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iTunes University and the classroom: Can podcasts replace Professors?

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ABSTRACT

iTunes University, a website with downloadable educational podcasts, can provide students the opportunity to obtain professors' lectures when students are unable to attend class. To determine the effectiveness of audio lectures in higher education, undergraduate general psychology students participated in one of two conditions. In the lecture condition, participants listened to a 25-min lecture given in person by a professor using PowerPoint slides. Copies of the slides were given to aid note-taking. In the podcast condition, participants received a podcast of the same lecture along with the PowerPoint handouts. Participants in both conditions were instructed to keep a running log of study time and activities used in preparing for an exam. One week from the initial session students returned to take an exam on lecture content. Results indicated that students in the podcast condition who took notes while listening to the podcast scored significantly higher than the lecture condition. The impact of mobile learning on classroom performance is discussed.

1. Introduction

The concept of electronic classrooms continues to evolve and change as the technology expands in many directions. One recent introduction is iTUNES University, a website with downloadable educational podcasts, that is sponsored by Apple Computers, Inc. The idea of educational podcasts that are easily accessible takes mobile learning, or m-learning, to the next generation. Apple points out that the benefits of iTUNES U include that it is easily accessible 24 h per day, students can listen to the podcasts whenever and wherever they choose, and it helps to keep the students motivated because it engages them in a way that is very familiar to them (iTunes U is a link on the iTunes website). Although these benefits seem to make educational podcasts appealing to students, the question of the educational benefits of m-learning remains to be answered. Thus, in this paper, we address the question of whether m-learning actually provides educational benefits, or at the very least, does not harm students that opt for a podcast instead of the actual in-class lecture.

Examining previous research on the educational benefits of computers and technology in general points to a complex picture. A meta-analysis of computer-based instruction for college students indicates small but positive effects (Kulik, Kulik, & Cohen, 1980). As technology evolved from the 1980's and became more pervasive in the college classroom, the use of PowerPoint slides that accompany professors' lectures has become commonplace. Students appear to generally have positive attitudes about the use of PowerPoint slides with lectures, and research indicates that PowerPoint slides can increase self-efficacy, organization and clarity, interest, and professor likeability (Apperson, Laws, & Scepansky, 2006; Susskind, 2005). Evidence, however, is mixed with regard to the educational effectiveness of the use of PowerPoint slides. Szabo and Hastings (2000) found an advantage for PowerPoint slides with one lecture, but not with a second lecture with different content. Other researchers have also found no educational advantage for the use of PowerPoint slides (Apperson et al., 2006; Susskind, 2005), but Austin, Lee, and Carr (2004) found that lectures with slides resulted in superior notes. Further evolution of technology and computers in educational settings has resulted in stand-alone web-based courses, where all learning takes place outside of the traditional classroom. Evidence for educational advantages for web-based courses also appears to be mixed, as it seems to depend upon the type of course, and what educational activities are included (Maki & Maki, 2002). Other research examining the effects of teaching with multimedia, where the multimedia included audio, video, animation, graphics and text, found that the multimedia resulted in better recall than traditional lectures with PowerPoint slides (Hallett & Faria, 2006). However, for multimedia learning to be effective, the overall cognitive load for the pictorial and verbal material needs to be taken into account (Mayer & Moreno, 2003). In general, the mixed results of all of these types of studies indicate that other variables may be crucial factors in explaining how computers and technology influence educational outcomes.

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One of the variables that may influence educational outcomes might be note-taking. Although note-taking while listening to a lecture generally results in higher test achievement than just listening to a lecture (Kiewra, 1985; Titsworth & Kiewra, 2004), when lecture material is complex or challenging, simply listening may result in higher achievement than taking notes (Hadwin, Kirby, & Woodhouse, 1999). The completeness of the notes also seems to have an effect. Students that received partial notes or a skeleton outline for lectures that they attended had higher achievement scores than students receiving complete notes for the same lectures (Annis, 1981; Russell, Caris, Harris, & Hendricson, 1983). These results were interpreted as evidence that personally taking notes (as opposed to being given full notes of a lecture) was more important to higher educational outcomes. Higher scores were obtained by students that created their own notes, even if those notes may have been less complete. Those in the partial notes condition were required to fill in the missing parts, and thus a retrieval process was involved. It appears this retrieval process was crucial to better performance.

