the VLH, judging it both to enhance their learning and improve their course grade. Not surprisingly, an overwhelming majority of students also wished to see the VLH incorporated in other courses. Indeed, although the VLH has since been used in both French and business classes at this university, no large-scale testing has been implemented to assess its relative effectiveness therein. Whether for those disciplines or others (e.g., chemistry, English, history, math, philosophy, physics), it would be worthwhile to assess not only its effectiveness in the classroom, but also students' perceptions of VLH as a learning tool. Certainly there may be a particular type of student who (more so than other students) may embrace this technology as a worthwhile tool. Very likely this student would be better skilled and knowledgeable about recent computer technology and software. Future research would do well to investigate the type of student who uses the technology.

One novel finding in the present study involved the interaction between grade expectations and both VLH access and duration by section. Whereas in-class students expected lower course grades with greater VLH use, the opposite was true for online students. In other words, both the struggling in-class students and the superior online students were using the VLH more and for longer periods of time. This reinforces the notion that a particular type of student may be more likely to enroll in an in-class vs. online section of a course, and then uniquely benefit from utilization of this resource.

We invite future researchers to consider these significant questions in follow-up studies: (1) Why exactly do students use the VLH? Is it for study purposes or rather to merely fill in the details from missed classes? Furthermore, how exactly do students use the audio clips to study—do they take notes from them or use them to augment notes taken earlier during the live lecture? Indeed, might we ask whether online and in-class students utilize the audio clips in a similar way? (2) How can we enhance the benefit of this feature for both in-class and online students? (3) Do students believe they have studied sufficiently well for their midterm from merely listening to the lectures? Are we creating a false sense of mastering the material by engaging in a potentially passive learning tool? (4) What particular areas of the midterm are especially affected by information in the audio and PowerPoint slides (i.e., what is the specific correspondence between these instructional elements)?

As a final note, several technological improvements may be suggested for the VLH that may well be seen in future development and testing. At present, the Centre for Flexible Learning has recently improved VLH performance via the Internet, along with cross-platform compatibility wherein it converts narrated PowerPoint lectures to much smaller and more feasibly downloaded Shockwave movies. Preliminary work has already begun, and there presently exists at least one commercial product that makes this type of conversion possible. Our current challenge then is to smoothly automate the conversion and publishing process, which would give faculty a tool to allow them to publish lectures easily for student access.

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APPENDIX

Survey Instrument

Use the 5-point Likert scale below to address the following three questions:

Strongly Neither Agree Strongly
Disagree…..….Disagree…….Nor Disagree……..Agree…..…..Agree

1. To what extent do you believe the Virtual Lecture Hall enhanced your learning of the course lecture material?
2. To what extent do you believe the Virtual Lecture Hall helped to increase your grade in the course?
3. To what extent would you like to see the Virtual Lecture Hall used in other university classes?

Now answer the following two questions:

4. What is your expected grade in the course?
   A B C D F
5. How many classes they have missed to date
   0 1–3 4–6 7–9 10 or more