# Objective Evaluation in an Online Geographic Information System Certificate Program

Asst. Professor. Dr. Scott L. WALKER
Texas State University-San Marcos
San Marcos, Texas, USA

## ABSTRACT

Departmental decisions regarding distance education programs can be subject to subjective decision-making processes influenced by external factors such as strong faculty opinions or pressure to increase student enrolment. This paper outlines an evaluation of a departmental distance-education program. The evaluation utilized several methods that strived to inject objectivity in evaluation and subsequent decision-making. A rapid multi-modal approach included evaluation methods of (1) considering the online psychosocial learning environment, (2) content analyses comparing the online version of classes to face-to-face versions, (3) cost comparisons in online vs. face-to-face classes, (4) student outcomes, (5) student retention, and (6) benchmarking. These approaches offer opportunities for departmental administrators and decision-making committees to make judgments informed by facts rather than being influenced by the emotions, beliefs, or opinions of organizational dynamics.

**Keywords:** evaluation, distance education, certificate program, geography

## INTRODUCTION

Distance education has become a firmly entrenched part of the post-secondary landscape over the last decade. Networked digital communication has facilitated an explosive growth in this method of reaching learning populations to the point that the higher education trend to produce distance education units and programs has been characterized as a "land rush" (Molenda & Harris, 2001, p. 6) to get online. For example, the *e*-Europe Plan proposes that by the end of 2005 all European Union member states' universities should "offer on-line access for students" (Commission of the European Communities, 2002, p. 12). Additionally, Molenda and Harris (2001) noted that 60 percent of all United States colleges and universities have Internet-based classes. However, when public four-year institutions were considered by themselves the figure increases to 90 percent offering distance education courses (National Center for Education Statistics, 2003). At the same time Australian universities are experiencing converging influences driving them "towards online, for profit education on a global scale" initiated by a "desperate need to improve income to compensate for the lack of public funding" (Gururajan, 2002, p. 2). These changing demands on institutions are of sufficient consequence that it prompted former Deakin University Vice-Chancellor, Malcolm Skilbeck, to pose the question "Does the university have a future?" (Skilbeck, 2001, p. 61).

**While change is inevitable in higher education, regardless of the forces driving it, quality and value in education must remain high, lest universities lose their status as degree-granting bodies and become little more than market players in the global corporate/workplace milieu. However, *value* in distance education is a difficult notion to pinpoint. Value, measured in some ways is perceptual—perceptions of learners, perceptions of university administrators, and/or perceptions of faculty determine the educational value of distance education. Measured in other ways value can be linked to costs. Regardless of definition, university administrators understand that they are offering services of some value in a marketplace that is highly competitive (Rovai, 2003). Competitiveness is of particular concern in workforce-oriented, higher education online certificate programs that may not be directly tied to an academic degree. Online certificate programs differ from traditional program delivery in terms of duration and focus (Wikle, 1999). They are shorter term, often workforce or skill oriented (Gaudet, Annulis, & Carr, 2003), and cater to a segment of the population that can be labelled as "non-traditional," thus they exist in a milieu unlike that of traditional university degree programs. Online geographic information system (GIS) certificate programs typically fit into this category of post-secondary education that competes outside of the traditional higher education market, however students within the traditional marketplace also enrol in online GIS certificate programs for degree credit.**

**In order to ascertain value to increase a program's competitive standing, any distance education program must be evaluated at some level in order to identify and make improvements and assure success for the long term (Rovai, 2003). However, evaluation implies both measurement and judgment (Rovai, 2003). In order for university leaders to make informed judgments, they must develop and implement evaluation that is based on multiple forms of evidence gathering so that the convergence of the measurement results presents the truest picture of a program's value and effectiveness. Without input from multiple measurements, distance education administrators are forced to rely upon their beliefs, or beliefs of others, rather than on less subjective data. Despite distance education being in its fifth generation, evaluation of distance education programs remains less than rigorous and relies on (a) student outcomes (achievement, grades, test scores), (b) attitudes of students and instructors, and (c) satisfaction of students and instructors captured through self-report instruments and subjective qualitative evaluation based in anecdote (Diaz & Cartnal, 1999; Ehrmann, 1990; Harnar, Brown, & Mayall, 2000; Olsen, 2000; Rovai, 2003).**

**This article presents a rapid, multi-modal evaluation of an online GIS certificate program in a four-year university. It offers views into the measurement phase of program evaluation designed to offer university administrators objective insight so they have opportunities to make sound judgements regarding program renewal.**

**DISTANCE EDUCATION PROGRAM EVALUATION BACKGROUND**

**Program evaluation is conducted to answer questions and address issues raised by stakeholders (Rovai, 2003). Evaluation is a collection of techniques, proficiencies, and sensitivities required to establish:**

**(a) if a service is needed and liable to be used,**
**(b) if a service is conducted as it was planned, and**
**(c) if a service actually helps people (Posavac & Carey, 2002).**

