Demand for Multimedia in the Classroom: Do Students and Faculty Really Want it All?

Tracy Boyer
Assistant Professor – Oklahoma State University

Brian C. Briggeman (contact author)
Assistant Professor – Oklahoma State University
317 Agricultural Hall
Stillwater, Oklahoma 74078
Phone: (405) 744-6171
Fax: (405) 744-8210
brian.briggeman@okstate.edu

F. Bailey Norwood
Associate Professor – Oklahoma State University

Selected paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Orlando, FL, July 27 – July 30, 2008

Senior authorship is not assigned.

Acknowledgements: The authors would like to thank the following individuals for their help: Edwin Miller, Associate Dean of Academic Programs, College of Agricultural Sciences and Natural Resources, Oklahoma State University; Joe Schatzer, Undergraduate Coordinator, Agricultural Economics, Oklahoma State University.; Kirby Barrick, Dean of College of Agricultural and Life Sciences, University of Florida; Lisa House, Undergraduate Coordinator, Food and Resource Economics, University of Florida; Frances Homans, Undergraduate Coordinator, Applied Economics, University of Minnesota; Frank Dooley, Undergraduate Coordinator, Agricultural Economics, Purdue University; and Steve Gilliand, Research Assistant, Oklahoma State University.

Soaring prices of college textbooks have prompted backlash from universities and students. Even the federal government has taken notice of these price increases. The United States Government Accountability Office (GAO) conducted a study in 2005 wherein they report that college textbook prices have increased a staggering 186 percent since 1986. This price increase is more than double the overall price inflation for the same time period, 72 percent. Today, the majority of new textbooks cost approximately $120 and most science and math textbooks reach $180 (Granoff 2007). Many popular microeconomics and introduction to agricultural economics textbooks fall into this price range. A popular corporate finance textbook, which is used by business and agribusiness professors, recently released its newest edition at the astonishing price of $150..

Several reasons are cited by the GAO study why new textbook prices have significantly increased. 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, on average, publishers are revising textbooks one year earlier than they would have ten years ago. Finally, the most intriguing reason why textbook prices have increased according to the GAO study is 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.

Even though bundling supplemental products with standard textbooks increases the price, benefits do accrue to instructors. These products, many of which are multimedia based products, provide instructional tools and teaching material to the instructor. In effect, these multimedia products provide an instructor a "ready-to-teach" course. New instructors or even seasoned instructors wanting to update an existing course can require these textbooks and significantly lower their start-up costs associated with preparing for a course. Another advantage of these bundled products is that using multimedia in the classroom is a way for an instructor to connect with today's student (Carlson 2005). While the potential advantages of using multimedia in the classroom are appealing to an instructor, one important question has not been addressed – are students willing to pay for these additional multimedia products?

Undoubtedly, students are paying more for their textbooks but are these extra costs somehow warranted. For example, 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 are these extra costs not acceptable? To further support this argument, the extant literature clearly demonstrates using multimedia in the classroom enhances learning. A rich and extensive body of literature exists on the learning benefits provided to students through multimedia use in the classroom. An excellent summary of this literature is provided by Mayer (2001). In addition, Mayer provides numerous examples of how multimedia enhances student learning in the classroom.

Since multimedia enhances learning, potentially there are ways to capture this benefit and use multimedia products to actually lower the costs of textbooks instead of increasing them. Lipke (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. If students are *not* willing to pay for additional multimedia products, then instructors should rethink the "ready-to-teach" course that may be more expensive and not valued by students.

The objective of this paper is to determine students' willingness-to-pay (WTP) for traditional lecture materials versus supplemental multimedia products. To date, little empirical research exists on whether students value the suite of multimedia products being offered.[1] Eliciting student's 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 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.

The results clearly demonstrate that on average, students prefer multimedia instructional tools be used in the classroom over a traditional chalkboard/whiteboard

lecture format. This result did not hold for all multimedia instructional tools considered. Most notably, electronic textbooks yielded a $0 WTP indicating students do not value electronic textbooks. There has been much discussion and adoption of clickers in classrooms across the nation yet; the WTP for clickers by students in the survey was not significant. Since many students prefer multimedia instructional tools over traditional instructional methods and a wealth of literature shows that multimedia does enhance learning (Carnevale 2005, French 2006, Trees 2007), it would behoove instructors and departments in agricultural economics to strongly consider integrating this into their classrooms and curriculum.

