Designing On-line Exams

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As the impact of Internet grows in education, more educators have turned toward computers as an instructional vehicle for delivering courses and course materials. There are three categories concerning the use of Internet in teaching and learning: (a) utilizing specific attributes of the Internet in creating supplemental on-line materials, (b) developing inclusive courses in which students take on-line, and (c) offering complete degree programs on-line. Regardless of the category in which these educators fall under, the Internet will be a major factor for delivering instructional materials to learners.

The use of computers in teaching and assessment already has a considerable history within education and training. However, the rise of the Internet presents new opportunities for many aspects of education, particularly assessment. With the Web technology, it is possible to construct on-line tests that are: (a) available beyond the walls of the classroom, (b) independent of paper or other physical resources (apart from a computer and access to the Web), (c) immediately graded with assurance of objectivity, and (d) used for formative or summative purposes (Dalziel & Gazzard, 1998).

Interactivity on the Internet is one component that educators have been drawn to recently. On-line assessment has been growing in popularity and educators have been exploring different ways in which exams could be delivered to students on-line.

On-line exams are simply defined as a mode of delivering tests, quizzes, and surveys via computer in a synchronous or asynchronous mode. An example of a synchronous environment would consist of students taking the on-line exam during class time where the teacher can monitor students’ behavior. An asynchronous environment is where students are taking the exam at their own chosen time and at their own pace either in a monitored (e.g., testing center, library, school computer lab) or unmonitored (e.g., home, work) situation.
Web-based assessment provides a way to administer, grade, and record a test via the Internet. Students can easily take the test by accessing the Web site. They enter their names and other information like an ID number and password. They are then presented with the test. When students have completed the test, they click on a "submit" button. Immediately, the test is graded and the results are shown. Questions answered incorrectly are shown with the option to reveal the correct answer in company with a brief explanation supporting the correct answer.

The types of on-line exam questions vary and are dependent upon the purpose of the exam itself. Most commonly used types are the true-false, multiple-choice, and fill-in question objects. Most on-line test development tools provide educators with a way to create questions and assign answers with individual scores. These question types can be graded automatically. Another question type is the short-essay. Short-essay questions cannot be graded by the computer, and thus, requires the instructor to grade the question individually. However, scores obtained from the short-essays can be added automatically to the scores from the computer-graded exam questions. Thus, writing for an exam to be delivered on-line do not vary much from the paper tests except that now the student and teacher both need access to a computer with Internet connection.

**Strengths and Weaknesses**

On-line testing has several advantages. For one, on-line testing is not restricted to time and place. On-line testing has the ability to deliver tests efficiently and effectively in asynchronous mode. Thus, timeliness is an advantage that educators have been drawn to as a result of on-line testing. Convenience and access are added benefits to non-traditional students.

Immediate feedback is an area of importance for many educators who have adopted the Internet as an assessment vehicle (Kibby, 1999). Allowing students to view how well they
performed on exams is an excellent way to reinforce learning, a feature found with most on-line assessment tools. Once students complete the on-line exam they can immediately examine their performance by viewing their overall score and discern which questions they answered wrong and find what answers were correct. In addition, instructors can add personal feedback to on-line questions to help the learning process. For instance, if instructors not only want their students to view the correct answer but explain why that answer is the right one, on-line assessment tools can provide that extended, immediate feedback. This way, students will remember the question more if the feedback occurs directly after completing the exam as compared to reviewing the exam a week later (Jonassen, 1988).

Interactive multimedia is another advantage of on-line testing. The primary strength of on-line testing in this area is to allow educators to create test items that incorporate other types of media besides text. On-line exams can incorporate visual, aural and interactive components. Multimedia elements such as charts, graphs, photos, animation, audio, and video can all be incorporated into the on-line exam.

Student tracking is a feature of on-line exams that can be of an asset to teachers (Juchnowski & Atkins, 1999). For teachers, on-line student tracking can provide them with information such as date and time in which students accessed the test site. It can also tell teachers whether students have made several attempts at taking the exam. Finally, student tracking provides teachers with information such as the length in which the students took the test. This could be beneficial in assessing whether an extended time-length could be a result of the student not understanding the material, especially when other students completed the exam in half the time.
On-line testing also provides statistical analysis that has been traditionally done by hand or calculator. Many test development tools provide instructors with the option to calculate the test scores for each student and provide an electronic grade book for all the students. On-line testing programs also provide instructors with other statistical analyses such as means, modes, medians, standard deviations, and item analysis on each test item.

