iPod Technology in Graduate Agricultural Education and Communications Courses: A Comparison of Adopters and Non-Adopters

Karin Fritz, Texas Tech University
Todd Brashears, Texas Tech University
Cindy Akers, Texas Tech University
Scott Burris, Texas Tech University
Christine Alvarado, Texas Tech University

Abstract

This descriptive research aimed to identify relationships between demographic and personological variables and adoption of iPod technology in college of agriculture graduate courses. Sixty-one graduate students enrolled in iPod-enabled courses were provided iPods during the 2007 spring semester. Students completed data collection instruments including the Group Embedded Figures Test (GEFT), California Critical Thinking Disposition Inventory, Computer Skills Inventory and a researcher-designed demographic instrument. The latter collected information such as gender, race, academic department and iPod usage during the semester. Researchers determined 34 of the 61 participants failed to adopt the iPod as an educational resource. T-tests determined significant differences in participants' GEFT scores, total GRE, and the value of an iPod as an educational resource score. The mean score for non-adopters GEFT was 10.06 (n=34) while adopters recorded a 13.15 (n=27). This suggests non-adopters of iPod technology are typically categorized as field-dependent learners and adopters are more likely to be field-independent learners. Adopters scored approximately 85 points higher on the combined quantitative and analytical sections of the GRE with adopters recording a mean score of 972.96 and non-adopters scoring 887.65. Recommendations are made for improvement of practice and future research.

Introduction

The Boyer Commission (1998) stated that the profession's best teachers and researchers should find options of designing courses which allows technology to enrich teaching rather than provide a substitute for teaching. This is occurring according to McKeachie and Svinicki (2006), who stated that the integration of technology into the educational process is becoming a major thrust for most colleges and universities. The National Research Agenda for Agricultural Education and Communications (2007) indicates that research should be conducted to determine "What teaching, advising, and mentoring strategies most effectively and efficiently yield desired student outcomes with particular groups of students?" In addition, it is a priority initiative of this research area to "Evaluate the costs and benefits of specific instructional practices on student academic achievement and career success." (p. 17). The purpose of this research was to evaluate student use of iPods in graduate courses and to determine the cost/benefit of incorporating this technology.

While most consumers purchase an iPod for the entertainment value, it has quickly been adapted for use in education. iPods have been a recent focus of attention as an educational tool on many university campuses. In August 2004, Duke University distributed 1,600 Apple iPods

to first-year students (Carlson, 2004). These iPods were distributed specifically for students to use for educational purposes. According to the *Duke University iPod First Year Final Evaluation Report*, a total of 15 fall courses (628 students) and 33 spring courses (approximately 600 students) integrated the iPod into the educational process.

An iPod is a hand-held device that allows digital information in the form of audio or video tracks to be downloaded, transported and viewed at the users' convenience. This device is a brand of portable media player, designed and marketed by Apple Computers, which has been the world's best-selling digital audio player since October 2004 (iPod, 2006). In Jobs (2006), Apple CEO, reported total sales of over 42 million iPods, and 14 million in the first quarter of the fiscal 2006 year, meaning that 100 iPods were sold every minute during that quarter. The sales of iPods have greatly increased since the 2002 fiscal year, when Apple Computers sold 381,000 iPods (Apple Computer, 2004).

In addition to individual programmatic implementation by universities, the Apple Corporation provides a web portal for hosting educational content for its members. This portal is called "iTunes U". Twenty-six United States universities are content-providing members including schools such as Duke, MIT, Stanford and Yale. This site provides iPod users with literally thousands of audio and video segments from a wide range of educational content areas.

While iPod technology is being implemented in various ways in the postsecondary classroom it is unclear if implementation equates into an increase in student achievement or satisfaction. In addition, the level of technology adoption for iPods by students has yet to be determined. This adoption rate will affect the impact of the technology on the population and the best intentions of teachers and researchers who rush to implement new technology.

