Assessing Alternative Delivery Methods for GIS Instruction in University Business Courses

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As GIS instruction moves into professional and technical education programs outside the geosciences, it role will shift from the focal point of courses t an enabling or instrumental role. Students in these programs are more likely to encounter GIS instructional materials as components of courses rather than stand alone courses. Moreover, they will be learning to use GIS as one of several enabling technologies which allow them to perform tasks within their professional disciplines more effectively or efficiently. There are several potential educational media in which GIS instruction can be delivered in this context. This paper evaluates several diverse delivery media for GIS modules in university business courses. It uses instructional design considerations, observations from instructors, and student evaluation surveys to assess the relative merits of these delivery systems for achieving GIS learning goals.

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Introduction

Business GIS applications and implementations continue to grow at a rapid rate. The growth of GIS tools for solving business problems, the expansion of support available from software and consulting firms, the development of specialized business GIS applications such as the Business Analyst extension to ArcGIS and the explosion of distributed and Web-based access to GIS capabilities have fueled this trend. (For examples of these applications and developments, see Akwright, 2005; Francica, 2006; Harris, Rubin and West, 2004; Mahany, 2007; Pick, 2005; Rubin, 2000; Vlachopoulou, Silleos and Manthou, 2001 and Weigel and Cao, 1999)

Despite this growth, business GIS instruction in business schools continues to lag. (Brickley, Micken and Carr, 2006, McNally, 2006) Though Kansas State University, the University of Redlands, James Madison University and Murray State University, among others, are adding GIS components to their curricula, most business schools continue to struggle with implementation issues.

Two specific issues have proven to be quite vexing. (Ervelles, Viswanathan and Huntley, 1998) The first is whether to integrate GIS content as a stand alone course or within existing courses in the curricula. The second, dependent upon the answer to the first, is how to design curriculum materials to support the desired integration.

In the Marketing curriculum at Murray State University, we have chosen to integrate GIS instruction within several existing marketing courses in the form of course-related GIS modules. We have used three different delivery methods to integrate modules into several different marketing courses, taught by several instructors via a range of course delivery methods. (Miller, 2004; Miller, 2006, Miller, Mangold and Holmes, 2006; Miller, Mangold and Holmes, 2007; Miller, 2007) This study reports our current assessment of the relative merits of those three module delivery methods.

Description of Alternative Delivery Methods

Beginning in Fall 2004, the Murray State University Marketing faculty selectively integrated GIS modules into several courses. This process has continued over seven semesters and 15 sections of five marketing courses. It began with a Web-based exercise in one Retail Management section and has expanded into other courses, delivery methods and course formats. The additional courses are Principles of Marketing, Sales Management, Global Marketing Management and Business Geographics for Managers.

The initial Web-based approach used Arc IMS coupled with online instructions to provide an exercise illustrating the use of GIS in retail site selection. Students could choose between HTML and Java versions of the exercises, with the Java version offering slightly more extensive GIS capabilities. Most students opted for the HTML version, as university labs did not allow students to download the Java-based browser to complete that version of the exercise.

In an effort to introduce more extensive GIS capability into this exercise, the instructors developed a lab-based version using first ArcView 8.2 software. This version of the exercise was presented to students in the form of a brief, lean instruction set, which required them to use the Help system, instructor assistance and print documentation to select and use appropriate GIS tools. This version was patterned after exercises developed for students who had completed a basic ArcView course in ESRI's Virtual Campus. In its initial semester in proved unsuitable for students (and faculty) who lacked that background. For this reason, this approach did not continue into a second semester.

The final project delivery method was a more extensive instructional set accompanied with screen shots. This approach was patterned after the *GIS Tutorials* series published by ESRI Press. Indeed, it ultimately

grew into the *GIS Tutorial in Marketing* volume in that series. This approach proved far more effective in allowing marketing students with little or no GIS background perform useful GIS analyses of marketing problems. It also allowed marketing faculty with similar lack of background to include GIS projects in their courses. Indeed, this approach became the foundation of the effort to move GIS modules into a variety of courses across the marketing discipline.

The courses in which the modules were used also included a range of delivery methods. Most of the sections were in a traditional face-to-face format. This format included introductory classroom discussion followed by hands-on experience in university labs and, less frequently, students own systems. The latter option increased in frequency as students used educational versions of ArcGIS software made available to them within the context of the statewide license to ESRI products in which the university participated.