**Program evaluation is most commonly used for:**
**(a) determining accountability and effectiveness,**
**(b) identifying weaknesses so effectiveness can be improved,**
**(c) gathering evidence of effectiveness to address questions of doubters, and (d) provide information for program renewal (Scriven, 1981).**
**Others suggest that in distance education programs, evaluation should focus on:**
**(a) the quality of students' learning in terms of class effectiveness,**
**(b) the quantity of their learning through enrolment and class completion rates,**
**(c) the status of the program in terms of course transfer equivalency and accreditation, (d) and the cost of learning in terms of cost effectiveness and cost benefit ratios (Keegan, 1996).**

**Regardless of the intended purpose of a distance education program evaluation there are six evaluation approaches that Worthen, Sanders, and Fitzpatrick (1997) have identified:**

**(1) objectives-oriented,**
**(2) consumer-oriented,**
**(3) management-oriented,**
**(4) expertise-oriented,**
**(5) adversary-oriented, and**
**(6) participant-oriented.**

**Objectives-oriented evaluation is aimed at determining the extent to which educational objectives of a program have been met. Difficulties arise within this approach when objectives have been poorly defined, when unintended outcomes exist, and/or when there are unwritten/unspoken program objectives (ex. profit making, being the first to offer online courses). In educational environments students' scores are often used as the measurement benchmark for objectives-oriented evaluation, despite the point that the unit of analysis of an individual's grades can seldom be directly correlated with the larger unit of analysis of program objectives. This is especially true when an individual's grades are tied to participation and late policies or when instructor-made exams are used, and since instructors are not likely to assign grades consistently across terms (Rovai, 2003).**

**Consumer-oriented evaluation is summative in nature for projects with a definitive ending, thus is not appropriate for ongoing programs. This**

**orientation also lacks consideration for differences in students' aptitudes, learning styles, and affective traits (Dille & Mezack, 1991; Ehrman, 1990; Westbrook, 1997).**

**Management-oriented evaluation is used primarily for university decision-makers to allocate funding. Problematic in this approach is that program evaluation conducted by those involved in the program tends to promote the status quo (Woolcot, 1997).**

**Expertise-oriented evaluation is commonly implemented by university accreditation organizations whereby content experts take part in determining the value of curriculum. However, given the unique nature of distance education, if the expert is not familiar with distance education, s/he may look unfavourably on what is otherwise a well-developed program simply because it is different.**

**Adversary-oriented evaluation of distance education incorporates some use of opposing evaluators aimed at instilling in them an appreciation of distance education. Likewise, sceptics' viewpoints, if addressed satisfactorily, can strengthen a program. And finally:**
**Pparticipant-oriented evaluation is one that is qualitative in nature and involves all stakeholders. Stakeholders with more influence or stronger voices may skew outcomes if this approach is used exclusively.**

**While the above approaches make for neat categorization in the development of distance education program evaluation, it is atypical of any program evaluation to be derived exclusively from any single approach listed above. Most distance education approaches are multifaceted and have various purposes in mind. Recent literature that focuses exclusively on distance education *program evaluation*, as opposed to distance education *class evaluation*, offers evidence that there is little consensus on what should be evaluated and which approaches or strategies should be used. In earlier generations of post-secondary distance education, when the "no significant difference" between asynchronous distance education and traditional classroom education was prominent, Dumont (1996) and Hiltz and Wellman (1997) reported that grades were the predominant measure of program effectiveness.**

**One study of 56 distance education program evaluations (Verduin & Clark, 1991) demonstrated that the most prevalent measurement compared grades of online students to those of face-to-face students. More recent program evaluations have expanded beyond simple student grade comparisons. For instance, Shea, Motiwalla, and Lewis (2001), looking at the broad perspectives of 68 distance education coordinators, used a non-validated, multi-scale survey instrument to determine characteristics of:**

**(a) class size,**
**(b) target populations,**
**(c) media and technology used,**
**(d) student characteristics,**
**(e) program administration issues,**

**(f) perspectives on distance education versus face-to-face classes,**
**(g) student requirements, and**
**(h) faculty requirements.**

**Grabe and Sigler (2002) reported on their program evaluation in terms of the use of technology study tools in a distance education psychology class as measured through student grades on examinations plus a non-validated study-tool questionnaire, triangulated with results from the Inventory of Learning Processes (ILP).**

## EVALUATION IN ONLINE GEOGRAPHIC EDUCATION

**Distance education evaluation specific to post-secondary geographic education has been conducted in a variety of locations around the world. In South Africa, Pretorius (2004) conducted a fundamental program evaluation measuring an online environmental management degree program in terms of student enrolment, the spatial distribution of students, student population demographics, and students' views on the relevance of the program by means of an non-validated questionnaire. In Norway, Lægran (2002) evaluated the "Geography on the Net" program by means of measuring student collaboration and communication.**

