Authentic Learner Assessment in an Online Environment: Using Instructional Design Techniques to Create an Assessment Model for an Introductory Computer Science Course

by

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Abstract

Development of the Internet and the World Wide Web just a few years ago gave birth to new learning environments such as electronic distributed education. Neither early attempts to transfer traditional scientific assessment models to an online learning environment, nor efforts to transpose more modern alternative or authentic assessment practices have been highly successful. There remains little evidence that an ideal model for assessing learners in an online learning environment has emerged, particularly in an introductory computer science, information technology or computer applications course. The theoretical basis for the study derives from the current multitude of challenges to the problem of authentic assessment in online learning environments. Practice has shown that simply transferring face-to-face classroom assessment tools and methods to an online environment is inadequate and that such methodologies do not constitute authentic assessment in the online instructional environment. A close analysis of methodologies currently in use in online assessment can provide the basis for developing a model for authentic assessment in an online computer science course. In order to build an authentic assessment model, this study attempts to identify assessment methodologies used in an online learning environment that are effective in measuring learning, engage the learner, are integrated into the learning process, and promote further learning.

Dedication

This paper is dedicated to my dear wife, Kay, who has loved and supported me through this doctoral study as well as previous educational endeavors, and to my daughters, Kathy Stubbs and Alecia Dent, educators in their own right, and Rebecca Drummond, future stage star, for their love and encouragement.

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CHAPTER 1: INTRODUCTION

Authentic Learner Assessment in an Online Environment: Using Instructional Design Techniques to Create an Assessment Model for an Introductory Computer Science Course

Background

The Internet, which has been in existence for about two decades, began to extend into universities about fifteen years ago. Has education been revolutionized by the Internet? Hardin and Ziebarth (2000) respond, "Well, not exactly. It did provide an opportunity to expand learning options for teachers and students who were fortunate enough to have Internet access, a few computers and appropriate guidance on usage" (p. 2). In addition, the Internet has played a role in establishing new learning environments, and some educators believe that a revolution is taking place that cannot be ignored by educators or administrators. Mosaic, the first World Wide Web (WWW) browser for all three computing platforms (Unix, PC, and Macintosh) was released by the National Center for Supercomputing Applications (NCSA) in November 1993. The Internet and WWW in essence became one entity. Mosaic allowed even computer novices to locate multimedia information quickly and easily on the Internet. Students and educators alike could now bring text, images, sound, and video to their desktops. Tools for searching and integrating information became easily accessible.

> So what is the difference between the past two decades of computers and Internet access and the present, since even now WWW access requires computers and an Internet connection? The difference is that the Web represents information, and information cannot be disregarded the way computers can be ignored. Teachers cannot choose to ignore or have their students omit available information on any subject when the goal is for them to learn. A revolution is taking place in education. (Hardin and Ziebarth, 2000, p. 2)

The theoretical basis for the study derives from the current multitude of challenges to the problem of authentic assessment in online learning environments. One might theorize that

simply transferring face-to-face classroom assessment tools and methods to an online environment would be adequate. However, practice has shown that such methodologies do not constitute authentic assessment in the online instructional environment. The underlying theory is that many of the traditional learner assessment methodologies used in face-to-face instruction will not produce the desired results of authentic assessment in an online learning environment and that a close analysis of methodologies currently in use in online assessment can provide the basis for developing a model for authentic assessment in an online computer science course. Perhaps as valid as educators' concerns about which assessment type or methodology to use in the current online environment is the issue of assessing or measuring learner achievement in the first place. Baker (2001) states,

> Instead of focusing on the important scientific underpinnings of testing and assessment, I consider briefly the social roots of achievement testing, shaped in part by the work of well-known philosophers and social historians. One could argue that the ultimate course of testing in America was strongly influenced, as was the American Constitution itself, by thinkers from the Age of Reason. John Locke's (1690/1988) perspectives on objectivity, education, and liberty led directly to a form of government that was highly empirical in nature. Its guiding principle was simple and data driven." (¶ 4)

In Baker's view, measurement of learner capacity could have external implications.

> "Testing began with a multiple set of purposes, however individually pursued. All were grounded, at least in part, in an empirical view of the measurement of human capacity and in our ability to find external facts to confirm internal states. The ultimate goal of testing practice was to predict future actions of test takers." (¶ 12)

Willis (1998a) states, "Effective teachers use a variety of means, some formal and others informal, to determine how much and how well their students are learning" (¶ 1). Willis states further, "When teaching at a distance, educators must address a different teaching challenge than when teaching in a traditional classroom" (¶ 3). Absent from the distance teaching and learning environment are the traditional classroom, relatively homogeneous group of learners and the

feedback available through face-to-face interaction. Neither does the instructor have total control of the course delivery system.

According to Patton (2002), "Attention to program theory has become a major focus of evaluation research (see Rogers et al. 2000), and with that attention has come some confusion about terminology" (p. 163). Based on the teachings of organizational theorist Chris Argyris, Patton (2002) concludes, "The espoused theory is what people say they do; it's the official version of how the program or organization operates. The theory-in-use is what really happens" (p. 163). The theory-in-use is the subject of the current study—what faculty actually use to assess learning in online instructional environments.

Modern society is fully aware of and accustomed to testing and assessment, both in educational environments and in the workplace. In addition to all the assessment activities required of our learners from preschool through graduate school, employers bombard prospective and current employees with assessment activities to determine their skill and knowledge levels as they relate to their jobs, and numerous organizations that deliver skills training have devised assessment procedures to certify the attainment of those skills. Baker (2001) continues,

> The routine use of tests has gained increasing credibility among much of the public as the primary source of information about individual student performance, the quality of educational innovations, and the effectiveness of educational institutions. ... The focus on account-ability (using whatever measures are convenient) is another illustration of the American belief in the superiority of quantitative over less-standardized information and the complementary view that numbers are inherently trustworthy. (¶ 15)

Assessment and testing in the twenty-first century educational environment will definitely offer challenges that have yet to be determined. Baker (2001), however, suggests that the challenges can be met and states boldly,

> Assessment and testing are bound to be more important at the beginning of this century than they have been, even in the near past. Politicians have embraced testing as a pillar of

> the educational edifice. However, we must bring interpretive intelligence to bear on the results of tests. (¶ 32)

One solution offered by Baker is the use of technological advances that allow practitioners to adapt measurement of achievement to the learner. Baker states further that,

> Testing will continue to pose new challenges in this century. Expect the set of people who are routinely tested to change to include more and more adults as they wish to develop their skills or to re-certify themselves for employment or to change their careers. In a fast-paced world, testing will grow in its non-institutional base, enabling individual self-assessment and improvement. (¶ 36)

Moving a traditional face-to-face introductory computer science course to an online Web-based environment involves much more than placing a syllabus and some content pages on the university Web site. The writer has taught an introductory computer science course for several years at Mercer University and was selected to recreate the course during the fall semester of 2001 to be taught totally online or with as much Web-based content as possible. The recreation or development process began in September 2001, and course refinement continues. Of major concern to the instructor was determining strategies for hands-on laboratory exercises and online learner assessment. It was necessary to develop an assessment model that will be effective in measuring learner achievement and also will enhance or cause new learning. Therein lies the major challenge for the study.

Technology provides new ways of designing and delivering learning systems. It also provides new methods for assessing learning. Current modalities of learner assessment that were designed for traditional face-to-face instructional systems are inappropriate and often ineffective when transferred to an online distance-learning environment. Anderson, Bauer, and Speck (2002) conclude that two major questions face instructors in higher education who choose to move their courses to an online environment: "What do we need to know about grading student

work in the online environment? and What are ways we can do it" (p. 1)? The challenge for educators is to devise online assessment methodologies that not only are authentic, reliable and ethical but that also engage the student and enhance learning. Instructional design techniques can be utilized to integrate assessment practices with other learning strategies and activities to accomplish the real task of instruction: optimization of learning. Whether there currently exists such a methodology for an online learning environment was investigated.

The complexions of institutions of higher learning are changing. Green (2002) reports, "As in the past five years, survey respondents across all sectors of higher education identify 'assisting faculty integrate technology into instruction' as the single most important IT issue confronting their campuses 'over the next two or three years'" (p. 5). Almost a third of the responding institutions cite integration of technology into instruction as their key IT issue for the near future. The survey reports further that although institutions are struggling with technology planning and budgeting, overall use of technology to support instruction is on the increase. The data show an increase in integration of technology resources into instruction: 64.1 % of all college courses now utilize electronic mail, and 47.4 % of college courses now use Internet-based resources. "The survey data also highlight the growing role of the Web pages for individual classes: over a third (35.2 percent) of all college courses have a Web page, compared to 30.7 percent in 2000" (p. 7).

The Chronicle of Higher Education (Small colleges lag, October, 1997) reports that based on a survey conducted by the National Center for Education Statistics, small colleges are not yet as involved in distance education as large universities, but they may be closing the gap. *The Chronicle* states, "By next fall [1998], 90 percent of all institutions with 10,000 students or more and 85 percent of institutions with enrollments of 3,000 to 10,000 expected to be offering at least

some distance education courses, according to the survey" (p. A57). Among those institutions with fewer than 3,000 students only 43 % expected to be offering distance-education courses by the fall of 1998. More than 750,000 students were enrolled in distance education courses during 1994-95, and over 3400 received degrees exclusively through distance education. As soon as such data are assimilated and published, they tend to be out-of-date.

Learners have a strong incentive to enroll in distance courses or even courses with a Web component because of the convenience of anytime, anywhere access to engaging independent learning environments. Institutions are motivated by the possible market increase beyond their normal geographical boundaries. Recent technological innovations have overcome many of the barriers imposed by earlier distance education systems. "The word 'distance' simply means that the instructor and teacher are never in the same physical space. Instead, all interaction between teacher and student is accomplished 'online' through an Internet or intranet connection" (Lorenzo, 2001, p. 1). The distance education model is compelling in today's educational arena, but it also offers challenges that educators must work to overcome. All instructional activities and learner activities must focus on learning outcomes.

Byers (2001) states, "Instruction gains value when measurement shows that objectives have been achieved and learning has occurred. Making the measurement an integral part of class activity allows the identification of problems and consequent improvements even while the course is ongoing" (p. 359). Designing authentic assessment methodologies and activities for online learning environments is a challenge for instructional designers. The current movement from a teaching infrastructure to a learning infrastructure produces challenges for higher education, particularly for online or distance courses. Among the needs identified in the December 2000 Web-Based Commission's report to Congress and the President were the

following: the need to establish a pedagogical base for the effective use of Internet learning, and the need for an educational program that includes research, development and innovation and is built on a deeper understanding of how people learn and how new tools support and assess learning gains. It is important that learning environments are centered around knowledge, learners, social interactions, and assessment. A review of current literature leads one to believe that there are few well-established methodologies or models in the distance education environment to assess real learning online. The current research will review other research on methodologies currently in use for assessing learning online and attempt to integrate them into a new assessment modality that will meet the criteria for authentic assessment in an online learning system.

Several years ago EDUCOM'S National Learning Infrastructure promoted the idea that distributed instruction can increase the quality of learning, increase the access to instruction, and contain the cost of instruction. In recent years, distance-learning initiatives have become important elements of the learning environments in colleges and universities. There is no evidence that this trend will soon diminish. A study by the National Center for Education Statistics in 1995 reports that one third of the higher education institutions in the United States were offering some type of distance education courses, and another one quarter had made plans to offer distance courses within the next three years (Dewald, Scholz-Crane, Booth, & Levine, 2000). From the Campus Computing Survey previously cited, it is obvious that an even more pervasive trend has started.

Further evidence of the trend to electronic, online teaching, learning and assessment comes from the Web-Based Commission Report (2000). The Commission expresses concern

that even in our present global economy, the technology of the workplace has yet to reach the educational arena in like proportion.

> If this era of globalization has proven anything, it is that a growing world economy can create a strong and lasting demand for skilled knowledge workers and a technologically savvy work force. But we haven't made the connection to education. We must seize the opportunities and complete these connections—technological and human. And we must advance with constant assessment and reflection. There is still much about learning and the impact of technology we do not know. We must continue to research what is not known, analyze what is proposed or underway, and then examine the results. We also must combine our belief in the great value of these advances with appreciation for the difficulties that we face: the inequality of access and the lack of teacher preparedness for web-based learning. (p. 22)

The Web-based Commission expresses further concern over the lack of access to Web-based resources in many educational institutions. "Without broad access, there will be little demand for the innovative content and applications that can bring new teaching techniques and new assessment models" (p. 38).

According to the Web-based Commission (2000) report, instead of focusing on assessing learners in areas of knowledge and skill that will help to prepare them for the world of work, school learning environments often "Focus on the short term recall of facts, rather than opportunities for deeper building of knowledge" (p. 74). There seems to be little if any attention focused on the individual learner. The report strongly favors the use of technology in instruction and assessment of learning. "Technology can support what we now know to be more effective learning environments. Interactive applications linked to the Internet can provide environments better matched to support learner-centered, knowledge-centered, community-centered, and assessment-center conditions for learning" (p. 75). The Web-based Commission report suggests, however, that there exist some barriers in current methods of teaching and assessment that need to be overcome.

> Perhaps the greatest barrier to innovative teaching is assessment that measures yesterday's learning goals. It is a classic dilemma: tests do a good job of measuring basic skills, which, in turn, influence the teaching of these skills so students can score well on the tests. Testing works well so long as we are testing the right things. (p. 75)

New opportunities abound for the use of information technologies in assessment as well as in instruction. Much research has shown that embedding learner assessment into the instructional process promotes continuous learning. New assessment methodologies are required, however. The Web-based Commission (2000) report states, "However, the current forms of testing are not designed to measure how educational reforms, including those based on technology, can improve student understanding" (p. 76). Important in this assessment methodology is how assessment activities are designed and delivered. "Fortunately, development of sophisticated test construction, delivery, and scoring through new technologies will make it possible to do a better job of evaluating the skills we seek to build" (p. 76). The Web-based Commission not only approves Web-based assessment activities, but also recommends the practice for economical as well as other reasons. "Web-based test administration could bring significant cost savings in assessment expenditures" (p. 136). To achieve national educational goals in this area, the Web-based Commission recommends,

> Focusing on high payback targets of educational opportunity where present links between leaning theory and technological innovation appear particularly promising. These include such areas as new forms of assessment of learning, early reading content, and the conceptual stumbling blocks that impact understanding and achievement in mathematics and the sciences. (p. 147)

Statement of the Problem

Neither early attempts to transfer traditional scientific assessment models to an online learning environment, nor efforts to transpose more modern alternative or authentic assessment practices have been highly successful. Numerous methods have been tried, but there is little

evidence that an ideal model for assessing learners in an online learning environment has emerged, particularly in a computer applications course. The opportunity to influence learning directly is overlooked within the context of traditional assessment (Meyers, 1987). So researchers such as Bransford et al. (1987) provide arguments for moving away from traditional assessment and toward dynamic assessment procedures: First, traditional assessment is concerned with the products rather than processes of learning. Second, traditional assessment fails to address the responsiveness of an individual to instruction because it is based on the premise that prior learning adequately predicts future performance. Third, traditional assessment does not provide prescriptive information for designing potentially effective instruction. In general, traditional assessment does not recognize the learner's potential to succeed with adequate environmental support. The failure of traditional assessment has prompted researchers to search for assessment approaches designed to be more responsive to individual learners' potential strengths and weaknesses

Purpose of the Study

The study was conducted to identify best practices of learner assessment used in an online learning environment in an attempt to construct a model for assessing learners in an online introductory computer science or information technology course. The study identified assessment methods currently previously used in online learning systems. It analyzed and interpreted the aim and purpose of those methods and used the data to begin developing a proposed model for measuring learner accomplishment in an online introductory computer science or information technology course. This assessment model will attempt to integrate assessment into the learning experience, engage the learner, and promote further learning.

Research Questions

The study attempted to answer the following questions:

1. What features, tools and methodologies are currently used in assessment paradigms in courses in post-secondary education?
2. Which methodologies provide authentic assessment appropriate for an online learner assessment paradigm in an introductory computer science or information technology course?

Significance of the Study

There is a sweeping movement among distance educators to prove that their online teaching is effective. Colleges and universities are experimenting with various methodologies to assess their programs as well as to assess their learners. Carnevale (2001) states, "Indeed, assessment is taking center stage as online educators experiment with new ways of teaching and proving that they're teaching effectively" (p. A 46). There is a dearth of available studies that address the issue of best practices for assessing learners online. Most studies of assessment in online learning environments deal with assessing the appropriateness, effectiveness, or acceptability of the program itself rather than assessing learner achievement. There is mounting evidence that instruction and assessment must be integrated, particularly in an online environment, to engage learners and maximize learning. Speck (2002) takes the position, "If it is to be effective, assessment must be part and parcel of the entire learning enterprise and therefore is not a distant stage of pedagogical theory. Assessment must be integrated into a holistic view of pedagogy. This means that any theory of assessment presumes and informs a theory of learning" (p. 5).

To Whom Is the Study Important?

This study may prove important to online instructors in a variety of disciplines, but it was specifically important to instructors in the field of computer science and information technology. It will also be extremely important to instructional designers who work closely with content specialists or subject matter experts (SMEs) during the design and construction of an online course. This study could prove important to anyone teaching an online course or taking an online course in the sciences in which procedures are often the main context. It might be important to both the teacher and the learner in the sciences.

How Has the Study Extended or Created New Knowledge?

This study has provided guidelines for the construction of effective and reliable assessment methods during the instructional design process. The course development team will be able to appropriate components of the model as needed to fit their specific course objectives. Since instructional designers are not usually content specialists, they find it difficult to design appropriate assessment in an online environment without support either from experienced learning measurement professionals or other sound guidelines such as a "best practices" model.

What Was the Importance of The Study to the Learner's Specific Discipline?

Mercer University has been delivering online courses for only a few years. Specifically the university has been using WebCT as a course management system (CMS) since fall semester 2000. Currently there are not any computer science courses online. The course the researcher has developed is a pilot course. One of the most difficult components of this course to design was learner assessment because of the integration of theory and practical application in the course content. Although this course has been taught for several years as a traditional face-to-

face course with traditional assessment methods used, some of these methods may not be appropriate for an online environment.

Definition of Terms

1. Alternative assessments—Rasmussen and Northrup (1999) define alternative assessment as, "Rather a myriad of responses that are considered "correct," each dependent on resources, thought patterns, and processes as evidenced by the learner" (p. 71). Alternative assessments are methods of determining learner achievement other than with traditional end-of-unit tests where there is only one correct answer.
2. Appropriate assessment methodology—An appropriate assessment methodology is one which can be easily used in an online environment, measures learning, engages the learner, is integrated into the learning process, and promotes further learning.
3. Assessment—Assessment of student learning "Is a broad term used to denote the process of gathering data from multiple sources to make a judgment about student learning" (Glatthom, et al., 1998, p. 5).
4. Authentic assessment—Authentic assessment measures what learners can do with the knowledge they have gained. Wiggins's (1998) characterizes authentic assessment as assessment that:

> Is realistic, ... requires judgment and innovation, ... asks the student to "do" the subject, replicates or simulates the context in which adults are "tested" in the workplace in civic life and in personal life, ... assesses the student's ability to efficiently and effectively use a repertoire of knowledge and skill to negotiate a complex task, ... and allows appropriate opportunities to rehearse, practice, consult resources, and get feedback on and refine performances and products. (p. 23)

5. Quality assessments—"Quality assessments arise from and accurately reflect clearly specified achievement expectations for students" (Stiggins, 1999, p.21).

6. Sound assessments—"Sound assessments are designed, developed, and used in such a manner as to eliminate sources of bias that can distort the accuracy of results" (Stiggins, 1999, p. 23).
7. Paradigm—A paradigm is "A pattern , example or model of an overall concept accepted by most people in an intellectual community, as a science, because of its effectiveness in explaining a complex process, idea, or set of data" (Webster's, 1988).
8. Phenomenography—Marton (1994) describes this method as an approach for understanding how people experience the world.

Assumptions and Limitations

Assumptions for the study were as follows:

1. It was assumed that participants would understand the language of assessment and how to respond correctly to the questions.
2. It was assumed that participants would understand the structure and scope of the study and its implications.
3. It was assumed that all participants were objective and accurate in self-assessing the effectiveness of their learner assessment strategies and methodologies.
4. It was assumed that participants were objective about their own professional practice.
5. It was assumed that the data would reveal the use of authentic assessment.
6. It was further assumed that participants would complete the survey within the time frame given.

Limitations of the study were as follows:

1. Response burden is considered to be a primary limitation when collecting survey data. Response burden is usually quantified in terms of how long the survey takes to complete. Other aspects of response burden include how difficult it is to provide the desired information

and how sensitive the respondent is about providing the information. As Zukerberg and Lee (1997) suggest, "Completing a survey is often a novel experience for respondents" (p. 1). In order to lower response burden, careful attention was given to the following aspects of the survey: design and implementation of the survey instrument, explanation of terms, clear instructions for completion, length of survey, time required to complete the survey, anonymity of respondents, and password protection.

2. The audience of participants was limited to members and conference attendees of academic organizations whose primary focus is the integration of technology into instruction.
3. The participants were limited to instructors who teach introductory computer science, information technology or similar computer applications courses either totally online or with some online components.
4. The participants were further limited to instructors within the above groups who volunteered to complete the online survey after an initial e-mail solicitation to organization members.

CHAPTER 2: REVIEW OF RELATED LITERATURE

Patton (2002) suggests a reason for reviewing related scholarly literature in a qualitative study and states,

> For *scholarly qualitative* research, the published literature on the topic being studied helps bring focus to a particular study. Scholarship involves an ongoing dialogue with colleagues about particular questions of interest within the scholarly community. The analytical focus, therefore, derives in part from what one has learned that will make a contribution to the literature in a field of inquiry. That literature will likely have contributed to the initial design of the study (implicitly or explicitly), so it is appropriate to revisit that literature to help focus the analysis. (p. 435)

Several learner-assessment issues have been addressed in the literature: What is the role of learner assessment in an online, technology-rich learning environment? How can faculty devise assessment activities and instruments that will truly measure learning in an online, technology-rich environment? What previous studies have identified key characteristics of effective online assessment? Do the current assessment methods in online learning environments engage the learner in the learning activities and add to his or her knowledge and skill development?