The addition of iTunes U as a resource for students in the classroom is interesting because it gives students a chance to listen to a lecture for the first time (if they missed a class) or listen to a lecture that they attended in person additional times after the class session is over. Since note-taking has been shown to influence achievement, the current study is interested in examining whether students would take notes when listening to a podcast of a lecture that they may have missed. It is clear that for a traditional lecture given in a classroom, students are expected to take notes. Peer example, and possibly pressure from professors, may create this expectation. Presumably, students have also learned that academic achievement is greater when notes are taken in class. But in a traditional lecture setting, the professor cannot be put on pause, or rewind, or asked to repeat a particular definition or example ad nauseam, all of which is possible with a podcast. So if students take advantage of this greater flexibility with the podcast, we might expect their notes to be more complete. On the other hand, if they treat the podcast less like a traditional lecture, and more like listening to music, then we might expect less complete notes than a traditional lecture. Although there have been a few studies examining learning with podcast-like conditions, these questions have not been previously addressed. Podcasts have enormous potential to change the study habits of college students, and we simply do not know what the educational implications of that are at this point.

Given the relative newness of podcast technology, it is not surprising that there is limited research available on this topic. One recent study did examine students' attitudes about using podcasts for revising existing notes from a previous lecture (Evans, 2008). Students believed that the podcasts helped them revise their notes more effectively than the textbook. Although the students seemed receptive to learning through podcasts and agreed with the advantage of being able to listen to podcasts when and where they chose, only 20% of the students actually listened to the podcasts on a mobile device. The remaining 80% listened to the podcasts on their computer. Thus, while all students in this study seemed to value the flexibility and mobility of m-learning, the majority of the students did not actually take advantage of the mobility of the podcast.

Other recent research indicates a preference by students for traditional lectures over computer-based lectures, including a podcast-like condition on the computer, where a PowerPoint lecture was narrated auditorily (Stephenson, Brown, & Griffin, 2008). Although 60% of students in this study felt that the computer-based lectures were appealing due to their flexibility, they still preferred the traditional lecture. In addition, 93% stated that they would prefer to have traditional lectures with computer-based learning as a supplement for revising their notes. Perhaps the lack of preference for the podcast-like condition was because students in this study were given the entire lecture content electronically, rather than just using the podcast for revisions, as in the Evans (2008) study. Unlike the previous podcast study where only attitudes were examined, educational outcomes of learning were also examined here. Stephenson and her colleagues used Bloom's taxonomy to assess increasingly deeper levels of learning. The questions assessed the cognitive skills of knowledge, comprehension, analysis, application, and evaluation. Across these types of questions, no advantage for either type of delivery mode was found. However, in keeping with the tradition of mixed results as found with earlier research on technology and education in the classroom, Cramer, Collins, Snider, and Fawcett (2007) found an educational advantage for a podcast-like condition. In their study, PowerPoint slides with audio clips were available on computer for students to use as a tool for reviewing lectures. Students who did use the 'virtual lecture' for 100 min or more scored higher on a subsequent test. Additionally, perceptions of these students about the 'virtual lecture' were quite positive.