In short, on-line testing can provide students and teachers with timeliness and convenience, the opportunity to increase retention through feedback, provide interactive multimedia to maintain interest, track and manage test scores, and obtain computerized statistical analyses. For these reasons, the use of on-line testing has experienced a significant increase and will continue to flourish in years to come.

On-line testing does have several limitations worth mentioning. Time is a major factor in developing on-line exams. It requires a large pool of test items to be effective. Not only do instructors have to learn the test development tool, but they also have to develop the exams and upload them to the Internet. Students must have regular reliable access to computer and a connection to the Internet without undue time restrictions. Network and server complications and phone line outages can cause a student to end the test prematurely and the educator can lose all of the student’s scores. This can double-up the management responsibilities of the instructor, and thus, take time away from the workday. However, once the exams are placed on-line, developing and implementing the exams are no longer a concern because the instructor can always modify the exam later.

On-line exams can also be impersonal (Juchnowski & Atkins, 1999). Often times, students take the on-line exams alone. If students are in a monitored situation (e.g., a librarian monitoring the exam period) with other students, the feeling of isolation will not be as
overwhelming. In addition, students often do not get the chance to ask for clarification on puzzling questions as they would in a classroom environment. Although students are getting feedback on their performance from most on-line exams, the human touch is missing. Students may become excessively discouraged if they encounter frequent poor results (Juchnowski & Atkins, 1999). This can lead to student isolation and disenchantment that will hinder the student’s academic performance and success.

Student integrity and cheating are other concerns for on-line testing (Juchnowski & Atkins, 1999). The common question that educators ask with on-line testing is, “How do I know whether the student sitting behind the computer is who she/he says they are?” The bottom line is that you will not know. Cheating is something that cannot be resolved either in an on-line environment or in a classroom. Although no one can guarantee that students taking on-line exams are not cheating, this should not sway educators away from using the medium because of the other advantages that on-line exams do provide.

Overall, although on-line assessment tools do have its limitations such as time consumption, remoteness, and student dishonesty, on-line assessment tools should not be disregarded. Depending upon the instructional situation, on-line exams can increase teacher productivity with better accuracy. For students, convenience and interactivity are major factors toward academic success.

Design

Creating and designing on-line exams are quite simple. In the past, educators had to know programming to create on-line exams. However, with the proliferation of the Web, there are many tools available to assist educators with various degrees of technical abilities to create on-line exams. These tools will be discussed later in this section. For now, issues concerning
design will be presented to provide educators with an idea of what needs be considered before embracing on-line exams.

Traditional instructional design models work well in terms of designing and developing on-line exams. The ADDIE and ASSURE (Heinich, Molenda, & Russell, 1993) models are the most popular and are similar in the way they present the steps toward designing and developing instructional materials, lesson plans, and in this case, on-line exams. In short, the steps toward designing on-line exams should include (a) assessing the learner, task, and learning environment, (b) generating objectives and goal, (c) designing the on-line exam and how it should be presented and delivered, (d) creating the actual on-line exam by writing test questions and developing the testing program, (e) implementing and delivering the on-line exam, and finally, (f) assessing the effectiveness of the on-line exam.

The first step in creating on-line exams is analysis. One must perform three types of assessment: learner, task and environment (Shambaugh & Magliaro, 1997). The learner must be identified and their computer skills must be documented (Gagne, Briggs, and Wager, 1992). It will be futile to deliver exams on-line if students do not have access to the Internet, a computer, or the technical skills to take the exam. In addition, the task must be identified by looking at what students need to perform to successfully complete on-line exams. Steps and procedures should be considered as well as the technical capabilities of the students. Finally, the environment must be assessed to identify what computer equipment or requirements need to be established prior to taking an on-line exam. Issues such as computer specifications, access to the proper software and Internet, and whether students need to locate and pay for a proctor has to be considered and articulated. If any of these three assessments fail to deliver positive/acceptable results, then delivering on-line exams needs to be re-examined.
Similar to developing a lesson plan or training module, learning/instructional goals and objectives need to be created. The overarching goal must be identified, as well as the specific learning objectives (Newby, Stepich, Lehman, and Russell, 2000). As with the learning, task and environment assessments, developing goals and objectives will help the instructor determine whether delivering on-line exams is the most productive. When developing learning objectives, following the simple ABCD rule is useful. In this model, the objectives have to address four criterion: (a) identifying the audience (e.g., college English students), (b) describing the behavior in which the audience will perform (e.g., type a reflective essay concerning the excerpt read in class), (c) stating the conditions under which the behavior is to be performed (e.g., audience will use a word-processor in the computer lab), and (d) identifying the degree or criterion in which the behavior is to be assessed (e.g., typed essays must receive a grade of “B” or better). By creating goals and objectives, one can assess whether on-line exams is an acceptable form of learning assessment.

