Journal of Agricultural and Applied Economics, 41,3(December 2009):791–808

Demand for Multimedia in the Classroom

Tracy A. Boyer, Brian C. Briggeman, and F. Bailey Norwood

This study elicits preferences for multimedia in the classroom for students and faculty members in agricultural economics. Employing an Internet-based conjoint ranking survey, the results show that students prefer multimedia instructional tools over a traditional chalkboard/whiteboard lecture format while faculty members do not. Neither students nor faculty members are enthusiastic about electronic textbooks, and students will accept them only if they save $80. Finally, preferences for multimedia are shown to differ with students who self-report differing note-taking abilities, preferences for chalkboard lectures, and the need for an engaging class. Successful multimedia adoption requires appropriate use and lowering costs for students.

Key Words: conjoint ranking, instruction, microeconomics, multimedia instruction, valuation

JEL Classifications: A22, Q19

The rising costs of higher education, and specifically textbooks, have led some to seek government intervention. The United States Government Accountability Office (GAO) conducted a study in 2005 wherein they report that college textbook prices have increased a staggering 186% since 1986 while the overall price inflation during this period was 72%. Several reasons are cited by the GAO study for the price increase. First, production costs associated with new textbooks have increased. Second, the supply of used textbooks, which are typically lower in price, cannot meet demand. Third, publishers revise textbooks one year earlier than they would have 10 years ago. Finally, the demand for textbooks with supplemental teaching materials has increased. Publishers told GAO officials that instructors now demand supplemental material, such as CD-ROMS, DVDs, printed study guides, Web based study guides, online access to test questions, or other supplemental multimedia material. According to publishers, these extra materials contribute to the increase in textbook prices.

Undoubtedly, students pay more for their textbooks each year (Government Accountability Office, 2005), but are these extra costs warranted? If the increased costs of textbooks are at least partially due to supplemental multimedia products (as argued by publishers) and students are willing to pay for multimedia in the classroom, then the increased cost should

Tracy A. Boyer, assistant professor, Agricultural Economics, Oklahoma State University, Stillwater, OK. Brian C. Briggeman, Ph.D. economist, Federal Reserve Bank of Kansas City, Omaha Branch, Omaha, NE. F. Bailey Norwood, associate professor, Agricultural Economics, Oklahoma State University, Stillwater, OK.

We are grateful for the assistance of colleagues from four institutions in conducting the survey, including Edwin Miller, Associate Dean of Academic Programs, CASNR, Oklahoma State; Joe Schatzer, undergraduate coordinator, Agriculture Economics, Oklahoma State; Kirby Barrick, Dean of College of Agricultural and Life Sciences, University of Florida; Lisa House, undergraduate coordinator, University of Florida; Frances Homans, undergraduate coordinator, Applied Economics, University of Minnesota; Frank Dooley, undergraduate coordinator, Purdue University; and Steve Gilliland and Phumsith Mahasuweerachai, research assistants, Oklahoma State.

not necessarily be deemed harmful. Support for this statement is found in the literature, which clearly demonstrates that using multimedia in the classroom enhances learning (Carnevale, 2005; French, 2006; Kozma and Russell, 1997; Mayer, 2001; Murray, 1999; Nowaczyk, Santos, and Patton, 1998; Trees and Jackson, 2007). Kennedy (1998) discusses the benefits of using a computer to teach Monte Carlo analysis rather than using chalk and talk and Dahlgran (1990) discusses the benefits that accrue to students and instructors from using a futures trading game. Recently, Reay, Li, and Bao (2008) found that if a personal response system (otherwise known as "clickers" or "voting machines") is used correctly in a large classroom setting, the grades of physics' students could be improved. Multimedia use does not guarantee increased student learning unless it is tied closely to learning objectives and serves as more than decoration (Nowaczyk, Santos, and Patton, 1998; Stone, 1999). In addition, effectiveness of multimedia varies with student ability and personality (Nowaczyk, Santos, and Patton, 1998).

Since appropriately using multimedia enhances learning, potentially there are ways to capture this benefit and use some elements of electronic media, such as online study guides and electronic texts, to lower the costs of textbooks. Lipka (2007) reported that Congress is discussing ways to increase the use of electronic text licenses or electronic textbooks as a method to lower textbook costs. Of course, this assumes students are willing to pay for electronic textbooks. Since students are the primary consumer of multimedia and their consumption is largely dictated by the instructor, students' willingness-to-pay for multimedia should not be ignored when designing courses.

The first objective of this paper is to determine students' willingness-to-pay (WTP) for traditional lecture materials versus supplemental multimedia products in an introduction to agricultural economics course. To date, little empirical research exists in any field of study to determine whether students value the suite of multimedia products being offered. Eliciting students' WTP for multimedia products is directly relevant to students' perceptions of the value multimedia products bring to the classroom and how quickly and completely they embrace the technology. These perceptions were elicited from students by emailing an Internet conjoint ranking survey to all enrolled undergraduate agricultural economics students at Oklahoma State University, Purdue University, the University of Florida, and the University of Minnesota. The multimedia instructional tools considered in this study are: electronic textbooks, Web based study guides, electronic notes (e.g., PowerPoint), personal response systems (e.g., clickers or remotes), podcasts of lectures and/or class related concepts, and in class videos.

Ultimately, faculty instructors choose the bundle of multimedia and instructional materials used in an introduction to agricultural economics course for a variety of motivations. Do they choose bundles that students demand? What motivates instructors to choose a certain textbook and multimedia combination for a course? Ideally, faculty motivations include the desire to effectively engage students and enhance learning, but few can ignore increased pressure to use multimedia and decrease textbook prices. The second objective of this study is to compare agricultural economics faculty choices of the same text bundles faced by students in the survey and assess their perceived barriers to multimedia adoption.

While there are barriers to multimedia adoption, benefits do accrue to instructors. These products, many of which are multimedia based products, provide additional instructional tools and teaching material to the instructor. In effect, these multimedia products provide the instructor with a "ready-to-teach" course. New instructors, or even seasoned instructors, who want to update an existing course can require these multimedia laden textbook bundles and significantly lower their start-up costs associated with preparing for a course. As an additional incentive, Fleming, Bazen, and Wetzstein (2005) found that instructors who taught in classrooms with multimedia technology (smart classrooms) had significantly higher teaching evaluations from students.

