A Software Platform for Online Exam Administration

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Abstract

This paper describes eTAP (electronic Test Administration Platform), an innovative software system that is designed to facilitate the administration of Web-based tests and exams. The purpose of the paper is to share the success of the approach, and to promote its further development and use in the e-learning milieu.

The eTAP system has been developed by the author for use in his own multi-section, Web-based course in response to his perceived needs in this setting. The software addresses issues of monitoring and attendance, academic honesty (e-cheating), and activity logging in the electronic testing environment. The testing platform provided by eTAP uses a software sandbox approach to exam integrity. That is, once the program is started, the user is limited to specific sanctioned computer functionality and is restricted to a well-defined, relevant region of the Web.

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The eTAP system has been developed by the author for use in his own multi-section, Web-based course in response to his perceived needs in this setting. The software addresses issues of monitoring and attendance, academic honesty (e-cheating), and activity logging in the (often frenetic) electronic testing environment. The testing platform provided by eTAP uses a software sandbox approach to exam integrity. That is, once the program is started, the user is limited to specific sanctioned computer functionality and is restricted to a well-defined, relevant region of the Web.

Introduction and Background

This section briefly describes the environments and accompanying challenges in which electronic exams are administered today. The ideas presented herein are based on a review of the relevant literature on the topics. The discussion will be primarily from the perspective of university-level education, but many of the concepts can be applied to other education and testing settings.

Web-Based e-Learning Support Systems

The term e-learning has often been used as a general term to denote IT-supported or technology enhanced learning (Dror, 2008; Markus, 2009; McGill & Klobas, 2009; Monahan,
McArdle, & Bertolotto, 2008). We will adopt a similar generic definition of the term in this paper. The roots of e-learning are in the stand-alone, computer-based training programs of the mid 1980s and in the CD-ROM-based distance education efforts of the early 1990s (Markus, 2009; Monahan et al., 2008). Today’s e-learning systems are primarily Web-based (Downes, 2005; Markus, 2009; Monahan et al., 2008; Roqueta, 2008). These e-learning systems use the Internet for course delivery and for exam administration in fully online and in blended learning courses.

As the read-only Web of the 1990s evolved into the dynamic, interactive Web 2.0 that we enjoy today, so did the demands and expectations of the users of these technologies evolve (Downes, 2005; Markus, 2009; Monahan et al., 2008). The composition of e-learning systems has similarly changed to meet these modern expectations (Downes, 2005; Markus, 2009; Roqueta, 2008). E-learning in higher education today is usually supported by software platforms known as learning management systems (LMS). These Web-based systems are now ubiquitous on both virtual and brick-and-mortar campuses. Familiar examples are Blackboard, Angel, Sakai, and Moodle. LMSs are usually adopted and implemented by the institution at large and are made available to faculty to support online and blended courses. Some argue that LMSs represent the greatest impact that information technology has had on higher education in recent years (McGill & Klobas, 2009).

A full description of the features and functions of LMS platforms is beyond the scope of this paper. It should be noted, however, that LMSs represent the second generation of Web-based e-learning support platforms, supplanting the earlier course management systems (CMS) (Roqueta, 2008). The difference in these systems is primarily one of focus. The emphasis of a CMS is on the course, specifically the delivery of the course. The emphasis of a LMS, on the
other hand, is on learning and on meeting the particular needs of the individual learner. In the words of Roqueta (2008, p. 61) “While CMSs are adequate for adding and delivering content, the LMS clearly outshines them on its focus on the learner. If your institution wants a system that promotes a focus on a quality experience for the learner, then you probably want an LMS.”

Unlike CMSs, learning management systems bring the participatory Web 2.0 approach to the e-learning environment through such features as collaborative authoring of Wikis and blogs, support for social networking, synchronous discussion forums, support for RSS and Flash, and the like. These capabilities lead to increased flexibility, interactivity, synchronicity, customization, and (hopefully) engagement. This format is clearly more in tune with the wants and expectations of today’s learners who often view education through the same lens as they view work and play (Downes, 2005).