In the design phase, things such as layout, flow, and feedback should be considered. Depending upon the tool being used to develop the exam, the educator can have either some or an abundant amount of freedom in how he/she wants the on-line exam to look like, the types of questions to be included, and how the program will respond to students’ answers. On-line course authoring tools such as Blackboard.com do not provide educators with that much freedom in terms of layout and appearance. However, multimedia authoring tools such as ToolBook II - Instructor do allow a great deal of autonomy for educators. Such software allows educators to determine the placement of the question and answers, how the feedback will be provided, whether the score is shown to the student, the type of background design used, the
style of fonts, and whether any multimedia or graphics is used. The following are some guidelines for those who are designing on-line exams:

- Keep the background design consistent for the entire exam and use a background that is not too busy such as textured patterns and those having more than two colors. Busy backgrounds can distract the student and make text difficult to read.

- Graphics and animations should be kept to a minimum. Use only graphics and/or animations that will complement the question or demonstrate a process. Decorative graphics should not be used except for the title slide or page.

- If different types of questions (e.g., multiple choice) are used, keep the types grouped together and reserve the fill-ins and short answers toward the end. True-false and multiple-choice questions are helpful for allowing students to become acquainted with the medium and also to get students in the correct mind-set. Fill-ins and short answers require a different performance task (e.g., typing), and thus, should be used toward the end when the student has become familiar with the environment.

- If feedback is provided to the student (e.g., telling students which is the correct answer and explaining why), the feedback should be presented at the end of the exam to prevent disruption. If the on-line exam is for practice purposes only, then immediate feedback should be offered because students will retain more information through instantaneous reinforcement.

- Use uniform placement of questions and answer choices (e.g., if answers are given on the right side of the first slide, then answers should always be presented on the right side). Inconsistency causes confusion that will lead students to spend more time in learning the structure of the exam.
• When working with fonts, keep the font style and typeface consistent (Forcier & Descy, 2002). In addition, avoid double emphasis such as simultaneously bolding and underlining a word because they only make words difficult to read. Finally, keep colors to a minimum and use the largest size of font for readability considerations.

When developing the questions and overall structure of the on-line exam, student attention must be considered. Limiting the number of questions to be asked at one time is recommended to help avoid student fatigue. Chunking questions related by theme, chapter, or lesson is also an effective organizational tool. Writing questions that are succinct and to the point are crucial. This is important because students who take on-line exams do not have the luxury of asking for clarification on confusing questions or unknown terms. Hence, the design of on-line exams is critical to the success of the student, and thus, need to be taken seriously.

Implementing and delivering the on-line assessment consist of uploading the on-line exam to a dedicated server. Some software programs have their own FTP programs. In this case, uploading the exam is simple in that an educator only needs to select the exam’s file name and the software will automatically upload all the necessary files to a server. For other programs such as some CGI scripts and JavaScripts, an educator must know which files he/she will need to upload to the server’s directory along with the regular HTML pages.

Evaluation of the on-line assessment generally occurs after one cycle. However, it is recommended that one perform both formative and summative evaluations during the development and implementation stages (Shambaugh and Magliaro, 1997). Formative evaluation takes place during the development and implementation phases. As one creates on-line exams, an educator should seek input and feedback from other colleagues and students concerning the overall design, flow, content, and interactivity of the on-line exam. Performing
several pilot tests with individuals who is not familiar with the content or the act of taking on-line exams can reveal interesting and worthwhile information. Problems that need to be debugged are disclosed during the formative evaluation stages that will help improve the overall effectiveness of the on-line exam. Summative evaluation occurs after the project has been implemented for one cycle. Feedback from actual users is most beneficial here as well as individuals who are not associated with the project such as principals and deans. Comments received from the summative evaluations will provide educators an idea of what specific content needs to be revised, how to modify the design layout for better presentation, how to alter feedback and interactivity for improved learning, and whether to use another software program. In short, the design aspect is central for ensuring successful results. By looking at the overall picture, educators can avoid the pitfalls that may come with delivering exams on-line.