What is the purpose, aim, or function of learner assessment? The terms *aim, purpose,* and *function* are used by different researchers and writers to identify what needs to be accomplished by learner assessment. What is the aim of assessment and how is assessment best used in an online instruction and learning process? "The central aim of all curricula, assessments, and instruction (the contributing components) is authentic learning (the central outcome)" (Glatthom, Buragow, Dawkins, Parker, 1998, p. 3). Assessment of student learning "is a broad term used to denote the process of gathering data from multiple sources to make a judgment about student learning" (Glatthom, et al., 1998, p. 5). The assessment process can take many forms such as: observation, interview, discussion, examination of student work and

products, test of knowledge, inspection of student performance and demonstration. Wiggins (1998) states strongly, "The aim of assessment is primarily to *educate and improve* student performance, not merely to *audit* it" (p. 7).

What is the purpose of assessment? "The report of the Task Group on Assessment and Testing (December, 1988) identified four purposes for assessment: formative, diagnostic, summative, and evaluative" (Drummond, 1994, p. 127). The most important function of assessment is to serve the interests of learners. Caine and Caine (1999) argue that every strategy and aspect of the education system needs to be assessed with the goal in mind of creating the conditions in which students are more likely to be intrinsically motivated and challenged. "A second inference from our brain/mind learning principles," say Caine and Caine, "is that anything that is going to be genuinely meaningful to a student *must* be embedded in an adequate amount of authentic, complex experience" (p. 11). Caine and Caine insist that only real world experiences in which an idea or skill was embedded lead people to learn anything to the point that it becomes "meaningful, useful, transferable, and available in spontaneous and unplanned context" (p. 11). According to Caine and Caine, assessment needs to be considered within the above context. At the very least, they contend, assessment should reflect what we as educators think the student should know.

Who is involved in learner assessment? "In evaluating student work and setting standards for performance and assessment, school educators and administrators are aided by others. College professors help develop and administer assessments that ensure students are prepared for college work, and business people help set specific performance standards and tasks related to business and professional needs" (Wiggins, 1998, p. 6). "In fact," insists Wiggins, "educative assessment is a community-wide affair, so teachers do not hesitate to ask for help

from anyone whose expertise might be valuable during a particular task" (p. 6). Wiggins reminds us also that in the world after high school employers and college admissions officers utilize prior assessments by devising various ways of interpreting portfolios of work performed while the candidates were students. From primary school through post-graduate work, educators are asking whether the traditional methods of assessing student achievement are adequate, fair, or even valid in today's educational environment of high technology, rapidly changing skill sets, and varied ways of learning. "We need to find new ways and new tools that will provide as many windows as possible into the subtle complexities of the mind," says Bridges (1995, p. 49). "Our goal as evaluators and teachers is to document, as richly as possible our students' learning and to accomplish this in a deeply thoughtful manner. To that end, we need to use an array of assessment tools from a variety of perspectives" (Bridges, 1995, p. 49).

Instructors use assessment for several purposes: to diagnose student needs, to grade student progress, to motivate students, and to evaluate the impact of their instruction. According to Stiggins (1999), student achievement should be assessed accurately, and the results of assessment should be used to the student's advantage. Integration of assessment and instruction is derived from the use of performance criteria as an instructional tool, and in order for that integration to be successful, the instructor must first understand the use of performance criteria as instructional tools and then create performance criteria that lend themselves to the necessary instructional uses. Stiggins identifies five standards for sound, quality learner assessment.

> Quality assessments arise from and accurately reflect clearly specified achievement expectations for students .... Sound assessments are specifically designed to serve instructional purposes .... Quality assessments rely on appropriate assessment methods. ...Quality assessments representatively sample student performance with enough exercises to permit confident conclusions about achievement. .... Sound assessments are designed, developed, and used in such a manner as to eliminate sources of bias that can distort the accuracy of results. (pp. 21-23)

It is important that we know how these standards apply to assessment. "Knowing precisely what we are asking students to master is important because different achievement targets require the application of different assessment methods" (Stiggins, 1999, p. 21). It is important to begin the assessment development process with a clear vision of what academic success means in that context. Throughout the schooling process, we expect students to know and understand subject matter that they learn from different sources. Some of it they should know outright, but some they should be able to retrieve from appropriate references. We expect them to be able to use previously gained knowledge to reason and solve problems. We want them to demonstrate mastery of specific performance skills because sometimes the "doing" is what is important. Often we expect them to use their knowledge, reasoning, and skills to create products that meet established standards of quality. "Because there is no single assessment method capable of assessing all these various forms of achievement, one cannot select a proper method without a sharp focus on which of these expectations is to be assessed" (p. 21).

"We cannot design sound assessments without asking who will use the results and how" (Stiggins, 1999, p. 21). Sound assessments can be a reliable source of quality information and immediate feedback for teacher, student and parent. The needs for assessment information at other levels differ, and because of these differences, it is important to begin each assessment event with a clear understanding of whose needs are to be met. Because students tend to make critical decisions on the basis of their interpretation of classroom assessment results, "it is the day-to-day classroom assessments that establish or destroy their confidence as learners" (p. 21). We have several different kinds of achievement that can be assessed such as knowledge, skills, and products. We already know that it is impossible to select a single assessment tool that will

reflect all the achievement types. Options include selected responses, essays, performance, and personal communications with the student. "Our professional development challenge is to be sure all concerned with quality assessment know and understand how the various pieces of this puzzle fit together" (p. 22). Since assessments rely solely on a relatively small number of exercises from which to draw inferences about a student's mastery of a larger domain of achievement, it is important that the assessment offers a representative sample of all possible types of exercises. The sample must be large enough to yield dependable judgments about the student's learning. Regardless of how careful assessment developers are in devising assessment tools, there are external factors such as the testing environment, problems with the test itself, problems with the student, or even student anxiety that can affect an individual learner's performance. In an online or distance environment, these problems offer an even greater challenge.

In recent years, the necessity of assigning either numeric or letter grades to student activities has encountered strong debate among educators. Arguments both for and against the practice abound in the literature. Kohn (1999) expresses a strong displeasure with the whole idea of assigning grades to student performance. "In my experience the most impressive teachers are those who despise the whole process of giving grades" (p. 39). Some teachers insist that grades are necessary to motivate students to study or work or learn. According to Kohn, researchers have discovered three consistent effects of using and emphasizing the importance of numerical or letter grades: (a) "Grades tend to reduce students' interest in learning," (b) "grades tend to reduce students' preference for challenging tasks," and (c) "grades tend to reduce the quality of students' thinking" (p. 39). According to Kohn there has been a series of studies in which students that were given numerical grades showed significantly less creativity than those who

received qualitative feedback but no grades. Kohn states that the most destructive form of grading occurs when teachers grade "on the curve." This form of grading artificially limits the number of top grades such that no matter how well all the students perform, not all of them can receive an *A*. The practical difficulties of abolishing grades altogether are probably quite real. Are those difficulties seen, though, as problems to be solved or as excuses for perpetuating the status quo? "The evidence indicates that the real problem isn't grade inflation, it's *grades*. The proper occasion for outrage is not that too many students are getting *A*'s, but that too many students have accepted that getting *A*'s is the point of going to school" (p. 41).

In his article *Grading Student Learning: Better Luck Next Time*, Ewell (2000) states, "The decision not to award a letter grade in student learning is the right one because there are no common benchmarks that would allow meaningful state-to-state comparisons" (p. 1). According to Ewell, the issue of what students learn in college has been of serious concern since the mid-1980s. Obviously, now that many colleges and universities are teaching courses with online components, assessing student learning in this new environment is also issuing challenges for today's educators.

A gradual move from scientific assessment to alternative or authentic assessment has been underway in American higher education for several decades. It is important to compare the nature of traditional assessment and authentic assessment. Numerous conceptual models of assessment abound that address what assessment means and its importance from accountability (summative), improvement (formative), and goal-based perspectives (Walker, 1999). Assessment can be thought of as an evaluation of the teaching and learning that takes place in the classroom as well as of student achievement in a subject area. Assessment also involves the process of gathering information. Thrash (1990) states, "Assessment should be seen as a means

of documenting that institutions are doing what they say they do and that students who complete their programs received what is promised. The emphasis should be on institutional quality and individual competence" (p. 391).

"Testing can be assessment but it need not be, and assessment can include testing but it need not. Assessment can best be described as the systematic collection and analysis of information from which to make a decision," declares McConnell (2000, p. 44). The dimensions of assessment include: purposes, assessment, methodologies, criteria for selection, quality of assessments, feedback, the teacher as assessor (background, time spent, and personal and professional characteristics), the teacher's perception of students, and the assessment-policy environment (Stiggins & Conklin, 1992). "The classroom assessment environment is not formed only by tests; it also encompasses all the exercises and opportunities arranged by teachers for observing and evaluating students, and sometimes, students' assessing each other" (Brookhart, 1997, p. 323). Quality and usefulness of feedback to students are strongly considered to be primary keys to effective use of learner assessment that enhances or causes learning.

"Traditional assessment practices are based on a model whose features are well known and understood, which we call the scientific measurement model. The scientific measurement model has led to an over-emphasis on statistical tests and the reification of single measure test scores" (Hager and Butler, 1996, p. 367). The scientific measurement model is challenged by such educational developments as problem-based learning, newer understandings of cognition, the rise of performance assessment, education for capability, portfolio-based performance assessment of teaching, and an increasing concern by cognitive theorists to assess how students actually proceed with problem solving and the solutions they reach. Recent developments such

as these seem to reflect widespread attempts by educators to reform assessment practice and thereby encourage more affective learning.

Traditional forms of learner assessment may not meet the challenges of teaching and learning in an electronic environment. Wiggins (1998) states, "Because each major test is a one-shot effort, and because much secrecy surrounds these questions and test scoring, conventional approaches to testing cannot provide what we most need in our schools: a way to help students systematically to *self-correct* their performance" (p. xi). Traditional testing adversely affects learning and performance. Wiggins argues, "A steady dose of simplistic tests in school then unwittingly teaches the student an incorrect view of intellectual performance in the adult world while undercutting the student's need for and right to user-friendly feedback from ongoing assessment on clear and worthy achievement targets" (p. 10). "But as long as assessment is conceived of as what we do after teaching and learning are over, and as long as it yields a hard-to-fathom score too late to be useful, assessment will never serve its primary client, the student, or its primary purpose, improvement leading to excellence" (p. 10). Wiggins concludes, "Our excessive reliance on short-answer and multiple-choice testing has landed us in a world I describe as 'teach, test, and hope for the best' (p. 10). "By contrast," Wiggins assures us, "if an assessment system were actually *working* to teach students, what would we see? We would see strong performance gain over time for *all* students" (p. 11).

Wiggins's (1998) characterizes authentic assessment as assessment that:

> Is realistic, ... requires judgment and innovation, ... asks the student to "do" the subject, replicates or simulates the context in which adults are "tested" in the workplace in civic life and in personal life, ... assesses the student's ability to efficiently and effectively use a repertoire of knowledge and skill to negotiate a complex task, ...and allows appropriate opportunities to rehearse, practice, consult resources, and get feedback on and refine performances and products. (p. 23)

Authentic assessment differs from traditional assessment in that it measures what learners can do with the knowledge they have gained. Bridges (1995) identifies several principles of authentic assessment:

> Authentic assessment is continuous, informing every aspect of instruction and curriculum building. As they engage in authentic assessment, teachers discover and learn what to teach as well as how and when to teach it. .... Authentic assessment is an integral part of the curriculum. Children are assessed while they are involved with classroom learning experiences, not just before, or after a unit through pre- or post-tests. ..... Authentic assessment is developmentally and culturally appropriate. ..... Authentic assessment focuses on students' strengths. Teachers assess what students can do, what they know, and how they can use what they know to learn. .... Authentic assessment recognizes that the most important evaluation is self-evaluation. Students and teachers need to understand why they are doing so that they may have some sense of their own success and growth .... Authentic assessment invites active collaboration; teachers, students, and parents work together to reflect and assess learning. (p. 8)

Assessing higher order learning in an electronic environment is a new challenge for some college and university professors. Educators are asking whether the traditional methods of assessing student achievement are adequate, fair, or even valid in today's educational environment of high technology, rapidly changing skill sets, and varied learning styles. "We need to find new ways and new tools that will provide as many windows as possible into the subtle complexities of the mind," says Bridges (1995, p. 49). "Our goal as evaluators and teachers is to document, as richly as possible our students' learning and to accomplish this in a deeply thoughtful manner. To that end, we need to use an array of assessment tools from a variety of perspectives" (p. 49).

Because the paradigms and methodologies of assessment of learner achievement in higher education cover a broad spectrum, the researcher will attempt through the literature review of assessment paradigms to answer the following questions: What features, tools and methodologies are currently used in authentic assessment paradigms in post-secondary

education? Which of these methodologies seem appropriate for an authentic online learner assessment paradigm in an introductory computer science or information technology course? The literature review will attempt to identify those methodologies with features, characteristics, and activities that seem appropriate for in an online instructional environment. Current methodologies used in traditional instructional environments but do not seem to fit well into the online environment will also be identified. The literature review combined with the survey of faculty teaching computer science, information systems, or similar courses online will attempt to identify methods of authentic assessment appropriate for online learning environments, particularly in the computer science, information systems, or computer applications disciplines.

It is important in attempting to answer the research questions to define authentic assessment. Wiggins (1998) suggests, "Authentic assessment is true assessment of performance because we thereby learn whether students can intelligently use what they have learned in situations that increasingly approximate adult situations, and whether they can innovate in new situations" (p. 21). Authentic assessment refers to assessing a learner's mastery of knowledge content by his or her performance, or "demonstration of mastery" (p. 42).

Another term used frequently in current literature is alternative assessment. Alternative assessments are methods of determining learner achievement other than with traditional end-of-unit tests where there is only one correct answer. Most of the assessment methodologies described in this review will fall into the alternative assessment category. According to Rasmussen and Northrup (1999) alternative assessment is, "Rather a myriad of responses that are considered "correct," each dependent on resources, thought patterns, and processes as evidenced by the learner" (p. 71). Jacobs and Chase (1992) state, "Most faculty continue to use the traditional in-class, closed-book paper-and-pencil exams to measure their students' learning.

They rarely have the time or the motivation to investigate alternative assessment procedures. A number of alternative techniques, however, have been used effectively in classroom assessment" (p. 123).

Current Methodologies that Could Be Applicable in an Online Environment

Of the most commonly used authentic online assessment methodologies, the researcher has identified the following group as those that seem most appropriate for online learner assessment in an introductory computer science or information technology course: open book and open notes, repeated testing, assessment based on course objectives, outcome- and performance-based, interactive activities, and continuous assessment. Various studies were reviewed under each methodology.

Open-Book and Open-Notes Assessment

One recommendation by Jacobs and Chase (1992) is the use of open-book, open-notes exams in classes where the exams consist of mathematical problems that require the use of formulas, tables, or graphs for their solution.

> The emphasis in open-book exams is on knowing how to use the references to solve the problems or answer the questions, rather than trying to memorize formulas or other material. Instructors believe that open-book exams promote a different type of study. Students must be able to apply knowledge rather than just memorize facts. Such exams better reflect real-life situations, where we are able to use references to solve problems. (p. 123)

Jacobs and Chase reflect on the use of oral examinations as an alternative for face-to-face assessment. "Oral examinations that measure students' knowledge of course material are rarely used in undergraduate education today" (p. 124). Oral testing was used early in this century, but because grading of oral exams is subjective, professors may be influenced by external factors in

evaluating a student's responses. Jacobs and Chase, however, suggest one possible benefit of oral exams, "They do provide flexibility lacking in some other types of classroom tests" (p. 125).

Repeated Testing

Another alternative assessment methodology reviewed by Jacobs and Chase (1992) is the process of repeating an assessment or testing exercise. "A number of studies indicate that retaking an alternate form of an exam benefits most students." (p. 128). "Under these plans, students typically have unlimited opportunity to retest until they can demonstrate mastery of the material covered on the unit preceding the test" (p. 128). Researchers Davidson, House, and Boyd (1984) report that students who were allowed to retest experienced reduced anxiety and opportunities to learn from their mistakes. Cates (1984) reports that there are fewer complaints and arguments about test scores and final grades with the retesting option and that students think it is a fair procedure.

Both of these alternative methodologies can be adapted to an online teaching and learning environment. Rather than open-book tests, however, threaded discussions might prove more appropriate for providing opportunities for learners to develop responses to questions both from their prior knowledge and from available references. The option of repeating a test is quite easily adapted to an online environment in which self-tests can be made available as frequently as a learner needs to review his or her mastery of material.

Assessment Based on Course Objectives

In a study of instructional design issues in distance learning courses, Dewald, et al. (2000) described assessment methods appropriate for an active learning environment and suggest that pedagogical objectives, or "the ultimate purposes of the learning experience" (p. 37) are the most important aspect of instructional delivery. Although some concepts may be delivered quite well

through static Web pages, others such as the learning from discussion of abstracts may be better suited to other delivery methods such as electronic mail, threaded discussions, or chat sessions. "In some cases, an instructor might want to choose one primary delivery method, while having other methods serve as learning reinforcement tools" (p. 37). According to the study, the active learning environment is well suited to distance learners. Task-oriented learners will benefit from the hands-on approach of using the online systems that will be needed for their educational success. "Active learning encourages the already high motivation of the student, rather than discouraging it with mere electronic page turning" (p. 38). Active learning increases retention of learned concepts and is therefore an important element of distance education.

The *Report of the Web-based Education Commission to the President and the Congress of the United States* declares in part, "We know from this research that learning environments should be centered around knowledge, learners, social interactions, and assessment" (2000, p.74). Because the Internet has no defined structure, it provides a quite suitable environment for learners to construct data or knowledge from vast resources. It is an ideal medium for problem-based learning activities because they ask a learner to, "1) refine a statement of a problem, 2) contrive or develop a sense of the structure of knowledge and reasoning relevant to the problem, and 3) go find the information needed to solve the problem" (Web-Based Commission, 2000, p. 6). Alley and Jansak (2001) state,

> The online classroom also greatly facilitates meta-cognitive thinking because the course site is a cumulative archive of all that has transpired in the class. After all, you cannot run a search on all in-class discussions. Nor do verbal exchanges accumulate into organized discussion threads, such as occurs naturally on the web. (p. 11)

"The No. 2 pencil," that trusty companion of generations of test takers, "may be an endangered species," states Greenberg (1998, p. 26). The computer mouse and keyboards are

now performing the electronic equivalent of filling in blanks and bubbles and writing essays. Greenberg suggests, "In its more sophisticated applications the computer is far more than a glorified substitute for a pencil and paper. It is changing the nature of test taking and the way we measure knowledge" (p. 26). Although electronic testing looks promising, according to Greenberg it is not a panacea for assessment woes in higher education. There are issues of fairness as well as security. However, several benefits arise from electronic online testing. "Ideally it is a highly efficient, thorough, flexible and precise way of measuring knowledge and skills" (p. 26). Interactive tests can be customized for individual learners. Another major advantage of computerized testing is the speed with which tests are graded and feedback immediately delivered to students and instructors. "Online tests can be scored instantly (for all but essay questions)" (p. 26). In contrast, paper-and-pencil tests may require several days or weeks before grading is complete. "Online test scores can then be used as a diagnostic or learning tool" (p. 27). Student progress can be easily analyzed electronically, weaknesses identified, and specific remediation or review recommended. "Some computerized tests include sound or graphics – or even interactive simulations that seek to replicate real-life workplace situations" (p. 29). These types of online assessment activities allow learners to rehearse activities they will find themselves doing in their careers after graduation. Greenberg reports on how several specific teachers are using online testing. In particular, Judy Vierra, who teaches a computer applications course, provides online tutorials through which her students work at their own pace. When they complete the tutorials and feel ready to take a test, they receive written instructions to open a test document online and complete the test. Vierra then checks the students' performance online.

> In this constructivist environment, students and teachers do not exist in a vacuum where performance is measured by an end-of-unit traditional test where there is only one correct answer. Rather a myriad of responses are considered 'correct,' each dependent on resources, thought patterns, and processes as evidenced by the learner. (Rasmussen & Northrup, 1999, p. 71)

When both instructors and learners become frustrated with traditional assessments, instructors have looked to the use of alternative assessments, especially to measure students' higher-order thinking skills.

Outcome- and Performance-Based Assessment

Assessment of learner outcomes continues to be a major challenge for the higher education community. Current literature indicates that online education is more learner-centered and outcome-focused than traditional education. It should, therefore, be in a better position to assess student learning than a traditional educational system. College and university educators are experimenting with new ways to teach as well as with new ways to prove they are teaching effectively. However, according to Carnevale (2001), "Education researchers caution that distance educators are still in the process of proving that they can accurately assess anything, and that comparatively few distance-education programs are actually participating in the development of new testing strategies" (p. 5).

The University of Phoenix Online uses a model whereby learners are grouped in courses throughout an entire degree program and given batteries of exams at the beginning of the program and after its completion. Not only does the university utilize the test results to evaluate student learning, they also use them to evaluate the courses (Carnevale, 2001). Much of the assessment of distance-education is geared toward students who are in the workforce and involves assessing their learning while doing. Student projects are used to show learner

understanding of the subject material and its application to real activities. Another popular assessment tool in distance education courses is the standardized test that can be administered online, generally in a proctored environment near where the learner works or lives.

Both Western Governors' University and the University of Phoenix Online are quite adept in creating assessment methods, but so are other distance-education programs such as those at Excelsior College, Pennsylvania State University's World Campus, Thomas Edison State College, the State University of New York's Empire State College, and University of Maryland University College (Carnevale, 2001). There is growing evidence much of higher education is moving toward outcomes-based assessments. Online education seems to be leading the way. Perhaps critics use a different standard for judging the quality of distance education because it is relatively new.

"There is increasingly a convergence of thought among decision makers that institutions must begin to reshape their services and products by focusing more effectively on outcomes" (Fodor, 2001, p. 366). In his examination of outcome-based evaluation (OBE) for online courses, Fodor defines OBE as "the measurement of results" (p. 366). OBE identifies observations that demonstrate changes in a credible fashion. According to Fodor, OBE is quite appropriate for online instructional or learning environments. Among those elements required for properly structuring OBE, Fodor includes realistic and measurable learner outcomes, and outcomes that are related to learning activities.