Interactive television is the second course delivery method included in this study. This approach involves two way video and audio feeds to students in several remote sites and one local studio. For evaluation purposes, students in the local studio are separated from those at remote sites because the local experience is much more similar to a traditional format than is the experience at remote sites. In either context, however, this approach offers less opportunity for direct supervision of GIS tasks. In addition, it necessitates using the Web-based version of exercises, as the necessary software was not available in computer labs at remote sites.

The final course delivery method is online. The graduate Business GIS class is offered online every fall semester by Murray State. In the Fall 2007 semester, eight students chose this option and six of them completed evaluation surveys for GIS modules. Though this sample is quite small, it is included here for three reasons. First, it provides some indication of the feasibility of using GIS modules in online classes. Second, it is the only graduate class in the study. Third, the course includes completion of an introductory

ArcGIS 9 course in the ESRI Training Center (formally the Virtual Campus). Thus, this group of students has a stronger GIS background than other classes and provides that perspective to the study.

In short, this study includes a reasonably broad range of marketing courses and course delivery methods. This range allows evaluation of the three alternative project delivery methods across the teaching landscape of most marketing departments.

Evaluation of Alternative Delivery Methods

In this study, the three alternative GIS project delivery methods were evaluated using data from both faculty and students. Faculty data was collected via post-project briefings with instructors in every section of each course which included a GIS project. These discussions included consideration of the relevance of the project to the specific class, level and value of the GIS analysis in each project and the difficulty of each project for students to complete and for faculty to teach.

Student evaluation was gathered in two ways. First, students were asked to make observations on the details and instructions of each project. This information was used to correct errors in the project, revise ambiguous instructions and improve students' understanding and performance within each project. This process is ongoing, very detail oriented and is more relevant to the execution of projects rather than their overall learning goals and, thus, are not included in this evaluation report.

Students also completed project evaluation surveys upon completion of each project. The survey instrument originally contained 18 items, of which 16 are relevant for this study. Subsequently, two items were added to the instrument to collect data on the amount of time students needed to complete the project and to write the relevant project report.

For evaluation purposes, these items are classified as Strategic, Tactical and Integrative. Strategic items collect data on student perception of project value relative to the learning objectives faculty sought to achieve. Tactical items collect data on student perceptions of the clarity of project descriptions, instructions and results. Integrative items collect data on student perceptions of the overall value of the project as a learning exercise.

The overall means and standard deviations for these sixteen items are reported in the following table. Also reported are the mean completion time data for both the project and its required written report.

Table 1 Student Evaluation of GIS in Marketing Exercises n=387		
Question	**Mean**	**SD**
Strategic Items: Strategic Mean = 3.80		
This assignment helped me learn about course content.	4.02	.59
This assignment helped me learn about Geographic Information Systems.	4.06	.66
This assignment enabled me to apply material presented in the textbook.	3..58	.80
This assignment was appropriate for the course.	4.20	.62
This assignment gave me an opportunity to develop my problem solving skills.	3.70	.78
This assignment gave me an opportunity to develop my computer skills.	3.64	.92
This assignment gave me an opportunity to develop my written communication skills.	3.42	.77
This assignment gave me an opportunity to develop my analytical skills.	3.78	.70
Tactical Items: Tactical Mean = 3.89		
I was given adequate information to complete this assignment.	3.91	.84
The directions for completing this assignment were clear.	3.84	.97
The terminology used in this assignment was clear.	3.91	.83
This assignment was adequately structured.	3.88	.72
Integrative Items: Integrative Mean = 3.59		
Overall, I am satisfied with this assignment.	3.77	.76
The knowledge and skills I gained from this assignment will be helpful in the workplace.	3.55	.85
The amount I learned from this assignment made the time I invested in it worthwhile.	3.48	.84
If I were discussing this assignment with a friend, I would evaluate it favorably.	3.57	.90
1 = Strongly Disagree 3 = Neutral 5 = Strongly Agree		

For the remainder of this study, these data will be reported as Strategic, Tactical and Integrative scores. In each case, the Strategic value is the mean of the eight items in the strategy category, the Tactical value is the mean of the four items in the tactical category and the Integrative value is the mean of the four items in the integrative category.