The purpose of this study was to identify characteristics of adopters of iPods versus non-adopters and to evaluate the impact of iPod implementation on adopters versus the costs associated with developing and implementing the technology. Objectives established for this study in order to help guide researchers were as follows:

1. Describe demographic characteristics of adopters and non-adopters of iPod technology in iPod-enabled graduate courses.
2. Compare personalogical characteristics and behaviors of adopters and non-adopters.
3. Examine the cost of iPod implementation in a graduate program.

Theoretical Framework

Rogers Diffusion of Innovations (2003) served as the theoretical framework for this study. Rogers stated the act of implementing a new technology as outlined in Figure 1. The subject must first acquire knowledge of the innovation then be persuaded to adopt that technology. This research project focuses on the third stage of this process, that of the decision to adopt or reject. Assuming adoption, the fourth stage is implementation followed by confirmation.

Rogers (2003) presented two types of rejection. Active rejection occurs when the subject considers adoption (even using on a trial basis) before deciding not to adopt it. Passive rejection occurs when the subject never really considers using the innovation. Several variables are

related to the relative speed, or rate, of adoption that an innovation experiences in a social system. These variables include: 1) Perceived Attributes of the Innovation, 2) Type of Innovation Decision, 3) Communication Channels, 4) Nature of the Social System, and 5) Extent of the Change Agents' Promotion Efforts (Rogers, 2003).

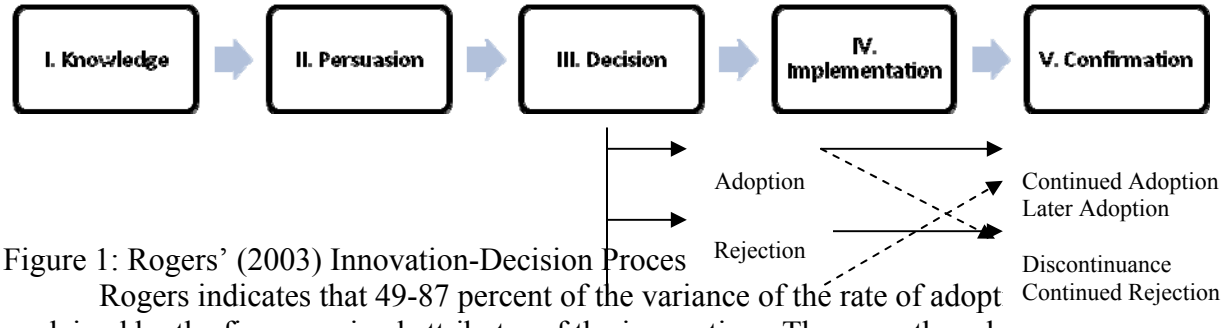

Figure 1: Rogers' (2003) Innovation-Decision Proces

Rogers indicates that 49-87 percent of the variance of the rate of adopt explained by the five perceived attributes of the innovation. These are the rela compatibility, complexity, trialability and observability. A more detailed model of these variables can be seen in Figure 2.