Students in some courses are required to perform complex procedures that demonstrate skills or ability to create a product or to demonstrate the ability to apply knowledge and skills previously learned. Jacobs and Chase (1992) state, "Designed to measure such objectives, performance tests enable faculty to observe the process of performing the task as well as the

finished product" (p. 134). As with other assessment methods, instructors should clearly state the objective of the performance as the student begins preparation for the exercise. "Clearly stated objectives will help counteract one of the major drawbacks of this type of assessment, namely, subjectivity" (p. 134). It is important also for the instructor to define or describe the conditions under which the activity will be performed. "All evaluations of performance should be guided by an evaluation instrument. Having an instrument ensures that the same criteria are considered for each student's product or performance" (p. 135). These evaluation instruments may include such devices as checklists and rating scales.

Arter (1999) looks closely at the role of performance criteria and integrating assessment and instruction. Teachers are asked more now than ever to assist students in acquiring more complex skills and to track how students are progressing toward mastering those skills. Arter recommends the use of clearly defined and explained performance criteria as a way to improve teaching and learning and suggests,

> Rubrics can certainly help teachers assess such skills, but more important, tantalizing preliminary evidence show that developing and using performance criteria can also improve instruction, student attitudes, and learning – even to the point that performance assessment materials and methods can be used to help students acquire the very skills being assessed. The use of performance criteria as an instructional tool thus integrates assessment and instruction. (p. 25)

Interactive Assessment

What is interactive assessment? Byers (2001) defines interactive assessment as "a set of Classroom Assessment techniques applied through the course, using technology-based data collection and analysis to promote dynamic feedback, which allows course corrections, to use the latest computer jargon, on the fly" (p. 362). Continuous assessment and feedback are necessary to provide both the learner and the teacher with information by which to improve the

effectiveness of teaching and the quality of learning. Byers's study measured learner achievement using online technology as a tool to integrate measurement into the learning activities. "When the flow of the course is affected by active assessment results, 'interactive assessment' may be a more descriptive term, implying that learner-initiated response to course materials directly effects change" (p. 359). According to Byers, we can think of interactive assessment as a construct that permits course improvements through collaboration with the students themselves rather than merely a summative tool. Adjustment during an ongoing course "has the advantage of using the students as teaching resources and enriching their learning by demonstrating to them that their participation in the course has a real educative application" (p. 359). Excellence in teaching is a common goal of faculty who work hard and long in material preparation and in striving for the best possible delivery of each portion of course content. Byers states, "However, after delivering the carefully prepared instructional material, unless an objective assessment tool is used to measure the effective contribution of the chosen approach to student learning, the faculty have to rely only on their instinct to judge how successful the teaching is" (p. 360). One should hasten to add that a critical measure of teaching effectiveness or success is the degree of learning accomplished by the students.

Designing and implementing online assessment tools for ongoing activities is time consuming and perhaps complex at times. Immediate feedback to the learner is most important in order to effect change in the learner's behavior. "The use of technology or more specific Web-based environments can not only provide adequate means to optimize assessment activities but also make available other resources to enhance learning and teaching" (Byers, 2001, p. 360). The research studies that show a positive influence of technology on learning indicate the changes may be in the enhancement of new or different kinds of learning rather than in significant

differences in direct learning between technology-based and face-to-face-face teaching. "Using the technology itself to better measure its effect on the ongoing teaching/learning activities seems to be not only appropriate but the next logical step to pursue" (p. 360). Current literature emphasizes that simply porting old methods to an online environment will not be productive. It is important to recognize the Web as a medium for introducing new ways of learning and as such is a powerful learning resource. These new ways of learning need to be put into practice. "The discipline responsible for directing these new ways of learning is instructional design. The process of instructional design precedes, includes, and is much broader than mere instructional delivery" (p. 361). Instructional design has long been a critical tool in construction and delivery of knowledge, and its essential role remains the same even though the technology with which it is used has changed. Its use in designing and delivering assessment activities follows the same pattern.

Alley and Jansak (2001) describe the relationship of core principles of learning and best practices in instructional design and their translation into online courses. Use of best practices in instructional design is applicable to the development of online assessment activities. They state, " A principle (of learning science) is applicable to nearly any formal learning situation, independent of the delivery medium" (p. 4). One of the basic premises of the current study is that assessment properly integrated into the learning process is another learning opportunity. While the assessment content of their study relates primarily to assessment of the quality of existing courses, some of the principles for the instructional design of quality pedagogy apply to learner assessment as well.

Most educators and employers place a much higher value on the three higher order levels of learning (as described in Blooms Taxonomy of Educational Objectives). The "level of

learning" that a student achieves on this scale of 1-6 is strongly linked to the extent of his involvement in the learning process (e.g., not just passive listening). "Good instructional design does not "over feed" the student by providing all the "answers." The best teaching leaves some things untaught. It prompts the student to exert creative effort to acquire new knowledge by constructing these cognitive links." (p. 7).

The Internet and World Wide Web are well-suited to online instructional and learning systems that prompt learners to construct knowledge by accessing and using the vast store of information available online. "Humans learn action-oriented competencies by doing. The proof of having acquired such competencies is the ability to replicate them through performance" (Alley & Jansak, 2001, p. 13). The act of doing promotes learning and reinforces prior skill and knowledge development. "'Doing' helps to transfer new knowledge from short term memory to long term memory" (p. 13). Performing real activities acts as formative assessment. "Good instructional design does not substitute active, expressive, demonstrable experiential learning with the passive intake of knowledge. It preserves some element of action and experience in the acquisition of action-oriented competencies (p. 13).

Fodor (2001) insists, "Interactive assessment implies a dynamic process based on objective results rather than on faculty's feeling of success or failure after delivering instructional material" (p. 367). Interactive assessment is deemed by some to be ideal for learner-centered instructional environments. Fodor states,

> The learner-centered environment is widely accepted as the optimum educational paradigm. This paradigm implies that the students themselves are the primary learning resource, which means that the instructor, as the designer of the learning environment, must sincerely and proactively seek the students' needs and opinions about their learning, respond in a timely and effective fashion, and constantly inform the students about what actions are being taken and why. (p.367)

The Internet and World Wide Web are experiencing an explosion of use and adaptation to online learning environments. These media offer learners the opportunity to take more control of their learning experiences. Bonham, Beichner, Titus, and Martin (2000) studied computerized assessment with a "focus on the marriage of computerized testing systems with the World Wide Web to produce Web-based Assessment and Testing Systems (WATS)" (p. 28). In their study, Bonham et al. looked at learner services as a course component that "(1) can be accessed from any standard browser and Internet connection, (2) can password-authenticate the user, (3) can grade student work automatically, and (4) can keep a permanent record of student scores" (p. 28). "A major characteristic of anything done on the World Wide Web is flexibility in time and location. Information can be sent and retrieved from any location in the world at any time of day or night as long as access to the Internet is available" (p. 30). Use of the World Wide Web in presenting assessment activities to learners allows the presentation of any digital format such as text, images, video, sound, animations and simulations. Assessing learner achievement does not have to rely solely on responses to written questions. An option such as allowing learners to select from several question formats enhances the authenticity of the assessment process. "Students may be presented with different material or problems depending on other information, such as previous submissions" (p. 32).

It is important that assessment be interwoven into the overall course design so that it enhances the learning experience. According to Walker (2000), an important question is, "Do students' answers show that they are locating appropriate material, acquiring appropriate facts and skills and then making appropriate interconnections" (p. 180)? Walker studied the behavior of students in an online information technology course designed in such a way that the "structure and assessment policy sought to "impel" students to acquire and deploy learning skills that would

stand them in good stead after graduation" (p. 173). "It can be argued, with justification," says Walker, "that those working in this sector (distance learning) have, by the very nature of open and distance learning, to be more aware of the need to help their students to become more effective learners, and that successful open- and distance-learning courses are doing just that" (p. 174). Learner assessment in Walker's study included a combination of summative continuous assessment consisting of written assignments, computer graded multiple-choice assignments, and a final examination.

Quality assessment is critically important in an online environment. In his study of teacher education programs, Neilsen (1997), observed:

> Distance education programmes are capable of turning out substantial numbers of novice or upgraded teachers; less clear is whether they turn out teachers of acceptable levels of quality. The latter issue is complicated by the fact that defining and measuring "quality" are both daunting problems for which there are no standard solutions. Increasingly, however, teacher educators are beginning to define programme quality in terms of the graduate's ability to teach well, that is, to create the conditions under which students, all students, can learn for understanding. (p. 1)

Quality assessment, according to Nielsen, must demonstrate the extent to which students have acquired knowledge, skills and dispositions necessary for their field. Nielsen describes at length three assessment or examination systems: external examination systems, internal examination systems, and continuous assessment. The continuous assessment approach to learner assessment, according to Nielsen, "requires students to master certain blocks of instruction before being allowed to go on to the next" (p. 6). Assessment can be done via written tests, observations, oral exams, completion of assignments, or group products. Nielsen suggests, "The advantage of continuous assessment is that it allows participants to proceed at their own pace" (p. 7). Evidence indicates that continuous assessment strategies avoid the pressures and cramming that

are often associated with final examinations. Continuous assessment can also cover a wide range of content areas and assessment strategies (Nielsen, 1997).

The research of Benigno and Trentin (2000) focused on the peculiarities that distinguish evaluation digitally delivered through online courses and traditional distance education. In developing their methodology, they emphasized "the use of computer conferencing systems which allow the creation of virtual environments that foster interpersonal communication and collaborative learning" (p. 260).

> Furthermore, because the key element in online courses is participant interaction, course evaluation entails some of the indicators typically adopted for evaluation of face-to-face courses, indicators that are strictly linked to the sociality of the process (participant interaction, tutor-participant interaction, participation and collaboration levels in course activities). (p. 260)

> Evaluating online courses poses a series of issues at various levels. Two aspects are of particular significance: the first is evaluation of learning, and the second is evaluation of the participants' performance, both in terms of time spent online and activities effectively carried out at a distance, either individually or during computer conferencing. Indeed, it is thanks to computer conferencing that online courses have a lot more feedback data to draw on than do traditional distance courses. Consider the possibility of analyzing course messages (number and content), automatically compiled log files, and the periodic production required of participants (reports, short essays on the contents of course modules, projects, etc.). (p. 262)

These researchers conclude, "The proposed framework is chiefly suited to project-based courses, namely those based on design activities, performed in unison with the acquisition of course contents" (p. 267). Their framework, based on computer conferencing, could have beneficial use in an online introductory computer science course in which students are required to create documents, spreadsheets, database files, and multimedia presentations.

Continuous Assessment

Thorpe (1998) studied how the use of computer-mediated communication in association with continuous assessment impacted students' study experience. She focused on assessment as

"the process of judging students' learned outcomes and assigning grades to individuals based on these outcomes" (p. 266). Thorpe agrees that assessment is integral to the learning process and that it can also have unintended consequences for the learning environment. "Tasks which are misconceived may undermine achievement of the explicit learning goals which are the objective of the whole activity. Students who experience failure or disappointing grades carry negative emotions about their experience into their future learning" (p. 266). Assessment must be integrated into the teaching and learning process as well as into the instructional design. It must not be an afterthought. Curriculum design, assessment and evaluation begin at the same point and are integral and equal components of the instructional system. Several important forms of communication are associated with the way knowledge is presented: face-to-face (both audio and visual), printed text, audio, television, and computing (which includes all elements of multimedia, sound, video, images, animation, and text). Any of these media can be delivered via different technologies that are currently in use. "It is important to remember these distinctions between media and technology, and the capacities for carrying complex human interaction which are different combinations of media and technology" (p. 268).

Most of the major assessment methodologies reviewed above are considered to be authentic assessment practices. Some are more easily transferable to an online introductory computer science course than others. In particular, those that utilize the online electronic environment extensively, are interactive, continuous, and measure the learner's skills and abilities as well as knowledge of course content are quite appropriate. Probably the most useful, according to the literature, are the following: open book assessment, assessment based on course objectives, and outcome- and performance-based assessment.

Other Assessment Methodologies Currently in Use

Assessment of Student Journals

Student journals have long been used extensively in courses such as English composition. They are becoming more popular in other disciplines. In journaling,

> Students are directed to record their reactions to reading assignments and other class sessions, to put down the ideas they have trouble understanding, to list questions and speculations about the material, and to look for connections between the course content and material previously learned. Essentially, the purpose of the journal is to increase students' learning by encouraging them to think about the subject matter. (Jacobs & Chase, 1992, p. 131)

The journals may take on many different forms as dictated by the subject matter and instructor expectations. Some journals are graded while others are not graded. "While faculty may not agree on whether they should grade journals, they do agree on the value of using peer critiquing. Having peers respond to their work broadens the audience for whom the students are writing and provides specific feedback on their thinking" (p. 131). If journals are to be graded, however, clear and specific criteria for grading must be identified at the outset.

Electronic journals are quite easy to use as a methodology for online assessment. Learners can simply submit their journals periodically in sections or as a final document file at the discretion of the instructor. The instructor can either read the entire electronic document or scan it for key concepts that demonstrate a learner's understanding of course material.

Assessment by Collaborative Testing

One form of learning that has had a great deal of hype in higher education over the past few years is collaborative learning. As a result, collaborative testing has also become an innovative testing strategy. One such technique for collaborative testing is group testing in which small numbers of students are allowed to take tests together. "Although they consult with

one another, the students turn in individual answer sheets. Faculty who have used this method find that it has several advantages. When students disagree over answers, they set about teaching one another the concept in question. And students will not sacrifice their grades; they have to be convinced of an answer they disagree with" (Jacobs & Chase, 1992, p. 129). Murray (1990) reported that when the students who used the group-testing strategy took an individual, in-class comprehensive final exam, they achieved mean scores consistent with their previous group exam grades and with class averages from previous semesters.

Students are generally rewarded for working independently of their classmates. Hardin and Ziebarth (2000) state, "Traditionally, schools and classrooms have tended to discourage many forms of collaboration" (p. 3). They insist, however,

> In contrast, success in graduate school, business, or life in general relies on collaboration and teamwork. The traditional education system being more evolutionary that revolutionary, is unlikely to transform itself anytime soon into an environment that teaches and encourages collaboration as a part of learning; emerging technologies, however, can catalyze this change much sooner than it would happen otherwise. (p. 6)

According to these researchers, the introduction of NCSA Mosaic "caused a 100,000-fold increase in WWW NSFnet backbone traffic and brought in millions of users, thus creating a market for the dozens of commercial browsers that subsequently have been introduced" (p. 8). The World Wide Web as it exists today is capable of handling a wide variety of media types, browsers, and server environments. Established standards make it possible for educational institutions to integrate all of these tools into a framework for using collaborative methods of instruction and assessment. These researchers state, "The Web has become a condensation point for virtually every advanced technology developed over the last two decades by the computational sciences and computer science communities" (p. 10).

Individualized computer-based learning has provided new opportunities for learners who want and need access to learning environments at times and places different from the normal face-to-face, large group, class schedules of most colleges and universities. Bernard and Lundgren-Cayrol (2001) state,

> From its earliest application to education and training, the computer has been viewed as a medium best suited for delivering instruction to individual learners. The first attempts were simply computerized adaptations of text-based programmed instruction, which itself had been heavily influenced by the theoretical perspectives of behaviorism. According to this view, learners were considered to be infinitely malleable, and so the role of the instructional system was to shape their response behaviors toward mastery of content." (p. 242)

A primary goal of instructional systems design is to develop digitally delivered instruction that is truly individualized and even customized for the learner. In contrast, collaborative learning environments provide a new approach to learner assessment in the online environment. Rather than individualizing learning, collaboration brings learner knowledge, skills, and abilities together during the learning and assessment process. Bernard and Lundgren-Cayrol express the results of their study of collaborative online learning in three phases. "In the first phase, students are motivated to explore the environment and they get to know their peers. In the second phase students elaborate and work together with the content. In the third phase they evaluate their learning processes as well as the products of their learning" (p. 258).

Portfolio Assessment

Electronic portfolio assessment can take several forms. Li (1999) recommends having learners create electronic portfolios in the form of disks or CD-ROMs as a way to assess their learning. However, for online courses, electronic documents submitted to a password protected online depository folder would be much easier for learners to accomplish and also permit revisions as needed. Arter and Spandel (1992) define a student portfolio as "a purposeful

collection of student work that tells the story of the student's efforts, progress, or achievement in [a] given area" (p. 36). Arter and Spandel (1992) state, "The portfolio has been used most often to assess writing in English, but instructors in many disciplines are having students prepare a portfolio of their writing relevant to the objectives of the course. Because portfolios contain a collection of student work, they provide a better picture of a student's achievement in a course" (p. 133). Belanoff and Elbow (1986) identify the following strengths of portfolio use for assessment: (a) instructors are able to assess students' abilities to write different types of academic assignments, (b) instructors are able to assess students' skills for revising their writing, (c) collaboration is encouraged between student in instructor, and (d) instructors are able to ascertain where students need help and intervene in the students' writing processes.

Self Assessment

Self-assessment is becoming a popular methodology of measuring learner achievement, especially in a distance or online environment. According to Ingram (1994), the remoteness of distance learners in relationship to the source of the instruction., the lack of formal learning situations experienced by some distance learners, and fewer opportunities for informal interactions increases the need for self assessment. Ingram concludes that self-assessment activities and opportunities should be built into instructional systems for online or distance delivery.

Taylor (1998) states, "Self assessment, the process of understanding more about oneself is a valuable skill, both in life and when studying. That fact is acknowledged regularly in the many descriptions and models of instructional design currently expounded." (p. 319). There are various techniques to structure self assessment depending on the purpose for the assessment. Journals and diaries may encourage learner reflections on affective or metacognitive

development. Various types of tests or exams can encourage learners to examine their own cognitive development. Gale (1984) in a review that discussed self assessment purposes indicated that "... overcoming isolation, promoting active learning, controlling learning behaviors, providing diagnosis and remediation, and focusing responsibility for learning on the students were all important reasons for development and integration of self assessment into learning experiences" (p. 319).

Taylor (1998) reports on a self assessment system named Self Test "that was designed primarily for distance students with the particular goal of providing students with a means to diagnose their preparedness for a subject or to ascertain their mastery of particular topics" (p. 320). Taylor suggests that many of the current self-assessment systems are not designed to account for learner diversity or different approaches to study that learners have already developed.

> As a consequence many students are often unsure of when they really 'know' an answer. Self assessment systems that provide students only with model answers or solutions as a *fiat accompli* are often not useful to students ... . Further, systems that use a right/wrong approach to assessment do not allow for situations in which a student is nearly correct, i.e., the part marks situations that expert markers often use. And finally in many instances there is more than one correct way to solve a problem ... it was obvious that a self-assessment system was required that: allowed for instant feedback on diagnostic or self assessment items; allowed students to use a range of solutions methods to solve problems; provided students with instructions on how to use model answers; allowed students to be credited for successfully mastering some of the content within a single question." (p. 320)

Taylor concluded, "The positive responses from the many students who participated in the program indicate that students are ready for such innovations in distance education" (p. 327).

Resource-Based Learning Assessment

Colleges and universities are rapidly adding information technology resources and tools to their courses as a resource based learning environment. Assessment of learning, however, may

not yet be in step with the instructional activities. "The challenge for course developers is how to support students appropriately in this new way of working, and in this context, the design of assessment is an important consideration" (MacDonald, Mason, & Heap, 1999, p. 346). Many educators recognize that assessment can produce learning. "It therefore follows that assessments are most likely to be effective in supporting student learning where they reflect the aims of the course" (p. 346). In courses that are designed to teach specific skills or methods of performing work, "an effective assessment structure must not only cover course content, but also reinforce the skills which students are expected to acquire" (p. 346). Clearly, many current assessment practices do not reflect the rapidly changing teaching and learning models, particularly those in an online or distance environment. Innovative assessment practices have been shown effective in enhancing or causing learning in these environments. It is important that the assessment activities be designed to reflect a level of learner achievement that is realistic.

Other challenges exist as well, according to MacDonald, et al. (1999). "Resource based courses encourage a particular study behavior in terms of the use of a wide variety of resources, and so the assessment of course content is problematic: How is this content to be defined, in terms of quantity, validity or depth" (p. 346)? The research described by MacDonald, et al., was aimed at establishing how assessment could support learning in an online Open University type environment. These researchers found that online collaboration could be effective once the management of group dynamics came under control. "The use of electronic information resources for study, particularly Web based information, is becoming increasingly common, and courses using this approach need to consider how best to support student learning in this context" (p. 351). MacDonald et al. identify two areas of concern: content definition and effective study skills needed for a resource based approach:

> Clearly effective assessment must cater for the use of a large information source, by allowing for flexibility in the requirements for content, whilst at the same time assisting the students to arrive at some focus in terms of what is most important. Second, assessment must support the process of study, particularly in terms of information handling, but also the development of more general higher cognitive skills, and in this case, computer conferencing skills." (p. 352)

Shepard (2001) states that many reasons exist for alternative forms of learner submission of assignments, particularly assignments that involve multimedia projects or activities. "Many subjects and research methodologies use images extensively" (p. 161). It is evident from Shepard's work that the submission of assignments in digital format is a viable alternative for online or distance learning environments.

> Reproducing images as evidence of raw data alongside a text or numerical summary of results may lead to better description by the author and better visualisation, recognition and identification by the reader. Educators also realize the value of formative assessment to the learning process and submitted assignments are replacing examinations in many institutions at all levels." (p. 161)

It has also been shown that formative assessment can provide a vehicle for "guided discovery." "These processes encourage students to acquire and use information from a wide range of media and it is likely that the learning process undergone by students benefits from more that just an analysis of text. It makes little sense, therefore, to restrict assessment to text or even to the use of electronic formats with limited storage capacity" (p. 162).