Thus, when we examine the limited existing research on podcasts, or podcast-like conditions, we find mixed results with regard to attitude. One possible explanation is the particular use of the podcast. The two studies that found positive attitudes regarding podcasts or 'virtual lectures' used these conditions as a tool to help students revise their notes from already existing lectures (Cramer et al., 2007; Evans, 2008). The remaining study where the traditional lecture was preferred assigned students to either an 'e-lecture' (podcast-like condition), a traditional lecture, or to a 'virtual lecture' condition which consisted of a multi-media presentation online (Stephenson et al., 2008). For each condition, the lecture material was only available in the assignment format, thus students had to rely solely on the electronic delivery of the necessary information, rather than just using the podcast to help revise already existing notes. Yet none of these studies had a podcast condition where all students in that condition truly participated in mobile-learning. Thus, we are interested in investigating what the attitudes of students will be when they participate in a true m-learning condition, that is, where the podcast is only available to them on a mobile device that allows them to take the lecture with them anywhere they go.

Finally, the research examining educational outcomes has only used podcast-like conditions, but even here the results are mixed. Some studies indicate an educational advantage for a podcast-like condition (Cramer et al., 2007; Spickard, Smithers, Cordray, Gigante, & Wofford, 2004), while another indicates no advantage (Stephenson et al., 2008). One proposed purpose of having iTunes U available to students is for them to use it as an alternative to getting notes from a friend if they miss a lecture. The student can download the exact lecture that was given by their instructor for the day they missed. In many cases, at larger universities, the podcasts even include video as well as audio. So rather than relying on notes that were taken by others of a lecture they missed, it is possible for the student to take their own notes of the lecture based on the audio (and possibly video) of the in-class lecture. What is unknown is what the students do with the lecture content they are given under these truly mobile and flexible conditions, and how these actions influence their educational outcomes.

The purpose of the current study is to evaluate this alternative to getting notes from a friend in the class for a lecture session the student missed. Other studies have examined the use of audio copies of lectures to help supplement and revise notes taken during a regular lecture session (e.g., Evans, 2008). However, the focus of this study is to examine how students would use this technology (including its true mobility) to make up for missing a lecture class that they normally attend. We were interested in the way they would use this technology (e.g., take notes vs. merely listen; listen once vs. listen multiple times) and the impact of these choices on educational outcomes.

2. Method

2.1. Participants and design

Participants were general psychology students attending a small, liberal arts college in New York state. They were given extra credit in a psychology course of their choice for their participation. In addition, participants in each condition were told that the highest score in each experimental condition on an exam given during session two of the experiment would be given a $15 iTunes gift card. This gift card allowed participants to download audiobooks or music, or to rent a movie, all of which could be viewed or listened to on their iPOD or on their own computer; thus, an iPOD was not necessary to utilize the gift card. This compensation was given to help motivate students to try hard to do well on the exam.

The design of the study was a non-equivalent group, post-test only quasi-experimental design. Students participated in either the podcast condition or the in-class lecture condition. Forty students attended session one of the experiment in each condition. However, the critical component of the experiment was attending session two, the follow-up exam. Thirty-two students completed both sessions of the in-class lecture condition; thirty-four students completed both sessions of the podcast condition. Students self selected into the two different conditions because assignment in the podcast condition was based on student ownership of an mp3 player. Students in this condition knew they were signing up for an experiment that would require the use of their mp3 player, and they were asked to bring it to the experimental session.

With this type of quasi-experimental design, one of the methodological questions that needs to be addressed is whether the two conditions were different before the treatment was administered. Thus, participants in the two conditions were evaluated with respect to existing differences in GPA and SAT scores. GPA and SAT (or ACT) scores were obtained by accessing the academic records of each participant. The independent samples *t*-tests indicated that there were no significant differences between the two conditions for GPA [$t(63) = 0.005$, *n.s.*] or for SAT scores [$t(56) = 1.06$, *n.s.*]. It should be noted that for the analysis of SAT scores, five participants only had ACT test scores available, which were converted to SAT scores for the analysis. In addition, seven participants did not have an SAT or an ACT test score available. Another potential difference between the conditions was the possession of an mp3 player, as this was required to participate in the podcast condition. It is possible that mp3 owners may have been more predisposed to learning from podcasts. However, 72% (23 out of 32) participants in the in-class lecture condition did own an mp3 player. In addition, only three of the students in the entire experiment indicated on the questionnaire that they had ever downloaded a podcast of any type. In addition, none of these three students indicated that they had ever listened to a podcast of educational or lecture-type content. Therefore, it seems unlikely that any differences that might emerge between the two conditions would be due to this factor.