From the users’ side, all interaction with a CMS/LMS is carried out through a standard Web browser client. This is true for both students and instructors. A user’s security, privacy, and identity are all maintained through a standard extranet model of access. That is, each user has their own private account that is protected by a username and password.

There remains yet one more type of Web-based e-learning support platform that is often overlooked in the literature, but is relevant to this discussion. These are performance-based training and testing systems that are designed around very specific skill sets. We will hereunder refer to these through the moniker TTS (training and testing systems). In contrast with learning management systems, TTSs are usually offered by academic publishers and are adopted by individual instructors for use in specific university courses. They can be used independently, or in conjunction with an institutional CMS/LMS. The systems come prepackaged with course content which is often mapped to traditional course texts offered by the publisher.
A common focus of TTSs aimed at the higher-education market is one of business software skills, such as the use of the MS Office suite of products. Considering the Excel product, for example, a TTS lesson would provide interactive, detailed training on the features, functions, and uses of the spreadsheet software in a business setting. This training would be carried out in a simulated spreadsheet environment, wherein the student is required to carry out specific keyboard or mouse actions to complete the lesson at hand. The assessment (i.e., testing) portion of the TTS would similarly provide a simulated spreadsheet problem scenario and require the student to enter a suitable sequence of keyboard and/or mouse actions to solve the problem on the (simulated) spreadsheet presented on the screen.

As is the case with CMS/LMSs, performance-based training and testing systems are accessed through standard Web browser clients and use the extranet access model of private, password-protected user accounts. Examples of TTSs are SimNet, SAM (Skills Assessment Manager), and myitlab. These systems are offered by, respectively, McGraw-Hill, Cengage Learning, and Pearson Prentice Hall.

**Academic Dishonesty in the Digital Age: e-Cheating**

Academic dishonesty and cheating on exams is certainly not a recent phenomenon. Indeed, such activities have occurred for thousands of years (Bushway & Nash, 1977). Ekstein (2003, p. 20) speaks of some historical artifacts of the practice: “As early as the seventeenth century, candidates for the oldest known national, public examinations, competing for entry into the Imperial Chinese civil service, no doubt smuggled notes into the examination hall. The evidence may still be seen at the Field Museum, Chicago and the Gest Library, Princeton University respectively: an exam crib in the form of a strip of silk inscribed with information, and the so-called ‘cheating shirt’.” Expanding on these same incidents, Bushway & Nash (1977,
p. 623) add that “the death penalty was in effect for both examinees and examiners if anyone was found guilty of cheating; but cheating still occurred.”

In our less Draconian modern society, the literature is rife with evidence that cheating practices have reached alarming levels (Ekstein, 2003; Genereux & McLeod, 1995; Hemby, Wilkinson, & Crews, 2006; King, Guyette, & Piotrowski, 2009; Popyack et al., 2003; Rowe, 2004; Tanner & Piper, 2010; Underwood, 2006). There are also indications that academic dishonesty may be even more prevalent in online courses. This is attributed to the fact that, whether real or imagined, cheating is perceived to be easier in the digital environment (Apampa, Wills, & Argles, 2010; Cordova & Thornhill, 2007; Ekstein, 2003; Fletcher, Tobias, & Wisher, 2007; Hulme & Locasto, 2003; King et al., 2009; Popyack et al., 2003; Rovai, 2000; Rowe, 2004; Tanner & Piper, 2010; Underwood, 2006). Using technology to support academic dishonesty is referred to as e-cheating.

