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The Efficacy of Podcasting Technology in Instructional Delivery

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iPods have become a cultural phenomenon. Not only do they serve as a mechanism by which to identify the Net-Geners, Millennials, and now post-Millennials (nicknames given to today's students), but they also hold valuable promise as a means by which to reach students inundated with fragmented learning environments, multitasking, and a world in which people are always connected. The University of Houston, School of Communication, in cooperation with Educational Technology and University Outreach, conducted a multi-phased podcasting project. This paper reports the survey data collected from this project and focuses on: (a) podcasting course materials, (b) podcasting and learning styles /study habits, and (c) podcasting and learning effectiveness. The authors provide podcasting best practices that draw on the findings from the data and also share the experiences in implementing podcasting technology.

Keywords: podcast, podcasting technology, iPod, MP3 player, mobile education

INTRODUCTION

The University of Houston is a large urban institution with an ethnically diverse student body. The majority of the student population is comprised of non-traditional commuters, with the older, working segment rapidly growing. Their family lives and work obligations

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can sometimes affect their regular attendance in class. Besides, today's students increasingly expect technology-rich learning environments and experiences (Brown, Myers, & Roy, 2003). Finding innovative instructional methods and strategies to reach students is becoming increasingly necessary and important.

Podcasting is a relatively new technology that has been used to deliver education to meet the flexible needs of students' dynamic learning activities. Higher education institutions began to pilot podcasting for instructional delivery in early spring of 2004, when Duke University distributed iPods to every freshman so that they might access course materials delivered via podcasts. The number of institutions that are incorporating Podcasting as an additional instructional delivery channel increases daily. The University of Houston (UH) is one such institution. A pilot project was launched in the fall of 2005 in the School of Communication. Though the pilot began as a localized project, it quickly became an interdisciplinary and collaborative project joined by several departments on campus. The funding came from the Division of Educational Technology and University Outreach. UH streaming media office provided technical support to help encode RSS for podcasts and also hosted the content on their media server. A group of instructional designers participated in the preparation meetings to offer ideas and suggestions on effective course design and content delivery. One effort worth mentioning here was the genesis and inclusion of a quality assurance group formed to assist faculty by reviewing produced podcasts before they were delivered to students. Each group contributed uniquely to the success of the pilot project.

The team reached a common consensus at the outset of the project that collecting feedback on students' perceptions and consumption patterns of podcasts was very important. It was necessary to investigate student knowledge of podcasting technology and usage patterns of portable devices. The first survey was conducted in the spring of 2006. We examined student podcasting knowledge before podcasts were used for course content delivery, and student feedback on the podcasting use at the end of the semester. Unlike the Duke University experiment (where students were given iPods as Freshmen), most UH students used their own iPods or other portable MP3 players to access course podcasts. The total number of student participants in this initial project was 164 (including both podcast-users and non-users) from four classes delivered by three faculty members at the School of Communication who augmented existing course curricula with podcasting content.

A follow-up scaled survey was conducted in the fall of 2006, which included students from other colleges and departments with a total of 1375 respondents from over 45 majors across different disciplines. Of the total number, 54% (N=743) of respondents indicated that they did not use podcasts, while 46% (N=632) of respondents used podcasts. One of the reasons given by students for the higher percentage of non-users dealt with the overall perceptions surrounding terminology: many of them thought an iPod or a MP3 player was required to view podcasts (which is, of course, a fallacy).

The results reported in this paper came from the second survey and focused on three areas: (1) podcasting course materials, (2) podcasting and learning styles / habits, and (3) podcasting and learning effectiveness. We also collected data on student demographic information, general use of podcasting, use of portable devices while involved in other activities, and general use of portable devices. One of the several major contributions of this project was that podcasting best practices were generated based upon students' feedback. This information was ultimately used to formulate guidelines for effective integration of podcasting technology in instructional delivery for other faculty members campus-wide and for educators world-wide.

PODCASTING COURSE MATERIALS

In this area, we tried to find out what methods students used to access course podcasts and how much time they spent on them. At the same time, we also tried to solicit students' feedback on the quality of podcasts in different delivery formats: audio only podcasts, enhanced podcasts (still image and audio), and video podcasts (or vodcast). Podcasting is using RSS (Really Simple Syndication) Web feed, which automatically updates the content for the subscribers. However we still provided instructions for students whenever there was new content uploaded. We wanted to know if this was necessary and valuable to them.