**Others involved in online geographic education have measured individual program components, yet their foci were narrow, typically on a class or on a strategy used in a class, and do not provide a larger picture of the effectives of entire programs of study. For example, using a non-validated survey instrument, Solem et al. (2003) measured students' perceptions of the value of a single module in a pilot geography class. They also measured students' perceptions of instructional procedures, technology, and positive and negative aspects of the class. Similarly, Harris (2003) measured classroom communication and learning community. In an online geographic information systems (GIS) class he measured the frequency of communication between the students and the instructor and among students when they used different online communication tools. He also qualitatively captured students' comments about the advantages and disadvantages of the differing communication tools. While these two examples do shed an important light on geographic-oriented distance education instruction, they do not offer insight on an entire program consisting of multiple online classes taught by multiple instructors.**

**Distance education program evaluation could stand to be more informed by a reliable body of literature sufficient to guide the design and rigorous evaluation in the form of purposes, approaches, and strategies, yet as currently practiced predominantly ends up measuring only student achievement, comparing online classes to face-to-face classes, or uses low-rigor self-report instruments that have not been validated or assessed for reliability. What is more, in online geographic education, and in online GIS certificate education in particular, there appears to be little progress in rigorous evaluation of programs. Chalmers et al. (2004, p. 1) noted that "much remains to be done to create, assess, and disseminate a set of**

**rigorous online classes and programs by geography faculty, departments, and higher education institutions worldwide."**

**A Rapid Multi-Modal Approach in Evaluating an Online GIS Certificate Program**

**The remainder of this paper presents an evaluation of an online GIS certificate program. The program consists of four asynchronous undergraduate-level geography classes, each equivalent to four semester hours. Class participants need not have a degree in order to take the course series, but the classes must be taken in sequence. Doctoral students who are content area experts in geographic information systems (GIS) teach the classes.**

**In order to circumvent problems in expert-oriented program evaluation, whereby the "expert" is often a content expert, but not a distance education expert, an evaluator was selected who is familiar with the content—GIS and remote sensing—and has 10 years experience in post-secondary distance education instructional design and teaching, as well having the unique perspective of having also been a distance education student.**

**The evaluation combines management-, expertise-, and participant-oriented approaches for the main purposes of (a) identifying weaknesses so effectiveness can be improved, (b) ensuring parity with face-to-face classes, and (c) providing information for program renewal—the purposes for which the program evaluation was requested. It used six strategies of:**

- **Student and instructor surveys regarding their perspectives of the online psychosocial learning environment**
- **Content analyses comparing the online version of classes to face-to-face versions**
- **Basic cost comparisons in online versus face-to-face classes**
- **Aggregated academic outcomes**
- **Student retention**
- **Benchmarking against other GIS certificate programs**

**The evaluation results are presented below by individual strategy with "observations" noted. This multi-modal approach offers opportunities for departmental administrators and decision-making committees to make judgments informed by data rather than relying exclusively upon their personal opinions or opinions of others.**

## METHODS AND RESULTS

### Psychosocial Learning Environment Evaluation Component

**The term learning environment carries with it a variety of meanings. It has been used to indicate a type of learning task (Tynjälä, 1999), to denote virtual spaces found in computer applications and on the Internet (Fulkerth, 2002), and to refer to the classroom psychosocial environment (Henderson, Fisher, & Fraser, 2000). In this paper the concept of environment refers exclusively to the psychosocial learning environment**

**that, in his foremost work, Moos referred to as the "social climate" and "personality of the environment" (1979, p. vii).**

**Learning environments research, just over three decades old, is firmly established (Fraser, 1998a; Goh & Khine, 2002) among a variety of educational research and evaluation methods dominated by the assessment of students' academic achievement (Fraser, 1998b). While quantitative measures of classroom effectiveness are often based on "narrow testable, standardized, superficial, and easily forgotten outcomes," other areas of higher education are less emphasized (Kyle, 1997, p. 851) and a complete image of the process of education is not formed within the research.**

**For this evaluation students in each of the online GIS classes were administered the *Distance Education Learning Environment Survey* (DELES). The DELES is a validated online survey (Walker, 2003) measuring six scales of the asynchronous online environment: (1) Instructor Support, (2) Student Interaction and Collaboration, (3) Personal Relevance, (4) Authentic Learning, (5) Active Learning, and (6) Enjoyment (an affective-trait scale). Two forms of the DELES were administered via an online survey. A *Student Form* was administered to students enrolled in the fall 2004 online GIS certificate classes. An *Instructor Form* of the DELES was administered to the two online instructors who each taught two of the classes. The purpose of administering two forms of the same survey is to compare students' perceptions of the online learning environment to that of their instructors. The aggregated program results of the DELES administration from the second week of classes are presented in Figure 1.**