**Development**

Though there has been a growing array of software tools being developed for creating computer-based tests, many tools have been developed recently to facilitate the teachers in authoring, delivering, grading, and analyzing the tests on the Web. The selection of the software determines the placement of the question and answers, how the feedback will be provided, whether the score is shown to the student, the type of background design used, the style of fonts, and whether any multimedia or graphics is used. In general, there are five categories of tools that can assist with the development and delivery of on-line exams: (1) CGI (Common Gateway Interface) programs, (2) JavaScripts, (3) commercial testing programs, (4) authoring software, and (5) on-line course authoring tools.

CGI is a server-based method that can be used to implement on-line testing. CGI relies on server processing and is more secure for on-line exams. It is a more powerful and robust
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means of delivering on-line exams. In most cases CGI scripts are written in Perl scripting language. The advantages of CGI programs are: (a) the scripts will work with virtually any browser, (b) permit interactivity between a client and a host operating system through the Web, and (c) the scripts allow the creation of a test report or a follow-up messages to the learner. The primary disadvantage of CGI scripts is that the teacher must be more knowledgeable about computers and be able to edit the CGI scripts to get them to work. Often, some technical assistance will be needed to identify sever paths, etc. or install the scripts to the server. Some institutions also have strict rules for installing CGI scripts for security reasons. In addition, CGI programs are well suited only for presenting basic types of tests. More advanced and interactive types of tests (e.g., tests which involve drag-and-drop activities) cannot be implemented with CGI programs (Brusilovsky & Miller, 1999).

There are a great number of CGI programs available on the Web and many of them are free. Exam Mail [www.oyston.com/ExamMail/home.html] and WebAssign [www.admin.northpark.edu/lmartin/WWWAssign/] are examples of the CGI programs for creating on-line exams. Exam Mail is a CGI script written in Perl language. It allows the automatic marking of any multiple-choice type on-line exam, regardless of the length or the number of possible answers to each question. The students fill out a multiple choice exam as a Web form, which can include multimedia and hints. When finished, the student clicks the “Submit” button and the program immediately returns the test result. The test results can be customized by instructors and can provide students (a) a percentage score, (b) a verbal grade, (c) the answers only to those questions answered incorrectly, and (d) a link to a page that offers further information and explanation to the question. The WebAssign is another CGI program written in Perl language. It takes a set of the test questions and turns each question into an
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HTML form that delivers the entire exam on the Web. WebAssign allows multiple choice, fill-in-the-blank, numerical, and essay questions. However, all questions, except essay questions, are graded automatically.

JavaScript is an interpreted scripting language that is embedded with HTML code to develop interactive Web pages. JavaScript processes information on the client side and works with all browsers. Most of the processing such as checking the correct answers takes place on the users’ browser. It is most suitable for creating tests with multiple-choice, fill-in-the-blank, and true-false type questions. The main advantage of JavaScript is that form validation can be built in to provide immediate feedback to the students. However, the major disadvantage is that the source code cannot be hidden (Hazari, 1998). A learner can easily find answers from viewing the source code of the page. In addition, there is no way for recording the test results. Thus, the JavaScript-based exams are more appropriate for self-assessment than for assessments used in grading (Brusilovsky & Miller, 1999). There are many pre-designed JavaScripts that are made freely available for educators to use and customize. Examples of these include Hot Potatoes [web.uvic.ca/hrd/halfbaked/] and QuizMaker [www.attotron.com/pub/QuizMaker.html]. Hot Potatoes is a collection of six utilities, each generating a different type of question. The Hot Potatoes suite comes with easy-to-use, fill-in-the-blanks interface and instructors do not need to know any HTML or JavaScript coding to create an on-line exam. Interactive multiple choice, short-answer, jumbled-sentence, crossword, matching/ordering, and fill-in-the-blank questions can be created with Hot Potatoes. All questions can be time-limited. Students are given immediate feedback on the correctness of an answer and can even be given hints and clues. QuizMaker is a Web-based program that generates JavaScript exams in batch mode from a user-friendly Web interface. It is simple to use
but a very limited program. Up to 99 multiple choice questions can be included in one quiz. The exam created by QuizMaker is an interactive Web page that contains mainly multiple-choice and true-false questions with pop-up feedback depending upon the answer that students choose for a question. The feedback messages can be simple, like Right! and Wrong!, or they can include explanations of why the chosen answer is correct or not.