METHODS FOR PODCASTING PLAYBACK AND CONSUMPTION

Whether at the gym or on the beach, there are no real clear-cut winners in the various activities where students use their iPods or MP3 players. However, when students are using iPods or MP3 players for academic purposes, it is clear that podcasting makes contribution in the manner in which students are studying. Though viewing podcasts and other curriculum materials on the computer represented the majority of consumption methods, downloading academic podcasts to portable devices became an increasingly popular activity with 33% (Table 1).

Table 1. Methods Students Used to View Podcast Course Materials

Methods to View Podcasts	Frequency	Percent
Viewed materials on a computer	456	67%
Downloaded materials to iPod	170	25%
Downloaded materials to other MP3 player	33	5%
Burned podcasts to CD to playback on a portable CD player	20	3%
Total	632	100%

TIME SPENT ON COURSE PODCASTS

Though students preferred using iPod and other MP3 players primarily for music, they overwhelmingly supported using these devices for consuming academic podcasts and other class materials. Even with general approval, it was interesting to note that more than 60% (Table 2) of those who used podcasting content on their iPods did so for five hours or less per week. This would suggest that students reviewed and consumed podcasting content primarily on the computer, but used the iPods and other MP3 players as a means to review or consume on the go, offering mobility as an option for extending the delivery channel from the constraints of the computer.

Table 2. Time Spent on Course Podcasts

		Frequency	Percent
Valid	Over 50 hours	3	.5%
	40-50 hours	2	.3%
	30-40 hours	11	1.7%
	20-30 hours	16	2.5%
	10-20 hours	46	7.3%
	5-10 hours	105	16.6%
	Less than 5 hours	381	60.3%
	Total	564	89.2%
Missing System		68	10.8%
Total		632	100%

Of the 632 students who said they used the iPod or other MP3 players for reviewing or consuming academic podcasting content, over 16% did so between five and ten hours per week. This was a significant number that suggested a large segment of the population found the additional delivery channel to be an effective resource in lecture or as an addendum to content delivery. Additionally, more than 7% of those who used the portable devices for this purpose did so ten or more hours per week, with 2.5% doing so between 20 and 30 hours weekly. While this may seem extreme, those who commute via public transportation (or other methods) could easily consider that time period as optimal for use. Student demographic information revealed that over 34% of students live over 20 miles away from school, and about 25% of students spent more than 40 minutes driving one way to school. Students could take advantage of their commute time to access podcasting course materials.

QUALITY OF COURSE PODCASTS AND PREFERRED FORMATS

From the beginning, it was extremely important in this pilot that quality of content was addressed and evaluated throughout the process, and in most cases, before students were exposed to the content themselves. To accommodate theses activities, a Quality Assurance team was included in the organizational structure of the pilot with the primary responsibility of monitoring both publishing methodologies as well as playback quality of all podcasting formats. Knowing then that we had quality product from the outset meant that we were able to focus on unadulterated feedback from participants who might have otherwise been biased because of poor quality playback.

Perhaps one of the most often overlooked components of podcasting is the need to generate quality content from the outset. Given that students will likely be consuming academic podcasts in a variety of settings, it is imperative that they be produced in a manner that will allow for efficient delivery while preserving resources. Because podcasts are actually downloaded to the user's computer and ultimately to the iPods or MP3 players, file size and compression can make the difference between a 5-minute download and a 25-minute download seem like an eternity. One of the biggest challenges

for those who encode and publish podcasting content is trying to apply the appropriate compression and encoding settings so that consumers obtain the minimal download time. One problem with this, however, is that the greater the compression and encoding, the greater the degradation of the final product. This is especially challenging for video playback and consumption, especially for academic content that involves instructor examples such as math, accounting, statistics, or other classes where being able to see the playback clearly is crucial. Table 3 reports the feedback from students on the quality of different format of podcasts.