Much of the discussion in the literature on e-cheating has focused on the prevalence of plagiarism in secondary and higher education. It is little wonder that electronic plagiarism is common today, with “search/copy/paste” operations almost relegated to pure muscle memory of computer users. Also found in the literature, however, are calls for greater emphasis on understanding and abating cheating on assessment and evaluation instruments, that is, e-cheating on exams and tests (Apampa et al., 2010; Ekstein, 2003; Fletcher et al., 2007; Hemby et al., 2006; Hulme & Locasto, 2003; Rowe, 2004). While we recognize the magnitude and import of the digital plagiarism problem in higher education, the project described in the current manuscript focuses on the electronic testing environment. Consequently, the term e-cheating will hereunder refer to cheating on assessment instruments such as exams, tests, and quizzes.
Using circumstance to justify acts of impropriety, or applying situational ethics, may boil down to basic human nature. We are hard-wired to neutralize cognitive dissonance, and society dictates clear mores of both thought and deed. Now more than two decades old, a study by LaBeff, Clark, Haines, & Diekhoff (1990) found that college students were quite adept at rationalizing their own cheating behavior, even though they disapproved of such acts in general. More recently, the literature indicates that such rationalization, or neutralization of harm, is widespread within the specific context of online coursework (King et al., 2009; Molnar, Kletke, & Chongwatpol, 2008). Of course, the “everybody’s doing it” rationalized excuse is ubiquitous in e-learning venues (Rowe, 2004). Research also provides evidence that Internet experience may be positively correlated with acceptance of unethical behavior (Fletcher et al., 2007; Underwood & Szabo, 2003).

Often noted in the literature on e-cheating (Cordova & Thornhill, 2007; Popyack et al., 2003; Rogers, 2006; Rowe, 2004) are:

1. The vulnerabilities of standard Web browsers in the electronic exam environment.
2. The need for better tools and techniques to combat e-cheating on exams.

Regarding the first point, Web browsers were surely not designed to provide a secure and trustworthy platform for administering online exams. Rather, they were intended for universal Web access in a generic multiprocessing environment. Perhaps the only element of security offered is the ability to transmit the client IP address to the server.

As for the second point above, the use of high-tech tools by e-cheaters has been very well documented (see Cordova & Thornhill, 2007; Ekstein, 2003; Popyack et al., 2003; Rogers, 2006; Rowe, 2004; Underwood, 2006). We as educators thus find ourselves forced into a “high-tech arms race” with our opponents, the e-cheating students, often having the advantage. One of our
simplest tactics in this rivalry, albeit a low-tech one, is the use of proctored exam venues in online courses. Proctored exams have almost universal recognition as an effective way to combat e-cheating (Apampa, Wills, & Argles, 2009; Apampa et al., 2010; Baron & Crooks, 2005; Fletcher et al., 2007; King et al., 2009; Maclean, 2009; Rogers, 2006; Rovai, 2000; Rowe, 2004; Underwood, 2006; Wulf, 2004). This simple tactic has additional benefits to the learning environment, which we will note later.

**Invigilation through Proctored Venues**

A 1993 *New Yorker* cartoon showing two canines working at a computer with one saying to the other “On the Internet, nobody knows you’re a dog” (see University of North Carolina at Chapel Hill, 1997) has become iconic of the notion of Internet anonymity (Fleishman, 2000). The unfortunate truth depicted in this cartoon plays directly into the hands of e-cheaters taking remote online exams. With the extranet security model used by CMS/LMS/TTS systems, anyone using a registered student’s username and password can login and complete work under the identity of that student. Allowing unsuperervised, online exams to be taken from remote locations obviously provides e-cheaters the opportunity to use “ringers” to take their exams (Fletcher et al., 2007; Maclean, 2009; Rovai, 2000; Rowe, 2004). Even if the proper student is on the other end of a remote browser, there is no way of knowing what unsanctioned resources, human or otherwise, are being used to complete the work. Using proctored exams in online or blended courses, for instance in an institutional computer lab, provides a straight-forward way of verifying the identity of the test takers. It can also help to reduce, though not eliminate, other types of e-cheating in Web-based exams since use of contraband or prohibited activities are less likely to occur when an instructor is in close proximity. The effectiveness of this simple tactic is
perhaps best captured in the term *exam invigilation* that has been used in the literature (Apampa et al., 2010).