Methodology

Student preferences for multimedia products used in the classroom could be determined by analyzing students' actual decision to take a course that offers multimedia products rather than a similar course that does not offer multimedia products. Conceivably, course sections do exist that only differ on 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 the 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. Finally, some attributes of multimedia products, such as 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

controlled experiment was designed to elicit students' stated preferences for multimedia products used in the classroom.

Eliciting these stated preferences from students is complex since many factors impact these preferences. To conceptualize the i^{th} student'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 to a student are: electronic textbook, Web-based study guide, electronic format (e.g. PowerPoint), personal response system (clickers or remotes), podcasts of lectures and/or class related topics and in-class videos. Multimedia course materials were selected based on the increasing popularity of use in the classroom and the considerable press coverage they have received (Carlson 2005). The marginal utility received by students from these multimedia course materials is determined through 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 where these preferences can be determined. The particular conjoint analysis employed in this study is conjoint ranking. Conjoint ranking is a stated preference method that has a distinct advantage contingent valuation because it can measure the WTP for multiple attributes simultaneously. In addition, conjoint ranking is preferred

over other revealed preference techniques that are often rife with multicollinearity (such as hedonic methods).

To elicit student preferences and their marginal WTP for multimedia course materials, a conjoint ranking survey was developed. Table 1 lists the multimedia course materials, their associated levels and total costs for the course materials. Hypothetical class scenarios were constructed from these various multimedia course materials and total costs. Each survey respondent was asked to imagine that they were enrolling in an entry level microeconomics or agricultural economics course. And, 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 difference between each course or class scenario was the required course materials and the total cost. A total of three class scenarios were presented to each survey respondent and they were asked to rank each class scenario from one, the most preferred, to three, the least preferred. To ensure the marginal utility of different multimedia course materials could be determined, a standard lecture format class scenario or status quo scenario was presented in each hypothetical decision as the third option. A standard lecture format class consisted of a paper textbook and no multimedia products however; the cost of this scenario was allowed to vary across survey respondents. Figure 1 shows an example ranking question presented in the survey.

Since having each survey respondent rank all potential class scenarios of multimedia course materials is not feasible, an orthogonal and efficient design was used. In addition, interaction effects between all multimedia course materials were accounted

for to ensure the experimental design yielded class scenarios with different multimedia course materials that were perfectly uncorrelated. Table 1 lists the six multimedia attributes, which varied across two levels and price varied across eight levels thus resulting in 512 possible class scenarios. Of these possible class scenarios, one remained constant in its multimedia course materials across all surveys. The status quo scenario or class scenario C, as shown in figure 1, gave survey respondents the opportunity to reject change from the traditional lecture format. Class scenarios A and B contained varying levels of multimedia course materials. All class scenarios, A, B and C, varied across the eight price or cost levels.

Random class scenarios were chosen from the full-factorial (504 class scenarios x 503 class scenarios x 8 status quo scenarios) to construct the conjoint ranking question. Lusk and Norwood (2005) demonstrated that this random assignment of profiles from the full-factorial both within and across profiles. Choices and surveys performed well in terms of efficiency of resulting willingness-to-pay estimates. Each respondent viewed two unique, randomly chosen sets of scenarios for which they ranked options A, B and C from most preferred to least preferred.

The ordinal rankings provided by students ranking the hypothetical class scenarios 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:

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

where V_{ij} is the utility derived by student i from the j class scenario, alternative specific constants (α) are included to capture any preferences for multimedia classes since scenarios A and B contained varying levels of multimedia course materials and scenario C was always the standard class format and β_n are coefficients to be estimated for the multimedia course materials, which come from table 1. Utility is assumed to be a function of class multimedia attributes and cost. 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 class scenarios varied across survey respondents and the specification of equation 1, average 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

The survey population consisted of all undergraduate students in the agricultural and resource economics departments at Oklahoma State University, Purdue University, the

University of Florida and the University of Minnesota. All students were emailed a cover letter describing the intentions of the survey and a Web link that would lead them to the aforementioned conjoint ranking survey at the beginning of fall semester 2007. These universities were selected based on the varying degrees of multimedia use in the classroom at their respective university, willingness to share their undergraduate email listservs and willingness to advertise the survey during their undergraduate classes once the emails had been sent.[2] To further increase the response rate, all survey respondents were entered into a drawing to win an iPod. The survey instrument was pretested using graduate students and faculty in the department of Agricultural Economics at Oklahoma State University for clarity, content and comprehension. A total of 302 students provided useable responses to the Internet conjoint ranking survey email, which resulted in a 23.3 percent response rate. Descriptive statistics of the survey respondents are provided in table 2.