However, Becker and Watts (2001) found that economists are less likely than instructors

in other fields to use nonlecture teaching methods, reinforcing the image of economics as "the dismal science." In fact, 83% of the time, economics instructors use chalkboards in class instead of small group discussion, overheads, or PowerPoint slides. Nonetheless, a large body of literature exists on the efficacy of using experiments, with and without computers, to enhance economics instruction (Nelson and Beil, 1994, 1995; Nelson and Wilson, 2003). A survey by Barnett and Kriesel (2003) indicated 50% of agricultural economics instructors used experiments in class, but that increased use could be facilitated by giving instructors time and financial resources for teaching enhancement. Similar hurdles may exist for instructors who wish to use different electronic media in the classroom.

The results of the present study show that students prefer multimedia instructional tools be used in the classroom over a traditional chalkboard/whiteboard lecture format. Faculty members, however, do not share this enthusiasm for multimedia. Electronic textbooks serve as the one point of agreement for which both faculty members and students have a negative value. In other words, electronic textbooks must provide a significant amount of cost savings over traditional textbooks. For example, only if an electronic textbook saves students more than $80, will they prefer it over a traditional paper textbook. Given the interest shown by Congress in promoting electronic textbooks, these results suggest Congress' interest may not be in the students' best interest.

Methods to Assess Multimedia Demand

Student preferences for multimedia products used in the classroom could be determined by analyzing students' actual decisions to take courses that offer multimedia products rather than similar courses that do not offer multimedia products. Conceivably, course sections do exist that only differ by multimedia course materials, but it would be difficult to identify them since many instructors use the same or similar textbooks/course materials. Even if these different course sections could be identified, students' preferences for taking a particular multimedia section may be due to the instructor, scheduled class time, class size, or even immeasurable or unobservable factors, rather than the required multimedia course materials. It is also questionable whether differences in the use of multimedia across faculty members' courses are known prior to class enrollment. Finally, some attributes of multimedia products, such as the cost of course materials, might reflect both supply and demand forces thus making it difficult to isolate the effects of interest. To circumvent these problems, a survey instrument was designed to elicit students' stated preferences for multimedia products used in the classroom.

Conceptual Model and Conjoint Analysis

To conceptualize the i^{th} student's or instructor's decision to select the j^{th} course with stated multimedia course materials, an indirect utility function is employed; $U_{ij} = V_{ij} + \varepsilon_{ij}$, where U is the utility derived from the differing multimedia course materials, V is the systematic portion of the utility function and ε is the stochastic error component. The different multimedia course materials that provide utility are: electronic textbooks, Web-based study guides, electronic notes (e.g., PowerPoint), personal response systems (clickers or remotes), podcasts of lectures and/or class related topics, and in-class videos. Multimedia course materials are selected based on the increasing popularity of their use in the classroom and the considerable press coverage they receive (Carlson, 2005). The utility function above is estimated using conjoint analysis.

Conjoint analysis allows a researcher to assess the impact of many attributes on a single choice (Louviere, Hensher, and Swait, 2000). Since many factors influence students' preferences for multimedia course material, conjoint analysis provides a framework for estimating student and faculty demand for different multimedia types in a course. The particular conjoint analysis employed in this study is conjoint ranking. Although conjoint analysis has been used extensively in marketing and environmental studies, it has been rarely used in evaluating demand for educational attributes. In

fact, quantitative analysis of college level teaching and assessment has predominantly focused on determinants of achievement such as grade point average and retention of students (Boyer and Hickman, 2007; Fleming, 2002; Fleming and Garcia, 1998; Harackiewicz et al., 2002).

Two studies have used choice based experiments to estimate student demand for educational attributes. Mark, Lusk, and Daniel (2004) used conjoint analysis to estimate graduate student demand for program attributes in agricultural economics, finding that students value school quality over office and computer facilities. Dubas and Mummalaneni (2007) look at student preferences for visual aids in the business school classroom using conjoint ranking. They found that students prefer guest lecturers and visual aids to illustrate real world examples/experiences as opposed to a faculty member using visual aids to illustrate similar topics.

Survey Construction

To elicit student and faculty preferences for multimedia course materials a conjoint ranking survey was developed. Before ranking a set of hypothetical class scenarios, each student respondent was asked to imagine that they were enrolling in an entry level microeconomics or agricultural economics course. They were also asked to assume each available course was taught by skilled and likeable instructors, the same material was covered, the class size was appropriate, and each course fit their schedule. The only differences between each course or class scenario were the required course materials and the total cost.

A second survey was designed to elicit faculty preferences for choosing a text and multimedia bundle for teaching microeconomics. Faculty members were given a similar conjoint ranking question with the same attributes and levels randomly assigned to choice sets seen by students. However, faculty members and instructors were asked to imagine that they must choose a suite/bundle of textbooks and/or multimedia materials to teach an entry level microeconomics or agricultural economics course.

Table 1 lists the course materials, their associated attribute levels, and total costs for the course materials used for survey design. A total of six attributes are considered. Each attribute has two levels except for the total cost of the bundle. For example, the attribute "text" could be randomly assigned to a bundled scenario as electronic or paper. Total cost of the bundle, the final bundle, varies across eight levels from $50 to $225. Having each survey respondent rank all potential class scenarios of multimedia course ($2^6 \times 8 = 512$) materials is not feasible, so an orthogonal and efficient design was used to construct a conjoint ranking question consisting of three hypothetical class scenarios.[1] The design was constructed to allow estimation of both main and interaction effects.

Utility is estimated on a scale, which requires a baseline good where utility is normalized to some level, usually zero. Thus, a standard lecture format class scenario or status quo scenario was presented in each conjoint ranking question, the utility of which was normalized to zero (if price of the baseline class equals zero). A standard lecture format class consisted of a paper textbook and no multimedia products; however, the total cost of this scenario was allowed to vary across survey respondents. Therefore, each conjoint ranking question was constructed by randomly selecting three random class scenarios from the full-factorial (504 class scenarios $\times$ 503 class scenarios $\times$ 8 status quo scenarios). Lusk and Norwood (2005) demonstrated that this random assignment of profiles from the full-factorial both within and across profiles performs well in terms of efficiency of resulting willingness-to-pay estimates.

Student and faculty survey respondents were given two separate conjoint ranking questions and each question had a total of three hypothetical class scenarios. Each survey respondent then ranked each class scenario from one, the most preferred, to three, the least preferred.

[1] For clarity, we have prepared an appendix that contains a figure of an example conjoint ranking question each respondent answered (see Appendix Figure A1).

