Eating Your Lectures and Having Them too: is Online Lecture Availability Especially Helpful in "Skills-Based" Courses?

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Abstract: At the University of Toronto at Scarborough, we provide enhanced flexibility to our students using a blended learning approach (i.e., the webOption) whereby classes are videotaped as they are offered in a traditional manner, then posted online for subsequent student access. Students can attend lectures live, watch them online at their convenience, or both. Previous research examining the webOption in the context of Introductory Psychology revealed that (a) students were satisfied with the webOption in general, (b) students used and appreciated the pause and seek features afforded by the webOption interface, and (c) those who used the pause and seek features performed slightly better on exams (Bassili & Joordens, 2008). The current research examines similar issues in the context of two mathematics courses. These courses differ from the lecture-based Introductory Psychology class in their emphasis on the teaching of mathematical proofs; cognitive skills that, like any other skill, are enhanced with practice (Schneider & Shiffrin, 1977). Access to online lectures allows students to re-experience the professor as they teach these skills. Given this, the webOption might be especially potent in these learning contexts. Surprisingly, the results we report here do not confirm that prediction. Students do use and appreciate the features of the webOption as was the case in our previous work, but those students who augmented their class attendance with online viewing, and those who used the lecture-control features the most, were actually the students who performed most poorly. Said another way, those students who had the most trouble with the course did indeed use the webOption as a way of understanding the material better but, interestingly, doing so did not result in better performance. Several possible reasons for this surprising result are considered.

Keywords: online lectures, webOption, calculus, performance, surface versus deep learning

1. Introduction

You can eat your cake and have it too. That notion of consuming something, and yet not losing it for future consumption, is impossible when it comes to food. However, it is not impossible when it comes to lectures (e.g., Halper, Kelly & Chuang, 2007). It is relatively trivial to tape lectures as they are presented, then making them available online for subsequent student access, a form of blended-learning that we at the University of Toronto Scarborough refer to as the webOption. This approach allows students the flexibility of attending lectures live, watching them online after the lecture, or of consuming the lecture live yet having it too.

In the remainder of this introduction we describe the webOption process with some background, present previously published research findings based on it, and then introduce the primary question of the current work; Does continued access to an online version of in-class lectures provide an especially potent tool for students in courses that emphasize cognitive skills as opposed to those that emphasize concepts?

We have offered webOptioned courses at the University of Toronto Scarborough for over 6 years, and have conducted research examining student satisfaction and performance since our first use (e.g., Bassili & Joordens, 2008). Our goal is not to replace traditional lectures but, rather, to augment them by providing students enhanced flexibility. Thus, lectures are presented as they normally would be with the following additions. As the professor lectures they are taped by a videographer using a standard tripod mounted video camera. A wireless microphone system is used to transmit the audio directly to the video camera. The videographer attempts to capture the classroom experience to the best of their ability, focusing the camera on whatever aspect of the lecture seems most critical to learning. The resulting videos are captured and compressed into realmedia format, then posted on the web typically on the same day. Six years ago we offered only our Introductory Psychology

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courses in this way, but the popularity of the webOption is continually growing to the point where we offered 17 webOption courses in Winter 2009, and 25 courses in the Fall 2009 term.

Our initial research was conducted in the context of our Introductory Psychology courses, courses that focus primarily on teaching students the theories, definitions, experiments and perspectives that form the field. For contrast, we will frame this sort of course as one the focuses on the communication of concepts rather than cognitive skills. It is clearly the case that most courses involve the communication of both concepts and skills, and we do not mean to imply that any course focuses exclusively on one or the other. But relative to the mathematics courses that will provide the context for the current work, it is fair to say that Introductory Psychology involves less emphasis on learning procedural skills of the sort needed to solve mathematical problems.

The findings from our previous research showed that students were satisfied by our implementation, a result bolstered by their loudly voiced desire to have more courses provided in this manner (Bassili & Joordens, 2008). Replicating previous work (e.g., Robertson, Wilson, Cetto and Pardo-Ballester 2008), overall performance did not differ depending on whether students experienced lectures online or in class. However, when students watched online they made extensive use of the pause and seek functions provided by the media player, essentially taking control of the rate of information presentation. Most intriguing, usage of these features was positively correlated with exam performance such that those who used these features more scored higher on a high-stakes exam. This result is consistent with the notion that the extent to which online learning might be beneficial depends critically on how much students interact with the online content (Davies & Martin, 2005).