Miscellaneous Electronic Assessments

Shepard (2001) believes that delivery of assignments on CD is a credible method for achieving desired educational objectives and currently offers more communications capacity than Web solutions will for some time to come. The availability of CDs and their adaptability to any platform make them ideal vehicles for integrating multimedia and other objects from a variety of sources for submission. Shepard emphasizes the importance of adhering to copyright laws when

having learners download images, text, video or other elements from the World Wide Web. "It is reasonable to assume that anything worth copying has already received copyright protection and to act accordingly" (p. 163). Although Shepard believes the use of CDs for assignment submission is currently superior to the Web, he states that the CD is likely to be replaced by other forms of media for student activities and assignments. "It is unlikely to have either the longevity or the historical impact of notepaper and it will probably be the forerunner of simpler electronic communication" (p. 167). According to Shepard, there are strong pedagogical implications to using this type of assessment of learner achievement. "Assignments that encourage the use of multimedia and make use of the CD enable the diversity and interactivity of multimedia to impinge directly on the experiences of learners in higher education. That approach may be relatively new to most practitioners of higher education but its pedagogical advantages have been debated for a number of years" (p. 169). Use of new methods of submission and assessment of learner assignments indicate a willingness of instructors to incorporate assessment into learner-centered instruction. "By providing the learner with new ways to access and manipulate information and, through the medium of assessment by assignment, encouraging the learner to use new ways, tutors in higher education are on the threshold of significant educational change" (p. 169).

Buchanan (2000) studied the value of formative assessment in an online instructional environment. Evidence abounds that many colleges and universities employ the Internet and the World Wide Web in their educational activities in both online and face-to-face courses. "Quite apart from the much-hyped emergence of 'Virtual Universities' offering portfolios of online courses in which teaching and assessment are conducted remotely via the WWW and associated technologies, Internet-mediated teaching and assessment is increasingly being used to

supplement traditional courses (e.g. Stockburger, 1998; Gibbs et al., 1998)" (p. 193). "The value of formative assessment—that is, assessment which is used to provide feedback to students rather than to evaluate them for course grades—is well known" (p. 193). Appropriate and timely feedback on performance allows the learner to correct improper study or performance habits and improve his or her learning. It is extremely important that feedback is timely so the learner can act upon it while it is relevant to the current learning period. According to Buchanan, giving computerized multiple-choice tests is a viable methodology. In his study of a World Wide Web-mediated assessment package, he identified a major feature that differentiates this methodology from others. The feedback given learners does not include the correct answers to items they missed. Instead the system provides references to the appropriate sections of text where they can locate the correct answer. This process engages the learner more fully than a system that automatically provides correct answers. Buchanan concludes that the study "seems to have demonstrated that use of a WWW-based formative assessment, when an integral part of a course syllabus, seems to be associated with superior performance" (p. 197).

Edwards, Fernandez, Milionis, and Williamson (2002 state, "Assessment is an ongoing process that evaluates samples of completed student assignments to determine whether the underlying curriculum effectively produces the desired learning outcomes" (p. 102). The Electronic Assessment and Storage Tool (EAST) system as described by Edwards et al. was designed "to reduce the labour involved in gathering artifacts for assessment purposes and to provide long-term storage of artifacts in a paperless environment"(p. 97). Students submit artifacts or assignments to the system; the system then attaches identifying student information and stores the artifact for assessment by one or more instructors. Probably the most critical

component of the EAST system is that students control the release of artifacts for review and assessment.

Morgan's (1995) study focuses on the use of project-based learning activities in distance education to determine how they might make a distinctive contribution to the improvement of student learning in an Open University (OU) course. Unlike other studies, the question of this study is "how can course design and assessment in distance education be developed to encourage students to tackle their studies so as to ensure "quality" in the learning outcomes" (p. 121)? Morgan agrees that the idea of "quality" is a highly contested concept and that different stakeholders in the teaching and learning process will put forth different definitions. Course design and assessment techniques have been shown in many studies to influence students' approaches to learning. Morgan's approach concurs with Biggs (1994) who summarizes the aspects of course design as likely to foster deeper learning under the following four key elements: motivational context, learner activity, interaction with others, and a well structured knowledge base. Much of what Biggs writes regarding conventional education is applicable to distance education and open learning environments. Morgan states, "... and it seems particularly relevant when the boundaries between conventional education and open and distance education are rapidly becoming blurred" (p. 121). Morgan suggests that course design in distance learning environments centers around structured correspondence teaching text "... which includes activities in text and self-assessment questions" (p. 122). Morgan concludes, "Although many distance educators may not now subscribe fully to the origins in behavioral psychology, the aim is still to influence students study behaviors in such a way that it is deemed to be necessary for them to gain a complete understanding of the text" (p. 122). The aim of the assessment structure

described by Morgan is to ensure that students and their instructors communicate regularly throughout the assignment or project process.

Some researchers emphasize the importance of integrating course design and assessment in online courses. One approach to this integration is the process of phenomenography. Marton (1994) describes this method as an approach for understanding how people experience the world. He defined the approach as "the empirical study of the differing ways in which people experience, perceive, apprehend, understand, or conceptualize various phenomena in, and aspects [of], the world around them" (p. 4425). Jones and Asensio (2001) state, "The experience of a student in a networked learning environment is clearly related to the design of the environment and the course. It is not clear however, what the relationship is" (p. 314). When instructors and students are separated by space, whether across campus, across town, or across the country, documentation of student learning and the interpretation given to the documentation are critical issues. Jones and Asensio state further, "It has been argued that there is a relationship between the approach adopted by a teacher and the students' experience" (p. 314). Jones and Asensio studied the relationship of course design and the student's experience with the qualitative research approach of phenomenography. According to their explanation, "The aim of phenomenography is to describe qualitatively different ways of experiencing phenomena..."(p. 315). Jones and Asensio found in their research that the issue of assessment in distance or online learning environments is problematic for course designers. The learner's view of assessment also plays a role in the learning process. In working with course designers and other practitioners and after reviewing their work with assessment in networked learning environments, Jones and Asensio conclude,

> This preliminary work with practitioners draws attention to the use of assessment criteria. Because practitioners of networked learning believe they can affect student behavior by altering assessment criteria amongst other features of course design, it is worth examining the students' understanding of assessment requirements in detail. Structures in a networked environment rely on being interpreted by student in such a way that the intentions of the course designer will be realised in the students' practice. (p. 317)

Jones and Asensio suggest that practitioners and students don't necessarily interpret assessment in the same way. Jones and Asensio conclude, "It points to a general problem with assessment criteria that no document however detailed or clear can provide for the interpretation given to it by a reader" (p. 320).

Various journal articles and research documents have described both the benefits of and the problems encountered with the use of computers for assessing student learning. Stephens (2001) states, "The term Computer Assisted Assessment (CAA) ... can include the assessment-related activities found in activities such as Computer Aided Learning (CAL), Computer Based Learning (CBL), Computer Aided Instruction (CAI), Computer Based Testing (CBT), and Computer Assisted Testing (CAT)" (p. 266). Objective exams, particularly multiple-choice-questions, tend to be the previous and current choice for computer delivery. However, there is some evidence that this type of assessment may not work best in various scientific fields. Meijer, Elshout-Mohr, and van Hout-Wolters (2001) state,

> For quite some time now it has been emphasized in educational science that the acquisition of knowledge is not of sole importance for learners. Apart from knowledge, they should acquire general skills as well ... The necessity to teach general skills has also received increasing attention among educational policy makers. The thought behind this is that in a society, which undergoes continuous change, it is important that students are capable of functioning properly by means of general skills, in the sense that they will acquire new knowledge by themselves and solve problems independently. Students who do not only acquire knowledge at school, but also learn these types of skill will profit from this in their further school careers and later lives. (p. 79

In their study of cross-curricular skill development, Meijer, et al. developed the Cross-Curricular Skills Test (CCST). These researchers discarded self-reporting instruments and performance-based testing in favor of a multiple-choice test that they concluded through a literature review could assess critical thinking. Although their data "showed that the CCST is appropriate for assessing students' overall proficiency in the eight represented cross-curricular skills," the researchers determined that one problem encountered is that paper and pencil tests do not measure the same skills that a real life situation would measure.

The instructor who is developing the assessment model concurs with conclusions of Meijer, et al. (2001). It has been his practice to test computer science skills with real-life activities and has determined that paper and pencil tests are not appropriate for assessing skills students are expected to develop in an online introductory computer science course. Learners' abilities to work with computer applications are best assessed with real-life activities.

The practice of reviewing answers and changing them on paper-and-pencil tests is a common behavior and it seems to have been studied by researchers from many years. According to Vispoel (2000),

> Taken as a whole, this research shows that a small percentage of answers is typically changed, that more answers are changed from wrong to right than from right to wrong, that a large proportion of examinees change answers to at least some questions, and that most examinees who change answers improve their scores by doing so. (p. 371)

It is common practice on paper and pencil tests, both written and "bubble in" types, for the learner to review his or her answers during the exam period and change answers about which he or she might have second thoughts. "Such options, however, are far less common on computerized tests, especially when the test items are administered adaptively based on the examinee's performance on previously answered items" (p. 371). Some test givers express

concern over the additional time that might be required for review and revision of answers online as well as possible reductions in measurement precision. Other concerns such as complications in item administration algorithms and reduced test score validity have arisen. Vispoel suggests that arguments against answer review on CATs "do not apply as strongly to computerized fixed-item tests (CFITs) because all examinees get the same items on these tests" (p. 371). Vispoel's view is that review may increase test score validity because examinees have an opportunity to correct incorrect answers resulting from typing errors, misread items, and misconceptions. According to Vispoel, his study is one of the few that addresses the effects of item review on computerized fixed-item achievement tests. He concludes,

> The results continue a long and consistent trend of findings about answer-changing behavior on objective tests that date back well over half a century. When given the opportunity to review and change answers, a large proportion of examinees will do so, but they will generally change answers to only a small proportion of items. These changes typically benefit examinees because their number [of] correct scores and/or ability estimates improve slightly on average and their wrong-to-right answers changes outnumber their right-to-wrong answers changes. This pattern of answer-changing behavior seems to hold regardless of whether examinees are taking paper-and-pencil or computerized tests. (p. 376)

Gretes and Green (2000) studied the affects of using computerized practice tests in and undergraduate education course and report the results of their study in terms of "non-instructional uses of educational technology for improving student achievement" (¶ 1). Gretes and Green report that computers have been used in various contexts for the past several years such as: record keeping drill and practice exercises, tutoring, programming exercises and others as well as automated testing. "In the context of education, the most general use of computers has been to enhance students' learning, from elementary through graduate school. In this respect, technology promises to be an effective learning aid" (¶ 2). They report that the use of computers in the area of assessing student achievement is growing, in both of the following assessment methods:

computer-based testing which replicates paper-and-pencil test content, and computer adaptive testing in which computer-selected items are presented from larger item pools. There is a major concern that computerized testing used for student assessment demonstrates equivalence with paper-and-pencil tests. "However, computer-based testing can be used for pedagogical purposes other than student assessment per se. For example, it could contribute to students' class performance by providing direct feedback about the adequacy of their studying and learning" (¶ 4).

Carbone, Schendzieborz, and Zakis (2000) report on the development and deployment of a Web-based multiple-choice quiz generator called CADAL Quiz. The goals of the development and deployment of this application include: reducing assessment costs, reducing learner cheating, maintaining records of learner achievement, and encouraging metacognitive learning. Advantages of the system include the ability to display assessments results to the learner immediately after completion of a self-test and can be hidden during a regular test until all learners have completed the test. The study involved the incorporation of CADAL Quiz into a first-year computer science course.

Thorpe's (2000) study on learner reflection in distance learning suggests reflection can be a viable component in a model for assessing online learning. According to Thorpe, course design that is oriented toward supporting the learning process and that includes assessment that incorporates reflection as a major criterion for success can provide the basis for an online assessment model. In her support of the distance-learning environment, Thorpe states,

> Distance Education has always suffered from detractors who base their critiques on weak or poorly implemented cases of provision. Thus the narrow behaviorism of some providers, with instrumental texts and little interaction, has served for some critics to signal that distance education per se must always be a form of spoon feeding and rote learning. This is as helpful as damning face to face education on the basis of the low

> quality of many lecturers and seminar leaders and the passivity of the participants. (p. 145)

Thorpe suggests, however, that there are both strengths and weaknesses in all forms of instruction and learning, regardless of the environment. Until recent years, distance education was built around individual study and prepared course materials. That structure often highlighted some of the weaknesses of learning on one's own with limited learning resources. New Web-based delivery methods and Computer Mediated Communication (CMC) have generated much excitement in recent years in distance learning environments. According to Thorpe, reflection

> Has developed as a means through which people develop relationships between what they already know and value, and the learning in which they currently engage. It should therefore engage the learner in a reflective process.... Reflection can thus be identified as a particular kind of thinking and feeling in combination. (p. 146)

Thorpe identified three perspectives of reflective learning: Experiential learning, perspective transformation, and cognitive monitoring and metalearning. As an assessment strategy, reflection is affected by the explicit goals of the course and cannot be simply an add-on. "Reflective strategies also need the commitment and response of tutors" (p. 157). The task of responding appropriately to learner reflective comments is challenging, and instructors must be willing to dialogue with learners in order to facilitate learning. Thorpe concludes, "However, reflection is not something that can be added into course design, formulaically. Each course team or learning designer faces anew the creative task of working out how an explicit emphasis on the students' own learning process can be expressed through the course at hand" (p. 157)

Inadequacies of Some Current Assessment Practices

Over a decade ago, Astin (1991) lamented the inadequacies of learner assessment. "The inadequacies of current student assessment practices have been responsible to some degree for the emergence of two trends in American education" (p. 2). He identifies those trends as (a)

widespread criticism of contemporary assessment practices in national reports on higher education and an increasing number of institutions that have undertaken major revisions in their learner assessment activities, and (b) the increased interest of governmental agencies in *outcomes assessment* and *accountability* in postsecondary education. Astin states, "As commonly used today, the term *assessment* can refer to two very different activities: (a) the mere gathering of information (measurement) and (b) the utilization of that information for institutional and individual improvement (evaluation)" (p. 2). Astin differentiates these two activities by how they are used. "Evaluation, of course, has to do with motivation and the rendering of value judgments" (p. 2). According to Astin, many instructors sometimes give course examinations because our institution requires us to give grades, and making students take exams is a simple method for arriving at a basis for awarding a grade.

> Under these conditions, we professors are merely measuring and not evaluating, since the evaluating is done by others: by the college registrar who determines whether the student should be put on probation or awarded honors, by the students who are trying to judge their own academic progress, and by the employers or graduate and professional schools who use college transcripts to help them make employment or admission decisions. (p. 3)

Instructors might also see some benefit in evaluating the information generated by examinations. "We might want to gauge the effectiveness of our own pedagogical efforts or to decide what kind of written or oral feedback to give to our students in order to facilitate their learning of the course material" (p. 3). "Students might be interested in evaluating their own test results for the same reasons: to know their strong and week points in order to become more effective learners" (p. 3).

The second type of assessment, *evaluation,* is the subject of the current research. The interest here is in developing appropriate assessment for online courses, particularly in an introductory computer science course, that will accomplish the goals stated above. Classroom

assessment is one of the major categories of assessment identified by Astin (1991). "Three major forms of assessment are involved here: course examinations, assessment of course projects (homework, term papers, etc.), and course grades" (p. 10). It is easy to see that course grades may be generated from any of the various forms of classroom assessment, but are the grades meaningful? "Some educators believe that the mere use of these classroom assessments can facilitate the talent development process by serving as incentives for the student to learn." (p. 11). Astin expresses strong concern regarding the benefit of course grades as they are currently used when he states, "Besides their relativistic quality, course grades also reflect little of what the student has actually learned in the course" (p. 11). In the practice of evaluating course examinations and class projects primarily for the purpose of grading, instructors may simply read the test results or examine the class project and assign a grade.

> Such practices would not appear to contribute much to the talent development process. Grading of course examinations and class projects can, of course be used to enhance talent development. In such cases the nature of the feedback provided by the professor normally goes considerably beyond merely assigning a grade. (p. 12)

Astin agrees with other researchers that specific feedback on the learner's activities or projects is critical to successful assessment. "In this connection, it is unfortunate that most such assessment occurs only after the course has been completed, and at a time when students are probably not very motivated to benefit from the feedback" (p. 12).

According to Astin, (1991) in order for any feedback to benefit the learning process, it must occur during the learning experience at frequent and appropriate intervals. "The more I think about the problem of assessing cognitive outcomes, the more convinced I become that holistic feedback, whether written or spoken, is far and away the most powerful assessment tool

we have for directly enhancing the talent development in particular and the educational process in general" (p. 55). Astin reports,

> It has been my experience that most academics who have merely seen a few real examples of such feedback, have been impressed by its educational value. Not only is the feedback itself extremely informative and useful to the student, but since the process itself requires the professor to get to know the individual students work personally, narrative feedback strengthens and enhances the relationship between student and faculty member" (p. 55).

Although holistic written evaluations of learner performance does not readily yield quantitative estimates of performance, Astin recommends "the evaluator also complete a brief set of rating scales, with each scale representing a different skill, area of knowledge, or personal quality" (p. 56).

Astin (1991) views assessment as direct feedback to the learner and an incentive for better performance rather than an incentive to attain a grade. "Theories based on 'carrot and stick' reasoning see assessment primarily as an external incentive to learn that operates both as a reward and a punishment. When it comes to facilitating learning, most of our traditional assessment in higher education can be best justified on the basis of its incentive value" (p. 188). Surely the most common example of assessment based on this particular theory is the grade. According to Astin, we grade all the various activities previously stated by Astin and aggregate them into a cumulative grade-point average (GPA). Astin agrees with many other educational researchers that assessment is also a tool for enhancing learning.

> Perhaps the best assessment for learning that goes on outside the performing arts occurs in laboratory work or with the homework assignments that are common in the natural sciences. Laboratory work is usually monitored closely, and homework (e.g., problem sets) is usually evaluated on an individual basis. Otherwise, about the only widely used assessment approach that might be useful in enhancing the learning process is the mid-term exam. Depending on the form of such exams and the type of feedback provided, such assessments have the potential for being of significant value in the learning process. The typical final exam, of course, comes far too late in the process. (p. 188)

Although there are several course management tools available for online delivery, some of their assessment tools are generally reproductions of ineffective assessment methods used in face-to-face courses. Yet, appropriate, valid, and reliable assessment of learner achievement is crucial in the distance-learning environment. Dewald et al. (2000) suggest,

> First, distance learning instruction is extremely time-consuming and costly to develop. Second, distance-learning courses frequently target new student audiences and use new delivery systems. And third, feedback is notoriously difficult to get in the online environment because instructors do not have the physical clues they have in the traditional classroom. (p. 39)

Not only did the study attempting to identify best practices of online assessment, it also looked for authentic assessment practices. Morgan and O'Reilly (1999) emphasize the importance of authentic assessment for enhancing learning. These researchers' reflection on their own undergraduate assessment experiences uncovered several common negative themes learners experience with assessment activities: Inscrutability, injustice, infallibility, mixed messages, administrative convenience, and cynicism. They also uncovered positive themes: Individuality, acknowledgement, relevance, and dialogue. Reviewing both the positive and negative themes, Morgan and O'Reilly identified a series of assessment issues related to:

1. Integrating assessment with overall learning aims;
2. Designing and communicating assessment tasks;
3. Communicating assessment feedback and results;
4. Portrayal of achievements;
5. Unintended consequences of assessment;
6. Appeal avenues and evaluation activities.

Morgan and O'Reilly state, "We argue that it is vital for distance and open educators to have a strong reflective core to their thinking, planning and conduct of assessment activities" (p. 11). They insist that, "The primary purpose of assessment is to increase students' learning and development, rather than simply to grade or rank student performance" (p. 13). Morgan and O'Reilly seem to agree with Rowntree (1990) who concludes that the two major purposes for assessing student learning are to improve ongoing learning with appropriate and timely feedback and report their achievement with either grades or written assessments. This theme seems to permeate much of the recent literature on learner assessment, especially in online or distance learning environments.

The educator's role includes facilitating appropriate and effective formative assessment. It also includes summative assessment as a means of reporting on learners' achievements. Morgan and O'Reilly (1999) state, "In most open and distance settings, assessments usually have both a formative and summative component–this is referred to as 'continuous assessment'" (p. 15). Is there a difference between assessing learner achievement in a face-to-face course and an online or distance course? According to Morgan and O'Reilly, assessment practices in face-to-face settings and in distance learning environments are much the same and perhaps indistinguishable. "Indeed, many dual-mode universities have policies to ensure that there is equity of treatment between internal and external students, and that all students in a subject have equitable, if not identical, assessment experiences" (p. 20). These writers suggest that the move into online learning with computer-mediated communications presents a challenge to "... devise effective learning encounters using this medium. Because of our preoccupation with shaping effective and creative learning experiences for our students, we tend to overlook the importance of assessment as the rather more powerful influence on student learning" (p. 20). Morgan and

O'Reilly, along with other researchers, insist that assessment tasks must be closely aligned with and interwoven into the course study materials.

In most cases, learners in online or distance environments do not have access to all the amenities available to learners in traditional classroom environments. Morgan and O'Reilly (1999) suggest, "Hence distance learners are more dependent upon effective, early communication of assessment requirements, together with well-designed and cohesive assessment tasks, useful and timely support, and a transparent marking scheme that explains how judgments are to be made" (p. 22). The instructor's perspective on distance learning will influence the effectiveness of the assessment activities. "The way in which we, as educators, conceptualize the distance learning experience will impact on all our teaching and learning activities, and most particularly the ways in which we facilitate assessment for learners" (p. 23). Morgan and O'Reilly insist that assessment activities have changed little in spite of the technological advancements used in distance learning and that "we have tended to remain with traditional forms of assessment, such as invigilated examinations and written assignments" (p. 33). Online technologies provide opportunities for immediate interactions between distance learners and instructors that were not previously possible. "When teaching online, your availability to students closely approximates the on-campus situation ..." (p. 34).

In considering the issue of peer and self-assessment, Morgan and O'Reilly suggest "the ability to reflect upon one's own work and that of one's peers is an important ability of any adult learner" (p. 35). They argue further the merits of self-assessment:

> With regard to self-assessment, it is a common perception that students are either the harshest judges of themselves, or they tend to have an inflated perception of their own capabilities. For this reason, the ability to reflect upon one's own understanding or performance is as much a learning process as it is an assessment process (Bout, 1986) and

> is greatly assisted by the use of guidelines, criteria or standards that support learner self-assessment." (p. 35)

Morgan and O'Reilly insist that collaborative assessment in distance learning environments was primarily restricted to situations in which there was an on-campus component that allowed for that type of activities. In an online or Web-based environment, however, there are expanded possibilities for teamwork and collaborative assessment exercises.