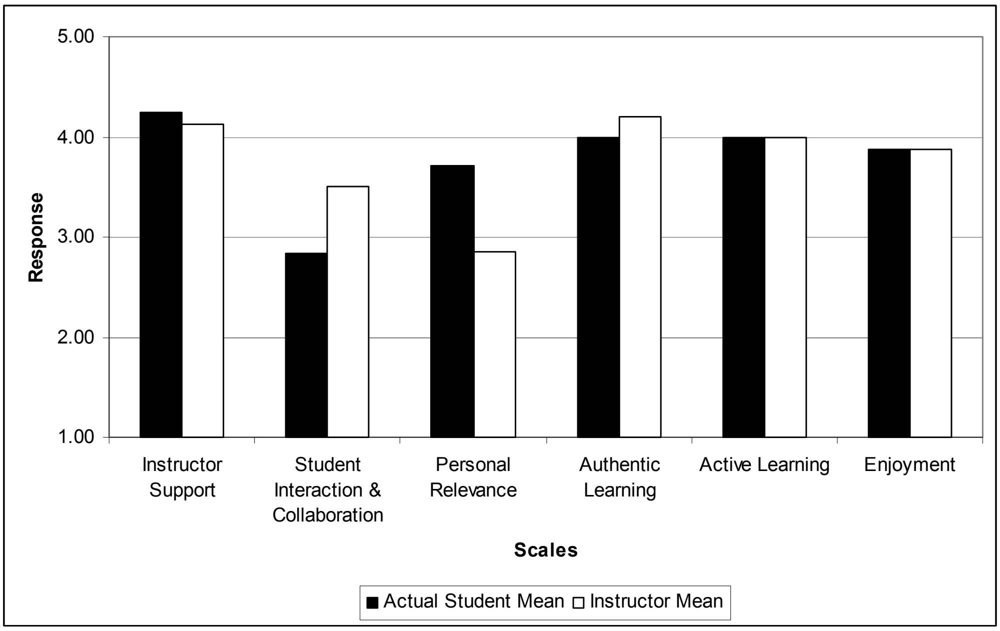


**Figure 1**
**Mean of all four online GIS certificate classes offered during fall 2004.**
**Student *n* = 17, instructor *n* = 2.**
**(Response scale: 5=Always, 4=Often, 3=Sometimes, 2=Seldom, 1=Never.)**

**Figure 1 presents a strong picture on the scale of *Instructor Support* whereby the students and the instructors all perceive the learning environment as *Often* including instructor support. On the scale of *Student Interaction and Collaboration* the students have a perception of the environment that is less than that of the instructors. In other words, the instructors have an inflated view of their work in creating a learning environment that has strong student interaction. On the scale of *Personal Relevance* the students' perceptions are strong; they rate the classes as *Often* being personally relevant. Personal relevance has been demonstrated as having the strongest association with student satisfaction in distance education (Walker, 2003).**

**Students and instructors perceive these online classes as *Often* being *Authentic*—that is, the extent to which students have the opportunity to solve real-world problems. Likewise, the students and instructors perceive the classes as *Often* offering opportunities for *Active Learning*. On the affective-trait scale of *Enjoyment*, the instructors and the students, for the most part, consider distance education as *Often* being enjoyable—a measure of satisfaction.**

**In relationship to the aggregate psychosocial learning environments found in the four Online GIS Certificate classes, there is room for addressing *Student Interaction and Collaboration*—the extent to which students have opportunities to interact with one another, exchange information and engage in collaboration. Student interaction plays one of the leading roles in online student satisfaction, retention, and outcomes (Walker 2003; Walker & Resta, 2002).**

### Content Analysis Evaluation Component

**In order to investigate parity between online classes and face-to-face classes, analysis was conducted regarding the subject matter of the online section of a fundamental GIS class as compared and contrasted to the content of one face-to-face section of the same class. The analysis is presented in Tables 1 and 2 unit-by-unit with grey cells representing content that is not equally covered in the variations of the class.**

**Table 1**
**Content comparison between online and face-to-face "lectures." Primary differences are highlighted**

| Unit | Online "Lecture" Content | *Face-to-Face Lecture Content* |
|---|---|---|
| 1 | **What geography means to GIS** | **History, and Applications of GIS** |
| 2 | **History of GIS** | **Scale and Projections** |
| 3 | **Scale** | **Types of data acquisition** |
| 4 | **Projections** | **Vector Data** |
| 5 | **Types of Data** | **Vector Data, cont** |
| 6 | | **Raster Data** |
| 7 | **Data Structures** | Databases, *TEST* |
| 8 | **Data Sources** | **Modelling** |
| 9 | **Data Input** | **Guest speaker** |
| 10 | **Evaluating Data Quality** | **Remote Sensing** |
| 11 | **Database Design** | **DEMs** |
| 12 | **Project** | **Data mining and visualization** |
| 13 | **Project** | **Project** |
| 14 | **Project** | **Review** |
| 15 | | *FINALS* |

**Although the terms used in each class vary somewhat, the primary differences between the online and face-to-face classes include the topics of, data input, evaluation of data, modelling, remote sensing, digital elevation models (DEMs), and visualizations. Furthermore, these two sections use different text books, complicating equal content coverage.**