Table 1. Multimedia Course Materials and Levels for Class Scenarios

Course Materials	Possible Attribute Levels
Textbook	Electronic, paper
Study guide	Web-based, none
Class notes	Electronic format (e.g., PowerPoint), taken in class
Personal response system (clickers or remotes)	Yes, none
Podcasts of lectures and/or class related topics	Yes, none
Videos	In class to illustrate concepts, none
Total cost of materials in each scenario	\$50, \$75, \$100, \$125, \$150, \$175, \$200, \$225

Empirical Model

The ordinal rankings provided by students and faculty members are assumed to proxy latent utilities. These latent utilities are derived from the presented multimedia course materials and are estimated via the following random utility model:

$$
\begin{aligned}
V_{ij} = {} & \alpha_j + \beta_1 ElectronicTextbook_{ij} \\
& + \beta_2 WebStudyGuide_{ij} \\
& + \beta_3 PowerPointNotes_{ij} \\
& + \beta_4 Clickers_{ij} + \beta_5 Podcasts_{ij} \\
& + \beta_6 Videos_{ij} + \beta_7 Cost_{ij} + \varepsilon_{ij}
\end{aligned} \tag{1}
$$

where V_{ij} is the utility derived by the i^{th} student or instructor from the j^{th} class scenario. Alternative specific constants (α) are included to capture preferences for multimedia options by survey respondents who may prefer any option containing multimedia attributes but who may have no specific preference over which multimedia type or status quo bias. The β_n are coefficients to be estimated for the multimedia course materials and cost, as described in Table 1. Since the course materials are either multimedia or not, they are incorporated as dummy variables with 1 indicating the presence of the multimedia course material and 0 otherwise. It is assumed that students rank each class scenario from the one that provides the highest utility to the one that provides the lowest utility. From these responses, a rank-ordered logit model is implemented to estimate the probability that class scenario j will be ranked above class scenario k, where $j \neq k$.

Once the parameter estimates are obtained from the rank-ordered logit, the welfare implications of changes in multimedia course materials can be assessed. Given that the class scenarios varied across survey respondents and the specification of Equation (1), average student WTP estimates for each multimedia course material are obtained by taking the multimedia course material coefficient (β_n) divided by the negative of the marginal utility of income ($-\beta_7$).

Data

At the beginning of fall semester 2007, undergraduate students in agricultural, applied, and resource economics at Oklahoma State University, Purdue University, the University of Florida, and the University of Minnesota were surveyed. All students were e-mailed a cover letter describing the intentions of the survey and a Web link that would lead them to the aforementioned conjoint ranking survey. These universities were selected based on their varying degrees of multimedia use in the classroom, willingness to share their undergraduate e-mail listservs, and willingness to advertise the survey during their undergraduate classes once the e-mails had been sent. To further increase the response rate, all survey respondents were entered into a drawing to win an iPod. A total of 302 students provided useable responses to the Internet conjoint ranking survey, which resulted in a 23.3% response rate. Descriptive statistics of the survey respondents are provided in Table 2.

The average age of the student sample was 21 and the majority of those that responded to the survey were seniors (46.5%). Nearly half of the sample was female, 47%, and over 80% were white. Also, 83.1% of the sample respondents have taken the required introductory

Table 2. Descriptive Statistics and Use of Multimedia of Student Respondents

Variable	N	Mean	25th Percentile	50th Percentile	75th Percentile
Demographics					
Age in years	302	21.00	20.0	21.0	22.0
Female = 1, 0 otherwise	300	0.47			
Freshman = 1, 0 otherwise	301	0.14			
Sophomore = 1, 0 otherwise	301	0.12			
Junior = 1, 0 otherwise	301	0.27			
Senior = 1, 0 otherwise	301	0.47			
Race is white = 1, 0 otherwise	301	0.84			
Race is black = 1, 0 otherwise	301	0.03			
Race is Native American = 1, 0 otherwise	301	0.02			
Race is Hispanic = 1, 0 otherwise	301	0.06			
Race is other = 1, 0 otherwise	301	0.05			
I have taken the required introductory microeconomics or agricultural economics course for my major. 1 = yes, 0 otherwise	302	0.83			
Familiarity with multimedia course material					
Have used "clickers" in class = 1, 0 otherwise	302	0.48			
I own an iPod = 1, 0 otherwise	301	0.49			
I have watched a podcast = 1, 0 otherwise	301	0.37			
I own a computer = 1, 0 otherwise	301	0.99			

Note: A total of 87 respondents were from Oklahoma State University, 104 respondents were from Purdue University, 86 respondents were from the University of Florida, and 25 respondents were from the University of Minnesota.

microeconomics or agricultural economics course for their major. A set of questions were asked to assess the students' familiarity with and use of multimedia course materials, primarily the "new age" materials. Approximately half of the survey sample has used clickers in class and own an iPod. Fewer individuals have watched a podcast (36.5%). Ninety-nine percent of students own a computer.

Faculty members and instructors of undergraduate agricultural, applied, and resource economics departments received a modified version of the student Internet conjoint ranking survey that used the same randomized conjoint ranking questions, but also solicited opinions about selecting course content and additional demographic characteristics including age, gender, race, and university class rank. Faculty members' e-mail addresses were selected from departmental Web sites and the Agricultural and Applied Economics Association teaching section. In total, 191 faculty members and instructors responded for a 20.7% response rate. Descriptive statistics of the faculty are provided in Table 3.

In the faculty sample, the average age was 47.24 years and 79% of respondents were male. The majority of respondents (94%) are in tenure track positions. An overwhelming percentage of the faculty use lecture notes on PowerPoint (93%) and have electronic handouts of PowerPoint slides (89%). Although 64% of respondents have used videos in class at some time, other types of multimedia are less common: faculty members have used laptops (40%), electronic study guides (25%), electronic textbooks (20%), Personal Response Systems or clickers (15%), and podcasts (10%).