Subsequent research on the webOption has been primarily concerned with what underlies student decisions to attend lectures or watch them online. For example, Bassili (2008a) showed that attitudes concerning whether students liked the option of having online lectures were predicted by motivational orientations, whereas the actual choice to attend lectures or watch them online was related to students' cognitive strategies. In addition, Bassili (2008b) showed that students' perceptions of media richness also predicted their tendencies to attend class or watch online, and that students were especially likely to attend classes when they perceived the content to be difficult.

However, the current work is most related to the original work by Bassili and Joordens (2008), assessing whether the performance advantage they documented might be especially potent in the context of mathematics. While there has been some previous research assessing tools that attempt to augment mathematics via online assignments (e.g., Carter, 2003; Kennedy, 1990; Kennedy, Ellis, Oien & Benoit, 2007), it appears that nobody has yet examined the effects of simply making lectures available after the traditional lecture has been presented. As mentioned previously, a correlation between use of the mediaplayer features and performance on a high stakes exam was observed in the context of Introductory Psychology, but those correlations were modest with Pearson r values in the 0.10 to 0.13 range. It seemed entirely plausible that the ability to pause or seek lectures, while clearly useful in the context of Introductory Psychology, might be even more valuable in the context of mathematics courses.

Mathematics courses, and especially the calculus courses we examine here, are notoriously difficult for many students (see Doorman & van Maanen, 2008; Pettersson & Scheja, 2008). This difficulty stems from several sources. First, students must keep up with the material as work tends to build incrementally. Having access to previous lectures should allow students to never miss a lecture, and to return to lectures they saw but perhaps forgot or never really understood. Second, the classes have a much larger emphasis on the deep learning of specific cognitive skills (Biggs, Kember, & Leung, 2001), the skills relevant to mathematics proofs. Typically these skills are demonstrated in class and then practiced by the students outside of class. If a student forgets some step between the presentation and the practice, they could encounter real problems. Having access to the lectures allows students to virtually return to the classroom and watch the demonstration again, perhaps with their homework problems in hand. These two issues alone suggest that the webOption approach might be especially beneficial to students in the context of challenging mathematics.

As every researcher knows, and as this paper will demonstrate, intuitions are only as strong as the data they predict. Given this, the purpose of the current work was to assess the impact of implementing the webOption in the context of two courses; Calculus I (MATA30) and Calculus for

Management I (MATA32). By performing the same study in two different classes we were also able to assess the reliability of the results.

2. Study

2.1 Method

2.1.1 Enrolment and participants

Participants in the study were enrolled in our MATA30 and MATA32 classes. Near the end of the term students were informed that we were performing research on their usage and satisfaction with the webOption, and they were invited to fill out an online survey. To motivate participation we had draws for iPod music players, with students informed that their name would be entered in the draw if they filled out the survey. For ethical reasons, the professors of the respective courses were not informed which students participated, and no component of the class was in any way linked to participation. Confidentiality was strictly maintained.

2.1.2 Materials

Lectures were made available online by capturing them in class on videotape and by uploading a compressed digital video file to a server where they could be accessed by means of streaming video in realplayer format. Pilot research has demonstrated that students find the quality of the video image and of the sound satisfactory (Bassili & Joordens, 2003).

2.1.3 Procedure and measures

Students viewed the lectures using the free version of realplayer. Like most media players, realplayer offers the ability to pause the media, and to navigate forward and backward through it via a seek bar. Our research will consider how often students choose to watch lectures via this medium, which features they used and how often, why they used the features, and whether using the features lead to a performance advantage. We obtained this data via an online survey containing 50 questions, a subset of questions used by Bassili and Joordens (2008) augmented by some questions especially related to mathematics. In this paper we focus primarily on the questions highlighted by Bassili and Joordens in order to compare findings across the Psychology versus Mathematics contexts.