The average age of the sample was 21 and the majority of those that responded to the survey were seniors (46.5 percent). Nearly half of the sample was female, 47 percent, and over 80 percent were white. Also, 83.1 percent of the sample has already taken the required introductory 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 actually watched a podcast (36.5 percent). An astonishing 99 percent own a computer

(although we note that one of the four universities, University of Florida, requires all incoming freshman to purchase a computer).

Results

Rank-ordered logit estimates are reported in table 3 for the full sample of respondents.[3] Nearly all estimates are statistically significant at least at the 10 percent level and many are significant at the 1 percent level. There is one exception however; the parameter estimate for personal responses systems or clickers was not statistically significant. The significance of the alternative specific constants for class scenarios A and B clearly demonstrates that the average student within the sample prefers multimedia over the standard or traditional classroom learning environment. Of the statistically significant estimates, all but one indicates a preference for the multimedia course material over the standard course materials. Electronic textbooks provide negative utility relative to a paper textbook. From these rank-ordered logit estimates, welfare implications of multimedia course material can be estimated and are discussed below.

Willingness-to-pay for Multimedia Course Material

Table 4 presents the WTP estimates for multimedia course materials and their estimated 95 percent confidence intervals for the hypothetical introductory microeconomics or agricultural economics class. Instructors considering switching to an electronic textbook should reconsider the decision because a negative $84.59 for willingness to pay clearly shows that students would reject an electronic textbook over a paper textbook. Students

are willing to pay $65 for a Web-based study guide relative to having no study guide. Admittedly, students may be paying for any study guide regardless of format since a paper alternative was not included and the base is no study guide at all. If so, this does not diminish our results because many publishers claim study guides (paper or Web-based) are partly to blame for the increase in textbook costs. Students, at least in this study, do value Web-based study guides over no study guides, which provides evidence they do indeed demand this extra material.

Similar to study guides, students do value electronic class notes over taking 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 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. For many large lectures on some campuses, typewritten notes have long been available for purchase from notetakers, but their reliability may be suspect. Anecdotal evidence obtained through many conversations with students and other faculty members suggest student do value and in may circumstances demand faculty use PowerPoint or other electronic notes and make them available to them.

Even though a lot of hype has been generated about personal response systems or clickers, students in our sample do not show a significant willingness to pay for them. The WTP measure, at the 95 percent confidence interval includes zero. Podcasts are

another multimedia tool that is gaining popularity. Yet, they even have a relatively low average WTP ($19.36) and the bottom 5th percentile is $0.22. A standard multimedia source used in the classroom, the in-class video, had a significant willingness to pay of $32.34, which is more than clickers or podcasts or the other "new age" multimedia course materials.

Conclusions and Recommendations

There has been a lot of enthusiasm for multimedia tools in the academic literature and on campus among faculty who seek to spice up lectures and engage students. The results of the present study shows that students do value certain types of multimedia used in the classroom and do not value other 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.

The multimedia tools not valued by students were electronic texts, clickers and podcasts. These three multimedia tools are relatively new compared to the three significantly valued multimedia tools and have received a lot attention in the media and on college campuses as discussed earlier. 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. In a sense, it is not surprising that electronic texts are not valued by students since student demand for used texts is high and selling books back is a large market. Although clickers are popular with students when

used well in class, the evidence that students do not value clickers shows that students are unwilling to incur these costs personally 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.

More analysis of these results is certainly warranted. It is the authors' opinions that students of different demographic groups, academic levels of performance and learning experiences will value these tools differently. To this point, the heterogeneity within the sample of students has not been controlled. This is a necessary step because each student has a different learning style, which may impact their preferences for multimedia use in the classroom. Extra work aside, this research shows that students may not be prepared to finance the multimedia classroom as anecdotal evidence of the "millennial generation" assumes. Certain technologies, i.e., clickers and electronic texts, may be embraced in the economics classroom only if the costs are spread out among multiple courses or included in the cost of tuition or existing technology fees rather than in the textbook package. Contrary to popular belief, traditional chalkboard and paper texts still have a place with economic students in the classroom.

Footnotes

1. Dubas and Mummaleneni (2007) look at student preferences for visual aids in the business school classroom using conjoint ranking. They found that students prefer guest lectures to use visual aids to illustrate real world examples/experiences as opposed to a faculty member using visual aids to illustrate similar topics.

2. *Chronicle of Higher Education*, "Abandoning Cassette Tapes, Purdue U Will Podcast Lectures in Almost 50 Courses." 9/9/2005. Vol 52. Issue 3, pA32-A32.