2.2. Materials and procedure

2.2.1. Session one

Lecture materials for the experiment were taken from an introductory psychology textbook chapter on perception. The lecture was constructed to be approximately 25 min in length. This was shorter than a typical course lecture, but still contained plenty of testable material. In an effort to keep the initial experimental session less than an hour to match academic course scheduling on our campus, this time limit was chosen. A PowerPoint slide show was constructed based on the lecture material. In addition a 50-point exam was created from this lecture content. The exam consisted of multiple choice, matching, and fill-in-the-blank questions. This format was chosen as it is the typical format used in large survey courses.

Students in the in-class lecture condition were told that they would be listening to a lecture on perception. Students began the session by receiving a copy of the PowerPoint slides that would be presented during the lecture. The printouts were four slides to a page, with accompanying lines to the right of the slides that students could use to take additional notes during the lecture. Students were also given several blank pages of paper that they could use for note-taking if they preferred. The students in this condition were told that the purpose of the study was to assess how they responded to technology in the classroom, specifically the use of PowerPoint slides in a lecture. They were told that many professors had adopted the use of PowerPoints in their lectures, but that not all professors have adopted this practice. They were told we were interested in seeing how they would make use of the PowerPoint slides to aid their note-taking during the lecture, their studying after the lecture, and how well they would do on a subsequent exam over the lecture material. The students were told that the participant with the highest score on the subsequent exam would be given a $15 iTunes gift card. This was specifically stated so the students would have some added incentive to try hard to do well on the exam. Past experience by these researchers has shown that merely giving a few points of extra credit in a course is not sufficient for the students to try to excel at the task.

Before the lecture began, students completed a questionnaire on demographics (class standing, major course of study, etc.), their study habits, and their ownership and use of mp3 players. In addition, they were asked if they had ever listened to podcasts of classroom lecture material. After the questionnaires were collected, students were instructed that they would now receive a lecture that would be approximately 25 min in length. They were also told that they would be coming back for a second session in one week's time for an exam over the material covered during the lecture today and so they should take notes as they normally would when they knew the material covered would be on an exam. Students were told to interact with the professor as they normally would in a classroom setting (feel free to ask questions, to tell the professor to slow down the presentation for note-taking purposes, etc.). At the end of the lecture, the students were given a handout that they were to use over the course of the week to record their study sessions of the notes and PowerPoint slide handouts from the lecture. They were told this was called the 'study session tally'. The sheet had a place for time of day, length of study time, and asked them what activities they did during each study session. There was enough space to record six study sessions. Students were told to record each time they studied and what activities they did during the study session (studied their notes alone, studied the PowerPoints and added additional things they remembered from the lecture, etc.). It was emphasized that this was an experiment about actual study habits, and that the experimenters knew that some students needed more study time to prepare for exams than others, and that they were to be honest in their recordings. Students were told to keep the notes and handouts they were given during the initial session to study from during the week, but to please bring them back (along with the study session tally) for the second session. Students were given reminder slips of the second session date, time and place, and then dismissed.

Students in the podcast condition were told that the experiment was examining the way that students use technology in a university setting. They were told that the experimenters were interested in exploring the use of podcasts on iTunes University to supplement in-class lectures. In particular we were interested in how they might use a podcast of a lecture they missed (as opposed to getting notes of the lecture from a friend) to prepare for an upcoming exam. It was explained to them that the experimenters knew from time to time students might miss a lecture session in a class that they were a member of, and that they might get notes from a friend. It was explained that many campuses have now made podcasts of course lectures available through iTunes University, and that students at these campuses could go online and get a podcast of a lecture from a class session they missed. They were told that the experimenters were interested in how students study from these podcasts, and how well they do on an exam over the material as opposed to students that attended the lecture in person. As in the lecture condition, students in the podcast condition were told that the participant with the highest exam score would be given a $15 iTunes gift card.