One positive educational externality that can be attained with the use of proctored exams is a reduction in feelings of isolation. Online course venues have been associated with feelings of social seclusion by students. As noted by Thompson (2010, p. 1249), “Students often report feeling more isolated in university online courses than in face-to-face courses. Even when communication tools are used for synchronous and asynchronous interactions, online students often fail to ‘connect’ with others due to low social presence.” Bringing the class together for periodic, physical (vis. virtual) meetings to take exams and quizzes increases the students’ sense of social presence and community. This perception, in turn, has been shown to lead to 1) increased learning and satisfaction with the class (Monahan et al., 2008; Thompson, 2010), and 2) a reduction in propensity to engage in academic dishonesty (Hemby et al., 2006; King et al., 2009; Rowe, 2004).

Yet another positive externality of proctored exams is the perception by students of increased instructor vigilance. The demands on the instructor, logistical and otherwise, of organizing supervised exams are far greater than those associated with remote online exams. This fact does not go unnoticed by students. Expending the extra energies to organize online exams where physical presence is required sends the message that the instructor is not apathetic about the integrity or the fairness of the course experience. Perceived vigilance of the instructor has been shown to abate the level of cheating in both the traditional and the online course environment (Genereux & McLeod, 1995; King et al., 2009; Underwood & Szabo, 2003).
An Electronic Test Administration Platform: eTAP

In the previous section we described the setting in which online and blended courses operate. We also discussed the current condition of e-cheating in such courses, including an attempt to understand the causes of, and possible solutions to, such acts of impropriety. The discussion has been shaped by the relevant research findings and literature in these areas. In this current section we will present a non-technical description of our eTAP software system which was designed to operate in the e-learning environment discussed above. The reader should note that e-TAP is intended to be used in a proctored setting such as an institutional computer lab. We believe that the use of such an invigilated exam environment has been adequately defended in the section above.

System Overview

The eTAP approach has been developed by the author in response to his recognition of the shortfalls of the common approaches to administering online quizzes, tests, and exams. Today’s multitasking operating systems allow multiple applications, including multiple browser sessions, to be active simultaneously. This puts the full power of Google as well as all other Internet knowledge stores at test-takers’ fingertips. Beyond Internet resources, the local storage partitions are usually loaded with potential hints and helps. For example, in a TTS exam on MS Excel as described above, the full Excel application, including the searchable online Help facility, may be legitimately installed on the local machine. Beyond this, a tech-savvy e-cheater could use installed screen-grab software or screen-recording programs to capture exam problems in response to simple hot-key sequences. This purloined material could then be fed to future test-takers.
These potential threats to the integrity of the process exist even in a proctored, computer lab setting because illicit applications can be minimized, hidden, or even killed with a few clicks or keystrokes. In the hectic context of an electronic exam, the instructor can not, and should not, expend excessive energies on closely monitoring the screens and keystrokes of individual examinees looking for furtive activities. Rather, the instructor or proctor should be focused on answering the legitimate needs and questions that arise during the session. This is especially true when the exam is timed, as is often the case with online exams. The eTAP system helps to maintain the integrity of the process by reducing the potential for unsanctioned behaviors by test takers.

In addition to the possibility of e-cheating, another unanticipated artifact of the proctored, online exam environment became apparent to the author when he moved into this domain. Even traditional exam sessions in higher education are often somewhat chaotic. This seems to be even more so in the case of online exams. Some students are invariably tardy for the start of the exam and expect to be accommodated. Examinees expect to be free to leave as soon as they have completed their exam, but in the online arena some often remain, without asking, to check their email, or to update Facebook. Beyond the usual perceived unfairness or ambiguity of the test questions by the students, there may be additional questions and problems regarding system login, forgotten passwords, network problems, slow system response time, or similar technical issues that are particular to online venues.

Especially in a timed exam setting, examinees expect and deserve to have their problems resolved post haste. With large sections this often leads to a frenetic environment where it is difficult to monitor who is or is not present, who is chronically late, who has completed their exam but remains in the room, which students always sit together, how many exams are still in
progress, etc. Part of an instructor’s due diligence is to maintain a record of such information for current or future analysis. The eTAP system addresses this issue, as well.