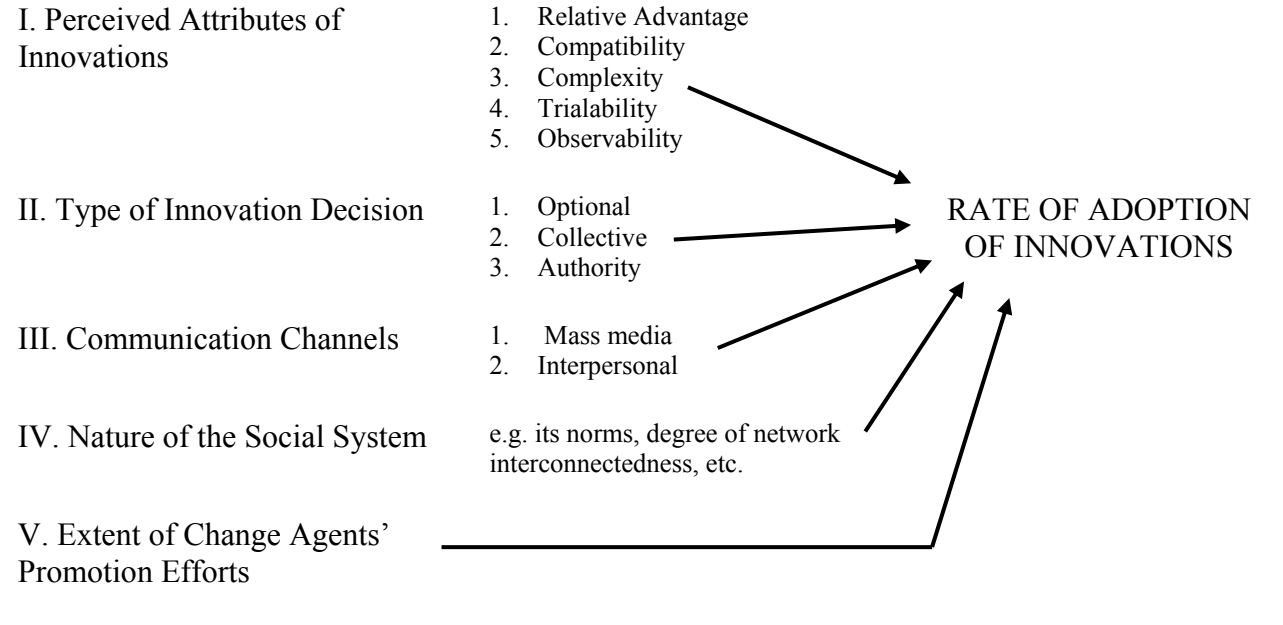

Figure 2. Variables Determining the Rate of Adoption of Innovations

Finally, Rogers used a standard normally distributed bell curve to identify adopter categories. This indicates that the first 50 percent of the population to adopt are categorized as Innovators (first 2.5%), Early Adopters (next 13.5%), and Early Majority (next 34%). The second half of the population to adopt an innovation were categorized as Late Majority (34%), and Laggards (the final 16%).

The adoption of certain learning technologies was addressed by Chen and Macredie (2002) who indicated cognitive styles had a significant impact in the adoption of content delivery methods when students were given control over the learning environment. Using the Group

Embedded Figures Test (GEFT) to identify students as Field-Independent or Field-Dependent, Yoon (1994) found students categorized as Field-Independent performed better in a content delivery model where they were given control of the delivery of the information. Field-Dependent students performed better using a content delivery model in which they had no control but were simply provided the content using a standard method.

The first article using the GEFT appeared in the Journal of Agricultural Education (JAE) in 1990. Since that time, 21 studies published in the JAE have used the GEFT to evaluate educational variables of college students. This includes 2280 undergraduate, graduate, on-campus, off-campus and several other designations of students. These papers reported mean scores on the GEFT from 10.51 to 13.98 with a categorical breakdown of field-independent/field-dependent/field-neutral students of 1108/698/129. Some studies failed to report a ratio of types of learners in the study. In a study of students receiving course content on videotape, Miller (1998) found the highest performing students in the class spent less time studying, spent more time viewing the videotape, were more likely to use alternative study methods and scored higher on the GEFT (field-independent). Torres and Cano (1995) found a moderately positive correlation ($r = .36$) between learning style and critical thinking of students. Garton, Dyer and King (2000) found a moderate positive correlation ($r = .36$) between GEFT scores and ACT scores.

Methodology

During the spring semester of 2007, four graduate courses at a single southern university were designated as "iPod enabled." This designation in the departmental course description was further explained in the course syllabi. Each of these courses included content that was delivered over the internet to the individual students' computers. This content was cataloged and indexed in iTunes, a program that automatically recognizes and downloads Podcast episodes. This program allows users to view content and transfer the content seamlessly to an iPod, allowing the student the ability to view the content virtually anywhere. Sixty-one master's and doctoral students self-selected and completed these courses. The census of this accessible population was a time and place sample (Oliver & Hinkle, 1982) allowing for an analysis using inferential statistics. Each student enrolled in these courses was provided a 60 Gigabyte video iPod for use during the semester. The courses included in this study were Methods of Technological Change, Statistics, Research Methods and Graduate Seminar.