3. An ordered probit model was estimated and it yielded similar estimates and statistical significance as the rank-ordered logit model.

References

Granoff, Michael, "Course Requirement: Extortion." *New York Times,* August 11, 2007.

Carnevale, Dan. 2005. "Run a Class Like a Game Show: "Clickers" Keep Students Involved." Chronicle of Higher Education. Vol 51 (42):B3. 1 page.

Carlson, Scott, "The Next Generation Goes to College" *Chronicle of Higher Education*, October 7, 2005.

Chronicle of Higher Education, "Abandoning Cassette Tapes, Purdue U Will Podcast Lectures in Almost 50 Courses. 9/9/2005. Vol 52. Issue 3, pA32-A32.

Dubas, Khalid M. and Venkatapparao Mummalaneni, 2007. "Self-Explicated and Full-Profile Conjoint Methods for Designing Customer-Focused Courses.." Marketing Education Review. Vol 7(1).

French, Donald P. 2006. "I Pods: Informative or Invasive?" *J. of College Science Teaching*. Vol 36 (1): 58-59.

Lipke, Sara*, "*Experts Discuss Textbook Costs*."* *Chronicle of Higher Education*, June 15, 2007.

Lohnes, Sarah and Charles, Kinzer. 2007. "Questioning Assumptions About Students' Expectations for Technology in College Classrooms." *Innovate*. 3(5):

Lusk, J.L., and Norwood, F.B., 2005. Effect of experimental design on choice-based conjoint valuation estimates. American Journal of Agricultural Economics 87 (3), 771-785.

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

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

Trees, April R and Michele, Jackson. 2007. "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. Vol 3291):21-40

Table 1. Multimedia Course Materials and Levels for Class Scenarios

Multimedia Course Materials	Level
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

Table 2. Descriptive Statistics of Student Respondents

Variable	N	Mean	25th Percentile	50th Percentile	75th Percentile
Demographics					
Age in years	302	21.0	20.0	21.0	22.0
Female = 1, 0 otherwise	300	47.0%			
Freshman = 1, 0 otherwise	301	13.6%			
Sophomore = 1, 0 otherwise	301	12.3%			
Junior = 1, 0 otherwise	301	26.9%			
Senior = 1, 0 otherwise	301	46.5%			
Graduate Student = 1, 0 otherwise	301	0.7%			
Race is white = 1, 0 otherwise	301	83.7%			
Race is black = 1, 0 otherwise	301	2.7%			
Race is Native American = 1, 0 otherwise	301	2.3%			
Race is Hispanic = 1, 0 otherwise	301	5.6%			
Race is other = 1, 0 otherwise	301	5.6%			
I have taken the required introductory microeconomics or agricultural economics course for my major. 1 = yes, 0 otherwise	302	83.1%			
Familiarity with Multimedia Course Material					
Have used "clickers" in class = 1, 0 otherwise	302	48.3%			
I own an iPod = 1, 0 otherwise	301	48.8%			
I have watched a podcast = 1, 0 otherwise	301	36.5%			
I own a computer = 1, 0 otherwise	301	99.0%			

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

Table 3. Rank-ordered Logit Results for Multimedia Course Materials in each Class Scenario

Multimedia Course Materials	Level	Parameter Estimates
Constant[a]	Scenario A	0.417***
		(0.150)
	Scenario B	0.472***
		(0.152)
Textbook	Electronic	-0.723***
		(0.102)
Study Guide	Web-based	0.556***
		(0.104)
Class Notes	Electronic Format (e.g. PowerPoint)	0.404***
		(0.106)
Personal Response System (Clickers or Remotes)	Yes	-0.084
		(0.103)
Podcasts of Lectures and/or Class Related Topics	Yes	0.166*
		(0.101)
Videos	In Class to Illustrate Concepts	0.276***
		(0.105)
Total Cost of Materials in Each Scenario	In Dollars	-0.009***
		(0.001)

Note: Numbers in parentheses are standard errors. Number of observations = 604 (302 respondents x 2 rankings). Log likelihood -924.921.