As its name implies, eTAP (electronic Test Administration Platform) provides a software platform on which online exams can be administered. The software improves the integrity of the exam process by limiting the examinee to the boundaries of a software sandbox. In layman’s terms, a sandbox is simply a well-defined, limited operating environment to which a software program is restricted. Java applets (small programs) which can be embedded in Web pages, for example, are constrained to operate within the Java sandbox, thereby keeping them from compromising a Web user’s system or data. Sandboxes are also used by software research labs to analyze software viruses in a controlled environment while developing anti-virus solutions.

In the context of eTAP, the boundaries of the sandbox are defined in two ways. First, Web access is limited to very specific URLs which relate to legitimate pages within the exam setting. Second, the set of active processes on the user’s machine is routinely checked against a list of forbidden applications (the so-called HitList Array). If discovered, an illicit application is immediately killed and can be logged by the system. The sandbox functionality of eTAP is actually distributed across two separate modules of the software. This will be further explained below.

To the online examinee, eTAP appears as a full-screen browser client, but does not provide any tools or controls to manage browsing operations. This browser client is the primary software module, which is called the eTAP Browser. Beyond this module, the system comprises the eTAP Sentry module and the eTAP Monitor module. These three functional elements, which work in concert to facilitate the administration of online exams, are described in the following sections. The software is currently being used by the author in conjunction with the SimNet
performance-based training and testing system (TTS), so the illustrations provided will depict this context. However, eTAP was designed with flexibility in mind, and can be easily adapted to other CMS/LMS/TTS environments. In fact, the system was initially conceived and developed around an entirely different TTS product. The eTAP application has been used with great success over the past several years as a platform for several thousands of online exams.

The eTAP Browser

The eTAP browser is a Windows application that was created in Microsoft’s Visual Studio software development environment. The heart of this module is the Microsoft WebBrowser Object. This software component allows the programmer to provide browsing functionality to applications, yet maintain total control over the extent and details of that functionality.

As noted above, the eTAP Browser module presents to the user at startup a full-screen application window that encases a browser window. However, no Address bar is provided, nor are there any menus, toolbars, buttons, or other controls that would be seen on a generic browser. The application window is locked in full-screen mode and cannot be resized or minimized until the application is terminated. The system contains a software mutex (mutual exclusion component), so only a single instance can operate on a user’s (client) machine at one time.

Upon startup, the browser takes the online examinee directly to the login page of the CMS/LMS/TTS. Figure 1 shows the eTAP browser while opening. The eTAP splash screen is in the foreground, but the SimNet login screen is displayed in the browser window. Since the browser contains no navigation controls, the user is restricted to Web resources that can be reached through their CMS/LMS/TTS account portal.

[FIGURE 1 ABOUT HERE]
A potential breach of security in the approach lies in the fact that some Web resources that are legitimately available through a user’s private account may have the potential to facilitate e-cheating. For example, user accounts invariably link to all of the learning and study resources for the course. Some of these may even extend to the Internet at large, including general search engines. In response to this potential, eTAP has an internal list of templates and rules against which all URLs are compared before access is granted. These rules and templates ensure that the URL in question matches a legitimate page within the context of an exam, for instance the exam itself, the exam results page, the initial login page, etc. If a URL is deemed out of context, the navigation request is ignored by the browser and a message is displayed to the user. Any popup window requests encountered by the eTAP browser are intercepted and redirected to the main browser window for display pending the context check.

An additional feature gives the proctor a quick visual check of all processes while the exam is in progress. The exam window is purposely sized and positioned by the software so that a substantial background area is visible on the borders of the screen. The software also sets the background to distinctive orange color, thereby displaying a distinguishing visual cue that is unique to this application. This feature allows the proctor to stand in the rear of the exam room and quickly survey all active screens for this visual assurance that the proper browser is being used in all cases. The eTAP browser also displays a custom icon, which is unique to this application, in the Windows Task Bar of the student’s machine (see Figure 1). This feature, too, can give quick visual confirmation to the instructor or proctor.