Given that faculty adoption of multimedia in the classroom varies within our sample, what is the primary impediment that prevents or limits adoption? As shown in Table 3, faculty instructors chose "time to learn the methodology" (38%) and "teaching is not as important as other duties such as research and extension" (14%) as the primary constraints. The latter response may reflect faculty members' appointments that are not teaching focused and may also include the perception by some faculty members that some

Table 3. Descriptive Statistics and Use of Multimedia of Faculty Respondents

Variable	N	Mean	25th Percentile	50th Percentile	75th Percentile
Age	146	47.24	39.00	48.50	55.00
Female	133	0.21			
Graduate instructor/lecturer	146	0.05			
Adjunct professor	146	0.01			
Assistant professor	146	0.16			
Associate professor	146	0.29			
Professor	146	0.49			
Have you ever used the following multimedia tools as part of any class for which you served as an instructor?					
Personal response system (clickers)	146	0.15			
Podcasts	146	0.10			
Lecture notes on PowerPoint	146	0.93			
Electronic handouts of PowerPoint slides	146	0.89			
Electronic study guides	146	0.25			
Videos	146	0.64			
Electronic textbooks	146	0.20			
Laptops	146	0.40			
What do you think is the most important impediment to faculty that prevents or limits the adoption of multimedia in the classroom? (select one)					
Time to learn methodology	146	0.38			
Funding to implement technology	146	0.19			
Lack of technical support for using the technology	146	0.12			
Investing in teaching is not as important as other duties (i.e., research or extension)	146	0.14			
Other	146	0.17			

universities do not emphasize or financially reward innovation and investment in teaching relative to research and extension activities. Some instructors also chose funding to implement technology (19%) and lack of technical support (12%) as their biggest barriers. Finally, 17% of the faculty chose "other" reasons for limiting adoption of multimedia in the classroom. Faculty members may never adopt these technologies unless they feel they are given time and resources to learn and to innovate in teaching and unless institutions subsidize these technologies in the classroom.

Deciding whether to implement multimedia in the classroom and selecting a package of required materials for a course, multimedia or not, involves balancing the needs of the instructor and students. Table 4 shows faculty responses to these decisions on multimedia use and classroom instruction on a Likert-scale from 1 being completely disagree to 7 being completely agree. Faculty members answered slightly higher than neutral, 4.3 on average, that multimedia use in and outside of the classroom (beyond PowerPoint slides) is important for helping students learn the material. Price of the textbook package was next important when selecting course required materials, but content of the textbook package was clearly the most important factor when selecting required course materials since the majority of the faculty respondents rated this higher than neutral.

Table 4 also presents faculty and student responses to Likert-scale questions regarding

Table 4. Student and Faculty Opinions about Instruction (scale is 1 = completely disagree; 7 = completely agree)

Statement to Disagree or Agree with:	Sample	Mean	25th Percentile	50th Percentile	75th Percentile	Wilcoxon Signed Rank Test
Multimedia use in and outside of the classroom (beyond PowerPoint slides) is important for helping students learn the material.	Faculty	4.3	4.0	5.0	5.0	—
The price of the textbook package is important to me when selecting required course materials.	Faculty	5.1	4.0	5.0	6.0	—
Content of the textbook package is important when selecting required course materials.	Faculty	5.5	5.0	6.0	6.0	—
For me to be able to understand the material being taught, it is important that the class be engaging	Student	6.0	5.0	6.0	7.0	−2.33[a]
For students to be able to understand the material being taught, it is important that the class be engaging	Faculty	6.4	6.0	7.0	7.0	—
I prefer microeconomics course material and lectures to be presented predominantly using a whiteboard or chalkboard	Student	4.3	3.0	4.0	6.0	2.88[b]
I prefer to present microeconomic course material and lectures predominantly using a whiteboard or chalkboard	Faculty	3.9	2.0	4.0	5.0	—

[a] Indicates statistical significance at the 1% level between students and faculty relative to the importance of an engaging class to learning.

[b] Indicates statistical significance at the 1% level between students and faculty relative to predominately presenting material on a whiteboard/chalkboard.

their preferences for delivering course material. Both the faculty and students strongly agree that an engaging class is important for students to understand the material being taught. While both strongly agree, student median statements were lower than those of faculty members and the difference was statistically significant according to the Wilcoxon signed rank test. For a class to be engaging, multimedia may or may not be needed. Some faculty members and students prefer course material, and in particular microeconomics course material, to be delivered through a standard chalkboard format. On average, the student sample showed a stronger preference for a chalkboard lecture format than the faculty sample. The range of student responses presented by percentile in Table 4 also shows that there are a variety of learning styles within the sample. At the 50th percentile, students are neutral about the statement that lectures should be presented predominantly on the chalkboard.

Results

Rank-ordered logit estimates for all student and faculty respondents are reported in Table 5. Student and faculty parameter estimates are similar in terms of sign but statistical significance differs. Most student parameter estimates are significant at the 1% level, but few faculty parameter estimates are statistically significant. The alternative specific constants show that on average students preferentially choose scenarios A and B which always included at least one multimedia attribute over option C, the standard or traditional classroom learning environment without multimedia. Faculty members and

Table 5. Rank-Ordered Logit Results for Multimedia Course Materials for Students and Faculty Members

Multimedia Course Materials	Level	Parameter Estimates	
		Student	Faculty
Constant[a]	Multimedia scenario 1	0.417*** (0.150)	0.144 (0.220)
	Multimedia scenario 2	0.472*** (0.152)	0.370 (0.228)
Textbook	Electronic	−0.723*** (0.102)	−0.657*** (0.149)
Study guide	Web-based	0.556*** (0.104)	0.210 (0.149)
Class notes	Electronic format (e.g., PowerPoint)	0.404*** (0.106)	0.244* (0.147)
Personal response system (clickers or remotes)	Yes	−0.084 (0.103)	0.070 (0.146)
Podcasts of lectures and/or class related topics	Yes	0.166* (0.101)	−0.197 (0.146)
Videos	In class to illustrate concepts	0.276*** (0.105)	0.113 (0.146)
Total cost of materials in each scenario	In dollars	−0.009*** (0.001)	−0.009*** (0.001)

Notes: Numbers in parentheses are standard errors.
Number of observations for students = 604 (302 respondents × 2 rankings). Log likelihood −924.921.
Number of observations for faculty = 292 (191 respondents × 2 rankings). Log likelihood −464.917.
[a] Alternative specific constants are for the two multimedia scenarios, which contained various combinations of multimedia attributes. The third scenario or status quo scenario was the base scenario with no multimedia attributes.
Significance levels are represented by *** and * for 1% and 10%, respectively.

instructors, however, do not choose or avoid multimedia on average as shown by the insignificant alternative specific constants for options A and B.