One potential criticism of the method used to encourage students to try hard for the exam is that in the podcast condition, students may have felt they were competing against students in an in-class lecture format. Thus it is possible, given their desire to try the new technology, they may have more incentive to try harder on the exam than their in-class lecture counterparts. This concern was addressed in two ways. First, the in-class lecture condition students were led to believe they would be compared to a group of peers in a traditional lecture condition that did not use PowerPoint slides. (Given the limited subject pool at our college, we did not in fact run this condition.) Second, the instructions were equally designed for each group to be competing against other members in their same group in order to be the winner of the gift card. The instructions were designed in such as way to encourage individual students in each group to try hard to do well on the exam for an external prize (competing only against other members in their same condition), as opposed to competing against another condition in the experiment.

The students were then asked to fill out the same questionnaire on demographics, study habits, and mp3 ownership as the students in the in-class lecture condition had completed. After the questionnaires were collected, students were given a copy of the PowerPoint slides used in the lecture, and their mp3 players were connected to a computer where they could download a podcast of the lecture. The podcast of the lecture was the same lecture that was given to the students during the in-class lecture condition. The podcast had been recorded using ProfCast software (version 2.2), which allows video syncing of PowerPoint slides along with recorded audio. They were told that the podcast they were receiving was a copy of an actual lecture that had been presented earlier in the week. Students that had mp3 players with video capabilities were told that the slides from the lecture would appear on the screen as the lecture progressed. Students who had mp3 players that did not possess video capabilities were told that during the lecture the professor would make reference to the slides in the PowerPoint handout, and that they should be able to follow along by having the handout available when they listened. In addition, students were told that if they chose to take additional notes while listening to the podcast, they could do so on the lines provided on the PowerPoint handouts, or that they could use separate paper if they preferred. They were told to bring back the handouts and any additional notes they made to session two. Students were then given a copy of the study session tally. As in the other condition, students were told to be honest in their recording. This was the same study session tally sheet that was given to the in-class lecture condition, containing spaces for six study sessions. Students were told to record how they used the podcast during each session (if they took notes, if they only listened but did not take notes). They were also told to record if they just studied the copies of the PowerPoint slides or copies of any notes they may have made from the podcast, but did not listen to the podcast again. They were given session two reminder slips and dismissed.

2.2.2. Session two

One week after their initial session, students returned for session two. In both conditions, students were instructed to pull out the notes and copies of PowerPoint slides from session one, and were given 5 min to study these notes. At the end of that time, all of their materials from session one, as well as their study session tally sheet were collected. They were then given the 50 point exam over the lecture material. After taking the exam, students in the in-class lecture condition were given a debriefing sheet and dismissed.

After taking the exam, the students in the podcast condition were given an additional questionnaire that asked them specifically about ways they used the podcast. They were asked how many podcasts they had previously listened to, and specifically, if they had ever listened to podcasts of classroom lecture previously. (This question was a repeat from the initial questionnaire that all students were given during session one.) It also asked them what they did when they initially listened to the podcast (listened while doing other things, listened while not doing other things but did not take notes, listened and took notes just as they would have in a classroom setting, etc.). It also asked about subsequent listening sessions. Lastly, it asked about their preference for the way to get material from lectures if they were to miss a class (get a podcast or get a copy of notes from a friend). After completing this additional questionnaire, students in this condition were given a debriefing sheet and dismissed.