Do learners in an online or distance learning environment have needs that differ from on-campus learners where the design, development and support of assessment tasks are concerned? Morgan and O'Reilly (1999) insist that these learners "have less opportunity in which to diagnose their errors or mistaken assumptions before they commit to a formal assessment task" (p. 44). It becomes critical, therefore, that assessment criteria and other instructions be clearly and realistically communicated to the learners. "A successful assessment scheme in a face-to-face setting may not necessarily translate well to an open and distance context" (p. 44). These writers rightfully insist that in an online environment "...we need to maximize opportunities for considered and meaningful learning through assessment" (p. 44). The design of assessment tasks in an online environment cannot be overlooked and must be included in the early stages of course development. Although learners will decide how they wish to proceed through course materials and complete various activities, Morgan and O'Reilly suggest that is not a problem. "Rather, the question is whether the assessment really engages the learner with the main bodies of knowledge and skills development as intended. In other words, does the assessment meet the aim and objectives" (p. 46)?

Which assessment methods might be appropriately applied to online and distance learning systems? Morgan and O'Reilly (1999) suggest,

> Traditionally ODL has relied heavily on 'pen and paper' assessments such as essays, journals, projects, or invigilated and take-home exams. However, with the relatively recent explosion of information and communication technologies, there are very few methods used in face-to-face learning that cannot be readily adapted for distance settings. We are seeing more frequent use of group work, debates, performance, discussions, role plays and other interactive and collaborative assessments that had previously been difficult or impossible to facilitate at a distance." (p. 50)

Online assessment tasks must be authentic. "In order to make judgments about students' acquisition of higher order abilities—particularly when there is a complete blend of skills, knowledge and attitudes—'authentic' or 'integrated' assessment tasks are often required" (p. 57). Authentic tasks are usually drawn from the world of work. They require learners to "identify issues or problems, draw upon their knowledge to carry out solutions, respond to contingencies as they arise, and evaluate their results" (p. 57). Through these types of assessments, learners develop vocational skills and experience in an applied context for their learning. "An authentic assessment is often the culmination of incremental skills development and acquisition of knowledge over time, with the benefits of formative feedback" (p. 57). Morgan and O'Reilly suggest along with other researchers that computer-based simulations support development of this kind because of built-in feedback and are appropriate for some disciplines.

CHAPTER 3: METHODOLOGY

Qualitative Evaluation Research was conducted by collecting survey data from a group of online instructors at several colleges and universities. By exploring what other instructors in the field are doing through Patton's (2002), "theory-in-use" (p. 163), the study should result in the construction of a methodology model to implement in Drummond's 2001 course as well as one that is portable to other online courses. Why should a survey be used in this study? Robson (1993) states, "The survey is probably the best tool that social scientists possess for generating useable information" (p. 4). Patton (1990) suggests, "Qualitative methods are particularly oriented toward exploration, discovery, and inductive logic. An evaluation approach is inductive to the extent that the evaluator attempts to make sense of the situation without imposing pre-existing expectations on the program setting" (p. 31). To explain the use of qualitative evaluation, Patton (1990) states, "The purpose of qualitative inquiry is to produce findings" (p. 371). The current research attempted to identify patterns based on findings of current assessment practices in online instructional environments. Patton observes, "Qualitative methods are first and foremost research methods. They are ways of finding out what people do, know, think and feel by observing, interviewing, and analyzing documents" (p. 94). Patton states further,

> Practical applications of qualitative methods emerge from the power of observation, openness to what the world has to teach, and inductive analysis to make sense out of the world's lessons. Where there are elegant philosophical rationales and theoretical underpinnings to qualitative inquiry, the practical applications come down to a very few basic and simple ideas: pay attention, listen and watch, be open, think about what you hear and see, document systematically (memory is selective and unreliable), and apply what you learn" (p. 139).

Patton (1990) justifies the use of evaluation research by stating,

> While applied research seeks to understand societal problems and identify potential solutions, evaluation research studies the processes and outcomes aimed at attempted solutions. Evaluators study programs, policies, personnel, organizations, and products.

> Evaluation research can be conducted on virtually any explicit attempt to solve problems or bring about planned change. (p. 155)

Patton further explains the purpose of summative evaluations in research by stating,

> Summative evaluations serve the purpose of rendering an overall judgment about the effectiveness of a program, policy, or product for the purpose of saying that *the idea itself* is or is not effective and, therefore, has the potential of being generalizable to other situations. Summative evaluations, then, examine and study specific programs, policies, and products in order to generalize about the effectiveness of the human action under investigation. (p. 155)

The nature of the activities to be studied clearly indicates that Qualitative Evaluation Research is the most appropriate methodology for the current research. It is Patton's opinion that,

> In many ways a major trade-off between quantitative methods and qualitative methods is a trade-off between breadth and depth. Qualitative methods permit the evaluation researcher to study selected issues in depth and detail; the fact that data collection is not constrained by predetermined categories of analysis contributes to the depth and detail of qualitative data. Quantitative methods, on the other hand, require the use of a standardized approach so that the experiences of people are limited to certain predetermined response categories. (p. 155)

Description of the Methodology Used

Qualitative Evaluation Research was used to conduct the study in an effort to identify best practices of learner assessment used in an online learning environment for the purpose of constructing a model for assessing learners in an online introductory computer science course. Qualitative Evaluation Research is clearly the appropriate research method for this study because it is imperative in this study to evaluate not only the selection of but also the effectiveness of and rationale for using specific assessment methodologies and strategies in online learning environments. Willis (1998a) states, "Effective teachers use a variety of means, some formal and others informal, to determine how much and how well their students are learning" (¶ 1). Willis states further, "When teaching at a distance, educators must address a different teaching challenge than when teaching in a traditional classroom" (¶ 3). Absent from the distance

teaching and learning environment are the traditional classroom, relatively homogeneous group of learners and the feedback available through face-to-face interaction. Neither does the instructor have total control of the course delivery system in many cases. Therefore, assessment strategies used must often lie within the bounds of the technology available to the instructor.

From these challenges emerges the question of whether to look at theories of online learner assessment or to study assessment strategies and methodologies actually used in online environments. This study will not look at program theory but will analyze how instructors actually assess learners in introductory computer science courses in an online learning environment. According to Patton (2002), "Attention to program theory has become a major focus of evaluation research (see Rogers et al. 2000), and with that attention has come some confusion about terminology" (p. 163). Based on the teachings of organizational theorist Chris Argyris, Patton concludes, "The espoused theory is what people say they do; it's the official version of how the program or organization operates. The theory-in-use is what really happens" (p. 163). Looking at qualitative inquiry from a practical perspective, Patton says, "Not all questions are theory based. Indeed, the quite concrete and practical questions of people working to make the world a better place (and wondering if [*sic*] what they're doing is working) can be addressed without placing the study in one of the theoretical frameworks" (p. 135). Patton states further, "It is not necessary, in my opinion, to swear vows of allegiance to any single epistemological perspective to use qualitative methods" (p. 136). Patton suggests that theory should not even be a concern of the researcher.

> While students writing dissertations and academic scholars will necessarily be concerned with theoretical frameworks and theory generation, there is a very practical side of qualitative methods that simply involves asking open-ended questions of people and observing matters of interest in real-world settings in order to solve problems, improve

> programs or develop policies. In short, **in real world practice, methods can be separated from the epistemology out of which they have emerged.** (p. 136)

"The methods of qualitative inquiry now stand on their own as reasonable ways to find out what is happening in programs and other human settings" (p. 137).

Bogdan and Biklen (1998) describe the theoretical underpinnings of educational research and discuss at length the distinctions between quantitative and qualitative research and their uses. They clearly state, "People use the word theory in many ways" (p. 22). These researchers associate qualitative educational research with the term *paradigm*. "A *paradigm* is a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research" (p. 22). The research will utilize the paradigm concept. Bogdan and Biklen also emphasize the relationship between research methods and methodologies and state,

> *Methodology* is a more generic term that refers to the general logic and theoretical perspective for a research project. *Method* is a term that refers to the specific techniques you have used, such as surveys, interviews, observations—the more technical aspects of the research. In good research, methods are consistent with the logic embodied in the methodology. (p. 31)

Drummond developed an online introductory computer science course in 2001 that was taught during the fall semester of 2002 and spring semester of 2003 at Mercer University. Learner assessment in an online environment must consist of methodologies and practices different from assessments in a traditional face-to-face learning environment. Although there are several course management tools available for online delivery, some of their assessment tools are generally reproductions of ineffective assessment methods used in face-to-face courses. Yet, appropriate, valid, and reliable assessment of learner achievement is crucial in the distance-learning environment. Dewald et al. (2000) suggest that the cost in terms of dollars and time for developing instruction and learning activities for distance or online environments, and the use of

new and unfamiliar delivery systems present a real need for instructional practices that differ from those used in traditional courses.

According to Willis (1998b), "Instructional development provides a process and framework for systematically planning, developing, and adapting instruction based on identifiable learner needs and content requirements. This process is essential in distance education where the instructor and students may share limited common background and typically have minimal face-to-face contact. Although instructional development models abound (see Dick & Carey, 1990; Gustafson & Powell, 1991), the majority follow the same basic strategies of design, development evaluation, and revision" (¶ 1). In addition, providing appropriate feedback to learners in an online environment is impacted by the lack of physical clues presented in the traditional classroom. Not only will the study identify and investigate best practices in online assessment, it will also identify and investigate authentic assessment practices.

Design of the Study

The survey instrument divided the data into two major classifications: course delivery and learner assessment. The delivery methods were further divided into courses delivered totally online and those delivered through traditional methods with some online components. The assessment models were classified by whether online assessment or traditional classroom assessment is used. Instructors surveyed were asked to select from a list the type of assessment methodologies they use and rate their effectiveness. A Likert scale was used to obtain qualitative data on the effectiveness of assessment methodologies used by the instructors. Instructors were also asked to state their reason for using a particular methodology as well as the reason for their judgment of effectiveness. The criteria for effectiveness was the instructor's judgment of how well the methodology measures learning, engages the learner, is integrated into the learning

process, and causes further learning. This study identified assessment methods these instructors have found to be most effective for authentic learner assessment in an online learning environment and a proposed model containing those practices has begun development.

Selection of Participants

An attempt was made to select instructors who teach introductory computer science courses similar in nature to the course taught by the researcher. Telephone and e-mail conversations were used to determine course content similarities. Instructors were selected from members of educational organizations such as the Association for Small Computer Users in Education (ASCUE), the Society for Applied Learning Technologies (SALT), and EDUCAUSE members who participate in the Seminars on Academic Computing (SAC). These organizations provide attendee registration lists to registered attendees at each conference. An e-mail letter was sent to members of these organizations requesting participant volunteers. The letter explained the purpose of the study and identified the criteria for participation, (i.e. instructor of an introductory computer science course, introductory information technology course, or similar course in an online environment). Respondents were then given directions for accessing and completing the online survey. Information regarding race, gender, ethnicity, age, length of time teaching, nor other such characteristics of the participants was not required for the study.

The purpose for selecting instructors who teach courses similar to those taught by this instructor was to satisfy the primary goal as stated above. Communication via e-mail was used to verify participant eligibility and willingness to participate. Gay (1996) states, "Subjects should be selected using an appropriate sampling technique (or an entire population may be used), and identified subjects must be persons who (1) have the desired information and (2) are likely to be willing to give it" (p. 255). Gay emphasizes the importance of not selecting individuals "...who

possess the desired information but are not sufficiently interested" because they are not likely to respond to the survey. Gay also suggests, "It is sometimes worth the effort to do a preliminary check of potential responders to determine their receptivity" (p. 255). The desire was to have participants from several different institutions.

Data Collection

According to Patton (1987), "There are no rigid rules that can be provided for making data collection and methods decisions in evaluation. The art of evaluation involves creating a design and gathering information that is appropriate for a specific situation and particular policymaking context" (p. 9). Patton further justifies the use of qualitative research and suggests, "Qualitative methods permit the evaluation to study selected issues, cases, or events in detail; the fact that data collection is not constrained by predetermined categories of analysis contributes to the depth and detail of qualitative data" (p. 9).

Data were collected by means of an online Web-based survey form. Participants were able to login to the survey site with a password, mark the survey, add applicable qualitative comments, and submit the form electronically. Patton (1987) stresses, "The validity and reliability of qualitative data depend to a great extent on the methodological skill, sensitivity, and training of the evaluator" (p. 8). Validity for the design of survey items is found in the review of assessment strategies described throughout Chapter 2. To validate the survey items further, professors in the Tift College of Education at Mercer University have previewed the survey items and judged them appropriate for the study.

Method of Data Analysis

Multiple methods for presenting qualitative evaluations exist. Patton (1987) states, "Qualitative evaluation data may be presented alone or in combination with quantitative data.

Recent developments in the evaluation profession have led to an increase in the use of multiple methods including combinations of qualitative and quantitative data" (p. 8). "Qualitative analysis transforms data into findings. No formula exists for that transformation. Guidance, yes. But no recipe" [*sic*] (Patton, 2002, p. 432). Patton states further, "the final destination remains unique for each inquirer, known only when—and if—arrived at" (p. 432). "*Inductive analysis* involves *discovering* patterns, themes, and categories in one's data. Findings emerge out of the data" (p. 453). An attempt was made in the study to identify patterns or categories of assessment tools and methodologies used successfully in online instructional environments. The process of analysis involved sorting the raw data and identifying patterns that were significant in order to communicate what the data reveal.

> There are no formulas for determining significance. No ways exist of perfectly replicating the researcher's analytical thought processes. No straightforward tests can be applied for reliability and validity. In short, no absolute rules exist except perhaps this: Do your very best with your full intellect to fairly represent the data and communicate what the data reveal given the purpose of the study. (2002, p. 433)

It was important to interpret the data in a way that would identify not only methodologies and strategies in use for online assessment but that would also unveil why the instructors used those strategies and how they felt about them. Patton (2002) states,

> Interpretation, by definition, involves going beyond the descriptive data. Interpretation means attaching significance to what was found, making sense of the findings, offering explanations, drawing conclusions, extrapolating lessons, making inferences, considering meanings, and otherwise imposing order on an unruly but surely patterned world. (p. 480)

Data analysis provided a description of a typical introductory computer science course. This course description was derived from the content of the courses taught by faculty who participated in the study through face-to-face conversation and e-mail correspondence. "Thick, rich description provides the foundation for qualitative analysis and reporting" (p. 437). According to

Patton, "A basic tenet of research admonishes careful separation of description from interpretation. Interpretation involves explaining the findings, answering "why" questions, attaching significance to particular results, and putting patterns into an analytic framework" (p. 438).

The findings from a qualitative study are not interpreted in the same way as those in a quantitative study, particularly in the area of determining significance. "In lieu of statistical significance, qualitative findings are judged by their *substantive significance*" (Patton, 2002, p. 467). Much of the analytical significance in a qualitative study depends on the research analyst's own perceptions. "The qualitative analyst's effort at uncovering patterns, themes, and categories includes using both creative and critical faculties in making carefully considered judgments about what is really significant and meaningful in the data" (p. 467). The following steps were taken to code and analyze data thematically:

1. Data were first coded by whether the courses under consideration are taught totally online or with only some online components.
2. Data were coded secondly by whether the learner assessment strategies are used online or in face-to-face environments.
3. The third level of coding identified each particular assessment strategy used.
4. The fourth level of coding signified the level of effectiveness of each assessment strategy used.

The purpose for coding the data as described above was to identify patterns or categories of assessment tools and methodologies used successfully in online instructional environments. Using the concept of convergence, the analysis looked for recurring regularities that reveal patterns that can be sorted into categories. If similar strategies were used frequently and successfully by multiple instructors, then these patterns may have emerged as strong candidates

for the proposed model. The process of analysis involved sorting and categorizing the raw data and identifying these significant patterns.

Data mean nothing to the researcher without interpretation. "Objects, people, situations, and events do not possess their own meaning; rather, meaning is conferred on them" (Bogdan & Biklen, 1998, p. 25). The following steps were taken to interpret the data collected in this study:

1. The surveys were reviewed for completeness before the data are organized.
2. Each response on the surveys was analyzed, coded, and categorized according to the coding methodology described earlier.
3. Statistical software was used to determine the frequency of use of each of the assessment strategies as well as the distribution of effectiveness levels.
4. It was important in the study to know not only that an instructor deemed an assessment strategy or methodology effective, but it was also important to know why he or she deemed it effective. Therefore, a portion of the interpretation process centered on the reasons participants judged particular assessment methods or practices at the effectiveness levels they chose
5. Participant responses to the level of effectiveness were analyzed to identify those assessment strategies deemed most effective in an online environment.
6. Textual data were analyzed to determine similarities or patterns of choice and judgments of effectiveness. Emerging patterns were identified.
7. Data analysis provided an overall picture of assessment methods and strategies used by other instructors in online environments and identified which of the varied strategies they judged to be used effectively as authentic assessments that engage learners in the acquisition knowledge and skills.

8. Responses that showed similar reasons for using a particular assessment strategy and for judging its effectiveness at a certain level were used to begin development of a proposed best practices model of assessment of online learning in this field.
9. Following Bogdan and Biklen's (1998) view, "Qualitative researchers tend to view reliability as a fit between what they record as data and what actually occurs in the setting under study ..." (p. 36), where possible further reliability was accomplished by interviewing the respondents via e-mail to ascertain whether the interpretation of the responses presented in the study concurred with the participants' own interpretations of their responses.

The findings from surveys submitted by instructors who teach introductory computer science, information technology or similar computer applications courses are described and interpreted in the following chapters of this dissertation. These findings update and compliment the body of educational research on assessment methodologies and provide a beginning for the development of an authentic assessment model for online courses in computer science or information technology. These findings present a pattern of views of instructors as to the effectiveness of various assessment types and their effectiveness for measuring learner success and promoting additional learning. Although instructors in this field may not be fully informed about authentic assessment methodologies, their judgments of the assessment types they have used in totally online courses and courses with only some online components, their views on the methodologies they have used provide a core of possibilities for building an authentic assessment model.

CHAPTER 4: PRESENTATION AND ANALYSIS OF DATA

The study was conducted to identify authentic assessment methods currently or previously used in online learning systems in introductory computer science, information technology, or similar computer applications courses. Authentic assessment measures what learners can do with the knowledge they have gained and allows appropriate opportunities for learners to rehearse or practice knowledge while consulting resources and receiving feedback to refine skills (Wiggins, 1998). Evaluation research was coupled with qualitative analysis to identify, analyze and interpret the aim and purpose of those methods as well as their effectiveness. Survey research was used to collect the data because of ease of replication. According to Charles and Mertler (2002), qualitative data analysis is commonly used in evaluation research. The data were identified and will be used to begin development of a proposed authentic assessment model for measuring learner accomplishment in online introductory computer science or information technology courses. Methodologies that meet the criteria for authentic assessment will be incorporated into a model. An online survey was completed by twenty-one participants. Survey respondents are instructors who are members of national organizations that focus on integration of technology into instruction and teach introductory computer science, information technology or similar computer applications courses either online or with some online components.

Data on types of assessment methodologies used, ratings of effectiveness, reasons for use, and reasons for judgment of effectiveness were collected with the online Survey of Assessment Methods in Online Courses (Appendix A). The survey was divided into two major categories, Section 1: Courses Taught Totally Online, and Section 2: Courses Taught with Some Online Components. Each of these major categories was further divided into two subgroups, Assess

Learners Online and Do Not Assess Learners Online. Using the grounded approach advocated by Glasser and Strauss (1967), assessment methodologies used were coded according to the categories above, and reasons for use were coded based on whether they met the criteria for authentic assessment.

Qualitative evaluation was used to query the selected instructors on their perceptions of how well the assessment methodologies they have used in an online teaching environment measure learning, engage the learner, are integrated into the learning process, and promote further learning. The findings in this chapter have been initially organized around the two basic research questions using categories of the study's basic framework.

Findings were organized based on two research questions: What features, tools and methodologies are currently used in assessment paradigms in courses in post-secondary education? And which of these methodologies provide authentic assessment appropriate for an online learner assessment paradigm in an introductory computer science or information technology course? An appropriate assessment methodology is one which: (a) meets the criteria for authentic assessment, (b) can be easily used in an online environment, (c) measures learning, (d) engages the learner, (e) is integrated into the learning process, and (f) promotes further learning. Findings include assessment methodologies used, judgment of their effectiveness, and reasons for their use.

It should be noted here that some survey respondents fell into multiple categories because they teach online courses as well as courses with only some online content. Some respondents also assess learners both online and offline. The survey software, Perseus©, permits respondents to select all appropriate response boxes or buttons.

Assessment Methodologies Used in Post-Secondary Education

Several assessment methodologies currently used in post-secondary education emerged from the study. Assessment methodologies from the literature are shown in Table 1.

Table 1. Assessment methodologies from literature

Frequently used methodologies in post-secondary education
Open-book and open-notes assessment
Repeated testing
Assessment based on course objectives
Outcome- or performance-based assessment
Interactive assessment
Continuous assessment
Assessment of student journals
Assessment by collaborative testing
Portfolio assessment
Self assessment
Resource-based learning assessment
Project-based assessment

Through use of an online survey instrument (Appendix A), respondents reported use, effectiveness, and reasons for use of the following assessment methodologies in introductory computer science, information technology, or similar computer applications courses in an online environment: (a) objective questions such as multiple-choice, fill-in blank, matching, and lists; (b) subjective questions which include short answer, and short paragraphs; (c) projects or assignments submitted electronically which include spreadsheets, documents, databases, presentations, program coding and other projects; (d) collaborative testing which incorporates individual responses to questions after teaching and group deliberation; (e) outcome- or performance-based assessment of learner skills or abilities; (f) interactive assessment of electronic correspondence between learner and instructor such as e-mail and chat sessions; (g) self-assessment, which requires learners to reflect upon their own work and knowing that they know the appropriate material; and (h) online threaded discussions through which learners

respond to questions or statements posted by the instructor or other learners. Assessment methodologies found in the literature were used as a basis for the methodologies included in the online survey.