One important point of agreement between the faculty and students is a dislike for electronic textbooks. Not only do students require a substantial cost savings to approve the replacement of traditional textbooks with electronic textbooks, but faculty members would have to observe this cost savings before they would approve of such a change in their classes. While electronic textbooks could certainly reduce textbook costs, the relevant question is whether the cost reduction is large enough to justify textbooks in electronic form. Another point of agreement between the faculty and students is a preference for notes provided in electronic format over notes taken in class.

Student Willingness-to-Pay for Multimedia Course Material

Although faculty members and instructors determine the supplemental multimedia materials used for a class, it is the student that must ultimately pay for the material costs. Therefore, the discussion focuses on calculating student willingness-to-pay for multimedia course material. Table 6 presents the WTP estimates for multimedia course materials and their Krinsky-Robb bootstrapped 95% confidence intervals for the hypothetical introductory microeconomics or agricultural economics class.

Instructors considering switching to an electronic textbook should seriously consider students' negative $80 WTP for such textbooks. This negative WTP illustrates that students would reject an electronic textbook over a paper textbook *unless* it provides significant savings for the entire bundle of required materials of $80 or more. Electronic textbooks may be able to lower textbook costs, but this result shows the savings would have to be large.

Students are willing to pay $62 for a Web-based study guide relative to having no study guide. While not measured here, students may also be willing to pay for study guides in hard copy. It was previously mentioned that study

Table 6. Student Willingness-to-Pay Estimates for Multimedia Attributes in the Classroom

			Subsamples					
WTP for	Relative to	All Student Respondents	Male	Female	Have Used Clickers	Have Not Used Clickers	Have Watched A Podcast	Have Not Watched A Podcast
Electronic textbook	Paper textbook	−$80 [−$109, −$62]	−$49 [−$73, −$24]	−$172 [−$254, −$109]	−$87 [−$122, −$56]	−$87 [−$117, −$55]	−$83 [−$123, −$47]	−$76 [−$109, −$55]
Web-based study guide	No study guide	$62 [$45, $87]	$45 [$22, $69]	$116 [$62, $172]	$72 [$43, $104]	$60 [$30, $90]	$87 [$55, $125]	$48 [$27, $79]
Electronic class notes (e.g., PowerPoint)	Notes taken in class	$45 [$26, $69]	$53 [$27, $77]	$43 [$1, $86]	$38 [$9, $69]	$60 [$28, $92]	$47 [$18, $88]	$41 [$21, $74]
Personal response system (clickers or remotes)	No personal response system	−$9 [−$30, $10]	−$8 [−$28, $15]	−$17 [−$57, $21]	$4 [−$23, $30]	−$24 [−$52, $7]	−$13 [−$41, $20]	−$7 [−$29, $20]
Podcasts of lectures and/or class related topics	No podcasts	$18 [$0, $38]	$31 [$9, $54]	$9 [−$32, $47]	$3 [$−23, $28]	$37 [$8, $64]	$34 [$5, $67]	$6 [−$18, $32]
In-class videos to illustrate concepts	No in-class videos	$31 [$11, $55]	$34 [$9, $56]	$38 [−$4, $79]	$47 [−$10, $46]	$19 [−$10, $46]	$11 [−$24, $43]	$42 [$16, $67]
Number of observations		604	318	282	292	312	220	384

Note: Numbers in brackets are 95% confidence intervals of mean WTP calculated by Krinsky-Robb bootstrapping method.
Each respondent provided two rankings or observations.

guides have been partly blamed for the increase in textbook costs. Given that students clearly value such supplements, this cost increase may not be harmful to the student.

Similar to study guides, students and faculty members on average value electronic class notes over having students take their own notes in class. Potentially, students value being able to have the notes as a reference for studying later and enjoy being able to add their own set of notes to a preexisting set of notes. Arguably this allows students more time to focus on the lecture and pick up additional material that would have otherwise been missed. However, some may speculate that today's students may just like not having to pay attention in class because they know the notes are already completed and they are willing to pay for it. Anecdotal evidence obtained through the comments from the student and faculty surveys suggests students do value faculty members who use PowerPoint or other electronic notes and who make them easily accessible. As stated earlier, 89% of the faculty report that they already provide PowerPoint handouts, so unsurprisingly they have already responded to student demand as a result of experience.

Even though a lot of attention has been focused on personal response systems or clickers, students in our sample do not show a significant WTP for clickers since the WTP measure, at the 95% confidence interval, includes zero. Podcasts are another multimedia tool that is gaining popularity. Yet, while the average WTP is a positive $18, the bottom 5th percentile is $0.22 (the table rounds to $0). A standard multimedia source used in the classroom, the video news clip, education video, or movie, defined as an in-class video to illustrate concepts, had a statistically significant WTP of $31, which is more than clickers or podcasts or the other "new age" multimedia course materials.

Understanding the average WTP for all of the data are insightful, but it does not illustrate how students differ in their familiarity with multimedia, learning styles, and motivation to learn material in class. These differences could certainly affect their demand for multimedia. Therefore, Table 6 presents a number of subsamples taken from the student responses to capture these differences. The WTP estimates are calculated by estimating separate rank-ordered logit models for each subsample. All rank-ordered logit models estimated to capture the heterogeneity in the sample are presented in the appendix.

All subsamples have a statistically significant and negative WTP for electronic textbooks. However, males have a higher WTP for electronic textbooks than females and this difference is statistically significant. Interestingly, these comparable WTP estimates (i.e., male/female, have used clickers/have not used clickers, have watched a podcast/have not watched a podcast) are the only WTP estimates that were statistically different in all subsamples.[2] Those that have used clickers do have a positive WTP but that estimate is not statistically different from zero. Potentially, these students have used clickers in a classroom but felt they did not enhance their learning. Having watched a podcast does increase the WTP point-estimate for podcasts of lectures to $34, but this estimate is not statistically different from the WTP estimate for podcasts for those that have not watched a podcast.

Many faculty members in our sample, and arguably most undergraduate instructors across the United States, use PowerPoint or electronic notes as a source of multimedia in their course. Using electronic notes may also serve as a substitute for a textbook, thus lowering the cost of course materials to a student. These are appealing advantages to electronic notes, but critics of electronic notes or PowerPoint often cite they can lead to rushed presentation of material, less discussion with students, and fewer digressions from the material given on screen (Nowaczyk, Santos, and Patton, 1998).

[2] Many students pay for textbooks using scholarships, loans, parents, etc. The survey did ask students to state how they paid for their textbooks because paying for textbooks from another income source other than their own may impact the marginal utility of income. WTP estimates based on creating a subsample of other income sources were not statistically different from those students that pay for their textbooks out of their own income.