**Table 2**
**Content comparison between online and face-to-face skill practice (i.e. labs). The primary differences are highlighted**

| Unit | Online Skill Practice Content | Face-to-Face Skill Practice Content |
|---|---|---|
| 1 | NONE | Personal Webpage set up |
| | | Introducing ArcGIS |
| 2 | Introducing ArcGIS | Projections |
| 3 | Working with ArcMap | Vector/Raster |
| 4 | Projections | Drawing and Symbolizing/Layouts |
| 5 | Drawing and Symbolizing | Data Acquisition |
| 6 | Working with Tables | Geocoding |
| 7 | Layouts | Tables and Queries |
| 8 | Queries | Joins and Overlays |
| 9 | Spatial Joins | Spatial Analyst |
| 10 | | Network Analysis |
| 11 | Overlays | *TEST* |
| 12 | Project | Project |
| 13 | Project | Project |
| 14 | Project | |

**Again, while the terms used by the instructors vary to a degree, the primary differences noted in Table 2 are that in the online version of the class the following content is not addressed: personal Web page development, data acquisition, geocoding, spatial analyst, and network analyst.**

***Observations*: In terms of equality in content coverage between online classes and face-to-face classes there are differences. However, there are also differences in content coverage (not shown here) when face-to-face GIS classes are compared from semester to semester and from instructor to instructor.**

### Cost Comparison Evaluation Component

**There are a variety of ways to compare the costs of asynchronous distance education classes to the costs of face-to-face classes (Geith & Cometa, 1999). For example, Internet telecommunications line charges, computer aided learning platform (ex. Blackboard, WebCT) software licensing fees, and production time could be figured. However, these detailed data (often buried in university-wide infrastructure costs) are often difficult to differentiate and are not considered in terms of the costs associated with online education in this evaluation. Likewise, the value of a classroom per square foot, photocopying, classroom presentation equipment, and computer lab hardware/software could be considered as part of the costs for face-to-face classes in direct comparisons with online classes. Nonetheless, for the sake of simplicity and rapid evaluation, these costs are not considered here. This review considers costs in a very basic way, being restricted to departmental salaries only.**

**Considering that there are four classes in this program, the total program cost in salaries for the online version, taught by doctoral-level students, equals approximately EUR10,350, while the salaries for the face-to-face versions, taught by full-time faculty, of all four classes adds up to approximately EUR29,970—a cost difference of EUR19,620. If a full-time faculty member making the mean assistant professor salary were to teach the online classes, the cost would increase to EUR21,940 for all four classes—a cost addition of EUR11,590. It is obvious that it is less expensive to the department to teach GIS certificate classes online using part-time Ph.D. students as instructors. However, course quality must be factored in along with simple cost measures.**

### Academic Outcomes Evaluation Component

**While student outcomes are one of the easiest and most common comparisons made between distance education classes and face-to-face classes because outcomes are one of the few consistent and measurable commonalities between the two methods of instruction, they must be considered in light of the many uncontrolled variables related to distance education. Likewise, assuming face-to-face classes are the ultimate standard by which learning should be measured in higher education is pretentious and can lead to a black-and-white view given what we know**

**about student learning and how higher education is traditionally conducted.**

**In terms of student grades, Figure 2 presents the distribution of all students' grades aggregated from 2001 to 2003 for online and face-to-face GIS certificate classes. The grades for the face-to-face classes follow a positive skew, likely characteristic of many university class grade distributions. However, the distribution of grades in the online classes follow a multimodal trend that is nearly the inverse of the face-to-face classes.**

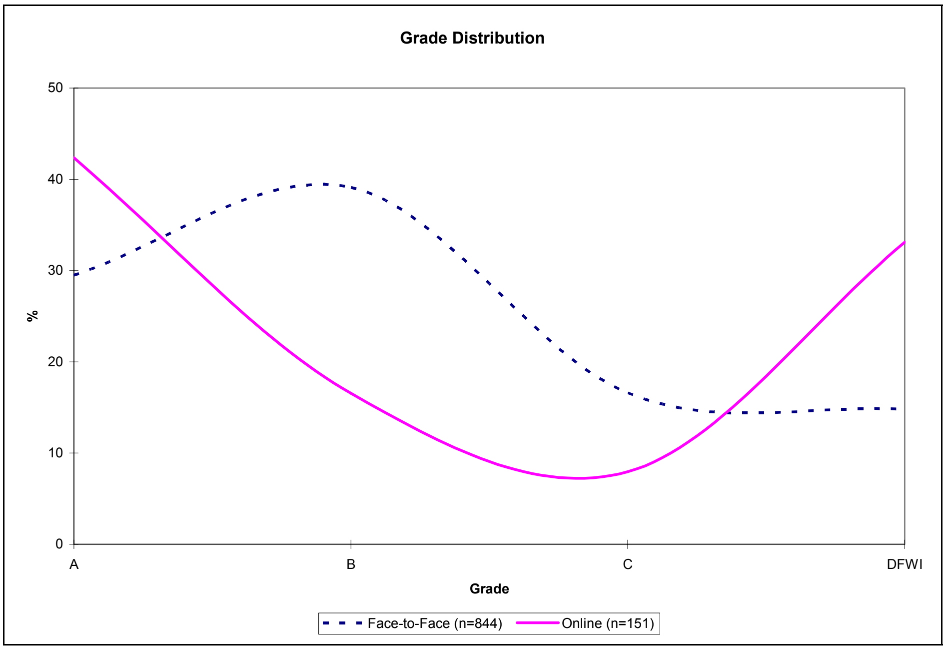


**Figure 2**

**Online GIS certificate class grade distribution 2001 to 2003. Face-to-face *n*=844; online *n*=151. (DFWI=Drop, Fail, Withdraw, Incomplete.)**