Table 3. Student Perceived Quality of Podcasts in Different Format

		Audio		Enhanced		Video	
		Frequency	Percent	Frequency	Percent	Frequency	Percent
Valid	Excellent	171	27.1%	123	19.5%	95	15%
	Good	359	56.8%	293	46.4%	301	47.6%
	Poor	28	4.4%	19	3.0%	28	4.4%
	Bad	4	.6%	2	.3%	4	.6%
	NA	0	0	72	19.5%	129	20.4%
Missing System		70	11.1%	560	11.4%	75	11.9%
Total		632	100%	632	100%	632	100%

Feedback from students suggests that audio-only podcasts were thought to have the highest quality, with video coming in a close second. Enhanced casts rounded out the third, though all formats received relatively high marks for quality. While the question posed was initially meant to gage their perception of the quality of the product, it was worth mentioning that students may have associated quality of the podcasts with the preferred format for consumption.

CLEAR AND EFFECTIVE INSTRUCTIONS FOR COURSE PODCASTS

One of the most important components to podcasting is providing effective and adequate instructions for consuming academic content through podcasting. These instructions should include, at the very least, the URL (feed) for subscription to the podcasts, as well as alternate options for receiving the content. In addition, the instructions should most certainly be made available electronically, through course delivery tools or other electronic syllabi. Given that the medium is produced and consumed online, making the instructions for consuming them available in the same medium is highly recommended. In the survey feedback, the overwhelming majority (80%) of those polled responded that the instructions to access the podcast course materials were clear, and almost as many students reported that the instructions by instructors were both easy to use and understand, as well as extremely helpful in the subscription process (Table 4).

Table 4. Clear and Easy to Follow Instructions as Perceived by Students

		Clear Instructions		Easy to Use and Follow	
		Frequency	Percent	Frequency	Percent
Valid	Strongly Agree	170	27%	171	27.1%
	Agree	335	53%	331	52.4%
	Not Sure	40	6.3%	44	7%
	Disagree	22	3.5%	21	3.3%
	Strongly Disagree	2	.3%	2	.3%
	Total	569	9%	569	9%
Missing System		63	10%	63	10%
Total		632	100%	632	100%

PODCASTING AND LEARNING STYLES / STUDY HABITS

PODCASTING AND LEARNING STYLES

Learning Style Theory has been considered as an important factor for developing effective teaching strategies and methods. Because podcasting can be presented to students in different formats (audio, enhanced, and video), this technology can help instructors respond to students' diverse learning styles by creating rich learning environments that engage students with auditory as well as visual learning styles. In this survey, the data indicated that there were more than 43% of students who self-reported themselves as visual learners, and this group was followed closely by 41% of tactile learners. Auditory learners took up 15% of the total number of students. When students were asked which podcasting format best suited their personal learning style, video podcasting (visual learners) took the lead with close to 60% of respondents (Table 5). The data provided valuable feedback for instructors on podcasting delivery format.

Table 5. Students Preferred Podcast Format Based on Their Learning Style

		Frequency	Percent
Valid	Audio podcasts	126	19.9
	Podcasts with audio and still images	167	26.4
	Video podcasts	275	43.5
	Total	568	89.9
Missing Syatem		64	10.1
Total		632	100.0

It should be noted that even though vodcasting (video podcast) is favored by students in this study, in reality, the production and playback of Vodcasting have higher requirements for both instructors and students as compared to audio podcasting. For instructors, the

development involves video taping, editing, encoding, etc. that could become a very time-consuming process. For students, they need portable devices that can display video images. The format selection should be determined by the content analysis. If the audio format can satisfy student learning, there should be no need for instructors to go through the lengthy process. But, the data results are very good indicators for future podcasting development as the technology becomes so advanced to the point where requirements will not be as demanding to both instructors and students.

PODCASTING AND STUDY HABITS

The availability of technology affects people's lives. We can see people's living habits and behavioral patterns changing with the development and advancement of technologies. For example, since online education became available, quite a few students choose to no longer attend regular on-campus classes. They access learning content and interact with their instructors and classmates virtually. Podcasting technology has created a new instructional delivery channel. In this study, there were more than 26% of participants who reported that the availability of course material podcasts changed their study habits, and about 38% of students stated that podcasting changed their behaviors outside of the classroom when studying for exams, especially when reviewing lectures was one of the top reasons students used podcasts.