To explore these opposing views in the context of WTP for electronic notes, additional rank-ordered logit models were estimated where responses to the aforementioned Likert-scale questions were interacted with all of the multimedia attributes (see Appendix, Table A1 for model estimates). In addition, students stated on a scale from 1 to 7 whether they completely disagreed (scale = 1) and completely agreed (scale = 7) with a question about how good they are at taking notes, the mean and median were 5.3 and 6, respectively. This question was also interacted with all of the multimedia attributes in a rank-ordered logit model. The only statistically significant difference in the WTP estimates for multimedia attributes across these three questions was for electronic notes.

Figure 1 shows the difference in demand for electronic notes across the Likert-scale questions (see Appendix Table 2 for Model results with Interaction Effects). Students who report they are good at taking notes are willing to pay much less than those who self-report they are poor note takers. These students' beliefs (note taking ability) make a priori sense with their preferences for electronic notes. Students who prefer chalkboard lectures (completely agree = 7) would need to be compensated in some form to accept electronic notes, whereas students who dislike chalkboard lectures are willing to pay over $100 for electronic notes. Finally, students who strongly agree that an engaging class helps them learn are willing to pay less for electronic notes. This could suggest that one feature of an engaging class is note taking.

Conclusions and Recommendations

There has been much enthusiasm for multimedia tools in the academic literature and on campus among faculty members who seek to potentially improve their teaching and to engage students. The current cohort of undergraduates, the "Gen Next" students up to the age of 28, is more technology savvy than any generation before (Taylor, 2006). A 2006 Pew survey found: "Their embrace of new technology has made them uniquely aware of its advantages and disadvantages." (Pew Research Center, 2007)

The results of this research show that students may not be *fully* prepared to finance the multimedia classroom as anecdotal evidence of the "Gen Next" assumes. Although students

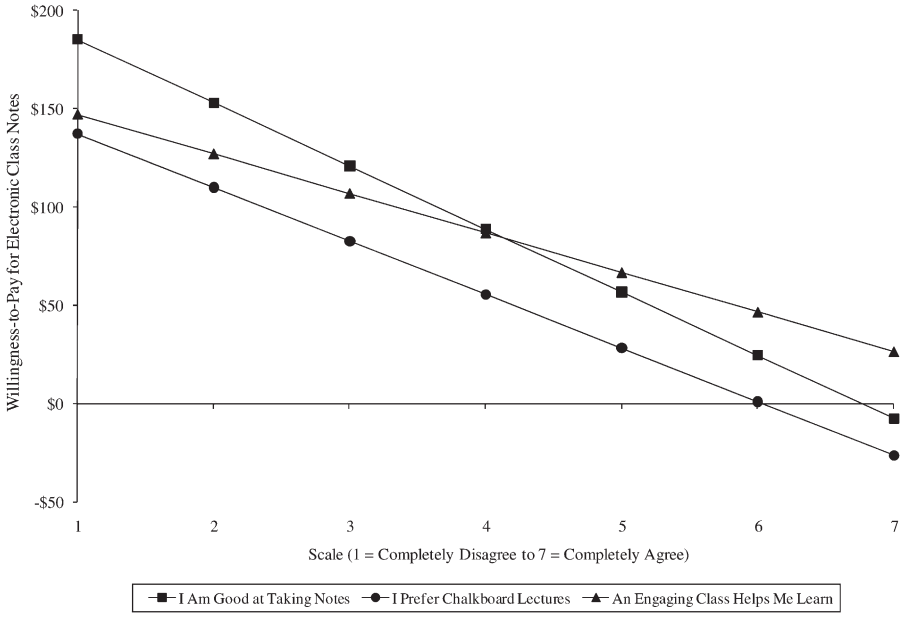

Figure 1. Statistically Significant Student Willingness to Pay for Electronic Notes by Note Taking Ability, Lecture Style, and Engagement

value certain types of multimedia used in the classroom, they are not willing to pay for all types. Web-based study guides, electronic notes, and in-class videos were significantly valued by students and, to a certain degree, these multimedia tools have been in use for many years in many classrooms across the nation (Engle, 2007).

The multimedia tools not valued by students were electronic texts, clickers, and podcasts. These three multimedia tools are relatively new compared with the three significantly valued multimedia tools and have received a lot attention in the media and on college campuses. Even Congress has considered the use of electronic texts as a potential way to lower the rising costs of textbooks. The results clearly demonstrate that electronic texts are not valued by students since the WTP estimates were negative and statistically significant. However, students will accept electronic texts if they are offered at a drastic savings over current paper text prices. In a sense, it is not surprising that electronic texts are inferior to paper texts in students' eyes since student demand for used texts is high and used books comprise 25 to 30% of the total text market (Government Accountability Office, 2005). Although clickers are anecdotally popular with students when used well in class, the results show that students are unwilling to incur these costs voluntarily as part of a textbook package. Furthermore, the wide interval on podcasts shows that students have mixed experiences with the use of these materials in class.

Our results demonstrate that on average across the four schools sampled, students like textbooks they can hold in their hand and are not impressed with clickers or podcasts. Faculty members interested in adopting these two technologies may want to consider keeping the costs of such instruments low by spreading the costs over multiple class sections or paying for them using technology fees, where the cost to the student is less obvious. Universities can help to control student costs for items such as clickers by promoting a common technology, which allows students to purchase one device for several classes.

At a time of increasing demands on faculty members' time and dwindling budgets at universities, widespread adoption of new multimedia technology, and adaptation of class material to its use, faces significant hurdles. First, faculty members must find the time and financial resources to learn and implement the technology in ways that enhance student learning. Second, they must have classrooms capable of using these resources and the technical support to handle issues as they arise. Thirty-one percent of the faculty listed funding or lack of technical support as their primary barrier to adoption. At the minimum, faculty members need upgraded facilities and the appropriate technical support to operate them. Third, faculty members must also feel that innovation in teaching and investment in teaching are rewarded by their institution. Fifty-two percent of the faculty cite "time to learn the methodology" or that other duties were emphasized over teaching as the primary impediment. Ideally, universities can support faculty investment in learning and designing courses to effectively use multimedia through funding for travel to teaching seminars, course reductions while testing new course formats, and grants for course development.