Methodologies Used in Courses in an Online Environment

Findings from the online Survey of Assessment Methods in Online Courses are presented in Tables 2 and 3. Table 2 shows findings for instructors who teach online courses and includes both online and offline learner assessments.

Table 2. Assessments used in online courses and effectiveness ratings

Courses Taught Totally Online (n=13)

Assess learners online (n=4)

	Used		Neutral		Effective		Extremely Effective	
Question Type	#	%	#	%	#	%	#	%
Objective	4	100	1	25	3	75		
Subjective	2	50	2	100				
Projects	4	100			2	50	2	50
Collaborative	0	0						
Outcome	2	50			2	100		
Interactive	3	75	1	33	1	33	1	33
Self-Asses	2	50		100	2	100		
Discussions	2	50	1	50	1	50		

Do not assess learners online (n=9)

	Used		Neutral		Effective		Extremely Effective	
Question Type	#	%	#	%	#	%	#	%
Objective	1	11	1	33	1	33	1	33
Subjective	1	11	1	33			1	33
Projects	2	22	1	33			2	67
Collaborative	1	11			1	100		
Outcome	1	11			1	50	1	50
Interactive	1	11			2	100		
Self-Asses	2	22			2	100		

Names of the assessment types were abbreviated for space considerations. Participant responses are assigned to sub-groups which correspond to the categories of assessments in online courses and courses with only some online components. Because no methodologies were rated

as extremely ineffective and only three were rated ineffective, these two effectiveness ratings were omitted from Tables 2a and 2b. In the opinion of Charles and Mertler (2002, p. 179), "Analysis helps to do four things: (1) describe the data clearly; (2) identify what is typical and atypical among the data; (3) bring to light differences, relationships, and other patterns existent in the data, and ultimately (4) answer research questions...".

Sixty-two percent of survey respondents teach one or more online courses. Thirty-one percent of these respondents assess learners online. Objective questions, projects or assignments submitted electronically, and interactive assessments are used more frequently than other assessment types. These assessment types also receive high effectiveness ratings. Although outcome- or performance-based and self-assessment methodologies are not used as frequently, they also receive high effectiveness ratings.

Sixty-nine percent of survey respondents who teach courses online do not assess learners online. They reported most frequently using electronically submitted projects or activities and self-assessment methodologies. These respondents also rated both assessment types as effective.

Findings from the survey show that instructors who teach courses with only some online content do not use online assessment as often as those who teach online courses. These instructors rely more heavily on more traditional offline assessment methodologies. Whether this practice is determined by the level of online content or the level of the instructors' desire to deviate from traditional assessment methods is not known. Online and offline assessment types used and effectiveness ratings for courses with only some online content are shown in Table 3.

Table 3. Assessments used in courses with some online components and effectiveness ratings

Courses Taught With Some Online Components (n=16)

Assess learners online (n= 8)

	Used		Neutral		Effective		Extremely Effective	
Question Type	#	%	#	%	#	%	#	%
Objective	8	100			6	75	2	25
Subjective	3	38	2	40	1	20	2	40
Projects	8	100			4	50	4	50
Collaborative	2	25			2	100		
Outcome	7	88			3	50	3	50
Interactive	5	63	2	50	2	50		
Self-Asses	2	25			2	100		
Discussions	4	50			2	50	1	25

Do not assess learners online (n=11)

	Used		Neutral		Effective		Extremely Effective	
Question Type	#	%	#	%	#	%	#	%
Objective	6	50	2	29	5	71		
Subjective	6	54	1	13	6	75	1	13
Projects	10	91	1	10	6	60	2	20
Collaborative	0	0			1	100		
Outcome	3	27	2	50			2	50
Interactive	3	27	2	50	1	20	1	25
Self-Asses	4	36	2	50	2	50		

Seventy-six percent of survey respondents teach courses with some online components. Only forty-four percent of this sub-group reported they assess learners online, yet fifty percent of this sub-group reported using the assessment types listed. Data reveal that three instructors failed to mark the Assess Learners Online box in the survey although they reported using the assessment types listed. The online survey software permits respondents to select items independently, and if an item is selected in error and not deselected, response errors occur which might taint results. This sub-group of instructors reported using objective questions, projects or assignments submitted electronically, and outcome- or performance-based online assessments most frequently. These three assessment types also are rated as either effective or extremely effective by this sub-group.

Sixty-one percent of respondents who teach courses with only some online components do not assess learners online. Some instructors may fall into both sub-groups because they assess learners both online and not online depending on the nature of their courses. Projects or activities submitted electronically is the assessment method reported by more instructors in this sub-group than any other assessment type. This assessment methodology is also rated effective or extremely effective.

Effectiveness of Methodologies Used in Courses in an Online Environment

Within the sub-group of respondents who teach courses online and assess learners online, projects or assignments submitted electronically, outcome- or performance-based assessment, and self-assessment are most frequently reported as either effective or extremely effective overall. Both objective questions and interactive assessment have effective and extremely effective ratings offset by neutral ratings.

The sub-group of instructors who do not assess learners online rated collaborative assessment, outcome- or performance-based assessment, interactive assessment, and self-assessment as either effective or extremely effective overall. Projects or activities submitted electronically also rated as extremely effective, but the rating is offset somewhat by a neutral rating.

The data show that fifty-six percent of this sub-group reported effectiveness levels of four assessment types which they do not report using. The online survey software allows selecting the Have Used button for each assessment and the effectiveness buttons independently. Therefore, some instructors appear to have rated the effectiveness of some assessment types although they do not report using that particular assessment. There are three neutral ratings and one ineffective

rating in this sub-group. These effectiveness ratings may indicate instructors' reasons for not using these particular types of assessment. A minor response error occurs in this case.

Within the subgroup of instructors who teach courses with only some online components and assess learners online, objective questions, projects or assignments submitted electronically, collaborative assessment and self-assessment are rated as effective or extremely effective assessment methodologies overall. The survey software allows selection of the Have Used button and effectiveness ratings for each question independently from the Yes and No questions regarding assessing learners online. As a result, the data show that three instructors in this sub-group reported using specific methodologies and rated their effectiveness although they did not report assessing learners online in an earlier question.

Within the sub-group of instructors whose courses contain only some online components and who do not assess learners online, collaborative assessment is the only assessment type that is rated either effective or extremely effective overall. Although no instructors in this group reported they used collaborative assessments, one instructor rated this method as effective. Both subjective questions and projects or activities submitted electronically are rated as effective or extremely effective by a majority of the instructors, but these ratings are offset by a small number of neutral ratings. The survey software allows selection of the Have Used button independently of the effectiveness rating buttons.

Reasons for Using Specific Methodologies in an Online Environment

Instructors were asked to give reasons for using specific assessment types and rating their effectiveness. Reasons for use of specific assessment types by both groups of instructors who assess online have been combined, and the resulting thirty-one reasons are shown in Table 4.

Table 4. Reasons for using specific online assessment types

Objective questions
Easy to grade, test banks easy to use, score large numbers of tests quickly
Broad coverage of material, test reviews, judge mastery of materials
Assess both construction and comprehension skills, test recognition skills
Easy way to measure student performance with immediate feedback
Used due to large numbers of students needing to be tested simultaneously
Clearly definitive answers for technology issues requiring one correct answer to show what students know

Subjective questions
Show ability to reason and apply concepts
Used for test review and to judge mastery skills

Projects or assignments submitted electronically
Concrete demonstration of skills students have learned
Used with large numbers of students and are easy to submit
Students cannot say they couldn't come in to turn something in or say they couldn't find the instructor
Just as effective as non-electronic submissions for this type of assignment
Provide a good way to consolidate efforts of students
Students need further experience in this medium for use in workplace

Collaborative testing
Provides group communications and teaches to work with others

Outcome- or performance-based assessments
Work well when there are large numbers of students to test
Best way to test whether the student can actually perform the software applications, demonstrate student abilities
Methodology is very effective—limited only by the constraints inherent in the testing software
Promote learning, time limits, changing parameters, simulate workplace
Easy communication with students, quick response to assignments and questions

Interactive assessment activities
Work well with large numbers of learners
Convenient and easy to use, requires minimum effort
Effectiveness of this method is excellent and is limited only by the student's willingness to check e-mails, answer, etc., in a timely manner
Students less inhibited in self expression

Self-assessment methodologies
Students know where they are in the course material.
Students realistically reflect on learning experience
Key to self growth, and this process encourages it

Online threaded discussions
Work well with large numbers of students,
Give all students the benefits of a particular question or problem dealt with
Students learn from each other
Show students apply reasoning and thinking skills

Instructors who assess learners online stated most frequently (six responses) their reason for using a specific assessment type is that it is a concrete demonstration of skills and knowledge students have learned. The second most frequently given reason (five responses) for using a specific methodology is that it works well with large numbers of students.

Nine instructors reported seven different reasons for using objective questions for assessment. Clearly these instructors feel that objective questions can be used to assess multiple skills such as construction, comprehension, item recognition, and content knowledge. Two additional comments are given by these instructors: (a) effectiveness is limited only by the same constraints with those types of questions—whether online or paper-based tests; and (b) fill in the blank questions are a little more problematic since misspellings, capitalizations, etc., will usually result in an incorrect answer.

Although five instructors in the two online assessment sub-groups reported using subjective questions, none in the online group and three in the partially online group reported reasons for using this type of assessment or for judging its effectiveness. The reasons given acknowledge the purpose of authentic assessment (Stiggins, 1999; Walker, 1999).

Projects or assignments submitted electronically ranks evenly with objective questions in order of use. Eight instructors reported reasons for using this assessment type. The two reasons (two responses each) most often given for using and judging this assessment type effective were: (a) concrete demonstration of skills students have learned, and (b) students need further experience in this medium for use in the workplace.

No reasons for using collaborative assessment were given. This assessment type ranks lowest in order of use for online assessment.

Six instructors reported reasons for using outcome- or performance-based assessment activities and judging the effectiveness of this assessment type. The reason most often given (three responses) is that it best measures student skills in performance of application software activities.

Five instructors reported reasons for using interactive assessment activities and judging the effectiveness of this assessment type. The reasons given were evenly distributed. An interesting additional comment was that this methodology is not effective for difficult topics areas.

Three instructors gave reasons for using self-assessment activities. Reasons for using this assessment type and judging its effectiveness were evenly distributed.

Four instructors gave reasons for using online threaded discussions for learner assessment. Reasons given for using this assessment type and judging its effectiveness were evenly distributed. One instructor commented further that this type of assessment has pretty good effectiveness but can be confusing, and students have to be willing to participate in a timely manner.

Of the thirteen instructors who teach courses online, nine do not assess learners online. None of them gave reasons for using specific methodologies or judging the effectiveness of methodologies used. Because these respondents submitted their survey responses anonymously, there is no way to identify reasons for this finding.

Of the sixteen instructors who teach courses with some online components, eleven do not assess learners online. It is important to note however, that ninety-one percent of these instructors reported they have learners submit assignments and activities through other electronic

media. The reasons this sub-group gave for using specific offline assessment types and judging their effectiveness are shown in Table 5.

Table 5. Reasons for using specific offline assessment types

Objective questions
Work well with extremely large class sections,
Work well if the goal is to test whether students know definitions

Subjective questions
Learners are able to use what they have learned and apply it to solve problems
Better measure yet requires subjective grading
Good at assessing critical thinking skills
Give students more room to express themselves about what they really know
Marginally improve research and writing skills

Project or assignments submitted electronically
When students submit projects electronically, instructors can check that they work first hand
Used for submitting programming assignments
Easy and convenient for submitting student work
Work well with small classes and projects involving systems analysis and design exercises
Instructors can see what learners actually do
Learners can demonstrate whether they know the tools or understand how to program
Can be used to help make loftier ideas more concrete
Provide an accurate timestamp for projects learners submit

Collaborative testing
No reasons reported

Outcome- or performance-based assessment
Students can assess their own performance and then have it assessed by the instructor
Instructor can see the students' work and hear their explanations

Interactive assessment
Convenient and easy to use
Responses can be individualized
Develops critical thinking skills

Self-assessment
I have students self-assess, and I assess their assessments
Key to self growth, and this process encourages it
Helps them see the purpose of some assignments
Used mainly for team projects to get a feeling for the work that individual members have contributed

Of instructors who reported using objective questions as an assessment methodology, two gave reasons for using this assessment type and judging its effectiveness. An additional comment that this assessment type is a weak measure was also given.

Five instructors reported reasons for using subjective questions and judging the effectiveness of this type of assessment. Reasons are evenly distributed.

All eight instructors who use project type activities submitted electronically gave reasons for using this assessment methodology and judging its effectiveness. Reasons were evenly distributed. Since this category does not include online assessment, these electronic submissions would likely have been on disk or CD-ROM or submitted via electronic mail.

Two of the three instructors who use outcome- or performance based assessments gave reasons for using and judging its effectiveness. Their reasons are strong indications of the validity of this assessment.

Two instructors reported reasons for using interactive assessment activities. Individualized responses and development of critical thinking skills stand out among these reasons although only half the instructors rated this assessment type effective.

Three instructors gave reasons for using self-assessment and rating its effectiveness. Self-assessment for team projects and helping learners see the purpose of assignments both engage the learners and promote future learning (Thorpe, 1998).

Reasons given for using specific offline assessment methodologies are quite similar to reasons given for using specific online assessment methodologies. Educators might expect the results to be similar. Data from the literature (Arter, 1999; Astin, 1991; Bridges, 1995; Ewell, 2000; Stiggins, 1999) and the online survey suggest that a instructors strive to use assessment methodologies that measure learning, engage the learner, and promote further learning.

Only three data items showing ineffective ratings were culled from the findings. Also, assessment types that instructors rated neutral in effectiveness were not considered to fall within the parameters of the second research questions. Instructor's comments regarding the value of objective question banks were not considered pertinent to the questions. Two instructor comments to the effect that a specific assessment type was either marginally effective or a weak measure were not considered pertinent to the questions.

Emerging Themes and Patterns of Assessment Methodologies Used in an Online Environment

Themes of assessment methodologies in use that emerge from a review of the literature focus on the concepts of alternative and authentic assessment (Astin & Jansak, 2001; Bridges, 1995; Byers, 2001; Carnevale, 2000; Fodor, 2001; Hardin & Ziebarth, 2000; Jacobs & Chase, 1992; Neilsen, 1997; Taylor, 1998). These researchers emphasize assessing higher order learning, skill development, use of prior knowledge, and the ability to perform tasks correctly coupled with timely and appropriate feedback from the instructor to allow learners to alter patterns of behavior during the course. Outcome- or performance-based assessment, interactive assessment through which learner and instructor communicate electronically, continuous assessment that is integrated into learning activities, collaborative assessment through which learners work together on assignments and are assessed as a group, and project based assessment are strongly recommended and highly praised in the literature cited above.

Patterns of assessment methodologies used, judgment of their effectiveness, and themes in reasons for using specific assessment types emerge from the survey data. This section identifies the three assessment methodologies with the highest use and their ratings of

effectiveness. This section also identifies the pattern of reasons instructors reported for using specific assessment methodologies in all the categories combined.

Assessment Methodologies Used and Effectiveness Ratings

With instructors surveyed who teach online and assess learners online, the following patterns emerge: (a) one hundred percent of these instructors reported using objective questions for assessment, and seventy-five percent of them rated this methodology as effective in measuring learning, engaging the learner, integrating into the learning process, and promoting further learning; (b) one hundred percent of this sub-group reported using projects or assignments submitted electronically, and one hundred percent of these instructors also rated this method as effective or extremely effective; (c) fifty percent of the instructors in this sub-group reported using outcome- or performance-based assessment, and one hundred percent of them rated this method as effective.

With instructors who teach with only some online content and assess learners online, the following patterns emerge: (a) one hundred percent of this sub-group of instructors reported using objective questions as an assessment methodology, and one hundred percent rated this type of assessment either effective or extremely effective; (b) one hundred percent of instructors in this sub-group reported using projects or assignments submitted electronically, and one hundred percent of them also rated this type of assessment effective; (c) eighty percent of instructors in this sub-group reported using outcome- or performance-based assessment, and one hundred percent of these instructors rated this assessment type either effective or extremely effective.

With the subgroup of instructors who teach online but do not assess learners online, no patterns of assessment types emerge. Use of the assessment methodologies presented in the survey were distributed almost evenly among these instructors with (a) projects or assignments

submitted electronically, and (b) self-assessment both showing the highest use at only twenty-two percent. These two methodologies are rated effective.

With the sub-group of instructors who teach with only some online content and do not assess learners online, the following patterns emerge: (a) ninety-one percent of this sub-group of instructors reported using projects or assignments submitted electronically, and eighty percent of these rated this methodology as either effective or extremely effective; (b) eighty percent of this sub-group of instructors reported using subjective questions, and of those instructors, eighty-eight percent rated this assessment type as effective or extremely effective; (c) fifty-four percent of this sub-group of instructors reported using objective questions, and (d) seventy-one percent of these instructors rated this assessment type as effective.

Although only fourteen percent of all instructors reported using collaborative testing as an assessment methodology, one hundred percent of these instructors rated this assessment type as effective. Forty-eight percent of all instructors reported using self-assessment as a methodology; however, eighty percent of these instructors rated this assessment type as effective. Both collaborative testing and self-assessment emerge as effective assessment methodologies although they are not used extensively by this group of instructors.

The overall pattern that emerges from these data is that in courses taught in an online environment with online learner assessment, seventy-five to one hundred percent of respondents use the following assessment methodologies: (a) objective questions, one hundred percent of instructors in this combined sub-group and fifty-seven percent of all instructors; (b) projects or assignments submitted electronically, one hundred percent of instructors in this combined sub-group and fifty-seven percent of all instructors; (c) outcome- or performance based assessment, seventy-five percent of instructors in this combined sub-group and forty-three percent of all

instructors. Objective questions, projects or assignments submitted electronically, and outcome- or performance-based assessment methodologies clearly emerge as the assessment types this combined sub-group of instructors used most and rated as effective for measuring learning, engaging the learner, integrating into the learning process, and promoting further learning.

Reasons for Using Specific Methodologies

Analysis of the survey data identified four reasons for using and judging the effectiveness of specific assessment types that were reported more often than others. Table 6 shows the four reasons and frequency with which they were reported.

Table 6. Most frequently reported reasons for using a specific methodology

Reason	Frequency Reported
This methodology measures performance, application of skills, and use of previously gained knowledge	33 %
This methodology measures both construction and comprehension skills	28 %
This type of assessment is easy to use with large numbers of students	23 %
These assessments are easy to grade	19 %

It is clear from the findings that only two of the reasons frequently given relate to the definition or characteristics of authentic assessment stated earlier in this chapter. The other two reasons relate to logistics of course management rather than how assessment is integrated into the learning process.

Methodologies that Provide Authentic Assessment

Based on findings from the literature review (Alley & Jansak, 2001; Byers, 2001; Carnevale, 2001; Dewalt, et al., 2000; Fodor, 2001; Jacobs & Chase, 1992) and survey data,

several assessment methodologies were identified that provide authentic assessment appropriate for use in building an online assessment paradigm for an introductory computer science course. This section evaluates the use and effectiveness of those methodologies. By integrating the methodologies most often used with the reasons for use and judgment of effectiveness, it should be possible to develop the desired model for assessing learners online in an introductory computer science or information technology course. Those assessment methodologies that have been used but instructors reported as ineffective or neutrally effective will not be considered appropriate for the model. Authentic assessment criteria require that methods are effective in measuring learner achievement (Wiggins, 1998).

Some assessment methodologies used in face-to-face learning environments are inadequate for use in an online learning environment as well as others that are currently in use in online learning environments. Findings from the literature on assessment methodologies which might provide authentic learner assessment in an online environment are shown in Table 7.

Table 7. Authentic methodologies for online assessment from the literature

Authentic Online Assessment Methodologies
Open-book and open-notes assessment
Assessment based on course objectives
Outcome- or performance-based assessment
Interactive assessment
Continuous assessment
Assessment by collaborative testing
Project-based assessment

Courses taught online and courses with only some online components were evaluated as a single unit in order to analyze methodologies used for online assessment in both categories. The purpose for identifying and evaluating assessment methodologies that were used for online assessment rather than offline assessment is two-fold: first to add to the body of research in

online learning, and second to attempt to identify authentic assessment methodologies for the proposed model.

Survey respondents were given the following assessment types from which to choose the assessments they have used:

1. Objective questions,
2. Subjective questions,
3. Projects or assignments submitted electronically,
4. Collaborative testing,
5. Outcome- or performance-based assessment,
6. Interactive assessment,
7. Self-assessment,
8. Online threaded discussions.

The eight assessment types were selected because they were discussed extensively in the literature, and several had been described as useful for assessing online learning. Other methodologies were discussed less extensively in the literature and not often in conjunction with online teaching and learning environments. Assessment types three, four, five, six and seven were found most often in the literature. It is critical to this study to identify which of the eight types of assessment methodologies used by the respondents met the criteria given earlier in this chapter for authentic assessment. It is just as critical to identify the reasons for using a particular assessment methodology that also meet the criteria for providing authentic assessment. Both the methodology used and reason for its use should fit into the authentic assessment category Since the assessment types listed were the same whether for courses taught online or with only some online components, the reasons for use have been combined in Table 8.