Content was captured and delivered to the students in a variety of formats with one overarching commonality, all content was provided in audio/video form which could then be viewed and heard using the iPod. Examples of content included videos of entire lectures, short-segment introductions of content and mid-length overviews of theory. The preceding examples were operationalized as combinations of video footage of the instructor, students asking questions and PowerPoint slides. In addition to this "live-action" video, instructors also created content that consisted of PowerPoint slides and full-motion screen captures of how to use SPSS with an accompanying instructor voiceover. The videos were captured in the departmental iPod studio classroom which is equipped with multiple cameras, computers, document camera, microphone and projector. These sources feed into two computers. The first renders the raw footage into the Podcasting format while the second acts as the server, making the files available to students within minutes of the end of each class. The type of file created for each class within the course depended on the content being taught as well as the instructor preference for creating the media.

Multiple instruments were used to collect data from the participants in the study. The first instrument was the Computer Skills Inventory. This self-completed instrument was designed by Compeau and Higgins (1995) to determine computer self-efficacy. Rogers (2003) stated that one of the variables that contribute to rate of adoption was the complexity. This instrument was used to measure the participants' self-efficacy toward the complexity of the computer aspect of the technology. The instrument was available in a web-based form and provided results on a 100-point scale with individual scores for the following subcategories: (1) computer hardware, (2) computer settings, (3) computer software, (4) computer terminology, (5) e-mail, (6) Internet, (7) keyboard usage, (8) networking, and (9) Windows.

The second instrument completed by the participants was the California Critical Thinking Disposition Inventory by Facione and Facione (1992). The authors state that the (CCTDI) is intended to analyze a person's disposition towards critical thinking. Rogers (2003) indicates that individuals who were able to determine the relative advantage of using an innovation would be more likely to adopt. This determination of relative advantage requires the participant to think critically, therefore necessitating the use of this instrument. The instrument itself consists of 75 questions on a 6-point Likert-type scale. Seven categories are measured, which include: truth-seeking, open-minded, analyticity, systematicity, confidence, inquisitiveness, and maturity. A score above 50 within a category indicates strength within that dispositional aspect. Scores between 30-to-40 express that the individual possess ambiguous dispositions within the category. Participant scoring below 30 within a specific category are negatively disposed. An overall score greater than 350 indicates a broad strength in the disposition toward critical thinking. Scores between 210 and 280 indicate ambiguous feelings toward critical thinking. Overall scores below 210 indicate a significant opposition towards critical thinking. This instrument was included as previous research indicated that a relationship exists between critical thinking and learning style (Torres & Cano, 1995).

The Graduate Record Examination (GRE), the General Test, is used in graduate academic settings as a predictor for graduate students' first-year grade point average (Guide to the Use of Scores, 2006). As each participant in this study was a graduate student, the research chose to use the GRE rather than the ACT for the timeliness of the test. Each participant's GRE score was obtained from university records. Researchers used each student's highest score if there was more than one score on a student's academic record. The combined score of the verbal and quantitative sections was recorded. Each student's undergraduate and current graduate grade point average (GPA) was collected in the same manner. Graduate GPA was recorded following the end of the semester including courses taken during the research project.

The Group Embedded Figures Test (GEFT) allowed researchers to determine if each student was categorized as a field-independent or field-dependent learner. Students each completed three sections of this instrument in the allotted time frame. The developers of this instrument report a national norm of 11.4. Participants scoring 12 or higher are considered field-independent learners while participants scoring 11 or less are considered field-dependent (Witkin, Oltman, Raskin, & Karp, 1971). Miller (1997) found that the average score on this instrumentation among agricultural education majors was 11.27 (s.d.=4.2) or virtually equal to the national norm.