Clearly, technology in the classroom should not be used for technology's sake alone (i.e., as a gimmick). Multimedia technology should be appropriate for the task. For example, PowerPoint lectures can enhance learning, but also can be used to rush material or result in a passive learning environment. Ideally, clickers can be used by faculty members to elicit real time feedback during lecture to see if students understand the concept just covered or to stimulate discussion. However, if clickers serve simply to take attendance and quiz students, they do not necessarily add more to a course than traditional roll call and paper handouts. Faculty members must also be mindful that class and students' time constraints will dictate how much material students can assimilate in any form, including podcasts or extra written chapters. Therefore, it is unlikely that all faculty members will use every possible form of electronic media in one class.

Ultimately, faculty members will choose texts and technologies best suited for the course content, size, and their own teaching style, so not all types of technology will suit all courses. Demand for these products, while consistent in direction among groups, differs in scale among students of different demographic groups, academic levels of performance, and learning experiences. The success of different technologies will depend on student engagement, which will involve more investment integrating technology with active learning. Inevitably a greater percentage of the faculty will adopt the newer multimedia forms over time, and perhaps other types of technology, but the pace of that adoption will depend on faculty and institutional investment in teaching and students' increased willingness to pay. Contrary to popular belief, traditional chalkboard and paper texts still have a place with economic students in the classroom.

[Received September 2008; Accepted February 2009.]

References

Barnett, B.J., and W. Kriesel. "Agricultural Economists' Use of Classroom Economic Experiments." *Journal of Agricultural and Applied Economics* 35(2003):321–35.

Becker, W.W., and M. Watts. "Teaching Economics at the Start of the 21st Century: Still Chalk and Talk." *New Research in Economic Education* 91(2001):446–51.

Boyer, T., and K.R. Hickman. "Do High School Study Habits Matter for First-Semester College Performance? Predicting Success Using Various Measures of Academic Preparation." *Journal of North American College Teachers of Agriculture Journal* 51(2007):50–55.

Carlson, S. "The Next Generation Goes to College." *The Chronicle of Higher Education* 52(2005): A34.

Carnevale, D. "Run a Class Like a Game Show: "Clickers" Keep Students Involved." *The Chronicle of Higher Education* 51(2005):1.

Dahlgran, R.A. "Teaching Innovations in Agricultural Economics: An Economic Approach." *American Journal of Agricultural Economics* 72(1990):873–82.

Dubas, K.M., and V. Mummalaneni. "Self-Explicated and Full-Profile Conjoint Methods for Designing Customer-Focused Courses." *Marketing Education Review* 7(2007):35–48.

Engle, R.L. "Digital Multimedia and the Teaching of Cross-Cultural Business Practices." *International Business Research*, *Teaching and Practice* 1(2007):87–96.

Fleming, J. "Who Will Succeed in College? When the SAT predicts Black Students' Performance." *Review of Higher Education* 25(2002):281–96.

Fleming, J., and N. Garcia. "Are Standardized Tests Fair to African Americans? Predictive Validity of the SAT in Black and White Institutions." *The Journal of Higher Education* 25(1998):281–96.

Fleming, R.A., E.F. Bazen, and M.E. Wetzstein. "Measuring the Impact of Externalities on College of Agriculture Teaching Evaluations." *Journal of Agricultural and Applied Economics* 37,3(2005):635–45.

French, D.P. "I Pods: Informative or Invasive?" *Journal of College Science Teaching* 36(2006): 58–59.

Government Accountability Office. "College Textbooks: Enhanced Offerings Appear to Drive Recent Price Increases." *Report to Congressional Requesters GAO; 05-906* (2005). Internet site: http://www.gao.gov/new.items/d05806.pdf (Accessed January 28, 2009).

Harackiewicz, J.M., K.E. Barron, J.M. Tauer, and A.J. Elliot. "Predicting Success in College: A Longitudinal Study of Achievement Goals and Ability Measures as Predictors of Interest and Performance from Freshman Year through Graduation." *Journal of Educational Psychology* 94(2002):562–75.

Kennedy, P.E. "Using Monte Carlo Studies for Teaching Econometrics." *Teaching Undergraduate Economics: Alternatives to Chalk and Talk*. W.E. Becker and M. Watts, eds. Aldershot, U.K.: Edward Elgar, 1998.

Kozma, R.B., and J. Russell. "Multimedia and Understanding Expert and Novice Responses to Different Representations of Chemical Phenomena." *Journal of Research in Science Teaching* 34(1997):949–68.

Lipka, S. "Experts Discuss Textbook Costs." *The Chronicle of Higher Education* 53,41(2007): A39.

Louviere, J.J., D.A. Hensher, and J.D. Swait. *Stated Choice Methods: Analysis and Application*. Cambridge: Cambridge University Press, 2000.

Lusk, J.L., and F.B. Norwood. "Effect of Experimental Design on Choice-based Conjoint

Valuation Estimates." *American Journal of Agricultural Economics* 87(2005):771–85.

Mark, D.R., J.L. Lusk, and M.S. Daniel. "Recruiting Agricultural Economics Graduate Students: Student Demand for Program Attributes." *American Journal of Agricultural Economics* 86(2004):175–84.

Mayer, R.E. *Multimedia Learning*. Cambridge: Cambridge University Press, 2001.

Murray, M.P. "Econometrics Lectures in a Computer Classroom." *The Journal of Economic Education* 30(1999):308–21.

Nelson, R.G., and R.O. Beil, Jr. "A Classroom Experiment on Oligopolies." *Journal of Agricultural and Applied Economics* 27(1995): 263–75.

——— "When Self Interest is Self-Defeating: The Public Goods Experiment as a Teaching Tool." *Journal of Agricultural and Applied Economics* 26(1994):580–90.

Nelson, R.G., and N.L.W. Wilson. ""It's for Teaching, not Believing": Comments on Teaching, Learning and Problem Solving Through Economic Experiments." *Journal of Agricultural and Applied Economics* 35(2003): 361–70.

Nowaczyk, R.H., L.T. Santos, and C. Patton. "Student Perception of Multimedia in the Classroom." *International Journal of Instructional Media* 25(1998):367–82.

Pew Research Center. "How Young People View Their Lives, Futures, and Politics: A Portrait of "Generation Next." *Pew Research Center Report* (January 9, 2007). Internet site: http://people-press.org/reports/pdf/300.pdf (Accessed February 6, 2009).

Reay, N.W., P. Li, and L. Bao. "Testing a New Voting Machine Question Methodology." *American Journal of Physics* 76(2008):171–78.

Stone, L. "Multimedia Instruction Methods." *The Journal of Economic Education* 30(1999):265–75.