**The eTAP Sentry**

The eTAP Sentry module adds a simple, but effective security capability to the system. The module is spawned when the custom browser is started and continues until the browser is
closed. The Sentry module is a type of *sleeper* program that runs in the background on the examinee’s machine. In other words, the program is usually doing nothing (sleeping), but routinely awakens, does its work, and goes back to sleep. The presence of this program is neither indicated in the Windows task bar, nor in the list of applications reported by the operating system. The length of the sleep cycle can be changed through a system setting, but has been operating at a ten second interval, which seems to work well.

Each time the module wakes, that is, every ten seconds, a list of forbidden processes (the aforementioned HitList Array) is compared against the list of processes running on the user’s machine. In the event that any matches are found, the illicit processes are immediately terminated by the system. The software module also has the ability to log the violation and/or display a warning notice on the user’s machine. The Sentry module returns to sleep mode as soon as the list has been processed.

The HitList software object is simply a text array of unwelcome process names such as “firefox.exe” (the Firefox browser) or “msnmsgr.exe” (the Microsoft instant messenger client). Banning applications from the exam environment is just a matter of adding the name of the forbidden process to the HitList Array.

Obvious members in the hit-list array are the common Internet browser clients (Firefox, Internet Explorer, Chrome, etc), and instant messenger clients that might be installed on the host machine. Other applications such as screen recording programs, and even Notepad, which could be used to display an electronic “cheat sheet” should be included for all exam contexts. The eTAP application is currently being used to administer exams on topics of the MS Office Suite, so those Microsoft applications (e.g., excel.exe), as well as the general *Office Help* viewing facility (named clview.exe) have also been added to the current list of undesirables.
By carefully populating the HitList Array and by specifying the URL-context rules described above, exam administrators are able to define a software sandbox to meet specific requirements of their particular exam setting. We believe that this approach goes a long way toward improving the integrity, validity, and equity of the online testing environment.

The eTAP Monitor

The eTAP Monitor module provides a software mechanism through which the instructor can 1) monitor the status and progress of an online exam in real time, and 2) maintain a record of exam administration processes from the perspective of both the examinee and the client machine. This can provide information value beyond what might be available through the instructors’ tools of the CMS/LMS/TTS. Much of the functionality of the Monitor module is derived through a Web-based database that resides on the server.

Whenever an eTAP browser session is opened, two shared, application-level variables on the server, call them TotalSessions and ActiveSessions, are incremented. The ActiveSessions shared variable is decremented whenever a browser session ends. At any point during the administration of an exam, therefore, the TotalSessions variable holds the total count of exam sessions that have been initiated, while the ActiveSessions variable holds the count of exams that have yet to be completed. These data are displayed in real time on a console screen available to the instructor as a dynamic Web page during the exam.

Another action that takes place whenever a browser session is opened is that a server timestamp is issued and stored as session-level data (i.e., linked to that particular client session). A second such timestamp is recorded when the exam session terminates. Furthermore, closing an exam browser session spawns the display of an online form on the client machine that must be completed by the examinee. This full-screen window cannot be closed until the form has been
properly completed and submitted (see Figure 2). With the submission of the form, the form data, as well as the timestamps and the client IP address are written to the database on the server. This information is immediately available in a standard browser on the instructor’s console view. After the exam, the database file can be archived to maintain an electronic “paper trail” of the event, including seating arrangements and session durations for all students.

[FIGURE 2 ABOUT HERE]

A snapshot of the instructor’s console screen, with actual exam-session data culled and modified to ensure privacy, is shown in Figure 3. The counts of the total and active exam sessions are displayed at the top, with textboxes to adjust these counts if necessary (e.g., exam restarts). The Clear button allows the count variables to be reinitialized on the server. The Earliest and Latest Check In: textboxes provide date/time filters to limit the display to individual class-session data, when appropriate. The exam data can be sorted in ascending or descending order by clicking on any column heading. We have found that the display is most valuable during the exam process when the data are shown in descending TimeOut order, which is the default. Since the eTAP console display is created as a webpage, it can be displayed in a tabbed browser arrangement and used in conjunction with any administrative display provided by a CMS/LMS/TTS.