3. Results and discussion

3.1. Questionnaires

Due to the descriptive and exploratory nature of the questionnaires, only percentages and means were calculated from the questionnaire data. Of the 66 students that completed the experiment, 57 of them owned mp3 players (86%). Twenty-eight out of the 57 also had video capabilities on their players (49%). While 57 of the participants had mp3 players, only 3 students in the study had ever listened to podcasts before (5%), and none of the students had ever listened to a podcast of a classroom lecture. The average amount of time the students who had mp3 players spent listening to them each day was 1.67 h (SD = 1.20 h). The most common answer to the question of time spent listening was 1 h per day.

Thirty-four students completed the podcast condition, and thus filled out the podcast usage questionnaire during the second session. Eighteen of the 34 participants had mp3 players with video capabilities (52.9%). We asked participants that had video capabilities if they felt having the PowerPoint slides on the screen matching the audio feed was helpful. All but 5 found this feature helpful (72.22%). In addition, one feature of using ProfCast software to record the lecture that was true regardless of mp3 video capabilities was the addition of chapter markers into the podcast. With each change of PowerPoint slide, a chapter marker was created. Several students commented that

these chapter markers were very useful for studying and reviewing desired sections of the podcast. It also helped those without video capabilities to coordinate with the PowerPoint handouts provided. The 16 participants who did not have video capabilities on their mp3 players were asked if they were able to follow along with the lecture and match the PowerPoint handouts to the lecture easily. Only 1 participant expressed difficulty matching the PowerPoint slides in the handouts with the lecture audio. Several of the participants indicated they used the chapter markers to help keep them on track. Participants in this condition were also asked if they missed a lecture in the future if they would prefer a copy of the lecture notes or a podcast of the lecture. Thirty out of the 34 participants said they would prefer podcasts (88%). Given that none of them had ever experienced listening to a podcast of a classroom lecture before, this was surprising.

3.2. Exam performance

An initial *t*-test revealed that the students in the podcast condition scored significantly higher on the exam in session two than the students in the in-class lecture, $t(64) = 2.12$, $p < .05$. Students in the podcast condition had an average score of 71.24% ($SD = 16.50\%$), whereas students in the in-class lecture condition had an average score of 62.47% ($SD = 17.03\%$). This result was surprising given the assumption that students who attend class and take notes normally score the best on exams.

The data from the podcast condition was then sorted into two groups: students who took additional notes on the PowerPoint slide handouts or on additional pages of paper, and students who took no additional notes of any kind. Of the 34 participants in the podcast condition, 22 students had taken additional notes, and 12 students had not. Results of a *t*-test on this data revealed a significant difference in performance between the two groups, $t(32) = 2.59$, $p < .01$. Students who took additional notes scored significantly higher, 76.23% ($SD = 13.61\%$) than students who merely listened to the podcast but did not take additional notes, 62.08% ($SD = 17.93\%$). The mean of the students that merely listened to the podcast but took no additional notes was not significantly different than the in-class lecture students, $t(42) = .06$, $p > .05$.

As students who took additional notes scored higher on the exam, we examined the quality and amount of the notes taken. We developed four categories of note quality by starting with the extremes of 'no notes at all' on any of the PowerPoint handouts, and 'extensive notes', which were defined as having something written on over 95% of the PowerPoint slides, which included key ideas and examples that were given in the lecture but not on the PowerPoint slide itself. In addition, participants in this category had additional notes on separate pieces of paper that they turned in. The two middle categories of 'minimal notes' and 'average notes' were then created. The category of 'minimal notes' was defined as notes taken on some of the slides, but many left blank entirely. The majority of the notes taken in this category were mainly the addition of definitions to some things on the PowerPoints, but rarely any examples given in the lecture were written down. It should be noted that this category also included several participants that may have only written on one or two slides. In general, any writing on the PowerPoint handouts (that would separate it from the 'no notes at all' category) was included in this grouping. The 'average notes' category included participants who had written something down on most slides, but not all the slides. No additional notes on extra paper were turned in. The notes often included examples, but most often were additional definitions or main points of the lecture. It is true that these groupings are quite rough in nature, however the limited size of our sample and the great variety and quality of notes taken did not lend itself to a more systematic analysis.