Besides using CGI and JavaScripts, commercial testing programs are also used to create and deliver on-line exams. These software are designed specifically for developing on-line exams. Most commercial on-line exam packages include at least four components: (a) an authoring component for use by the instructor in preparing exams, (b) a delivery component for administering exams, (c) a grading component for scoring the exam that reports the results either to the student or to the instructor, and (d) a security/administrative component for controlling who can take the exam. Generally, they are user-friendly and provide manuals and technical support. Some examples of commercial testing programs are Question Mark [www.questionmark.com], Interactive Test [www.interactivetest.com], Quiz Factory [www.learningware.com/quizfactory/], and Quiz Maker [www.mrtc.org/~twright/quizzes/quizcenter/].

A few authoring software that have the capability of providing on-line exams are ToolBook [www.click2learn.com] and Authorware [www.macromedia.com]. There are others, but ToolBook will be discussed in more detail because of our personal experiences with this. Advantages of using ToolBook include easy uploading of files to the server and the freedom to personalize the exam. Though the software is mainly intended for creating multimedia based training modules or lessons, computer-based exams can be created and uploaded to the server, and thus, become on-line exams.
Overall structure of ToolBook is similar to most presentation software. The layout, feel, and look are similar to electronic presentations such as PowerPoint in that slides are used to house text, graphics, animation, etc. In addition, inserting graphics, text boxes, bullets, video, and animation uses a drag-and-drop action feature. For instance, to insert a multiple choice question box onto a slide, clicking and dragging the action feature to the slide is all one has to do.

ToolBook provides many types of question-objects. These include multiple-choice, drag-and-drop, matching, order-objects, and fill-ins. However, if one is using the software to create on-line exams, then only the multiple-choice, true-false, and fill-in options are available. When creating exams in ToolBook, educators have the choice to select (a) the types of questions to use (e.g., multiple choice), (b) how the exam will be graded (e.g., point over a percentage value, grade each question individually as the student progress or wait to tabulate scores at the end), (c) how many points will be allocated to correct responses or subtracted for wrong answers, (d) whether feedback is given at all (immediate or upon completion), (e) randomization of questions so a student will not see the same order of questions more than once, and (f) how the interaction will occur (e.g., when a student clicks on an answer the bullet changes to a check mark).

Uploading of the exam to the Web server is quite simple. ToolBook has its own Distribution Wizard that allows an educator with three choices: save as an .exe program, convert files to HTML and DHTML pages on the hard drive, and upload all pages directly to the server.

ToolBook also has its disadvantages. One major disadvantage is the steep learning curve. The software offers a lot and requires a bit of time to learn all of its features. In addition, the manual that accompanies the software lacks detailed instructions, and thus, one has to perform a lot of troubleshooting. The second disadvantage is cost. The software does have a higher
purchasing cost compared to others, even with the educational discount. For those reasons, some may resort and find more value in other authoring software packages.

Examples of on-line course authoring tools include WebCT [www.webct.com] and Blackboard [www.blackboard.com]. Both WebCT and Blackboard are not just a test authoring tool, but an online teaching environment that provides functions like housing the syllabus, course schedule, lecture notes, assignments, chat area, discussion area, glossary, index, presentations, on-line exams, and much more. These tools are provided on-line and educators have to be connected to the Internet to gain access to these sites. WebCT and Blackboard have their own design layout and instructors do have the options to change certain features such as the style of buttons and what buttons provide. However, the layout is consistent for all course sites. One major advantage of using these tools is the template. The on-line course tools contain primarily of templates that educators fill in with either typing the test items or uploading documents and files from the hard drive, and selecting and deselecting certain features that they want on their course site. No HTML programming is necessary. It is merely just filling in the blanks.

Another advantage is the cost. Blackboard.com provides its services for free. Each instructor can create a course Web site for his/her own. For an additional fee, the instructor receives extra storage space on the server, free advertising on the Blackboard.com’s Web site, and some additional features not provided with the free service. WebCT also provides a free trial period of six months for those who want to test the program first before purchasing. Some educators enjoy using these on-line course authoring tools because they can host their course Web site on WebCT’s or Blackboard.com’s server. Not all educational institutions have the capability of hosting course Web sites, thus increasing the importance of WebCT and Blackboard.com.
The only drawback of using on-line course authoring tools to create exams is inflexibility. The layout of the on-line exams is the same. Multiple-choice, true-false, fill-in, matching, and short answer questions can all be used, but the appearance will be the same no matter which course Web site you are accessing. Feedback is possible, but it can only be given at the end of the exam. In addition, students have to scroll down to answer questions that may not appear in the window. This can be distracting and cumbersome. Thus, limiting the amount of questions for each exam needs to be done. Nonetheless, ease of use and economic convenience are reasons why educators should investigate on-line course authoring tools as an option for developing and delivering on-line exams.