The target time commitment for the GIS modules is roughly one week of class and study time. This includes class time for introductory materials, supervised work in the labs and/or independent work in labs or the Internet for Web-based tutorials. In the three classes in which students were asked about the time committed to completing the exercises and writing the accompanying report, that goal appears to have been met. On average, students report spending a total of 3.55 hours on projects (2.18 completing the project and 1.37 writing the report). Principles of Marketing students report the lowest average completion time of 2.60 hours (1.94 on the project, .66 on the report) and Global Marketing students report the highest average completion time of 3.94 hours (2.58 on the project, 1.36 on the report).

Before focusing directly on project delivery methods, it is useful to observe how student responses varied across different courses and course delivery methods. Table 2 reports student responses by course. In addition the rightmost column reports the differences in group means that emerge as statistically significant ($p < .05$) in post-hoc comparisons in the SPSS One Way Analysis of Variance procedure.

Note that both the Principles of Marketing and Business GIS courses produced significantly higher ratings than other courses, while the ratings of the Sales Management course were significantly lower. The Business GIS results are not surprising given the enhanced background of students in this graduate class. The Principles of Marketing results were not expected, but are very positive. As many business students who are not marketing majors take this course, it is important that it provide a positive introductory experience to GIS. This prepares marketing students well for exercises in subsequent courses while

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providing other business students with their first exposure to and, perhaps their only hands-on experience with, GIS tools in their academic careers.

The most troubling results are those of the Sales Management project, which are significantly all other projects in at least one of the three measures. This is a difficult project, including sales territory design and sales call routing. However, these functions are key components of sales management and it is important that students appreciate the value of GIS relative to them. As a result, this project has been significantly revised and awaits implementation in another section of this course to assess the results.

TABLE 2 Business GIS Modules by Course						
Course	**n**		**Strategic**	**Tactical**	**Integrative**	**Significantly Different From**
Principles	31		3.91	4.30	4.00	RM(T,I) SM(T,I) GM(I)
Sales Mgt	16		3.56	3.13	3.22	PR(T,I) RM(T) GM(T) BG(S,I)
Retail Mgt	252		3.80	3.84	3.57	BG(S) PR(T,I) SM(T)
Global Mkt	81		3.75	4.00	3.51	PR (I) BG(S) SM(T)
Business GIS	6		4.40	4.46	4.25	SM(S,T,I) RM(S), GM(S)

Student evaluation scores may also be affected by the medium of course delivery. Table 3 reports student evaluation scores by category for the course delivery methods included in the study. Note that the scores for online delivery are significantly higher and those for ITV-local delivery significantly lower than traditional face-to-face delivery. However, the values for ITV-remote delivery and traditional delivery do not differ significantly.

Once again, the high values for online delivery are not surprising given the more extensive GIS background of these students. However, the relationship between traditional delivery and the two ITV formats is surprising. As local ITV more closely resembles the traditional format than does remote ITV, it would be expected that survey results would parallel this pattern. In addition, instructor debriefing indicated that remote ITV students reported more problems and performed more poorly on project reports than did local ITV students.

At present, we can offer no explanation of these results, though it is possibly the result of differing faculty and student perceptions of these formats. That is, while faculty perceive the local studio to be a reasonable approximation of a traditional class setting, students might not. From their perspective, the slower pace, occasional technical problems and difficulty in communicating with remote students might detract more from the learning environment than faculty appreciate. Remote ITV students, on the other hand, frequently take the majority of their courses in this format and, therefore, are less sensitive to the differences between this format and traditional course delivery. This is clearly a dimension of this study which warrants further work.

TABLE 3 Business GIS Modules by Course Delivery Method							
Method (n)	n			Strategic	Tactical	Integrative	Significantly Different From
Traditional (327)	327			3.80	3.93	3.62	OL (S) ITV-L (T)
Online (6)	6			4.40	4.46	4.25	TR (S) ITV-L (S,T,I)
ITV- local (30)	30			3.58	3.40	3.29	TR (T) OL (S,T,I)
ITV- remote (23)	23			3.83	3.77	3.45	none

Early survey responses and student feedback indicated that students' did not fully appreciate the value of GIS tools in marketing or the relevance of project analysis to course content upon completion of projects. In response, we developed introductory PowerPoint presentations for each project to make these points more clear.