Table 8. Authentic reasons for using specific online assessment methodologies

1. Objective questions
Assess both construction and comprehension skills
An easy way to measure student performance with immediate feedback
Clearly definitive answers to technology issues are required
Used for test review and to judge mastery of materials
Test recognition skills and are highly effective

2. Subjective Questions
Shows ability to reason and apply concepts
Used for test review and to judge mastery skills
Allows students to apply knowledge intuitively to problem solutions

3. Projects or activities submitted electronically
Concrete demonstration of skills students have learned
Shows ability to apply skills and previous knowledge
Ability to see files produced by learners rather than viewing a printed copy shows instructor the depth of a learner's knowledge
Eliminates missed due dates and deadlines
Speeds instructor's ability to correct and return materials to the learner
For Web classes, it is imperative that learners are comfortable with posting their work to the net

4. Collaborative assessment
Provides group communication and experience working with others

5. Outcome- or performance-based assessment
Having the student perform the Microsoft Office© exercise is a better test than answering questions about it
Shows learners' skills and demonstrates abilities
Instructors are able to respond quickly to learner's questions about assignments
With time limits and constantly changing parameters, tests workplace survival skills

6. Interactive assessment
Work well with large numbers of learners
Convenient and easy to use, requires minimum effort
Effectiveness of this method is excellent and is limited only by the student's willingness to check e-mails, answer, etc., in a timely manner
Students less inhibited in self expression

7. Self assessment
Lets the students know where they are in the course material
Learners can realistically reflect on their learning experience

8. Online threaded discussions
Shows some students apply reasoning and thinking
Allows learners to learn from one another

The data shown in Table 8 strongly suggest that a combination of methodologies will be required to meet authentic assessment criteria and successfully measure the skill and knowledge

level of learners in this type of online course. This section will describe the methodologies used, judgments of effectiveness, and reasons instructors reported for using specific online assessment methodologies that provide authentic assessment in an online environment.

Objective Questions

Objective questions were used most often among both major groups of instructors who reported they assess learners online. A majority also ranked this methodology as either effective or extremely effective. In general, respondents' reasons for using this type of assessment did not exhibit the criteria for authentic assessment.

Assessment of construction and comprehension skills provide a measure of higher order leaning and what the learner comprehends about the subject matter. However, this reason does not give a clear indication that the learner will actually be able to do something with the knowledge gained. One would hope use of knowledge is also included.

Measuring student performance as suggested indicates only how well a student understands or comprehends the subject matter and not what he or she can actually do with the knowledge or skill gained. This reason does, however, partially meet the criteria of providing immediate feedback on the learner responses.

In an introductory computer science course, there is a multitude of terms for learners to recognize, understand, and use. Assessment for discernment of terms is quite beneficial in this content. The instructor who reported this reason for using objective questions states further that with terminology in technical applications, only one answer can be correct. Selection of the correct term or definition is required for appropriate application to specific problems. Coupled with other assessment strategies, this reason for use of objective questions may meet authentic assessment criteria.

Use of objective questions for material review and mastery can be part of authentic assessment if appropriate and timely feedback is provided. Learners are able to attain additional knowledge and skills by repeated testing on the same material or repeated practice on the same activities (Jacobs & Chase, 1992; Cates, 1984).

Testing for recognition skills promotes only a limited use of assessment. As important as recognition skills are, they must be paired with skills and abilities necessary to manipulate information learned through recognition in order for learners to be successful in use of their knowledge (Greenberg, 1998).

Subjective Questions

Subjective questions were not favored highly by these two groups. Instructors who teach courses online did not rate this methodology effective while only a slight majority of instructors who teach partially online courses rated it either as effective or extremely effective. In this type of subject matter, subjective questions can assess learners' understanding of concepts, their reasoning abilities, and their abilities to carry prior knowledge over to new subject areas.

Measuring learners' reasoning ability and application of concepts fall within the criteria of authentic assessment. Measuring these abilities and skills indicates what learners can do with the knowledge they have gained. This type of assessment allows appropriate opportunities to rehearse, practice, consult resources and receive feedback on performance. Mastery of skills, or the ability to use knowledge and skills together, is a valuable learning component. Students must be able to apply knowledge gained through course content activities to real world situations. Subjective questions assess their ability to make the transition from knowing to applying knowledge in these situations (Fodor, 2001).

Projects or Assignments Submitted Electronically

Projects or assignments submitted electronically can provide effective and authentic assessment. In this type of course, learners produce formatted documents with a word processing program and demonstrate their ability to use correctly an array of tools for formatting, page layout and other features of the documents. They create electronic spreadsheets that represent real world activities they would encounter in the workplace. These activities require the use of various tools to create and format spreadsheets as well as to perform calculations and other business scenarios. Learners also create database applications, load data records, create and print reports, and create and execute queries to extract and exhibit desired data from multiple data files. Learners in these courses create and deliver electronic presentations both online and before other students and the instructor in a face-to-face environment. They must use various tools in the presentation software to demonstrate their understanding of selecting appropriate information for presentation, arranging and formatting the information, and inserting charts, graphics, animations, videos, and sound. Learners also demonstrate their knowledge of best practices for presentation design and delivery. In addition to the application suites used in these courses, most learners are also required to utilize the Internet and the World Wide Web for data searches and other types of research.

This combination of activities presents a realistic assessment battery to the learners which requires judgment and innovation and asks the learners to do the subject matter in addition to learning it. Learners perform an array of activities common to the workplace, civic life, and their personal lives while assessing their ability to use a variety of knowledge and skills to complete tasks successfully. After reviewing the steps necessary to complete the various tasks, learners are generally given several practice exercises through which they improve their skills. Electronic

submission of the activities allows the instructors to provide feedback in a timely manner so learners have ample opportunity to correct erroneous methods they might have used.

All the instructors who assess learners online in both sub-groups, courses taught online and those with some online components, have used projects or assignments submitted electronically. All instructors in both sub-groups rated this type of assessment as either effective or extremely effective. Although this methodology meets the criteria for authentic assessment, only six of the reasons they report for using this assessment type and judging its effectiveness meet those criteria. The remaining reasons have nothing to do with authentic assessment although they are generally considered to be good reasons for using a particular type of assessment.

These types of online or electronically submitted assessment activities allow learners to rehearse activities they will find themselves doing in their careers after graduation. Assessment that requires working in an online environment utilizing the type of media students most likely will encounter in the workplace provides further experience. Measuring how learners apply skills developed and previous knowledge acquired are authentic methods of assessment (Jacobs & Chase, 1992). In authentic assessment practices, it is important to determine the depth of knowledge of learners. Their depth of knowledge helps determine their ability to transfer prior knowledge to new learning events (Jacobs & Chase, 1992).

Although due dates for assignments are an important component of the learning process, and the learner is wise to develop such habits, providing learners with the opportunity to develop these habits alone does not suggest this type of assessment is authentic in nature. Coupled with timely and appropriate feedback, however, this reason could conform to authentic assessment practices. Timely and appropriate feedback provided to learners improves the assessment

process by allowing learners to correct erroneous practices or improve skills throughout the duration of the course. The ability of the instructor to assess activities quickly and easily is beneficial to both instructor and learner.

In this type of course, appropriate use of the Internet and the World Wide Web are key skills learners must already possess or develop during the course. Submission of projects or activities via the Internet and World Wide Web measures learners' understanding of and ability to manipulate this medium. It has been well documented that the Internet and World Wide Web are well-suited to online instructional and learning systems that prompt learners to construct knowledge by accessing and using the vast store of information available online. "Humans learn action-oriented competencies by doing. The proof of having acquired such competencies is the ability to replicate them through performance" (Alley & Jansak, 2001, p. 13). The act of doing promotes learning and reinforces prior skill and knowledge development. "'Doing' helps to transfer new knowledge from short term memory to long term memory" (p. 13). Performance of real activities acts as formative assessment. The elements of action and experience in the acquisition of action-oriented competencies provide a measure of learners' abilities to use knowledge gained.

Collaborative Assessment

The data suggest that perhaps collaborative assessment is not understood and not widely used in this type of course. Two instructors in each sub-group report using collaborative testing. These instructors rated this type of assessment as effective, but they gave only one reason for using or judging the effectiveness of this assessment type.

Based on the research of Benigno and Trentin (2000), collaborative assessment can be authentic assessment. Hardin and Ziebarth (2000) also recommend the use of this assessment

methodology because of the collaborative and teamwork environment in graduate school, business activities, and life activities in general

Outcome- or Performance-Based Assessment

Outcome- or performance-based activities rank third in order of use among this group of instructors, and the effectiveness level is split evenly between effective and extremely effective. Seventy-five percent of instructors in this combined sub-group report using outcome- or performance-based assessment, and all rated this type of assessment as effective. This group gave four reasons for using this type of assessment and judging its effectiveness that meet the criteria for authentic assessment.

Creation of products by using the appropriate tools to solve real world problems is an authentic assessment methodology and superior to having learners simply answer questions about how to use the application software. This type of assessment clearly demonstrates the learners' skills and abilities to use the knowledge they have gained. This methodology also provides a constructivist environment for learners (Rasmussen & Northrup, 1999). The evaluation of this reason is similar to that of the previous question. Whenever learners are assessed through an opportunity to perform real-world activities, their assessment contains authentic components.

Rapid or immediate feedback on learner activities promotes new learning and guides the learner to a more appropriate learning strategy when needed. Learners are given the opportunity to alter their learning habits throughout the duration of the course.

Learners must be able to apply knowledge and skills in a learning environment in the same manner in which they will be required to do so in the workplace. Schedules are frequently imposed on work assignments in the real world, and imposition of time limits on assessment activities emulates workplace activities. Assessment of learner outcomes continues to be a major

challenge for the higher-education community. Current literature suggests that online education is more learner-centered and outcome-focused than traditional education. Online learning environments should, therefore, be in a better position to assess student learning than a traditional educational system. College and university educators are experimenting with new ways to teach as well as with new ways to prove they are teaching effectively. Fodor (2001) and Jacobs & Chase (1992) strongly recommend the use of outcome measurements to aid in determining learners' abilities to perform a task and complete an assignment.

Interactive Assessment

Interactive assessment ranks fourth among the instructors who assess learners online both in courses taught online and courses with only some online components. Four out of eight instructors rated this assessment type as either effective or extremely effective. The reasons these instructors reported for using interactive assessment and judging its effectiveness may be generally accepted reasons for using the methodology; however, none of the reasons meet the criteria for authentic assessment. Based on discussions by Byers (2001) and Fodor (2001), interactive assessment itself meets several of the criteria for authentic assessment because it permits both learner and course improvements through collaboration between the learner and the instructor. Fodor (2001) further recommends use of interactive assessment because of its learner-center environment and its objective results.

Self-Assessment

The same number of instructors in both sub-groups reported they have used self-assessment as a methodology of learning measurement. All these instructors rated this assessment type as effective. Two reasons that meet the criteria for authentic assessment were reported for using and judging this type of assessment as effective.

Students' ability to know where they are in the course material is in itself not sufficient to determine whether the instructors who use self-assessment regard it as an authentic assessment type. Coupling this reason with the second reason adds credibility to this assessment type and its use.

Learner reflection allows adjustment and correction of the learning process to improve future learning. In addition, evidence in assessment literature indicates that authentic assessment criteria can be met by self-assessment. Self-assessment is becoming a popular methodology of measuring learner achievement, especially in a distance or online environment. According to Ingram (1994), the remoteness of distance learners in relationship to the source of the instruction, the lack of formal learning situations experienced by some distance learners, and fewer opportunities for informal interactions increase the need for self assessment. Ingram concludes that self-assessment activities and opportunities should be built into instructional systems for online or distance delivery. Taylor (1998) states, "Self assessment, the process of understanding more about oneself [*sic*] is a valuable skill, both in life and when studying. That fact is acknowledged regularly in the many descriptions and models of instructional design currently expounded" (p. 319).

Online Threaded Discussions

Only one third of instructors who use online threaded discussions as an assessment methodology rated this type of assessment as effective for this type of course. Two of the three reasons for using online threaded discussions and judging the effectiveness of this type of assessment meet criteria for authentic assessment.

Both reasoning ability and thinking skills are important in higher order learning activities. They allow learners to apply previously develop skills and prior knowledge to new learning

events. Assessing reasoning and thinking skills comprises authentic assessment activities. Online threaded discussions might prove appropriate for providing opportunities for learners to develop responses to questions both from their prior knowledge and from available references.

Online discussions used as assessment also provide opportunities for learners to interact with each other and the instructor to explore the subject matter. Working with and learning from other learners improves the process of developing and applying reasoning and thinking skills. This process is a highly desirable goal in instruction, learning, and assessment, and this type of assessment probably will fit into a paradigm of authentic assessment for an online introductory computer science course.

Emerging Patterns of Use and Effectiveness of Assessment Types in an Online Environment

Themes of authentic assessment methodologies that may be appropriate for use in an online environment emerge from a review of the literature and focus on the concepts of alternative and authentic assessment (Carnevale, 2001; Fodor, 2001; Alley & Jansak, 2001; Byers, 2001; Thorpe, 1998; Morgan, 1995). Although not all researchers use these specific terms, the characteristics of the assessment practices they describe and recommend are those of alternative assessment practices, many of which also meet the criteria for authentic assessment as previously defined. Emphasis is on assessing higher order learning, skill development, use of prior knowledge, and the ability to perform tasks correctly coupled with timely and appropriate feedback from the instructor to allow learners to alter patterns of behavior during the course. Outcome- or performance-based assessment in which learner skills at using knowledge are assessed is suggested by Carnevale (2001), Fodor (2001) and others and seems quite appropriate as an assessment type for these courses because learners are required to perform specific tasks in

addition to gaining amounts of knowledge about the subject. Interactive assessment, the use of collecting performance data through the use of technology as Byers (2001), Alley & Jansak (2001), Fodor (2001) and others describe is a natural component of a computer science, information technology, or similar computer applications course. Not only is the use of interactive resources taught, their use is an integral component of the learner's communications with the instructor. Continuous assessment, the practice of integrating assessment activities into learning activities of the curriculum and providing timely feedback to learners, makes sense as a viable assessment type for use in almost any curriculum. Continuous assessment requires integration of assessment into all course activities. Thorpe (1998) and others highly recommend the use of continuous assessment. Project-based assessment, which incorporates assessment into curriculum design, is quite popular in higher education and particularly in courses which use or teach information technology as Morgan (1995) reports. Many activities such as creation of electronic documents, spreadsheets, databases, presentations, and Web pages require the completion of project assignments in both a timely and accurate manner.

Patterns of use and judgment of effectiveness of assessment types also emerge from the findings in the data. Among instructors in both major groups who assess learners online, objective questions, projects or activities submitted electronically and outcome- or performance-based assessment types received the highest overall rating of use and effectiveness combined.

Objective Questions

One hundred percent of all participants who assess learners online have used objective questions. Eleven out of twelve instructors rated this type of assessment as effective or extremely effective.

Projects or Activities Submitted Electronically

One hundred percent of respondents who assess online have used projects or activities submitted electronically as an assessment methodology. All instructors rated this type of assessment as effective or extremely effective.

Outcome- or Performance-based Assessment

Outcome- or performance-based assessment ranked third for use and effectiveness. Seventy-five percent of respondents who assess online have used this type of online assessment, and eight of nine instructors rated it as effective or extremely effective.

Relationship of Online Assessment Types Used to Effectiveness Ratings

An important relationship should exist between the types of online assessments instructors use and the judgment of the effectiveness of these assessments. The findings indicate however, that this relationship does not always exist. Figure 1 shows the relationships between assessment types and effectiveness ratings for courses taught online.

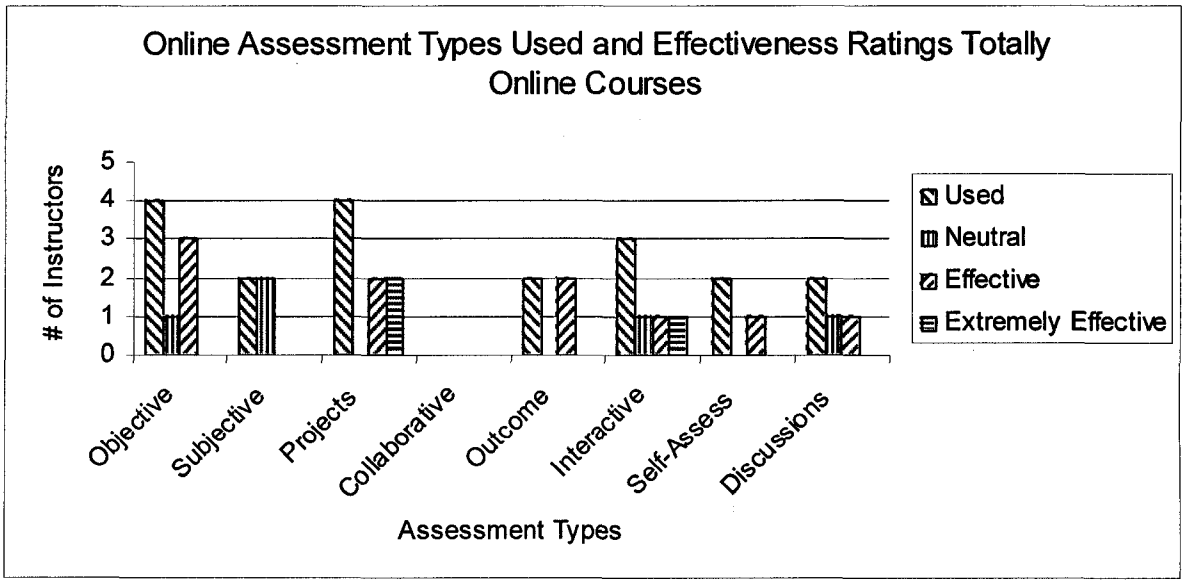

Figure 1. Relationship of online assessment types used to effectiveness ratings in online courses

Figure 2 shows the relationships between assessment types and effectiveness ratings for courses with only some online components.

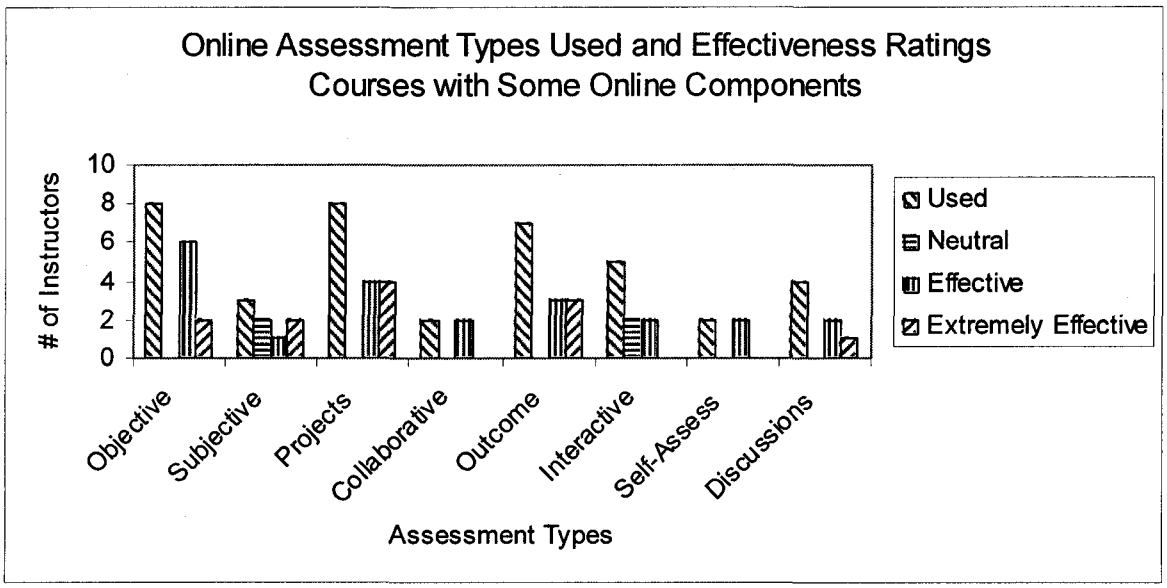

Figure 2. Relationship of online assessment types used to effectiveness ratings in courses with only some online components

Most Often Used Offline Assessment Types and Effectiveness Ratings

Both major groups of instructors reported using offline assessment strategies for their courses. The following section describes use of offline assessments in online courses and those with only some online content.

Projects or Activities Submitted Electronically

Among instructors in both major groups who do not assess learners online, projects or activities submitted electronically rank highest of all assessment types used. Twelve of twenty respondents in this combined group have used this type of assessment offline. It is worth noting that these instructors use electronic media other than online resources for student submission of

assignments that are assessed. Ten of twenty instructors rated this assessment type as effective or extremely effective.

Objective and Subjective Questions

Objective and subjective questions tied for third place in use among instructors in this combined group. However, overall effectiveness ratings for subjective questions are higher than for objective questions among this group. Eighty-eight percent of instructors who teach online courses and courses with only some online components rated this type of assessment as effective or extremely effective.

Self Assessment

Self assessment ranks next within this group of instructors when use and effectiveness are combined. Two thirds of instructors in this group rated this type of assessment as effective.

Emerging Themes in Reasons for Using Specific Online Assessment Methodologies

Among the combined thirty-one reasons shown in Table 4 for using a specific online assessment methodology and judging its effectiveness, the following reasons were reported most often for authentic assessment methodologies that may be appropriate for use in this type of course: (a) this methodology measures performance, application of skills, and use of previously gained knowledge, thirty-three percent; (b) this methodology measures both construction and comprehension skills, twenty-eight percent. These reasons fit well into the category for providing authentic assessment.

Summary

Use of objective questions for learner assessment is popular even in an online environment. Course Management Systems (CMS) are designed for easy distribution of objective type questions in quizzes, practice tests, and exams. However, this methodology is not

seen in the literature as an authentic assessment type. Projects or assignments submitted electronically as an assessment methodology were strongly favored by instructors in the survey group and are also seen in the literature as an effective alternative online assessment type. This assessment type was also strongly favored by instructors who teach courses with only some online components and who do not use online assessment. Collaborative testing as a methodology is recommended in the literature and was rated effective in the survey data although few instructors reported using it in an online environment. Outcome- or performance-based assessment is strongly recommended in the literature as an effective alternative and authentic assessment methodology and was also highly favored by the survey respondents for online assessment. Interactive assessment ranked high as an effective online assessment type among instructors in the survey group and is also strongly recommended in the literature.

Analysis of Data Validity

Data were validated by an in-depth review of assessment strategies in online instructional environments in current literature. Data were further validated through telephone or e-mail conversations with three of the instructors who participated in the survey, as well as by a review of the findings by a Ph.D. faculty member in Mercer University's Tift College of Education and an additional Ed.D.

Potential Sources or Basis of Errors

Potential errors exist in the survey data in two categories of responders. Five instructors in the sub-group who teach courses with only some online components and do not assess learners online rated the effectiveness of specific assessment types but failed to indicate they actually have used those methodologies. The Perseus© software used to collect, store, and analyze the survey data counts every selection of the Have Used button although instructors may have

deselected it later during their completion of the survey. This possible error does not affect the final analysis because these instructors do not assess learners online. Charts produced by the Perseus© software are too voluminous to include in this paper and would not appear meaningful to the reader.