**Grade distribution characteristics demonstrate a large dichotomy between distribution of online class grades and face-to-face class grades, which is counter to what has been found in recent empirical studies elsewhere in distance education (Allen et al., 2004; Alstete & Beutell, 2004). The Figure 2 grade distribution comparison prompted a closer look at grades within the online program with the grades of "D", "F", "W" (withdrawn), and "I" (incomplete) broken out (Figure 3) rather than combined as they are in Figure 2.**

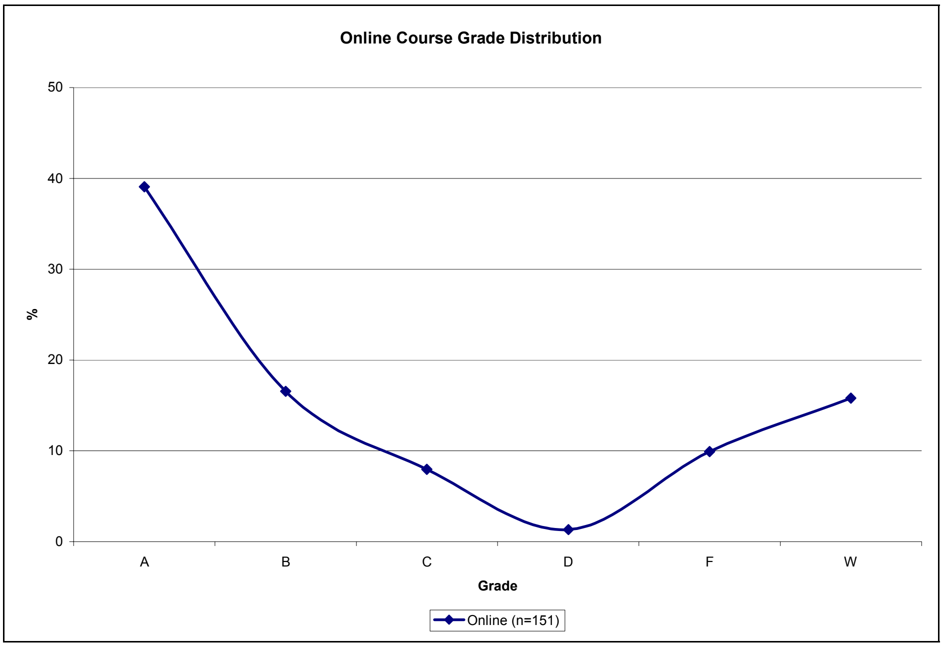


**Figure 3**
**Online GIS certificate course grade distribution 2001 to 2003 (*n*=151).**

**Figure 3 demonstrates that in the three years of score tracking in this program, there is a tendency toward high numbers of "A" grades, few lower "C" grades, almost no students dropping (D), yet 10% of the students failing. What stands out are the numbers of students who either withdrew themselves (W) or the instructor withdrew them for lack of participation/class activity. In short, in this program, either students are success or they are not. There appear to be few "average" students. This raises the question of "why?", given that in similar face-to-face classes the grade distribution curve is somewhat more normal.**

## Student Retention

**Regarding student retention in distance education, Table 4 presents a snapshot of student retention in face-to-face classes university-wide and in online classes university-wide as benchmarks for the online GIS certificate program. Table 4 also presents retention figures for face-to-face GIS certificate classes and online GIS certificate classes from the spring 2001 semester to the summer II 2003 semester.**

**Table 4**
**Student retention**

| | Face-to-Face Classes Percent Retention | Online Classes Percent Retention |
|---|---|---|
| University | 94 | 92 |
| GIS Certificate Program | 98 | 93 |

**Online GIS certificate course retention appears to hold consistent with university-wide retention rates for both online and face-to-face classes.**

**Benchmarking Against Other GIS Certificate Programs Evaluation Component**

**In order to benchmark the online GIS certificate program for the sake of placing it within the context of similar programs it was compared against 25 GIS certificate programs at four-year universities in the United States in terms of semester hours required and whether or not other programs are offered online.**

**The mean required semester hours of all of the GIS certificate programs considered is 19 semester hours, while the mean is only 16 semester hours for online programs. The online GIS certificate program under review in this paper requires 16 semester hours—consistent with other U.S. online programs. Regarding online program delivery, 20% of other U.S. university GIS certificate programs are online, while 16% of other programs are offered in some hybrid form of online and face-to-face. Sixty-four percent of the GIS certificate programs are not offered by distance.**