Table 4 reports the data relevant to the evaluation of this approach. It reports the mean responses of respondents on several relevant questions divided into the group that was exposed to the introductory presentations and the group that was not. The results are moderately encouraging. Students exposed to the introductory PowerPoint presentation had higher scores on four of the five questions, though the difference was not great. Indeed, an Independent Samples T-Test reveals that only one of the results is statistically significant.

Though these differences are modest, the role of introductory PowerPoint materials remains important, as information relative to these questions is highly unlikely to be included in current textbooks in marketing fields and, therefore, must be provided by each individual instructor. Increased emphasis on these points in project instructional materials and PowerPoint introductory materials is, therefore, very important.

TABLE 4 Student Evaluations Based on PowerPoint Exposure			
Question	Introductory PowerPoint?		Significant (p < .05)
	Yes	No	
This assignment helped me learn about course content.	4.07	3.97	
This assignment helped me learn about Geographic Information Systems.	4.11	4.01	
This assignment enabled me to apply material presented in the textbook.	3.55	3.61	
This assignment was appropriate for the course.	4.27	4.14	*
The knowledge and skills I gained from this assignment will be helpful in the workplace.	3.61	3.49	
1 = Strongly Disagree 3 = Neutral 5 = Strongly Agree Statistical significance determined by Independent Samples T-Test in SPSS			

While these results are instructive, the purpose of this study is to assess alternative project delivery methods using data from faculty and student evaluations. Table 5 summarizes the results of debriefing sessions with the faculty who used GIS modules in their courses. While this data is not numeric, it does represent the general conclusions emerging from those debriefing sessions.

As Table 5 indicates, teaching faculty view Web-based and tutorial, on screen modules more favorably than they did the brief printed instruction approach. Web-based are perceived as the easiest to learn, implement and use. Faculty reported relatively short preparation time, few in-class problems and reasonably good results from this approach.   However, they also recognize that this approach offers the

least exposure to GIS analysis and is, therefore, best suited to general orientation exercises rather than more in depth instruction.

The brief, printed project approach offers greater opportunity for skill development, according to these faculty, but achieve this objective at a high price. Specifically, this approach requires a significantly higher level of GIS training for faculty and a significantly greater capability to respond to errors students make in completing exercises. Indeed, in this approach, successful completion of lab activity required the presence of a guest instructor with significant GIS background. Thus, it would be difficult to achieve widespread integration of GIS exercises in marketing courses with this approach absent a very significant and broad based training effort.

The on screen tutorial model is viewed as a nice balance of GIS instruction and demands upon students and faculty. The GIS tools in each tutorial require more extensive faculty training than do those in the Web-based module. However, individual faculty need learn only the tools necessary for the modules in their courses, which proved manageable in the view of these faculty. Further, the marketing scenarios, structured learning exercises and organized report templates are viewed as beneficial for both teaching faculty and students.

This is not to say that this approach is ideal. Faculty with tutorial-specific GIS knowledge have difficulty responding to student problems if they get off the intended track of the tutorial. This means that exercises must be continually revised as students encounter this kind of ambiguity. Further, though this approach allows students to performed structured GIS analysis of marketing problems, it is less successful in developing students skills to craft their own GIS solutions to similar problems. This is not an inherent weakness of the format, but does require more extensive GIS knowledge among teaching faculty. It should be among the priorities as GIS literacy improves among marketing faculty.

TABLE 5 Faculty Assessment of Business GIS Modules by Project Delivery Method					
Method	GIS Skills Taught	Difficulty to Learn	Difficulty to Teach	Difficulty for Students	Quality of Student Work
Web-based	orientation	easiest	easy	moderate	good
Brief, printed	moderate	difficult	very difficult	very difficult	poor
Tutorial, on screen	basic	easy	moderate	moderate	very good

Table 6 reports student perceptions of these three delivery methods as captured by the evaluation survey instrument. These date do not reveal large variations in perceptions of the three methods, nor are any of the variations that do exist statistically significant. The most surprising single result is the positive evaluation of the brief, printed exercise format that is viewed as so difficult by faculty. This may well be the result of the increased supervisory presence of faculty in this approach, which provided the direction the printed instructions lack. This means that this approach might be of significant value in a dedicated Business GIS in Marketing course taught by an instructor with enhanced GIS skills.