A second potential source of error lies within the sub-group of instructors who teach courses with only some online components and assess learners online. A total of eight instructors reported using specific assessment types and rated their effectiveness while only five of these instructors selected the Assess Learners Online button in the survey. This selection error will not affect the outcome because an adequate number of instructors reported using these assessment types and rated their effectiveness. Because some respondents teach courses in both online and offline environments, each response selection was independent of other selections. Although instructions embedded within the online survey and in the cover letter clearly explained which sections of the online survey should be completed based on the nature of an instructor's course and assessment activities, it is clear as explained above that a small number of instructors may not have followed instructions explicitly. Percentage calculations made with Microsoft Excel© are error free but are generally rounded to whole numbers in the text

CHAPTER 5: RESULTS, CONCLUSIONS AND RECOMMENDATIONS

Results

The purpose of the study was to answer the following questions:

1. What features, tools and methodologies are currently used in assessment paradigms in courses in post-secondary education?
2. Which of these methodologies provide authentic assessment appropriate for an online learner assessment paradigm in an introductory computer science or information technology course?

Working within assumptions and limitations set forth in Chapter 3, data were collected through the online Survey of Assessment Methods in Online Courses (Appendix A). Directions for completing the survey were embedded within the survey and also fully explained in the e-mail cover letter (Appendix B). Findings from the survey data indicate the assumptions were valid. According to Zukerberg and Lee (1997) and others, response burden is considered to be a primary limitation when collecting survey data. Response burden is usually quantified in terms of how long the survey takes to complete. In order to lower response burden, careful attention was given to the following aspects of the survey: design and implementation of the survey instrument, explanation of terms, clear instructions for completion, length of survey, time required to complete the survey, anonymity of respondents, and password protection. The group of participants was limited to instructors who are members of academic organizations whose primary focus is the integration of technology into instruction, who teach introductory computer science, information technology, or similar computer applications courses either online or with some online components, and who responded positively to an e-mail request for participants.

Thirty-two instructors agreed to participate in the survey, and twenty-one actually completed the survey.

Qualitative evaluation research was used to analyze and interpret the aim, purpose, and effectiveness of assessment methodologies used in introductory computer science, information technology, or similar computer applications courses. The findings will be used to begin development of a proposed authentic assessment model for measuring learner accomplishment in this type of course in an online teaching and learning environment. Effective methodologies that meet the criteria for authentic assessment will be incorporated into the model in an attempt to integrate assessment into the learning experience, measure learning effectively and accurately, engage the learner, and promote further learning.

This section identifies those methodologies instructors reported using that provide authentic assessment and the reasons they reported for judging them effective. Authentic assessment differs from traditional assessment in that it measures what learners can do with the knowledge they have gained. Wiggins's (1998) characterizes authentic assessment as follows:

> [Authentic assessment] is realistic,... requires judgment and innovation,... asks the student to "do" the subject, replicates or simulates the context in which adults are "tested" in the workplace in civic life and in personal life,... assesses the student's ability to efficiently and effectively use a repertoire of knowledge and skill to negotiate a complex task,... and allows appropriate opportunities to rehearse, practice, consult resources, and get feedback on and refine performances and products. (p. 23)

Attributes of authentic assessment were found in fifty-eight percent of the assessment methodologies described in the literature. Fifty percent of the assessment types presented in the survey were found to present attributes of authentic assessment. Attributes of authentic assessment were found in only thirty-one percent of the reasons for using specific online

assessment types. Eighty-eight percent of the assessment types used for online assessment were found to be effective.

Use of objective questions for learner assessment was found to be popular in an online environment. An online Course Management Systems (CMS) allows easy distribution of objective type questions in quizzes, practice tests, and exams. However, this methodology is not seen in the literature as a good alternative or authentic assessment type. Projects or assignments submitted electronically as an assessment methodology was strongly favored by instructors who assess learners online and is also seen in the literature as an effective alternative online assessment type. This assessment type was also strongly favored by instructors who teach courses with only some online components and do not use online assessment. Collaborative testing as a methodology is recommended in the literature and was deemed effective in the survey data although few instructors reported using it in an online environment. These data seem to indicate that in introductory computer science, information technology, or similar computer applications courses, instructors either do not often assign group activities to their students or do not use these activities for assessment purposes. Outcome- or performance-based assessment is strongly recommended in the literature as an effective alternative and authentic assessment methodology and was also highly favored by the survey group for online assessment. Interactive assessment ranked high as an effective online assessment type among instructors in the survey group and is also strongly recommended in the literature.

Conclusions and Recommendations

Conclusions are organized around the research questions and although tentative, represent a contribution to an area important to the administration of higher education and assessment of learning in an online environment. The literature base clearly identifies and describes assessment

methodologies, previously used and currently in use in higher education, which exhibit attributes and characteristics of authentic assessment as set forth in Chapter 1. The literature further describes methodologies used in traditional classroom settings which may be portable to online teaching and learning environments and explains why some assessment methodologies used in traditional face-to-face instructional systems are not appropriate for and cannot be easily ported to online learning environments. Assessment methodologies to be considered for inclusion in the proposed online assessment paradigm met the following criteria: (a) the methodologies exhibit attributes or characteristics of authentic assessment; (b) they are found in both the literature and the survey data; (c) they are rated as effective or extremely effective in measuring learning, engaging the learner, integrating into the learning process, and promoting further learning by the group of instructors participating in the study; (d) they are appropriate for use in online introductory computer science, information technology, or similar computer applications courses; and (e) the reasons instructors reported for using these assessment types also exhibit characteristics of authentic assessment. The study found the following assessment methodologies that meet these criteria: (a) projects or assignments submitted electronically, such as spreadsheets, documents, databases presentations, program coding, and other objects; (b) collaborative testing, in which learners respond individually to questions after group deliberations and teaching one another; (c) outcome- or performance-based assessment, in which learners are assessed on demonstration of skills or abilities; and (d) interactive assessment, in which instructors and learners correspond through e-mail or chat sessions.

Clearly objective questions, projects or activities submitted online, and outcome- or performance-based assessments were most favored among this group of instructors who teach introductory computer science, information technology or similar computer applications courses.

Objective questions do not fully meet the criteria for authentic assessment, but projects or activities submitted online and outcome- or performance-based assessments are strong authentic assessment methodologies. Interactive assessments also ranked high in use as an online assessment methodology; however, only about half of those instructors who have used this type of assessment felt it was effective. It is recommended that to create an online assessment paradigm for an introductory computer science or information technology course and to meet the authentic assessment criteria established by Wiggins (1998) and Bridges (1995), these four assessment types be considered as the most likely candidates: (a) projects or assignments submitted electronically, (b) collaborative testing, (c) outcome- or performance-based assessment, and (d) interactive assessment. Other assessment types that received high effectiveness ratings may also be included to provide a balanced authentic assessment paradigm that measures learning, engages the learner, is integrated into the learning process, and promotes further learning.

The finding that collaborative testing is seldom used in introductory computer science, information technology, or similar courses is surprising in light of the extensive literature on collaborative learning and learner-centered education at the post-secondary level. According to the literature, collaborative learning is taking a foothold in post-secondary curricula as the current trend in learner-centered education. Team work in the market place is so prevalent that this assessment methodology appears to be a logical stepping stone to learner career development. In the field of computers and technology, the team approach is used extensively in developing new products and services. It was not surprising to find that outcome- or performance-based assessment is widely used and strongly recommended for an introductory computer science or information technology course which requires extensive student interaction, project development,

and online assignments. Neither was this finding surprising in light of the knowledge and skills students must acquire for performing numerous interactive tasks in the field of computer technology.

There remain unanswered questions, the most prominent of which are, "Why do instructors use assessment methodologies that apparently do not meet the criteria for authentic assessment? And why do instructors not make better use of assessment methodologies that are authentic in nature?" Authentic assessment seems to be the key. Could it be that instructors do not understand the meaning of authentic assessment? How would instructors have to modify their instruction and assessment methods in order to incorporate into their courses authentic assessment that is effective in measuring learning, engages the learner, is integrated into the learning process, and promotes further learning? An underlying question that has evolved from the study is whether instructors must be more diligent with assessment in an online environment than in face-to-face classroom instruction? In addition, does the online environment mitigate the use of different paradigms of assessment, and if so, how will instructors begin to learn of these paradigms and integrate them into their teaching and learning systems?

Colleges and universities must accept the challenge to adopt current effective teaching methodologies, including authentic assessment as an integral part of teaching and learning, in order to meet the educational demands of learners. Faculty must learn to use the four authentic assessment methodologies identified in the study to assess both what learners know and what they can do with their knowledge. It is imperative that colleges and universities institute extensive ongoing programs for faculty and staff development that include current effective teaching and learning strategies.

Further research is recommended to answer these remaining questions in light of recent developments in online learning environments. Clearly additional research is also recommended to identify assessment methodologies which have come into use in online instructional and learning systems within the past year and to fine tune assessment methodologies as higher education institutions become more involved in online teaching and learning.

If the study is replicated, it is recommended that the online survey instrument be redesigned to omit questions related to off-line assessments and the analysis software be reprogrammed not to allow respondents to rate the effectiveness of assessment types and submit comments unless they have first selected the Used button for those assessment types. It is further recommended that more thorough profile data be collected on respondents to provide background for interpreting reasons given for using and judging specific assessment types.

The findings of this study will be used to develop an online model for authentic assessment in an introductory computer science course. Although all the methodologies rated as effective for measuring learning in the study do not meet the criteria for authentic assessment, modifications and blends of these assessment types will make it possible to form a usable and acceptable model that will evolve over time. Drummond (2000) describes future educational institutions and systems with a holistic view of instruction and learning processes when he states:

> Successful educational institutions in the future will of necessity integrate the worlds of education, work, and leisure with leading edge electronic technologies as they become available. The new model for educational activity will be that which is delivered by the institutions and acquired by the students in an anytime, anyplace, on-demand fashion. The educational institution of the future, at the post-secondary level at least, will not be a campus we drive through and view the ivy covered halls of wisdom, but it will be a learning experience we participate in while we drive along the highway, relax at home, work at our desks, fly to distant locations, collaborate with fellow learners, and accomplish all the other tasks required of us to be productive, useful, and educated citizens of the world. It will always be at our fingertips, or at least no more than a click away. (p. 34)

One of the major challenges of this new "at-our-fingertips" learning environment will be how to assess learner achievement in an online course in which learner and instructor seldom or never see each other in face-to-face contact. The assessment must be authentic as defined by Wiggins (1998), Bridges (1995) and others and must be effective in that it measures learning, engages the learner, is integrated into the learning process, and promotes further learning. The assessment paradigm developed as a result of this study will be a step forward.

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APPENDIX A. SURVEY FORM

Survey of Assessment Methods in Online Courses

When you have completed the applicable sections, please click the SUBMIT button at the end.

SECTION 1: COURSES TAUGHT TOTALLY ONLINE.

Do you assess learners online?
____ Yes (Please complete Section 1a below) ____ No (Please complete Section 1b below)

Section 1a: Assess learners online
Indicate the types of learner assessments you have used online by selecting the corresponding Have Used buttons. If you have not used a particular assessment type, do not select that button.

Select the appropriate effectiveness button for each type of assessment used with 1 being extremely ineffective and 5 being extremely effective. Effectiveness is based on your judgment of how well the methodology measures learning, engages the learner, is integrated into the learning process, and promotes further learning.

Note:
In the comments section for each methodology, please add comments regarding reason for its use and judgment of its effectiveness.

		Have Used	Extremely Ineffective (1)	Ineffective (2)	Neutral (3)	Effective (4)	Extremely Effective (5)
1	Objective Questions (Multiple-choice, fill-in blank, matching, lists)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
2	Subjective questions (Short answer, paragraphs, short papers)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
3	Projects or assignments submitted electronically (Spreadsheets, documents, databases, presentations, program coding, other projects)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
4	Collaborative Testing (groups of 2 or more) (Individual responses to questions after group deliberation and teaching one another)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
5	Outcome- or Performance-Based Assessment (Assess demonstration of skills or abilities)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
6	Interactive Assessment (Interactive correspondence between learner and instructor such as e-mail, chat)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						

7	Self-Assessment (Reflection upon one's own work, knowing that one knows the appropriate material)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
8	Online threaded discussions (Learners respond to question or statement posted by instructor; instructor responds to learner comments, learners may respond to each other's comments)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						

Section 1b: Do not assess learners online
Indicate the types of learner assessments you have used by selecting the corresponding Have Used buttons. If you have not used a particular assessment type, do not select that button.

Select the appropriate effectiveness button for each type of assessment used with 1 being extremely ineffective and 5 being extremely effective. Effectiveness is based on your judgment of how well the methodology measures learning, engages the learner, is integrated into the learning process, and promotes further learning.

Note:
In the comments section for each methodology, please add comments regarding reason for its use and judgment of its effectiveness.

		Have Used	Extremely Ineffective (1)	Ineffective (2)	Neutral (3)	Effective (4)	Extremely Effective (5)
9	Objective Questions (Multiple-choice, fill-in blank, matching, lists)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
10	Subjective questions (Short answer, paragraphs, short papers)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
11	Project type activities (Spreadsheets, documents, databases, presentations, program coding, other projects)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
12	Collaborative Testing (groups of 2 or more) (Individual responses to questions after group deliberation and teaching one another)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
13	Outcome- or Performance-Based assessment (Assess demonstration of skills or abilities)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
14	Interactive Assessment (Interactive correspondence between learner and instructor such as e-mail, chat)	()	()	()	()	()	()

	Reason for use and judgment of effectiveness						
15	Self-Assessment (Reflection upon one's own work, knowing that one knows the appropriate material)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						

SECTION 2: COURSES TAUGHT WITH SOME ONLINE COMPONENTS.

Do you assess learners online?
____ Yes (Please complete section 2a below) ____ No (Please complete section 2b below)

Section 2a: Assess learners online
Indicate the types of learner assessments you have used online by selecting the corresponding Have Used buttons. If you have not used a particular assessment type, do not select that button.

Select the appropriate effectiveness button for each type of assessment used with 1 being extremely ineffective and 5 being extremely effective. Effectiveness is based on your judgment of how well the methodology measures learning, engages the learner, is integrated into the learning process, and promotes further learning.

Note:
In the comments section for each methodology, please add comments regarding reason for its use and judgment of its effectiveness.

		Have Used	Extremely Ineffective (1)	Ineffective (2)	Neutral (3)	Effective (4)	Extremely Effective (5)
16	Objective Questions (Multiple-choice, fill-in blank, matching, lists)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
17	Subjective questions (Short answer, paragraphs, short papers)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
18	Projects or assignments submitted electronically (Spreadsheets, documents, databases, presentations, program coding, other projects)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
19	Collaborative Testing (groups of 2 or more) (Individual responses to questions after group deliberation and teaching one another)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
20	Outcome- or Performance-Based Assessment (Assess demonstration of skills or abilities)	()	()	()	()	()	()
	Reason for use and judgment of effectiveness						
21	Interactive Assessment (Interactive correspondence between learner and	()	()	()	()	()	()

	instructor such as e-mail, chat)						
	Reason for use and judgment of effectiveness						
22	Self-Assessment (Reflection upon one's own work, knowing that one knows the appropriate material)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
23	Online threaded discussions (Learners respond to question or statement posted by instructor; instructor responds to learner comments, learners may respond to each other's comments)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						

Section 2b: Do not assess learners online
Indicate the types of learner assessments you have used by selecting the corresponding Have Used buttons. If you have not used a particular assessment type, do not select that button.

Select the appropriate effectiveness button for each type of assessment used with 1 being extremely ineffective and 5 being extremely effective. Effectiveness is based on your judgment of how well the methodology measures learning, engages the learner, is integrated into the learning process, and promotes further learning.

Note:
In the comments section for each methodology, please add comments regarding reason for its use and judgment of its effectiveness.

		Have Used	Extremely Ineffective (1)	Ineffective (2)	Neutral (3)	Effective (4)	Extremely Effective (5)
24	Objective Questions (Multiple-choice, fill-in blank, matching, lists)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
25	Subjective questions (Short answer, paragraphs, short papers)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
26	Project type activities (Spreadsheets, documents, databases, presentations, program coding, other projects)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
27	Collaborative Testing (groups of 2 or more) (Individual responses to questions after group deliberation and teaching one another)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
28	Outcome- or Performance-Based assessment (Assess demonstration of skills or abilities)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						

29	Interactive Assessment (Interactive correspondence between learner and instructor such as e-mail, chat)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						
30	Self-Assessment (Reflection upon one's own work, knowing that one knows the appropriate material)	( )	( )	( )	( )	( )	( )
	Reason for use and judgment of effectiveness						

Additional Comments

Name: (Optional)_____ E-mail: (Optional)_____

When you have completed the applicable sections, please click the SUBMIT button below.

SUBMIT

APPENDIX B. SURVEY RESULTS

Section 1: Courses Taught Totally Online

Section 1a: Assess learners online

Question Number	Question Type	Used	Extremely Ineffective	Ineffective	Neutral	Effective	Extremely Effective
1	Objective	4			1	3	
2	Subjective	2			1		
3	Projects	4				2	2
4	Collaborative	0					
5	Outcome	2				2	
6	Interactive	3			1	1	1
7	Self-Assessment	2				2	
8	Discussions	2			1	1	

Section 1b: Do not assess learners online

Question Number	Question Type	Used	Extremely Ineffective	Ineffective	Neutral	Effective	Extremely Effective
9	Objective	1			1	1	1
10	Subjective	1		1	1		1
11	Projects	2			1		2
12	Collaborative	1				1	
13	Outcome	1				1	1
14	Interactive	1				2	
15	Self-Assessment	2				2	

Section 2: Courses Taught With Some Online Components

Section 2a: Assess learners online

Question Number	Question Type	Used	Extremely Ineffective	Ineffective	Neutral	Effective	Extremely Effective
16	Objective	8				6	2
17	Subjective	3			2	1	2
18	Projects	8				4	4
19	Collaborative	2				2	
20	Outcome	7				3	3
21	Interactive	5			2	2	
22	Self-Assessment	2				2	
23	Discussions	4		1		2	1

Section 2b: Do not assess learners online

Question Number	Question Type	Used	Extremely Ineffective	Ineffective	Neutral	Effective	Extremely Effective
24	Objective	6			2	5	
25	Subjective	6			1	6	1
26	Projects	10		1	1	6	2
27	Collaborative	0				1	
28	Outcome	3			2		2
29	Interactive	3			2	1	1
30	Self-Assessment	4			2	2	

APPENDIX C. PARTICIPANT SOLICITATION E-MAIL

Dear (Instructor's Name):
For my doctoral research in Instructional Design for Online Learning, I am looking for instructors of information systems courses, introductory computer science or similar classes who might be willing to answer a short questionnaire, particularly those who teach online or have some online components in their courses. If you would be willing to participate, please e-mail me at drummond_m@mercer.edu.

Thanks in advance.

A merry heart doeth good like a medicine. Proverbs 17:22

Mike Drummond	Director, Instructional Technology Center
Mercer University	Phone 478-301-2419
1400 Coleman Ave.	FAX 478-301-5521
Macon, GA 31207	E-mail drummond_m@mercer.edu

APPENDIX D. SURVEY COVER LETTER AND INSTRUCTIONS

February 14, 2003

Dr. (Participant Name):

You recently agreed to participate in a study I am conducting as a part of my doctoral research at Capella University. The title of my dissertation is *Authentic Learner Assessment in an Online Environment: Using Instructional Design Techniques to Create an Assessment Model for an Introductory Computer Science Course.* I greatly appreciate your willingness to participate in this study. I have posted the survey online at the following site http://survey.mercer.edu/drummond.asp. Your password is your e-mail address williams_j@mercer.edu to which this notice was sent. The survey will be available until March 15, 2003.

The purpose of the study is to identify best practices of learner assessment used in an online learning environment in an attempt to construct a model for assessing learners in an online introductory computer science course. The study will identify assessment methods and strategies that have been used in online learning systems. It will analyze and interpret the aim, purpose, and effectiveness of those methods in order to identify authentic assessment strategies that can be used in that model.

The expected payoff from this study will be an assessment model that contains strategies and methodologies proven effective in assessing learning and that will demonstrate authentic assessment strategies in an online teaching and learning environment. This assessment model will attempt to integrate assessment into the learning experience, engage the learner, and cause learning to occur. It is expected that this model can be transferred to other courses as well as other disciplines. As a professional educator, your views and experiences are highly regarded, and I appreciate your willingness to contribute to the improvement of teaching, learning and theory building.

Please take a few minutes at your earliest convenience to complete the survey. The survey will be completely anonymous unless you choose to include your name in the comments box. Please complete SECTION 1: COURSES TAUGHT TOTALLY ONLINE, if you teach courses totally online or SECTION 2: COURSES TAUGHT WITH SOME ONLINE COMPONENTS, if you teach courses with only some online components. Complete both sections if they are appropriate for the courses you teach. Both sections are further divided into sub-section a. Assess learners online, and sub-section b., Do not assess learners online. Please complete all sections that are appropriate for the courses you teach.

Please check the Use button for each type of assessment you have used. Select the appropriate scale value to signify how effective you feel that type of assessment was based on your judgment of how well the methodology measured learning, engaged the learner, was integrated into the learning process and caused further learning.

In the comments section for each assessment type, please give your reasons for using that particular type of assessment, the reasons for you judgment of its effectiveness, and any other related comments. Please enter any additional comments regarding learner assessment in the Additional Comments box at the end of the survey.

Personal anonymity will be preserved unless you feel comfortable entering your name and e-mail address in order for me to contact you to review some of your responses. This review will assist me in making sure that I have interpreted your responses correctly. These surveys will not be seen by anyone else, so even if you include your name, no other parties will be privileged to see your responses.

You will be able to change any selections and edit any text you enter prior to selecting the Submit button. Once you have completed the survey, please click the Submit button. Your responses will be stored in a secure database at Mercer University where I am employed.

Again, I appreciate you willingness to participate in this study. At the end of the study I will forward a copy of the study results to all who have agreed to participate.

Sincerely yours,
Carlton M. (Mike) Drummond