[FIGURE 3 ABOUT HERE]

Discussion

Commenting on higher education, poet and novelist Oscar Wilde once wrote that academic examinations “are pure humbug from beginning to end” (Andrews, 1987, p. 87). Regardless of the accuracy of Mr. Wilde’s sentiment on this topic, there is no doubt that exams,
quizzes, and tests of various forms will remain as primary instruments of student performance assessment for the foreseeable future. With online venues approaching ubiquity in our systems of higher education, we should expect more and more of these assessments to be conducted over the Internet. This provides us as educators with great opportunities as well as great challenges. Success in this emergent arena demands that we embrace the opportunities, and that we understand and face the challenges. Both of these, the opportunities as well as the challenges, lend themselves to innovative approaches.

Employing technology for technology’s sake under the guise of innovation seldom, if ever, results in process improvement. Unfortunately, history offers a great deal of anecdotal evidence of this fact. In researching information system success, Goodhue & Thompson (1995) developed the technology-to-performance chain (TPC) as a model to understand the suitability of technologies to problem settings. A critical element in their TPC is the construct of task-technology fit, which they define as the extent to which the technology in question “assists an individual in performing his or her portfolio of tasks” (p. 216). Task-technology fit is positively related to the general effectiveness of the information system in this model. The task-technology fit construct has more recently been applied to a variety of situations, including LMS success in the e-learning domain (McGill & Klobas, 2009). We propose another e-learning setting to which this notion can be applied. Specifically, we suggest that using eTAP in lieu of the traditional approach to online exam administration (i.e., generic browser and LMS tools) represents an improvement in task-technology fit in the sense of Goodhue & Thompson’s TPC. We further suggest that this in turn enhances the efficacy of the online examination process as a whole, per the TPC model.
Alternatives to eTAP

To the knowledge of this author, there is only one commercially available alternative to eTAP. This is the Respondus LockDown Browser (see Respondus Inc., 2011). The Respondus LockDown Browser provides similar functionality to those of eTAP’s Browser and Sentry modules. The product can be integrated with certain CMS/LMS products thereby allowing exam events administered through that CMS/LMS to be forced through the LockDown Browser application. The Respondus product does, of course, require the purchase of either a campus-wide, or an annual per-seat license.

Although similar in functionality, the Respondus product could not be used in our current context for at least two reasons. First, our exams must be administered through the SimNet TTS (skill-based training and testing system), not through our institutional LMS. The Respondus product, to our knowledge, could not be integrated with this TTS system. Second, our exams are skill-based, so specific sequences of keystrokes or mouse clicks are needed to respond to exam questions. The Respondus system, as part of the static definition of its sandbox, prohibits the use of certain keystrokes and mouse actions (e.g., right-click) within the examination context. Some of these banned actions may, in fact, be part of a legitimate response to a skill-based question.

Summary and Conclusions

This paper has described the form and function of a flexible software system that has been developed to address several perceived needs in the online examination environment in higher education. We believe that this approach improves the integrity, and therefore the validity and the equity of the online testing process. The eTAP system is actually an ongoing software development project, with features and functions being added or revised as needs, threats, and
opportunities present themselves. Like many software solutions, it may always be a work-in-progress.

College students are certainly becoming increasingly facile with computers. In the nomenclature of Downes (2005), today’s students are true digital natives, having grown up with computers as common appliances for household and entertainment use. Students today also seem to view their tasks and trials through the lens of gaming. This is perhaps because video- and online-games have had such a significant role in their lives. In the world of online-games, the end (getting the highest score) often justifies the means (whatever is needed); concepts such as good sportsmanship and moral compass are less important in the gaming environment. We suspect that this is why, as noted in a previous section, research has linked online experience with an increased acceptance of cheating behavior. This results in a situation where the very individuals who are most likely to seek out online options may, perhaps, be those who are the most skilled at, and the most accepting of, e-cheating.