Taylor, M.L. "Generation Next Comes to College: 2006 Updates and Emerging Issues." *A Collection of Papers on Self-Study and Institutional Improvement, Volume 2*. Chicago, IL: The Higher Learning Commission, 2006.

Trees, A.R., and M. Jackson. "The Learning Environment in Clicker Classrooms: Student Processes of Learning and Involvement in Large University-Level Courses Using Student Response Systems." *Learning, Media and Technology* 32(2007):21–40.

Appendix Table 1. Rank-Ordered Logit Results for Multimedia Course Materials for Students by Subsamples

Multimedia Course Materials	Level	Subsamples					
		Male	Female	Have Used Clickers	Have Not Used Clickers	Have Watched a Podcast	Have Not Watched a Podcast
Constant[a]	Multimedia scenario 1	0.293 (0.213)	0.558 (0.219)	0.527** (0.215)	0.305 (0.213)	0.701*** (0.271)	0.29 (0.182)
	Multimedia scenario 2	0.263 (0.208)	0.705 (0.228)	0.480** (0.223)	0.453** (0.211)	0.762*** (0.268)	0.325* (0.187)
Textbook	Electronic	−0.493*** (0.141)	−1.034*** (0.154)	−0.785*** (0.148)	−0.694*** (0.143)	−0.751*** (0.175)	−0.687*** (0.127)
Study guide	Web-based	0.448*** (0.143)	0.701*** (0.155)	0.651*** (0.155)	0.481*** (0.140)	0.781*** (0.176)	0.428*** (0.129)
Class notes	Electronic format (e.g. PowerPoint)	0.527*** (0.147)	0.257* (0.156)	0.346** (0.152)	0.480*** (0.149)	0.420** (0.183)	0.373*** (0.130)
Personal response system (clickers or remotes)	Yes	−0.081 (0.144)	−0.103 (0.151)	0.034 (0.146)	−0.19 (0.148)	−0.12 (0.170)	−0.06 (0.131)
Podcasts of lectures and/or class related topics	Yes	0.308** (0.138)	0.054 (0.151)	0.027 (0.147)	0.299** (0.140)	0.308* (0.171)	0.057 (0.126)
Videos	In class to illustrate concepts	0.335** (0.147)	0.226 (0.154)	0.427*** (0.154)	0.152 (0.146)	0.097 (0.183)	0.376*** (0.130)
Total cost of materials in each scenario	In dollars	−0.01 (0.001)	−0.006*** (0.001)	−0.009*** (0.001)	−0.008*** (0.001)	−0.009*** (0.001)	−0.009*** (0.001)
Log likelihood		−476.44	−434.558	−437.214	−483.282	−318.2105	−600.9016
Number of observations		318	282	292	312	220	384

Note: Numbers in parentheses are standard errors.

[a] Alternative specific constants are for the 2 multimedia scenarios, which contained various combinations of multimedia attributes. The third scenario or status quo scenario was the base scenario with no multimedia attributes.

Significance levels are represented by *** and * for 1% and 10%, respectively.

Appendix Table 2. Rank-Ordered Logit Results with Interaction Terms for Multimedia Course Materials

			Interacted Parameter Variables (IPVs)		
Multimedia Course Materials	Level	Base Model (no interactions)	I Prefer Chalkboard Lectures[b]	I Am Good at Taking Notes[b]	An Engaging Class Helps Me Learn[b]
Constant[a]	Scenario A	0.417***	0.429***	0.407***	0.427***
	Scenario B	0.472***	0.506***	0.478***	0.488***
Textbook	Electronic	−0.723***	−0.542*	−0.698*	−0.723
Study guide	Web-based	0.556***	0.634**	0.190	−0.001
Class notes	Electronic format (e.g. PowerPoint)	0.404***	1.480***	1.956***	1.506***
Personal response system (clickers or remotes)	Yes	−0.084	0.394	0.403	−0.858*
Podcasts of lectures and/or class related topics	Yes	0.166*	0.402	0.575	0.857*
Videos	In class to illustrate concepts	0.276***	0.095	0.687*	−0.106
Total cost of materials in each scenario	In dollars	−0.009***	−0.009***	−0.009***	−0.009***
Multimedia Course Materials - Descriptive Variable Interactions			Interaction Term Coefficients (Multimedia Course Materials × IPV)		
Textbook	Electronic	NA	−0.051	−0.005	0.001
Study guide	Web-based	NA	−0.013	0.068	0.090
Class notes	Electronic format (e.g. PowerPoint)	NA	−0.245***	−0.289***	−0.181**
Personal response system (clickers or remotes)	Yes	NA	−0.114*	−0.093	0.128
Podcasts of lectures and/or class related topics	Yes	NA	−0.052	−0.074	−0.114
Videos	In class to illustrate concepts	NA	0.047	−0.074	0.063
Number of observations		604	602	604	602

Note: Standard errors are suppressed because of table size.
Each respondent provided two rankings or observations.
[a] Alternative specific constants are for the 2 multimedia scenarios, which contained various combinations of multimedia attributes. The third scenario or status quo scenario was the base scenario with no multimedia attributes.
[b] Interaction variable is a scale variable where 1 = Completely Disagree to 7 = Completely Agree with the statement.
Significance levels are represented by ***, ** and * for 1%, 5% and 10%, respectively.

Please rank the class scenario you most prefer 1, prefer next 2, and prefer least 3.			
Required Course Materials	Class Scenario A	Class Scenario B	Class Scenario C
Textbook	Paper	Paper	Paper
Study Guide	Web-Based	None	None
Class Notes	Electronic Format (e.g. PowerPoint)	Taken in Class	Taken in Class
Personal Response System (Clickers or Remotes)	None	Yes	None
Podcasts of Lectures and/or Class Related Concepts	None	Yes	None
Videos	In Class to Illustrate Concepts	In Class to Illustrate Concepts	None
Total Cost of Materials in Each Scenario	$225.00	$100.00	$50.00
Please rank the scenarios from most preferred (1) to least preferred (3)	--	--	--

Figure A1. Example of a Conjoint Ranking Question (This is an example of a conjoint ranking question presented to the student and faculty respondents. In Figure 1, class scenario A and class scenario B are the class scenarios that contain the various multimedia required course materials while class scenario C is the status quo scenario. Each respondent would then click on the drop down box and provide a unique ranking to each class scenario with 1 as the most preferred and 3 as the least preferred.)