The results of our notes analysis are included in Table 1. One thing of note is that everyone in the in-class lecture condition took some notes, but none of them were extensive. The note-takers in this condition were split evenly between the minimal notes and average notes category. Twelve out of the 34 participants (35%) in the podcast condition took no notes at all. The fact that so many in this condition did not take any notes may be due to the fact that they may not have known what to do with the podcast for studying purposes. No one in the study had ever experienced lecture type podcasts, which also may help explain the large variability in the completeness and amount of notes taken. It is also possible that the lack of the educational setting and other classmates during the time of listening may have eliminated the social pressure and expectation of note-taking when listening to a lecture. The extensive notes in this condition (4 participants) may be due to the ability of the participants to rewind and pause the lecture at will. Given the huge variability of the amount and nature of notes taken, it is somewhat hard to draw firm conclusions based on this alone. During this study we gave no specific direction as to how or even if students in either condition should take notes. We were most interested in learning when left to their own discretion, how students would use the podcasts to prepare for an upcoming exam. Future studies that include more specific instructions to students about using this medium may reveal more concrete conclusions.

It was not unnoticed that the performance on the exams overall seemed a little lower than is normally expected on exams in survey courses. Two of the authors of this study regularly teach Introduction to Psychology courses, and usually the average scores are closer to 70% on any given exam during the course. Given that this was not a true course exam (students were only participating to receive extra credit and a chance to win a gift card), it is likely that the motivation of the students may be less than that of a student taking a course for college credit. However, there is no reason to suspect that there were any particular differences in motivation level between the two groups. Analysis of the study habits questionnaire responses revealed no difference between the groups in study time per week, nor any differences in specific tasks done during study or preference for studying alone or in groups.

Lastly, the answers on the podcast questionnaire were examined to see if there may have been anything specific in these answers that could help explain the significant advantage students in this condition showed on the exam. Table 2 shows the results of the podcast

Table 1
Mean score on exam by experiment condition and note-taking category.

	No notes	Minimal notes	Average notes	Extensive notes
In-class lecture	$N = 0$	$N = 15$ $M = 57.87$ $SD = 16.85$	$N = 17$ $M = 66.53$ $SD = 16.62$	$N = 0$
Podcast	$N = 12$ $M = 62.08$ $SD = 17.93$	$N = 1$ $M = 63$ $SD = –$	$N = 17$ $M = 77.12$ $SD = 13.94$	$N = 4$ $M = 76.00$ $SD = 14.02$

Table 2
Number and time of listens by participants in the podcast condition.

Never	Once	Twice	Three	Five	Seven	Total
Number of total times podcast was listened to						
1	11	8	11	2	1	34
8 am–2:55 pm	3 pm–8:55 pm	9 pm–later	No am/pm	Never listened	Total	
Time of day of all listens						
16	31	16	11	1	75	
Time of day of initial listens						
7	11	9	6	1	34	

questionnaire. Based on these results, two things emerged that may have contributed to the higher exam scores in the podcast condition. First, in examining the number of total times the podcast was listened to by participants, we found that of the 34 participants in the podcast condition, all but 12 listened to the podcast more than once (even if they did not ever take notes). One person never listened to the podcast, but took the exam based on reviewing the PowerPoints alone. Thus, 22 of the students listened at least twice and the mean number of times the podcast was listened to was 2.56 times (SD = 2.13). The standard deviation of this mean is somewhat high, but there were three students who listened more than 4 times (highest number was 7 times), and this influenced the overall mean.