In discussing the key countermeasures to e-cheating during online testing, Rowe (2004) asserts that prohibiting Internet access is essential. Specifically, he writes “if computers are used for the assessment, communication should be made as difficult as possible between them and the rest of the Internet” (p. 6). The normal means of accomplishing this is to simply block all access to specific communication ports on the client machine. Unfortunately, in the online testing environment, Internet access is essential to the exam administration process. The eTAP system addresses this issue by restricting Internet access to those Web destinations that are legitimate within the context of the examination.

In eTAP, the potential to commit e-cheating is limited by defining a customizable software sandbox to which the examinees are restricted during the examination process. This
sandbox can be configured to restrict network-based and non-network-based functionality, as the situation requires. The sandbox can be easily reconfigured as the requirements and the situation change. The eTAP software also facilitates efficient and effective administration by providing the instructor with a set of tools to monitor the progression and the status of exam activities. This allows him or her to focus energies and attention on activities that are more pedagogically appropriate during the exam. That is, activities that relate to the validity of the learning assessment that is underway.

With systems such as eTAP, we recognize a danger of possibly creating a climate of mistrust in the course, where students perceive that the instructor has the expectation that they will be dishonest. To avoid this perception, eTAP has been specifically designed to downplay the cheating-mitigation aspects of the software in its presentation to the student user. The splash screen that the user sees at startup (see Figure 1) does not refer to academic dishonesty, nor does the form presented to the student at completion (Figure 2). The examinee who never attempts to stray from the sandbox need never, in fact, realize that a sandbox has been in place.

The eTAP approach has been used in an actual production environment with great success, and there is no doubt in this author’s mind that this methodology is an improvement beyond the traditional approach of relying only on a generic browser and the tools offered by a CMS/LMS/TTS system. After administering many thousands of exam sessions on this platform, there has not been a single complaint, criticism, or question from a student user regarding the use of the system. We encourage others to direct research and development efforts toward this important area of online education.
References


Figure 1: eTAP Client at Startup
Figure 2: Data-Form Displayed to Student Upon Closing Browser
**Figure 3:** eTAP Instructor’s Console During an Exam
Founded in 1892, the University of Rhode Island is one of eight land, urban, and sea grant universities in the United States. The 1,200-acre rural campus is less than ten miles from Narragansett Bay and highlights its traditions of natural resource, marine and urban related research. There are over 14,000 undergraduate and graduate students enrolled in seven degree-granting colleges representing 48 states and the District of Columbia. More than 500 international students represent 59 different countries. Eighteen percent of the freshman class graduated in the top ten percent of their high school classes. The teaching and research faculty numbers over 600 and the University offers 101 undergraduate programs and 86 advanced degree programs. URI students have received Rhodes, Fulbright, Truman, Goldwater, and Udall scholarships. There are over 80,000 active alumnae.

The University of Rhode Island started to offer undergraduate business administration courses in 1923. In 1962, the MBA program was introduced and the PhD program began in the mid 1980s. The College of Business Administration is accredited by The AACSB International - The Association to Advance Collegiate Schools of Business in 1969. The College of Business enrolls over 1400 undergraduate students and more than 300 graduate students.

Mission

Our responsibility is to provide strong academic programs that instill excellence, confidence and strong leadership skills in our graduates. Our aim is to (1) promote critical and independent thinking, (2) foster personal responsibility and (3) develop students whose performance and commitment mark them as leaders contributing to the business community and society. The College will serve as a center for business scholarship, creative research and outreach activities to the citizens and institutions of the State of Rhode Island as well as the regional, national and international communities.

The creation of this working paper series has been funded by an endowment established by William A. Orme, URI College of Business Administration, Class of 1949 and former head of the General Electric Foundation. This working paper series is intended to permit faculty members to obtain feedback on research activities before the research is submitted to academic and professional journals and professional associations for presentations.

An award is presented annually for the most outstanding paper submitted.