**The online GIS certificate program evaluated here is equal to other online programs' required semester hours.**

## CONCLUSION

**This paper has presented differing perspectives on distance education program evaluation, aside from class evaluation or evaluation of the results of a particular interdictions in a class. It provides a glance at contemporary ideas used in program evaluation in general and in distance education evaluation in particular. It has also presented the state of published program evaluation in distance education that remains challenged with low rigor and makes particular note of the fact that program evaluation in geographic distance education—particularly that of online GIS certificate programs—is lacking. However, multi-modal strategies are offered for measuring online GIS certificate programs. Judgment has been withheld due primarily to the fact that it is not the author's place to make judgments regarding this program, but rather to report on methods that work in one particular institution. While many of the six methods of evaluation are not novel by any means, when combined they provide administrators and decision-makers with an overall program outlook informed by non-biased data that should aid in more objective decisions.**

## REFERENCES

**Allen, M., Mabry, E., Mattrey, M., Bourhis, J., Titsworth, S., & Burrell, N. (2004). Evaluating the effectiveness of distance learning: A comparison using meta-analysis. *Journal of Communication, 54*(3), 402-420.**

**Alstete, J. W., & Beutell, N. J. (2004). Performance indicators in online distance learning courses: A study of management education. *Quality Assurance in Education, 12*(1), 6-14.**

**Chalmers, L., Dibiase, D., Donert, K., Hardwick, S., & Solem, M. (2004). Internationalizing online courses and degree programs in geography. Retrieved October 25, 2004, from http://www.gees.ac.uk/pigupapc.rtf**

**Commission of the European Communities. (2002). *eEurope 2005: An information society for all*. Accessed November 16, 2004, from http://europa.eu.int/information_society/eeurope/2002/news_library/documents/eeurope2005/eeurope2005_en.pdf**

**Diaz, D. P., & Cartnal, R. B. (1999). Students' learning styles in two classes: Online distance learning and equivalent on-campus. *College Teaching, 47*, 130-135.**

**Dille, B., & Mezack, M. (1991). Identifying predictors of high risk among community college telecourse students. *American Journal of Distance Education, 5*(1), 24–35.**

**Dumont, R. (1996). Teaching and learning in cyberspace. *IEEE Transactions on Professional Communications, 39*(4), 192–204.**

**Ehrmann, M. (1990). Psychological factors and distance education. *The American Journal of Distance Education*, *4*(1), 10–24.**

**Fraser, B. J. (1998a). Classroom environment instruments: Development, validity and applications. *Learning Environments Research, 1*, 7-33.**

**Fraser, B. J. (1998b). Science learning environments: Assessment, effects and determinants. In B. J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 527-564). London: Kluwer Academic Publishers.**

**Fulkerth, R. (2002, November). *Managing for course and program quality in the online environment*. Paper presented at the 2002 Teaching Online in Higher Education Conference, Fort Wayne, IN. Retrieved October 13, 2004, from http://www.ipfw.edu/as/tohe/2002/Papers/fulkerth.htm**

**Gaudet, C. H., Annulis, H. M., & Carr, J. C. (2003). Building the geospatial workforce. *URISA Journal, 15*, 21-30.**

**Geith, C., & Cometa, M. (1999). *Cost analysis results: Comparing distance learning and on-campus courses*. *Teaching, Learning, Technology Group*. Retrieved October 11, 2004, from http://www.tltgroup.org/resources/F_Eval_Cases/Geith_Cometa.htm**

**Goh, S. C., & Khine, M. S. (Eds.). (2002). *Studies in educational learning environments: An international perspective.* River Edge, NJ: World Scientific.**

**Grabe, M., & Sigler, E. (2002). Studying online: Evaluation of an online study environment. *Computers and Education, 38*, 375-383.**

**Gururajan, V. (2002). Knowledge management a new game in higher education: A discussion paper on the new trends of technology influencing the higher education landscape. In *Focusing on the Student. Proceedings of the 11th Annual Teaching Learning Forum*, 5-6 February 2002. Perth: Edith Cowan University.**

**Harnar, M. A., Brown, S. W., & Mayall, H. J. (2000). Measuring the effects of distance education on the learning experience: Teaching accounting via PictureTel. *International Journal of Instructional Media, 27*, 37-49.**

**Harris, R. (2003). Building a GIScience community in cyberspace: Reflections on GIScOnline. *Journal of Geography in Higher Education, 27*(3), 279-295.**

**Henderson, D., Fisher, D., & Fraser, B. J. (2000). Interpersonal behavior, laboratory learning environments, and student outcomes in senior biology classes. *Journal of Research in Science Teaching, 37*, 26-43.**

**Hiltz, S. R., & Wellman, B. (1997). Asynchronous learning networks as a virtual classroom. *Communications of ACM, 40*(9), 44–49.**