Of the remaining methods, students view the on-screen tutorial approach more positively, but not significantly so. Though students do not share faculty perceptions of the significant advantages of this approach, they do view it positively. Thus, faculty can achieve greater instructional effectiveness with relatively little increase in commitment to training and teaching and no sacrifice of student satisfaction with the technique.

TABLE 6 Student Assessment of Business GIS Modules by Project Delivery Method						
Method	n		Strategic	Tactical	Integrative	Significantly Different From
Web-based	143		3.76	3.83	3.54	none
Brief, printed	36		3.85	3.99	3.51	none
Tutorial, on screen	207		3.81	3.92	3.64	none

Finally students were invited to write open-ended comments on the parts of the project they liked and the how the project could be improved. Not surprisingly, these included a wide range of opinions. Among

the most positive is this statement from a student who used the tutorial format in a traditional Principles of

Marketing course,

> "The ability to see location and demographics in a map form was helpful in
> understanding marketing concepts."

Equally rewarding were these comments from Retail Management student whose appetite for GIS skills

was whetted with the Web version of the project.

> "I would prefer to have spent a lot more time learning the software. We were given a good
> foundation, but I would prefer to learn how to operate the program in depth."

On the other hand, the following observation from a Global Marketing Management student who

completed the project in tutorial format in a traditional setting, signals less sympathy with the learning

objectives of the exercise and argues for modesty in claims of pedagogical success.

> "I felt that the amount of time put into the project was too much mainly because the
> directions teaching you how to use the software made the project at least an hour longer
> than it should be."

Conclusions

Based on these data, we conclude that the tutorial method is the most effective for integrating GIS content

across a range of marketing courses. The method allows coverage of a greater range of GIS skills than

does the Web-based approach while avoiding the difficulties of training and implementation of the brief,

printed exercise format. Based on student comments, we believe that this approach will be a bit more

effective in printed form than in the current on-screen presentation, which requires some cross computer

manipulation of files when used in a team approach.

To date, the faculty training requirements of this approach and the commitment of class time to their

completion seem to be within target ranges. This allows GIS instruction to be shared by several faculty

within Marketing departments and integrated over a range of courses in the discipline. This, in turn,

allows students to appreciate the relevance of GIS tools for marketing more fully than would a dedicated, but elective, Business GIS in Marketing course.

However, the data also suggest that students do not share faculty's relatively negative evaluation of the brief printed instruction approach. As this approach depends upon an instructor with more advanced GIS skills, this approach is still viable for the departments opting for a dedicated course.

Finally, the Web-based approach also has a potential place in the marketing program. It is valuable for course delivery formats which do not lend themselves to class exercises in computer labs or on personal systems. If the goal is a simple orientation exercise in a single class, this approach retains merit. However, as a method for more extensive integration, it has significant weaknesses.

Note that the conclusions in the preceding paragraph are reached relative to an HTML based Web site using ArcIMS. Innovations in distributed and Web-delivered GIS tools such as ArcGIS Server 9.2 and ArcGIS Business Analyst Online place more GIS power in the hands of the Web-based user. On these platforms, Web-based GIS instruction may well overcome the limitations of the system described in this study.

In sum, while each of the three methods studied have a role to play in overall GIS instruction in marketing, the detailed tutorial approach seems to have the greatest potential for supporting greater integration of Business GIS tools across the various courses in the university marketing curriculum.

References

Akwright, James (2005), "Successful Integration of Business Intelligence and GIS," *Proceedings* ESRI GeoInfor Business Summit, April 2005.

Boyles, David (2002), *GIS Means Business: Volume 2*; Redlands, CA, Environmental Systems Research Institute, Inc.

Brickley, Mark, Kathy Micken, and Ben Carr (2006), "Can GIS Play a Role in the Business Curriculum?" *Proceedings* of the Northeast Decision Sciences Institute, March 21-24.

Dennis, Alan R. and Traci A. Carte (1998), "Using Geographical Information Systems for Decision Making: Extending Cognitive Fit Theory to Map-Based Presentations," *Information Systems Research*, June, Vol. 9 Issue 2, p194-204.