In order to measure student attitudes, prior experiences with technology and iPod usage the researchers created an instrument to be completed by the subjects. The pilot test was conducted during the fall 2006 semester. A total of 69 graduate students completed the

instrument for the pilot test. Researchers were able to establish measurement error and edit unclear questions found within the instrument. Section A used 21 questions to collect data on use of the iPod. Section B consisted of questions regarding barriers for non-adopters. Section C used 19 Likert-type questions to establish attitudes and beliefs about using the iPod for educational purposes. The final two sections established prior technology use and demographics of users. Table 1 presents the reliability coefficients for all instruments.

Table 1

Instrument Reliability Scores for Instruments Administered to iPod-enabled Graduate Classes

Instrument	Reliability Type	Calculated Reliability
GRE		
Verbal	KR-20	.92
Quantitative	KR-20	.91
GEFT	Spearman-Brown	.82
CCTDI		
Overall	Cronbach's Alpha	.91
Truth Seeking	Cronbach's Alpha	.71
Open Mindedness	Cronbach's Alpha	.73
Analyticity	Cronbach's Alpha	.39
Systematicity	Cronbach's Alpha	.74
Self Confidence	Cronbach's Alpha	.78
Inquisitiveness	Cronbach's Alpha	.80
Maturity	Cronbach's Alpha	.75
Computer Skills	Cronbach's Alpha	.81-.85
Demographics	NA	NA
Attitudes and Beliefs	Cronbach's Alpha	.91

Data was collected at the beginning of the semester with the researchers administering the Computer Skills Inventory, GEFT, and CCTDI during the first week. During the semester, university records were accessed to determine GRE and GPA data. The final day of class, the participants completed the demographic and attitudes and belief instruments. iPods were collected to record participant usage throughout the semester. All data was entered into SPSS 13.0 for analysis. Descriptive statistics were calculated including frequencies, means, and standard deviations. In addition, t-tests were used to compare means of adopters and non-adopters for selected variables.

Results

Objective one.

Objective one in this study was to describe demographic characteristics of adopters and non-adopters of iPod technology in iPod-enabled graduate courses. Question 4 on the researcher designed instrument asked each student if they used their iPod to view course materials during the semester. Thirty-four of the 61 respondents replied "no." These respondents were coded as non-adopters while the 27 students who responded "yes" were coded as adopters. Table 2 indicates demographic descriptions of each group.

Table 2
Demographic Characteristics of Adopters and Non-Adopters of iPod-Enabled Graduate Courses

	Adopters ($N = 27$)		Non-Adopters ($N = 34$)	
Characteristics	Frequency	Percent	Frequency	Percent
Gender				
Male	14	51.9	17	50.0
Female	13	48.1	17	50.0
Total	27	100	34	100
Ethnicity				
Caucasian	24	88.9	29	85.3
Hispanic	2	7.4	1	2.9
African American	1	3.7	2	5.9
Native American	0	0.0	2	5.9
Asian	0	0.0	0	0.0
Other	0	0.0	0	0.0
Total	27	100	34	100
Academic Standing				
Masters	16	59.3	23	67.6
Doctoral	11	40.7	11	32.4
Total	27	100	34	100

Adopters and non-adopters completed each of the measurement instruments. Comparisons of the groups are provided in Table 3. With GEFT scores of 11 or less, 31 students were categorized as field-dependent, while 30 were categorized as field-independent with scores of 12 or more.