**Implementation**

Administration and distribution are critical for successful implementation of on-line exams. Certain factors need to be addressed ahead of time before making the final leap to offer exams on-line. Based upon personal experiences, these are just a few of the areas that need to be investigated before deciding to deliver exams on-line.

Network capability is the first area of consideration. There are several aspects that instructors must examine. First, one must find out whether the server he/she is uploading the files to is software-friendly. In other words, will the server be compatible with the chosen test development tool. For instance, many school servers have strict firewalls that do not allow certain scripts or Applets to be used because of security reasons. Second, one must consider the computers that the students will be using. Assessing whether students have access to the proper equipment, and even the proper browser and plug-ins, is important. If students cannot gain access to the on-line exam, then the whole purpose of offering on-line exams in the first place is defeated.
Staffing is another important issue concerning the implementation of on-line exams. The instructor may not be the only one responsible for administering and delivering on-line exams. Others may include teaching assistants, administrative assistants, and test monitors (e.g., testing coordinator, librarians) who need to be trained. If students are required to attend a facility in which their exams are to be monitored, then the other individuals will come into play. In short, when on-line exams become a heavy part of the curriculum, others will eventually become involved.

Support is vital toward the success of delivering and administering on-line exams. When situations arise that require troubleshooting, a supportive and competent technical staff is important. Often the companies that provide the software or on-line course authoring tool provide support, but that support is not always immediate or even effective. Thus, instructors need someplace else to turn for assistance. In addition, not only do instructors need assistance, but students. If students are taking the exam in a monitored situation, it is important that the test facilitator or librarian knows how to use the program (Kibby, 1999). Problems will arise if the monitor does not know anything about the program students are using. No matter who is the monitor, students will consider that person as the instructor and expect the same. Therefore, the support structure must be considered before implementing on-line exams.

Student integrity is the final area of consideration. Issues surrounding cheating and plagiarism exists with on-line exams as they do for in-class exams (Juchnowski & Atkins, 1999). No one will ever circumvent cheating, and thus, should not be used as an excuse to denounce on-line exams overall. However, student integrity is an issue and needs to be approached carefully. One suggestion is to develop the on-line exam with the intention that it will be offered as an open-book or take-home test. Although the exam may not be open-book, one must consider the
fact that students will be taking these exams on their own, even in a monitored situation, and will have the opportunity to cheat. Thus, one might even consider on-line exams as take-home tests, thus eliminating instructor’s concern of deception. In short, if the assessment requires strictly controlled conditions and requires a high degree of security, then delivering exams on-line should not be performed (Kibby, 1999).

There are many more issues that involve the implementation of on-line exams. However, network capacity, staffing, technical assistance, and student honesty are major concerns that have been brought up repeatedly. For these reasons, educators must have a contingency plan to deal with unforeseen technical difficulties such as the server being down and for handling disciplinary issues. As long as the educator is aware of these problem areas and anticipates such obstacles ahead of time, then the implementation process will be much more successful.

**Conclusion**

Testing has always been an important part of the instructional process for traditional classroom courses as well as Web-based courses. The goal of testing is to determine if learning objectives have been accomplished by providing feedback to the instructor of what students are understanding and the areas that need further explanation or clarification (Hazari, 1998). Assessment is also a powerful motivator of student learning. With the rise of the Internet, Web-based assessment has also grown considerably in education.

Appropriate use of Web-based assessment can play an important role in student learning while at the same time reducing teacher workload. However, one must be careful not to resort to on-line exams without taking into consideration the aspects of student accessibility and computer skills, technical support, and the time one is willing to devote to actual development. Many authoring tools are now available to facilitate educators in authoring, delivering, grading, and
analyzing tests on the Web. These tools include CGI programs, JavaScripts, commercial testing programs, authoring software, and on-line course authoring tools. In short, Web-based assessment has the ability to deliver exams efficiently and effectively at anytime and anywhere. In years to come, on-line assessment will continue to grow.
References