The integration of podcasting for instructional delivery also affected student's study time allocation. About 36% of students reported that their study time decreased with the addition of podcasts for content delivery. More than 17% of students reported that their reading time decreased with the addition of podcasts. Because listening or watching podcasts is an individual learner-centered activity, more than 31% of students agreed that learning via podcasting decreased their need to study with others. On the other hand, 22% of students reported that learning via podcasts made them feel more involved with their peers and the academic social environment. One of the suggestions made by students is that podcasting should be integrated with other learning activities. These data results provide a very good guidance for the effective instructional design via podcasting.

PODCASTING AND CLASS ATTENDANCE

The most valuable features that students found with podcasting were flexibility and mobility. The data showed that more than 83% of students favored these two features because these features fit perfectly into their living condition and dynamic life style. University of Houston is a large urban commuter school. The majority of students have either full-time or part-time jobs. They spend a lot of time on the road driving to school and struggle to find a parking spot. This is especially difficult for morning classes. Our study indicated that students who had morning classes preferred podcasting to attending class lectures. When the morning class instructor started to deliver the full class content via podcasting, more than 85% of students accessed podcasting material instead of coming to class. For the other afternoon classes, majority of students still attended class regularly. 26% of students reported that they learn better from face-to-face classes, and about 60% of students preferred the combination of podcasting delivery and face-to-face classroom experiences. Table 6 shows the overall results of students' preference of using podcasts for course delivery as opposed to attending lectures.

Table 6. Students Preference of Podcasts for Course Delivery to Attending Lectures

		Frequency	Percent
Valid	Strongly Agree	62	9.8%
	Agree	156	24.7%
	Not Sure	120	19%
	Disagree	163	25.8%
	Strongly Disagree	64	10.1%
	Total	565	89.4%
Missing System		67	10.6%
Total		632	100%

PODCASTING AND LEARNING EFFECTIVENESS

The ultimate goal of integrating podcasting in education is to provide a new instructional delivery channel to facilitate student learning and to improve their learning outcome. The quality of course design is not determined by teaching or designing experts, but by the students – if they learn, how they learn, and what they learn. Podcasting's quality of delivery affects student learning quality. The following data represents students' perceptions toward podcasting quality and their learning experiences and outcomes.

PODCASTING COURSE DESIGN QUALITY

Podcasting design quality was measured through content delivery accuracy, clarity, logical presentation, as well as the integration with other content and activities. Table 7 shows students' feedback on the quality of course design from the users' perspective.

Table 7. Podcasting Content / Activity Integration as Perceived by Students

		Well-integrated with other content		Well-integrated with other class activities	
		Frequency	Percent	Frequency	Percent
Valid	S. Agree	96	15.2%	74	11.7%
	Agree	361	57.1%	315	49.8%
	Not Sure	81	12.8%	134	21.2%
	Disagree	22	3.5%	39	6.2%
	S. Disagree	2	.3%	4	.6%
	Total	562	88.9%	566	89.6%
Missing System		70	11.1%	66	10.4%
Total		632	100%	632	100%

Over 72% of students indicated that the course podcasts were well-integrated with other content, and 65% of students reported that podcasts were well-integrated with other class activities. This positive feedback owed a great deal to the collaboration of the teamwork. During the piloting process, the whole team had regular meetings. Every team member contributed suggestions and ideas. Podcasts were used not only for lecture replay, but also used for supplementary content, tutorials, and onsite instructions for media production students. Those class activities included discussion board postings, hands-on projects, group activities, and using varieties of assessments. Student feedback helped instructors realize the importance of quality course design. For some instructors, it was the first time they had even examined their course design and delivery from a student perspective and made the necessary improvements to meet students' expectations.

PODCASTING AND STUDENT LEARNING EXPERIENCES

Student enjoyment of a course is positively related to their learning attitudes and to their perceived value of the course they take (Patti & Saroja, 2005). Learning enjoyment also has been explored to design game-based instructional delivery to motivate and engage student learning. iPods and MP3 players have been used for entertainment. The data indicate that most students' primary use of their portable devices is to listen to music. Will the enjoyable experiences transfer to their learning processes? The survey results (Table 8) indicated that 53% of students stated that podcast course delivery format made their learning more enjoyable. More than 57% of students reported that podcasting delivery format enhanced their learning experiences. The best types of engagement stem from the learner's enjoyment of a more effective learning experience that places them in control and encourages active participation, exploration, reflection, and the individual construction of meaning (Galarneau, 2005).