Table 3
Instrumentation Scores of iPod Adopters and Non-Adopters in Graduate-Level Courses

		Adopters ($N = 27$)		Non-Adopters ($N = 34$)	
Instrument	Scale	Score	*SD*	Score	*SD*
Computer Skills Inventory					
Overall	0-100	64.00	14.18	62.47	8.62
Hardware	0-100	41.37	33.34	40.21	27.05
Settings	0-100	88.46	29.35	79.69	35.60
Software	0-100	89.85	17.47	86.77	17.76
Terminology	0-100	64.81	41.17	65.52	44.52
Email	0-100	72.44	12.72	78.68	9.35
Internet	0-100	61.07	37.32	48.06	38.04
Keyboard	0-100	56.15	37.94	55.68	28.82
Networking	0-100	63.56	31.38	56.25	43.53
Windows	0-100	51.84	25.95	52.21	17.46

CCTDI					
Overall	70-420	298.48	24.52	302.47	27.57
Truth Seeking	10-60	39.25	4.39	38.47	5.94
Open Minded	10-60	37.48	5.11	40.23	4.88
Analyticity	10-60	46.07	4.57	44.32	4.49
Systematicity	10-60	42.14	6.82	41.73	8.73
Confidence	10-60	44.40	5.61	45.38	4.18
Inquisitiveness	10-60	46.88	5.73	48.08	4.44
Maturity	10-60	43.77	5.92	44.23	6.45
GEFT	0-18	13.15	3.73	10.06	3.99
GRE					
Total	0-1600	972.96	164.40	887.65	160.43
Verbal	0-800	447.41	75.32	402.35	76.91
Quantitative	0-800	525.56	109.83	485.29	111.43
GPA	0-4	3.90	.20	3.74	.35

Objective two.

The purpose of research objective two was to compare adopters and non-adopters using personalogical and behavioral variables. These were measured using the four instruments described in the previous section as well as the GRE and GPA scores. To accomplish this objective, independent-samples t-tests were conducted to determine if mean score differences occurring between adopters and non-adopters was a statistically significant variation. The assumption of equal variances was met except where noted. In two cases, Levene's proved significant at ά = .05; therefore the adjusted p value was used to determine significant differences in the means. Age was included for adopters (M = 31.85, SD = 8.59) and non-adopters (M = 28.73, SD = 7.78). The tests for GEFT, GPA, Verbal GRE, Total GRE, Verbal GRE and the iPods value as an educational resource were significant. Values for these tests as well as non-significant variables are shown in Table 4.

Table 4
Independent t-Tests for Equality of Variable Means Between Adopters and Non-Adopters

			Levene's Test for Equality of Variances		t test for Equality of Means		
	Adopter mean	Non-Adopter mean	*F*	*p*	*t*	*df*	*p*
GEFT	13.15	10.06	.110	.741	-3.08	59.00	.003*
GPA[a]	3.90	3.74	7.06	.010	-2.058	54.64	.044*
Total GRE	972.96	887.65	.054	.816	-2.041	59.00	.046*
Quant. GRE	525.56	485.29	.618	.435	-1.407	59.00	.165

Verbal GRE	447.41	402.35	.065	.799	-2.293	59.00	.025*
CCTDI	298.48	302.47	.306	.582	.589	59.00	3.980
Computer Skills	64.00	62.47	13.594	.001	-.520	59.00	.605
Age	31.85	28.73	.717	.400	-1.483	59.00	.143
iPod value as educational resource[a]	14.67	3.13	4.606	.036	-5.449	47.31	.001*

[a] Equal variances not assumed
* Significant at ά = .05

Objective 3.

Various costs are associated with implementing the iPod-enabled courses described in this research study. Software costs, faculty time, student time, and hardware are just a few of the expenses incurred while developing this program. Objective three sought to determine the expense of such a program. It should be noted that this project was funded with a grant provided by the International Center for Food Industry Excellence. Funds from this grant purchased hardware, software and paid for graduate assistants to provide labor. Faculty time is calculated using average assistant professor salary for the southern region (AAAE, 2002). Known costs of this project are shown in Table 5.