2.2 Results

Table 1 provides a breakdown of students' responses with respect to how many lectures they attended, viewed online, attended and viewed online, or missed completely. Across 4 questions they were asked to estimate the number of lectures they experienced in each format using the categories indicated in Table 1. There were 24 lectures in total during the fall term. As the data suggest, over 50% of the students attended over half of the lectures even when the online lecture option is available. The online lectures are also being heavily utilized with over 40% of the students watching at least half of the lectures online. Students sometimes attend and watch lectures online, but most do so for only a small percentage of classes. Less that 10% of students both attend and watch more than half of the lectures online. These patterns seem relatively stable across the two math courses.

Table 1: Breakdown of number of lectures attended, viewed online, both, or neither expressed as the percentage of students within each response category

	Attended	Online	Both	Neither
MATA30	***n = 196***	***196***	***196***	***196***
None	6.1	2.6	49.0	71.9
1-5	17.9	32.1	32.1	25.0
6-10	10.7	13.3	9.7	2.0
11-15	14.3	13.3	5.6	0.0
16-20	17.3	15.3	2.0	0.5
21-24	1809	11.7	0.5	0.5
All	14.8	11.7	1.0	0.0
MATA32	***n = 292***	***293***	***293***	***292***
None	1.4	4.8	46.8	76.7
1-5	8.6	4.0.6	33.1	20.2
6-10	10.3	17.1	7.2	1.0
11-15	13.0	15.7	5.8	0.7

	Attended	Online	Both	Neither
16-20	16.4	9.9	2.4	0.7
21-24	28.1	5.8	1.7	0.3
All	22.3	6.1	3.1	0.3

As presented in Table 2, there were also some expected correlations with respect to how students viewed the lectures. Those students more likely to attend lectures were less likely to watch online, $r(490) = -.64$, $p < .001$, but were more likely to both attend and watch online, $r(490) = .31$, $p < .001$. Those more likely to watch lectures online were also more likely to both attend and watch online, $r(490) = .26$, $p < .001$. Given that doing both requires one to both attend and watch online, these last two correlations are hardly surprising. However, the relatively strong negative correlation between attending versus watching online does suggest that most students prefer doing one or the other.

Table 2: Correlations with among responses, and with final grade

	Pause	**Seek**	**Attended**	**Online**	**Both**	**Grade**
Pause						
MGTA30		.24**	-.06.	.15*	.13	-.17*
MGTA32		.45**	-.01	.07	.13*	-.08
Combined		.38**	-.03	.10*	.13*	-.11*
Seek						
MGTA30			-.05	.07	.06	.00
MGTA32			-.07	.11	.08	.07
Combined			-.04	.08	.08	.05
Attended						
MGTA30				-.74**	.35**	-.03
MGTA32				-.53**	.29**	-.09
Combined				-.64**	.31**	-.04
Online						
MGTA30					.08	-.08
MGTA32					.40**	-.04
Combined					.26**	-.07
Both						
MGTA30						-.33**
MGTA32						-.19**
Combined						-.22**

When students watch online they utilize the features provided by the media player. Descriptive statistics concerning mediaplayer usage are presented in Table 3, alongside previously published findings for Introductory Psychology (PSYA01). Students clearly use the pause and seek features extensively; even more so in the mathematics courses than they did in the psychology course. Approximately 77% of the students in the mathematics courses would pause lectures at least once per lecture, and over 52% would use the seek bar at least once per lecture. Pausing was used primarily to take notes, or to consult the instructor's notes, whereas the seek function was used primarily to revisit parts of the lecture. This high level of feature usage suggests that students perceive them to be valuable in terms of allowing control over the information flow from lectures.