Table 8. Podcasting and Student Learning Experiences

		Podcasting Makes Learning More Enjoyable		Podcasting Enhances Learning Experiences	
		Frequency	Percent	Frequency	Percent
Valid	Strongly Agree	70	11.1%	73	11.6%
	Agree	265	41.9%	288	45.6%
	Not Sure	150	23.7%	122	19.3%
	Disagree	62	9.8%	70	11.1%
	Strongly Disagree	18	2.85%	15	2.4%
	Total	565	89.4%	568	89.9%
Missing System		67	10.6%	64	10.1%
Total		632	100%	632	100%

Podcasting is becoming a mutual communication tool instead of one-way delivery tool. Instructors can take advantage of this delivery media to possibly improve student learning effectiveness. Positive podcasting experiences will benefit student learning.

EDUCATIONAL EFFICACY OF PODCASTING IN STUDENT LEARNING

In this pilot, podcasting was used for both full course content delivery and as a supplementary to lecture content to facilitate student learning. More than half of podcasting users enjoyed podcasting and had positive experiences. However, did the podcasting assist students in their learning and improve their learning outcomes? We investigated podcasting educational efficacy from two perspectives: (1) whether the addition of podcasting material was helpful to the understanding of course content, and (2) whether listening to podcasts would help students better retain the class content and information. The data in Table 9 indicated that over 74% of respondents agreed that podcasting was very helpful toward their understanding of content material. The professors who used podcasts for course content preview were able to spend more class time to discuss the content with students instead of spending class time for lecture. Students had more time to interact with instructors in this manner. More than 60% of students reported that podcasting helped them retain course content and information. Both data sources endorse the value of podcasting in the process of education.

Table 9. Educational Efficacy of Podcasting in Student Learning

		Helpful to the Understanding of Content		Helpful to the Retention of Content and Information	
		Frequency	Percent	Frequency	Percent
Valid	Strongly Agree	115	18.2%	101	16%
	Agree	356	56.3%	280	44.3%
	Not Sure	68	10.8%	127	20.1%
	Disagree	22	3.5%	49	7.8%
	Strongly Disagree	3	.5%	4	.6%
	Total	564	89.2%	561	88.8%
Missing System		68	10.8%	71	11.2%
Total		632	100%	632	100%

Last but not least, when students were asked if the use of podcasts improved their grades, more than 36% of students reported positively. We did a grade comparison between the two fully online classes with identical content material being taught by the same instructor. The fall 2005 class did not use podcasts, while the spring 2006 class used podcasts. There was a 12% increase with students receiving an "A," and overall performance had been improved with the class using podcasting. Comments from students in the survey were also very positive toward using podcasting for instructional delivery.

PODCASTING BEST PRACTICE

Here are several recommendations based on the data collected from the research study regarding the effective integration of podcasting technology into instructional delivery.

1. Always have a back-up plan. Podcasting should not be the only delivery channel for

instruction. You can implement it together with other delivery media such as streaming and CD/DVDs. Do not forget text, which is always the safest way to prevent any technical difficulties. The study results indicated that the students who had dial-up Internet connections had problems downloading large file size video podcasts; some students had limited storage space on their MP3 players for a full-length lecture podcast. Preparing material in different formats can satisfy different users and guarantee equal student access to the course content.