Table 5
Costs Associated with Creating and Delivering iPod-enabled Courses

Item	Purpose	Cost per item	Quantity	Total Cost
Hardware				
60 G Video iPod	Used by students to view course content.	$349.00	100	$34,900.00
Mac Server	Provides storage of video podcasts and link to the Internet for downloading.	$2857.00	1	$2857.00
Windows PC	Connected to video cameras in iPod studio. Captures raw video and audio.	$2213.00	1	$2213.00
Sony EV100 analog camera	In studio to capture video of lectures.	$1100.00	2	$2200.00
Software				
Adobe Premiere Pro	Capture raw video and audio in studio.	$800.00	1	$800.00
Garage Band	Convert files to podcast format. Part of the iLife suite.	$79.00	1	$79.00
Labor				
Student Assistantship	One graduate student worked for one year organizing and creating content.	$12,000.00	1	$12,000.00
Faculty Labor (4 faculty members)	Faculty estimated an extra 200 hours to create content for this project per semester.	$29.51	200	$5,902.00
Total Estimated Cost				$60,951.00

One hundred iPods were purchased that were available for check-out to students on a semester-by-semester basis. First priorities were students currently enrolled in iPod-enabled courses and faculty teaching those courses. In addition, faculty members who were interested and graduate students who have previously taken an iPod-enabled course were able to check out any excess iPods.

Conclusions

In regards to objective one, the researchers administered several instruments to the population to measure variables for the purpose of describing characteristics of adopters and non-adopters in iPod-enabled courses. Forty-four percent of the population (n =27) were categorized as adopters. It was determined adopters and non-adopters were both split relatively equally across genders and ethnicities. The typical adopter and non-adopter was likely Caucasian and were as likely to be male as female. Doctoral students were more likely to be adopters than master's students. In addition, the groups were similar in age with adopters having an average age of almost 32 years and non-adopters being almost 29 years old.

For objective two, researchers compared personological and behavioral measures using independent t-tests. Evaluation of the GEFT revealed a statistically significant difference between adopters and non-adopters. Of particular interest was the fact that the mean score for adopters was 13.15, greater than the national average of 11.4 indicating that, on average, adopters tended to be more field-independent learners. Alternatively, non-adopters recorded a GEFT mean score of 10.06, indicating that this group tended to be field-dependent learners. Rogers (2003) refers to a large quantity of research literature to summarize characteristics of adopters (innovators, early adopters and early majority) compared to late adopters (late majority, laggards). These characteristics fall into three categories; 1) socioeconomic status, 2) personality values, and 3) communication behaviors. Because adopters in this study tended to be field-independent, Table 6 provides a comparison of personality characteristics of early adopters and field-independent learners.

Table 6
Comparison of Field-Independent and Early Adopters Characteristics

Early Adopters Personality Characteristics[a]	Field-Independent Learners[b]
May be less dogmatic than later adopters	Accepting to ideas strengthened that are through analysis
Have greater intelligence than later adopters	Demonstrate greater proportional reasoning skills
Have a greater ability to deal with abstractions than do later adopters	Are able to reorganize information to provide context for prior knowledge
	Are good with problems that require taking elements out of their whole context
Have a greater rationality than later adopters	Experience their surroundings analytically, with objects experiences as being discrete from their backgrounds

[a] Rogers (2003)

[b] Adapted from Chen and Macredle (2002)

Forty-four percent ($N = 27$) of the students adopted the iPod during the first semester of use. See Figure 3. This indicates that there is opportunity for further adoption even within the early adopter category. The adoption of this innovation has not yet reached its peak within the population and additional trialablity with the device may persuade non-adopters to adopt during subsequent courses.