Table 3: Percentage of students (total responses in parentheses) who indicated the specified reason for using the specified mediaplayer function

	MATA30	**MATA32**	**PSYA01**
Overall use of Pause	**74.0 (196)**	**80.8 (292)**	**60.0 (205)**
To write notes	76.5	71.2	46.7
Consult the textbook	31.6	27.7	
Consult classmates	1.0	3.1	
Take a break	63.3	52.7	43.0
Read instructor	50.5	59.6	

notes			
	MATA30	**MATA32**	**PSYA01**
Overall use of Seek	**50.5 (196)**	**53.9 (293)**	**42.0 (205)**
Rewatch lecture	78.1	73.0	62.9
Skip to future location	36.2	42.3	10.8
	MATA30	**MATA32**	**PSYA01**
Skip to future location	36.2	42.3	10.8

Use of the pause and seek functions was positively correlated for both MATA30, $r(196) = .24$, $p < .001$, and MATA32, $r(292) = .45$, $p < .001$. Thus, as was observed in PSYA01 ($r = .28$), those who utilize one of the features are also more likely to utilize the other. That said, the correlations remain relatively modest, suggesting that some students use one of the features more heavily than the other. In addition, use of the pause features was positively correlated with a tendency to either watch lectures online, $r(490) = .10$, $p < .001$, or to both attend and watch online, $r(490) = .13$, $p < .001$. Given that these features are only provided in the online environment, these correlations are expected. All of the above suggests that students are utilizing the online lectures when they are made available, and that they also utilize the unique features provided within the media player.

This leads us to the primary issue: do students who use the online lectures and the features of the interface achieve better performance? As an initial analysis we correlated the various indicators described above with students' final grade in the class. Recall that our previous research in the context of Introductory Psychology produced a modest positive correlation between use of the pause and seek features and performance on a high stakes exam, and we expected perhaps stronger correlations here. The relevant correlations are presented in the rightmost column of Table 2.

The surprising result is that while final grades in the course were unrelated to most variables, they were negatively related to use of the pause feature, $r(490) = -.11$, $p < .001$, and also to the tendency to both attend and watch lectures online, $r(490) = -.22$, $p < .001$. That is, opposite to our previous findings in Introductory Psychology, reliance on the media-player functions, and the tendency to both attend and watch lectures online, was associated with worse performance in the course.

One possible explanation of this surprising result revolves around what might be called student-specific characteristics. Most students find mathematics challenging, but some find it downright impossible. Perhaps there are students who simply cannot grasp concepts, and hence end up with low final marks, but their performance does not reflect a lack of trying. That is, perhaps these students know how challenging they find mathematical concepts and thus they show the highest tendency to both attend classes and watch online, and the highest tendency to pause lectures often to take it in slowly, and yet still they do not get the concepts. If this possibility is correct, we would expect the negative correlations we observed to become less negative as we consider only higher performing students.

While plausible, subsequent analyses do not support this student-specific characteristics explanation. We examined three subsets of the data related to students who scored better than 50%, better than 60% and better than 70% respectively. The negative correlations observed in the data set were present for all subsets, and showed no indication of systematically changing in strength. In addition, all students had completed a diagnostic test of ability prior to taking these courses. When we partialed diagnostic test performance out of the correlations, the negative correlations between final performance and use of the pause button, $r(476) = -.09$, $p < .06$, and the tendency to both attend class and watch online, $r(476) = -.19$, $p < .001$, remained. Thus, these correlations do not arise from differences among students in terms of their general math abilities.

If the correlations do not reflect attributes of the students' abilities, perhaps they reflect differences in learning strategies (Biggs et. al, 2001) that interact with course content. That is, it may be the case that some students approach learning by attempting to memorize concepts. Such students might be more likely to rely on the online lectures, pausing them often to take notes or remind themselves of concepts. Such a "surface" strategy might work well in the contexts where students are primarily learning definitions, theories, etc. as is more the case for courses like Introductory Psychology. But it could actually be a counterproductive in courses where one truly learns by working through novel

problems, generalizing the examples in class to new situations. The students who attempt to memorize may feel like they are learning the class content, and they may be, but if the assessment focuses on deep learning and the ability to transfer cognitive skills, then knowing the lecture content may be insufficient.