2. Re-structure the content and "cut" it into meaningful segments for effective delivery. Keep your podcasts short, especially a video podcast (vodcast). For an audio podcast, it should be under 30 minutes, for an enhanced podcast, under 20 minutes, and for vodcast under 15 minutes. Several issues arise when using long podcasts. It takes longer to download content, require more space to store the information, and some MP3 players have limited battery power to download successive podcasts.
3. Incorporate other learning activities with podcasting content delivery. There is a variety of learning activities that can help students recall the information delivered via podcast such as discussion forums, assessments, projects, etc. Faculty members can also create learner-centered activities to improve students' ability to apply knowledge application. They may also provide students opportunities to re-construct the information for better understanding, and strive to find out the best teaching pattern that is favorable to student learning.
4. Make the vodcast complimentary to the information rather than replication of the information. Effective use of the video images can greatly increase the stimuli of the information to the learner's brain. Instead of showing a "talking head" on the screen, extra visual information related to the content can enhance the learning effect by triggering new focus and attention. Do not use technology for the sake of technology.
5. Use the lowest format to achieve best results. Here, lowest format means an audio only podcast. When you analyze the content, start with the lowest format of delivery. An audio podcast has a smaller file size and takes less time to download. In addition, you can reach more students. The study results from the UH School of Communication show that more than 65% of students own iPods or IM3 players, but only one third of this population has an iPod with video capabilities. You should choose enhanced formats only when they can provide additional value to the content; otherwise, the audio podcast is just as good as (or better than) the others.

ACHIEVEMENTS AND CHALLENGES

The number of faculty members on campus interested in incorporating podcasting into their curriculum as a new and/or an additional instructional delivery channel continues to rise. The survey findings provide faculty members with very valuable information on producing quality podcasts and incorporating podcasting technology into other academic activities. This research study had achieved the following:

1. A podcasting portal (http://www.uh.edu/podcast) was created as a central resource for the entire UH community. The site consists of two sections. One section collects all the information about this research study and research artifacts, presentations and papers presented at state and national conferences. The other resource section provides all the necessary information for podcast production. This portal is expected to serve as a component to UH presence in iTunes U.
2. This study promoted faculty members' research on the improvement of teaching effectiveness through the delivery of podcasting materials. The design process

provided faculty an opportunity to rethink about the quality of course delivery relating to student learning experiences, learning styles, accessibility issues, and the availability of resources.

3. The research data generated standards for podcasting best practices (do's and don'ts) and provided tips that other faculty members could utilize for effective production of podcasting materials such as the appropriate length of podcasts, the best format of podcasts for student easy access and storage, etc.
4. This study set up an exemplary model of teamwork collaboration of campus resources. People from different departments worked cohesively in providing technical support, quality control, and conducting research. All team members helped each other produce quality podcast content.

In spite of the fact that we did achieve a lot from this pilot project, non-podcasting users did mark that they did not use podcasts because they did not have iPods. They had no knowledge about podcasting technology and how it works. Neither did they know that computers could also be used to access podcasts. Had we educated students before podcasts were delivered, more students would have benefited from the delivery format. One student suggested that we should have included an instructional video to show them how to use podcasts. The podcasting length issue was reflected in students' feedback. Students who had dial-up Internet connection had difficult time downloading video podcasts. Even though we had a quality assurance team to check the quality of downloads ahead of time, they did so on campus with faster Internet connections. Besides, long podcasts sometimes do not benefit student learning. One student commented that "when watching materials via podcasts, my attention span faded towards the end of long podcasts verses face-to-face lectures."

CONCLUSION

Podcasting used for instructional delivery is still in the stage of infancy. The research data presented in this paper provide some indication that podcasting technology is helping to broaden education to our students. As Farkas (2005) notes, with the proliferation and ubiquity of iPods and other digital media players, it is clear that podcasting is here to stay. The responsibility falls upon the educator to find out an innovative way to address the needs of students. The world is changing, so should be the educational delivery method. Understanding what and how it takes to reach to our students is an important part of quality education.

REFERENCE

Brown, G., Myers, C., & Roy, S. (2003). Formal course design and student learning experience. *Journal of Synchronous Learning Networks.* 7(3), 66-77.

Farkas, B. (2005). *Secrets of podcasting*. Berkeley, CA, Peachpit Press.

Galarneau, L. (2005). Authentic learning experiences through play: games, simulations and the construction of Knowledge. *International DiGRA Conference*. June 16th - 20th, 2005. Retrieved January 25, 2006, from: http://www.gamesconference.org/digra2005/overview.php

Patti, C., & Saroja, S. (2005). Learning experience and learning effectiveness in undergraduate statistics: modeling performance in traditional and flexible learning environments. *Decision Sciences the Journal of Innovative Education*. *3*(2), 251-271.