Erevelles, Sunil, Nanda Viswanathan, and Chris Huntley (1998), "The Use of GIS in Marketing" in *Great Ideas for Teaching Marketing*, Eds. Joseph Hair, Charles Lamb and Carl McDaniel, Cincinnati, OH, South-Western College Publishing.

Evans, Martin; Clive Nancarrow, Alan Tapp and Merlin Stone (2002), "Future Marketers: Future Curriculum: Future Shock?" *Journal of Marketing Management*, July, Vol.18 Issue 5/6, pp.579-96.

Francica, Joe (2006), "Hillman Bolts Together GIS and Business Intelligence Solution," *Directions Magazine*, July 7.

Francica, Joe (2006), "SAP Takes Another Hard Look at the GIS Market," *Directions Magazine*, July 1. .

Goor, Wilpen L. and Kristen S. Kurland (2005), GIS Tutorial: Workbook for ArcView 9, Redlands, CA, Environmental Research Institute Inc.

Grimshaw, David J. (1994), *Bringing Geographical Information Systems Into Business*, New York, Wiley.

Harder, Christian (1997) *ArcView GIS Means Business*, Redlands, CA, Environmental Systems Research

Harris, Richard, Peter Sleight and Richard Webber (2005), *Geodemographics, GIS and Neighbourhood Targeting,* John Wiley and Sons, Chichester, West Sussex, England.

Hess, Ronald, Ronald Rubin and Lawrence West Jr. (2004),"Geographic information systems as a marketing information system technology**,"** *Decision Support Systems*, November, Vol 39, Issue 2, pp 197-213.

Mahany, Richard (2007), "Geospatial Intelligence in Financial Risk Assessment in Fleet Management," *Directions Magazine*, February 15.

McBane, Donald (2003), "Getting The Horse To Drink: Teaching Technology To Marketing Students," *Marketing Education Review*, Summer, Vol. 13 Issue 2, pp. 1-6.

McNally, Mary (2006), "Market Mapping: A Project to Teach Business Students about Business Geographics," *Directions Magazine: The Worldwide Source for Geospatial Technology*, http://www.directionsmag.com/features.php?feature_id=16

Miller, Fred, Glynn Mangold and Terence Holmes (2007), "Integrating Geographic Information Systems (GIS) Into the Marketing Curriculum," with Glynn Mangold and Terry Holmes, M*arketing Education Review*, forthcoming

Miller, Fred (2007), GIS Tutorial for Marketing, ESRI Press.

Miller, Fred, Glynn Mangold and Terence Holmes (2006), "Integrating GIS Applications into Business Courses Using Online Business Geographics Modules." *Journal of Education for Business*, Vol 82, No. 3, Nov/Dec 2006.

Miller, Fred (2006), "A Modularized Approach to GIS Instruction in Business School Curricula: The GIS Tutorials in Marketing Project," Proceedings, ESRI International Educators Users Conference, August 2006.

Miller, Fred (2004), "Using Online Business Geographics Modules to Disseminate GIS Applications," *Proceedings*, ESRI Educators' Conference, August 2004.

Pick, James (2005), *Geographic Information Systems in Business,* Idea Group, Hershey, PA.

Rubin, Ronald S. (2000), "Interactive Geographic Information Systems (GIS) on the World Wide Web," *American Business Perspectives*, Mar/Apr Issue 220, p1-4.

Smith, Ross and Christopher J. Dircks (2007), "Maximizing Value through GIS Organizational Design," *Directions Magazine*, March 1.

SPACE – Spatial Perspectives on Analysis for Curriculum Enhancement (2006), "Choosing a GIS," <http://www.csiss.org/SPACE/resources/gis.php/#Goal>

Vlachopoulou, Maro, George Silleos and Vassiliki Manthou (2001), "Geographic information systems in warehouse site selection decisions," *International Journal of Production Economics*, Vol. 71 Issue 1-3, p205-213.

Weigel, Don and Buyang Cao (1999), "Applying GIS and OR Techniques to Solve Sears Technician-Dispatching and Home-Delivery Problems," *Interfaces*, Jan/Feb, Vol. 29 Issue 1, p112-31.