The second thing that was revealed when examining the responses to the podcast usage questionnaire was the time of day that students chose to listen to the podcast. As can be seen in Table 2, across all the participants in this condition, the podcast was listened to a total of 75 times. We used the study session tally sheet to categorize the times of day for listening to the podcast. The highest number of listens fell into the late afternoon and early evening category (31 in the 3 pm–8:55 pm category), with other listens equally split between earlier in the day and later in the evening. We also examined the time of day the podcast was *initially* listened to—meaning, the time it was when the students listened to the podcast for the first time. A large majority of initial listens were in the later afternoon hours, with only 7 between the hours of 8 am and 2:55 pm (see Table 2). We chose this break of hours because the majority of regular classes on the Fredonia State campus are between 8 am and 3 pm. Evening classes start at 4 pm. Thus, one explanation for the low numbers during the day could be that these hours are when the students are attending actual classes on campus. This was experimental participation mainly for extra credit, so it is fair to assume the students may choose to do it when they were completely at leisure. One aspect of m-learning that was discussed in the introduction to this paper was the preference for ability to learn 'on-the-go,' without being tied to any one particular place or set time (e.g., Evans, 2008). The current study asked about the time of day they listened to the podcast, and how many times they listened, but we did not ask about where they were located during the time(s) they listened. Other studies on mobile learning have included conditions of listening on a computer, and this could be generalized to listening in an internet café. The new mp3 players have enough memory and are small enough to truly be taken in your pocket anywhere you want to go. Future studies would benefit from asking about the place of listening, as well as the time of day to help get a better understanding of how they use the true mobility of the technology.

4. Conclusions

The results of this study are in no way an indication that audio copies of lectures could or should replace actual professors, or even regular class attendance. The advantage the students in our study received was only when the student took notes as they would do during a lecture, and when they listened to the lecture more than once. In essence, the same things a student does during the actual lecture, they would need to do to show a benefit of the podcast.

This study is small in nature, but it is the only study we found that examined podcasts in a format that incorporated true m-learning conditions accompanied by educational outcomes. The finding that students in the podcast condition did significantly better than students who attended the in-class lecture was unexpected and somewhat novel in the body of literature on the use of technology to aid learning. One particular aspect of this study that generated much debate among our colleagues on campus was that in this study the podcast condition was not used to *enhance* a college lecture (perhaps giving students who attended the actual lecture a chance to listen to it again), but rather was *in place of* attending the lecture. We chose this aspect to explore because many studies have shown that class attendance is far superior to getting lecture notes from a friend or even from the professor. The original intent of this study was to explore if getting a copy of the audio (along with copies of the PowerPoint slides) from a class lecture a student missed during the term would show the same detriment. The results of this study show there was no detriment—in fact, there was a significant advantage.

A key area of interest, and one that needs further exploration in future studies, is the way the students used the podcasts they were given. After the in-class lecture was over, students in that condition could only refer to notes they had taken during that session and copies of the PowerPoint slides that were presented. Those students could never go back and hear the lecture again as many times as they wanted. The students in the podcast condition were not given any specific instructions about *how* to use the podcasts to study. They were simply asked to record what they did. The majority of the students took notes from the podcasts, and they listened to it multiple times. Future studies may explore the type of notes taken when a student has a podcast (perhaps the notes are more complete than notes taken during an in-class lecture because the student can stop the audio when they wish), or if the student listens to certain sections of a given lecture more than others. In addition, findings in the literature on using PowerPoint slides in the classroom has shown that difficulty of the subject matter, and the specific content or discipline of study influences how well the students learn the material (Szabo & Hastings, 2000). Future studies need to explore which disciplines lend themselves better to m-learning, and which do not (e.g., we would expect that mathematics would clearly be more difficult if only audio were available). This study focused on psychology, but the content of the material was perception, which is somewhat closer to biology than some other topics covered in an Introductory Psychology course (e.g., personality, social psychology, or counseling methods). It is reasonable to assume these results may be limited to specific types of content, and thus further research is needed.

The current generation of college student has never known a time before cell phones and personal computers. They are eager to use technology to enhance their learning. More research is needed to discover best practices of integrating the new technology into the classroom setting so that technology enhances the learning environment and does not become one more distraction.

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