**Keegan, D. (1996). *Foundations of distance education* (3rd ed.). London: Routledge.**

**Kyle, W. C. (1997). Editorial: Assessing students' understanding of science. *Journal of Research in Science Teaching, 34*, 851-852.**

**Lægran, A. S. 2002. Geogra. pae nett–Interaktiv læring eller digital distribusjon? Om integrering av IKT i undervisninge n ved Geogra. sk institutt , NTNU. [Geography on the Net–Interactive learning or digital distribution? On the integration of ICT in teaching at the Department of Geography, NTNU.]. *Norsk Geogra. sk Tidsskrift–Norwegian Journal of Geography, 56*, 230–234.**

**Molenda, M., & Harris, P. (2001). Issues and trends in instructional technology. In R.M. Branch and M. A. Fitzgerald (Eds.), *Educational media and technology yearbook* (Vol. 26, pp. 3-15). Englewood, CO: Libraries Unlimited, Inc.**

**Moos, R. H. (1979). *Evaluating educational environments*. San Francisco: Jossey-Bass Publishers.**

**National Center for Education Statistics. (2003, July 18). *Distance education at degree-granting postsecondary institutions: 2000-2001*. NCES Number: 2003017. Retrieved October 25, 2004, from http://nces.ed.gov/surveys/peqis/publications/2003017**

**Olsen, J. K. (2000). Is virtual education for real?: Issues of quality and accreditation. *TechKnowLogia, 2*(1), 16-18.**

**Posavac, E. J., & Carey, R. G. (2002). Program evaluation: Methods and case studies (6th ed.). Englewood Cliffs, NJ: Prentice-Hall.**

**Pretorius, R. W. (2004). An environmental management qualification through distance education. *International Journal of Sustainability in Higher Education, 5*(1), 63-80.**

**Rovai, A. P. (2003). A practical framework for evaluating online distance education programs. *Internet and Higher Education, 6,* 109-124.**

**Scriven, M. S. (1981). *The logic of evaluation*. Inverness, CA: Edgepress,**

**Shea, T., Motiwalla, L., & Lewis, D. (2001 November/December). Internet-based distance education—the administrator's perspective. *Journal of Education for Business*, 112-117.**

**Skilbeck, M. (2001). Panel discussion: The e-learning revolution—Implications for academic work and university culture. In *Online learning in a borderless market*. Proceedings of a conference held 15–16 February 2001 at Griffith University Gold Coast Campus (pp. 59-63). Canberra: Department of Education, Training, and Youth Affairs.**

**Solem, M. N., Bell, S., Fournier, E., Gillespie, C. M., Lewitsky, M., & Lockton, H. (2003). Using the Internet to support international collaborations for global geography education. *Journal of Geography in Higher Education, 27*(3), 239-53.**

**Tynjälä, P. (1999). Towards expert knowledge? A comparison between a constructivist and a traditional learning environment in the university. *International Journal of Educational Research, 31*, 357-442.**

**Verduin, J. R., & Clark, T. (1991). *Distance education:The foundations of effective practice.* San Francisco: Jossey-Bass.**

**Walker, S. L. (2003). *Development and validation of an instrument for assessing distance education learning environments in higher education: The DELES*. Doctoral thesis, Curtin University of Technology, Perth, Western Australia.**

**Walker, S. L., & Resta, P. (2002 September). *Collaborating for online instruction*. Invited speakers for the 2002 Technology Leadership Academy Fall Institute, Technology Leadership Institute, University of Texas, Austin, Texas.**

**Westbrook, T. S. (1997). Changes in students' attitudes toward graduate business instruction via interactive television. *The American Journal of Distance Education, 11*(1), 55–69.**

**Wikle, T. A. (1999). GIS education through certificate programs. *URISA Journal, 11,* 53-60.**

**Woolcot, L. L. (1997). Tenure, promotion, and distance education: Examining the culture of faculty rewards. *American Journal of Distance Education, 11*(2), 3–18.**

**Worthen, B. R., Sanders, J. R., & Fitzpatrick, J. L. (1997). *Program evaluation: alternative approaches and practical guidelines* (2nd ed.). New York: Longman.**

## Author's Biodata

**Scott L. WALKER, ScEdD is an Assistant Professor of Geography, Associate Director of the Grosvenor Center for Geographic Education, and Associate Director of the Center for Texas-Mexico Applied Research at Texas State University-San Marcos. He has over ten years of experience developing, implementing, teaching, and being a student in online environments.**

## Contact Addresses of Author

**Scott L. WALKER, ScEdD**
**Department of Geography**
**Texas State University-San Marcos**
**601 University Drive**
**San Marcos, Texas, USA 78666**
**walks@txstate.edu**
**http://uweb.txstate.edu/~sw36/**
**Asst. Professor of Geography**
**Assoc. Director - Grosvenor Center for Geog. Ed.**
**Assoc. Director - Center for Texas-Mexico Applied Research**
**Phone: (512) 245-1724**