2.3 General discussion

The current paper examined usage of online lectures, and the features they provide, in the context of two math courses. Of primary interest was the relation between feature usage and performance in the class. To our surprise, and in contrast with previous findings in the context of Introductory Psychology, students who both attended and watched lectures online, and those who pause online lectures frequently, actually performed worse in the course. We cannot be sure of the reason for these contrasting results, but we believe it is due to different learning strategies and the manner in which they interact with course content. In courses where students are primarily learning relatively shallow concepts and definitions, the ability to pause lectures may facilitate memorization strategies and result in better performance. However, in courses were students must learn, and learn to transfer, cognitive skills those who rely on memorization strategies may actually perform worse.

It would be a mistake, however, to view these findings as a reason to not provide access to online lectures in mathematics contexts. Many students did indeed utilize the online lectures, some watching over half of their lectures online. Clearly the presence of online lectures provides a great convenience to students and thereby enhances their satisfaction with the learning experience (Bassili & Joordens, 2008). In addition, it is not the case that those who watched lectures online performed generally more poorly; mode of lecture viewing (Online vs. Traditional) was unrelated to performance.

Instead, the primary message of this paper is that if left on their own devices, some students may utilize online lectures in a manner that is not beneficial to their learning. Specifically, they may be attempting to "understand" calculus by memorizing what occurred within the classes, a tendency that can be detected in the variables measured here (i.e., the tendency to both attend and watch online lectures, and the tendency to pause the online lectures often while viewing). In the absence of online lectures these students may nonetheless attempt such a surface learning strategy, but this tendency would remain unnoticed. The presence of online lectures may have provided a new tool to support the non-effective strategy, but it is the chosen strategy, not the tool, that is the primary problem.

This all leads us to the following recommendation. Providing access to online lectures in skills-based courses like calculus can provide flexibility and convenience, but students should instructed on how to use the online lectures to their benefit. They should not be pausing lectures in order to better memorize what happened in the class but, rather, they should be pausing with the intent of gaining a deeper understanding by applying what happened in the lecture to novel problems. Pausing should be used to go beyond the lecture, not further within it.

References

Bassili, J. N. (2008a). Motivational and cognitive strategies in the choice to attend lectures or watch them online. *Journal of Distance Education*, *22(3)*, 129-148.

Bassili, J. N. (2008b). Media richness and social norms in the choice to attend lectures of watch them online. *Journal of Educational Multimedia and Hypermedia*, *17(4)*, 453-475.

Bassili, J. N., & Joordens, S. (2003) [Questionnaire administered in PSYA01 at UTSC on December 02]. Unpublished raw data.

Bassili, J. N., & Joordens, S. (2008). Media player tool use, satisfaction with online lectures and examination performance. *Journal of Distance Education, 22*(2), 93-108.

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, *71*, 133-149.

Blake, R., Wilson, N.L., Cetto, M., & Cristina, P. (2008). Measuring oral proficiency in distance, face-to-face, and blended classrooms.

Carter, M. B. (2003). An analysis and comparison of the effects of computer-assisted instruction versus traditional lecture instruction on student attitudes and achievement in a college remedial mathematics course. (Doctoral dissertation, Temple University).

Davies, J. & Martin, G. (2005). Performance in e-learning: online participation and student grades. *British Journal of Education Technology*, *36(4)*, 657-663.

Doorman, M., & van Maanen, J. (2008). A historical perspective on teaching and learning calculus. *Australian Senior Mathematics Journal*, *22(2)*, 4 – 14.

Halper, S., Kelly, K. & Chuang, W. H. (2007). A reflection on coursestream system: A virtual classroom streaming system designed for large classes. *Techtrends: Linking Research and Practice to Improve Learning*, *51(2)*, 24-27.

Kennedy, P., Ellis, W., Oien, J., Benoit, S. (2007). Mastery with meaning: Access to mathematics online. *Old Bethpage: Spring*, 41(2), 118-126.

Kennedy, P. A. (1990). Mastery teaching in college mathematics: Reteaching/retesting, Mathematics and Computer Education, 24(1), pp. 44-51

Pettersson, K., & Scheja, M. (2008). Algorithmic contexts and learning potentiality: A case study of students understanding of calculus. *International Journal of Mathematical Education in Science and Technology*, *39(6)*, 767-784.

Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. Detection, search and attention. *Psychological Review*, *84*, 1-66.