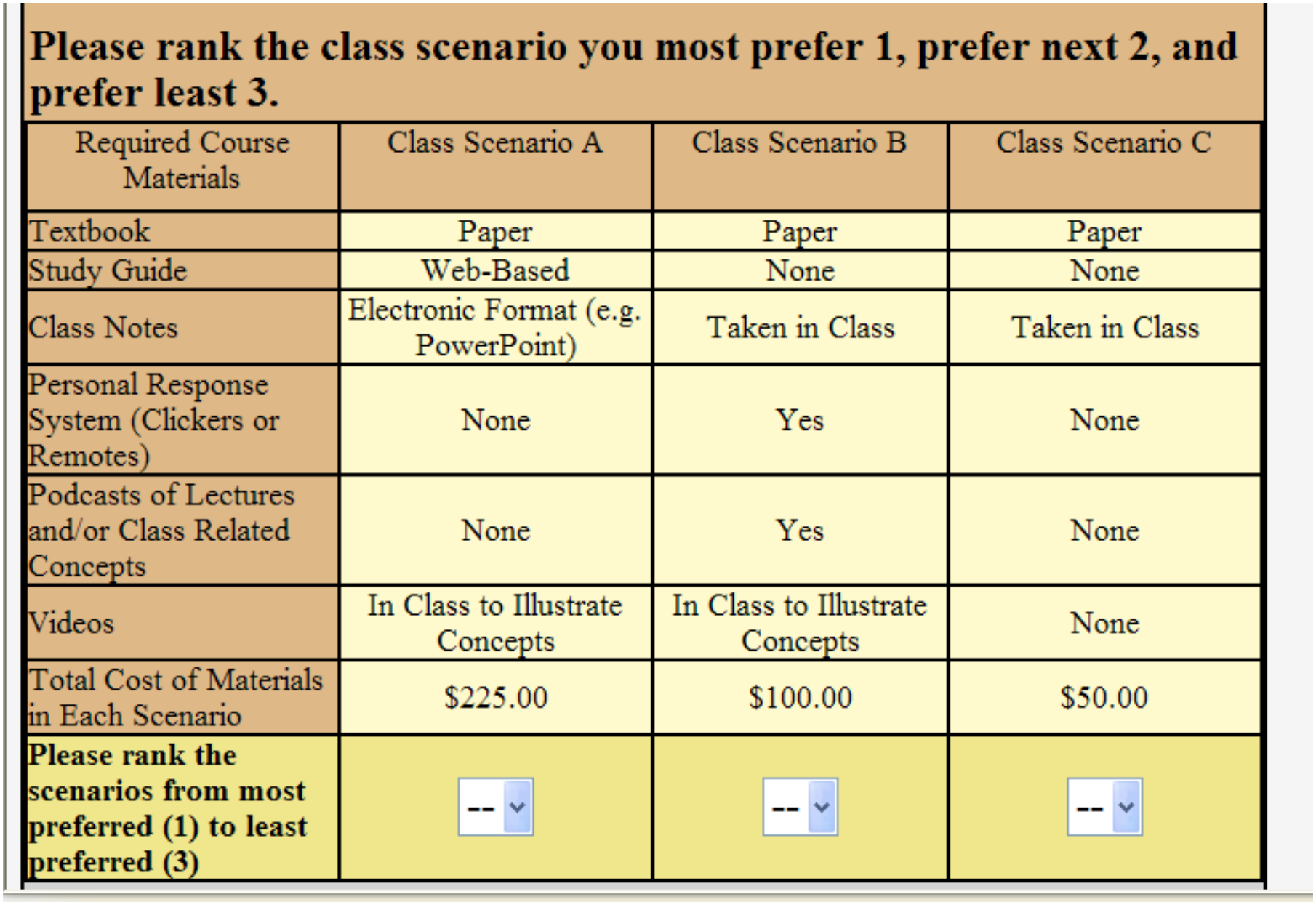
Significance levels are represented by *** and * for 1% and 10%, respectively.

a) Scenario A and scenario B contained various combinations of multimedia attributes and scenario C was the base scenario with no multimedia attributes.

Table 4. Willingness-to-pay Estimates for Multimedia Course Material

WTP for	Relative to	All Data
Electronic Textbook	Paper Textbook	-$84.59
		[-$108.85, -$62.32]
Web-based Study Guide	No Study Guide	$65.00
		[$44.62, $86.76]
Electronic Class Notes (e.g. PowerPoint)	Notes Taken in Class	$47.31
		[$25.74, $69.44]
Personal Response System (Clickers or Remotes)	No Personal Response System	-$9.87
		[-$29.95, $9.80]
Podcasts of Lectures and/or Class Related Topics	No Podcasts	$19.36
		[$0.22, $37.68]
In-class Videos to Illustrate Concepts	No In-class Videos	$32.34
		[$11.38, $54.79]

Note: Numbers in brackets are 95% confidence intervals of mean WTP calculated by Krinsky-Robb bootstrapping method.



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 1. Example of a conjoint ranking question – two random questions as above were presented to each survey respondent