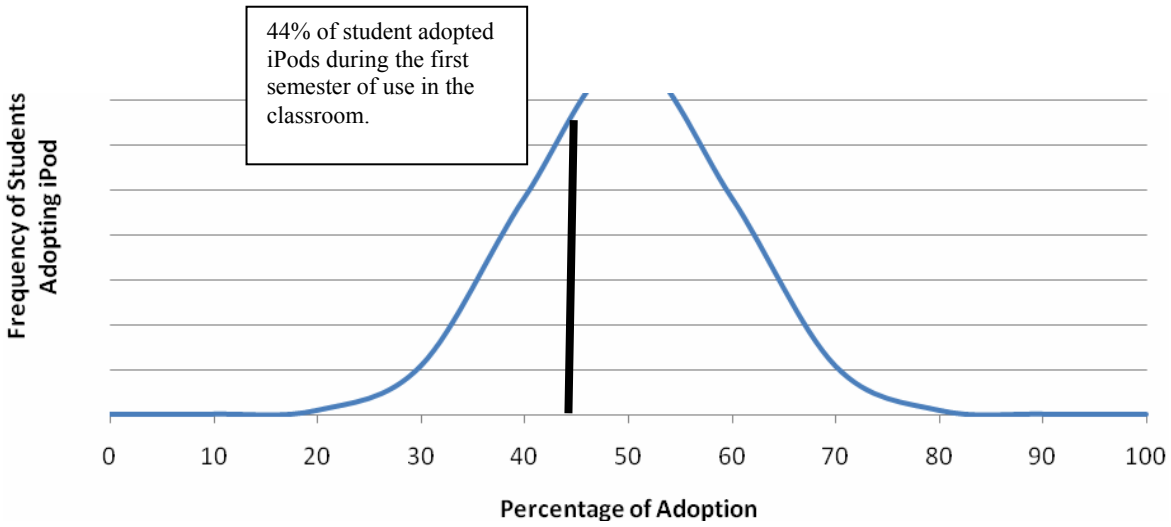

Figure 3. Student Rate of Adoption of iPods as Educational Tools during a Single Semester

Adopters and non-adopters expressed significant differences in the area of GPA and Verbal and Overall GRE scores. GPA was measured at the end of the semester including the iPod-enabled courses but significant differences in student performance in the individual classes were not observed. This indicates that students who typically score higher in classes were more inclined to adopt the iPod. The researchers did not interpret this to mean the use of the iPod resulted in a higher GPA. In the same manner, Verbal and Overall GRE scores do not reflect use of the iPod but could be an indication of the characteristics of early adopters and field-independent learners expressed in Table 6.

The final variable that exhibited a significant difference was the Likert-type item that asked adopters and non-adopters to rate the iPod's value as an educational tool. Adopters rated the iPod significantly more valuable that non-adopters. It is unclear whether this reflects student attitudes about prior opinions or at the end of the trialability stage. Further studies should incorporate this question as a pretest/post-test item.

In regards to cost analysis (objective 3), it may seem that nearly $62,000 is a great deal of expense for the development and delivery of four graduate courses. It should be noted that programs wanting to create iPod-enabled courses can do so in a less expensive manner. iPods do not have to be provided as it could be argued that adopters will have purchased their own. In addition, many of the computer and software resources that are required for this program are currently available on many university campuses. It is also of note that after the initial time

expense of creating the courses, the upkeep required from semester to semester is minimal, thereby reducing average costs over time.

Recommendations/Implications

This research raises several important questions in the context of iPod adoption by students in graduate courses. Some of these new research questions include: Can researchers predict technology adoption in the classroom by regressing a combination of personolgical variables and behaviors? Are the non-adopters actively or passively rejecting adoption of the technology? Is there a connection between adopter category and field-dependence/field-independence? What actions can be taken to help facilitate adoption of technology in the classroom? Is it necessary that all students adopt iPods for iPod-enabled courses to be considered effective? Do students view iPods favorably in the same proportion before and after the trialabiliy stage, or are adopters swayed toward that attitude through the adoption process?

Students continue to purchase and use iPods for personal entertainment and will do so until the "next big thing" comes along. Until that time, educators should look to use iPod-enabled courses as another method of delivering course content to students who prefer to receive it in that manner. Non-adopters should be identified and provided additional chances to adopt through informing them about the attributes of the innovation as suggested by Rogers (2003) or providing other options more suited to their learning style. Continued research on the most effective delivery method as well as identifying barriers to adoption may also influence the study of classroom technologies.

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