

A Case Study on Computerized Take-Home Testing: Benefits and Pitfalls

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This paper explores the benefits and pitfalls of computerized take-home testing in an undergraduate curriculum. A case study of how health science course "nutrition" utilized computerized take-home testing is presented. A survey was conducted after the implementation of computerized take-home testing program. After detailed data analysis on students' feedback, advantages and disadvantages of computerized take-home testing are discussed. It is concluded that the biggest advantage of computerized take-home tests is the convenience it brings to both instructors and students, however students' aberrant behaviors such as cheating still presents the biggest challenge to the instructors who intend to implement take-home testing.

Keywords: computerized take-home testing, cheating, advantage, disadvantage, undergraduate curriculum, health science

INTRODUCTION

Since testing consumes such a large amount of instructor and student time in college level courses, it is important to learn as much as possible about the effects of different testing formats (computerized or paper-and-pencil, in-class or take-home) on learning. Computerized testing has become a reality on many campuses with the introduction of robust learning management systems (LMS) such as Blackboard Learn, Moodle, Instructure Canvas and others. Instructors have two options of delivering computerized testing: (a) each student takes the computerized exam in the classroom with the instructor as the proctor; (b) the instructor implements computerized take-home exams. The first option is executable if every student brings his or her laptop to the classroom or the exam has to be administered in a computer lab. The advantage is that the instructor is right there to answer questions and proctors during the test, which makes it highly secure. In the meantime, the instructor can fully enjoy the benefits of computerized testing such as reduced cost of delivery, improved efficiency of administration, and immediate scoring

(Beatty et al., 2011; Bugbee, 1996; Niemeyer, 1999; Tippins et al., 2006). However, the drawback for this option is that it takes up the class time. For the second option, students take the exam on their own computers at home at their own convenient time. It will save classroom time and supposedly bring convenience both to the students and to the instructor. However, it also brings the instructor a number of other issues. For example, since it is take-home, cheating can be a potential problem (Tippins et al., 2006). Another problem is that the instructor has no control over the test being open-book or closed-book, therefore most likely it will be assumed as open-book (Schultz, Schultz, & Gallogly, 2007), which brings new issues such as lack of testing effect as students tend not to study hard for open-book tests, compared with in-class closed-book tests (Rakes, 2008).

With the increasing popularity of online learning management system, more instructors are taking advantage of the system to administrate take-home exams. The purpose of this case study was to explore the benefits and pitfalls of computerized take-home exams. Both quantitative and qualitative data were collected and analyzed.

LITERATURE REVIEW

Computerized testing, also known as computer-based testing (CBT) or computer-based assessment (CBA) refers to the method of administering tests using computers or similar technologies (Davey, 2005). Compared to the traditional paper-and-pencil testing (PPT), computerized testing offers a number of advantages, such as fast delivery, immediate scoring and feedback, enhanced consistency and reliability, and minimized human errors (Niemeyer, 1999; Tippins et al., 2006). Computerized testing also makes adaptive testing possible by forming a test dynamically based on a user's answers to a combination of questions (Niemeyer, 1999). Two well-known examples of computerized-adaptive testing (CAT) are the Graduate Record Examinations (GRE) created and administered by the Educational Testing Service (ETS) and the Graduate Management Admission Test (GMAT) administered by Pearson VUE.

Computerized testing has drawn a lot of attention from both educators and researchers due to many of its advantages. However, most of the research studies on computerized testing focused on large-scale standardized tests instead of teacher-made tests that are more commonly seen in schools (Dorr-Bremme, 1983; Haynie, 1983, 1990, 2003). Computerized teacher-made tests became common due to the wide use of computers on campus and the appearance of robust commercial learning management systems (LMS) such as Blackboard Learn or Moodle. Jacobsen and Kremer (2000) studied computerized testing and automatic grading in a commercial learning management system. In their study, WebCT (later acquired by Blackboard) was used to construct, administer, and score a midterm examination made up of randomly selected items from a test bank. Their findings suggested that learning management system such as WebCT offers an effective computerized examination environment (Jacobsen & Kremer, 2000).

With the prevalence of home computers and Internet, combined with robust learning management systems, computerized take-home testing has become a reality. Since there is no control over open-book or closed-book when the tests are take-home, most instructors assume take-home tests are open-book (Schultz et al., 2007). Researchers examined the testing effect with open-book and closed-book tests, and found that both types of testing produced equivalent learning retention (Agarwal, Karpicke, Kang, Roediger, & McDermott, 2007). However, Moore and Jensen (2007) found that students who had upcoming open-book exams attended fewer lecture sessions and submitted fewer extra-credit assignments than students who had upcoming closed-book exams.

Therefore they pointed out that open-book exams undermine long-term learning and promote lower levels of academic achievement (Moore & Jensen, 2007).

Despite many of its advantages, there are also concerns associated with computerized testing. One of the early concerns regarding computerized testing was computer literacy. Test-takers had to be comfortable with using computers and they might have to understand and deal with computer problems if any arise (Bugbee, 1996). Researcher also argued that computerized online testing could potentially discriminate against those test-takers who are less computer literate (Greenberg, 1998). In a research study conducted by Tippins and colleagues (2006), unproctored Internet-based testing introduced a number of issues ranging from hardware and software problems to concerns about the security of the test content, and the identity of the candidates.

As computerized testing becomes a necessity for instructor to cope with large class sizes, aberrant behaviors such as cheating becomes a serious issue. Rogers (2006) investigated instructors' perceptions about cheating during computerized testing. He reported that more than 50% of the instructors were using computerized assessments on his campus and although there was some concern about online cheating, the majority of instructors were not proactively implementing measures to prevent it (Rogers, 2006).

One of the techniques that are often used to limit the likelihood of cheating in computerized testing is the randomization of the test items so the test-takers are presented with different items. However, Marks and Cronje (2008) suggested that the randomization of test items could be a disadvantage to those students who were randomly presented with difficult items, which undermined the principle of fairness for test-takers.

Prior research in take-home testing led to mixed opinions with some praising its positive effects on learning while others focusing on its negative side. The purpose of this study is to explore the pros and cons of computerized take-home exam in a health science curriculum. Specific issues about computerized take-home testing such as cheating and lack of motivation are discussed.

COMPUTERIZED TAKE-HOME TESTING PROGRAM

Computerized take-home testing program allows students to take exams on their own computers in a home setting at their own convenient time and it was first implemented in an undergraduate course "*Nutrition*" on the first author's campus. The nutrition course explores general and clinical nutrition for pre-nursing students. The course is currently taught in a blended learning environment where Angel learning management system (ALMS) is used to host pre-recorded lectures, administrate quizzes and tests, and manage grades.

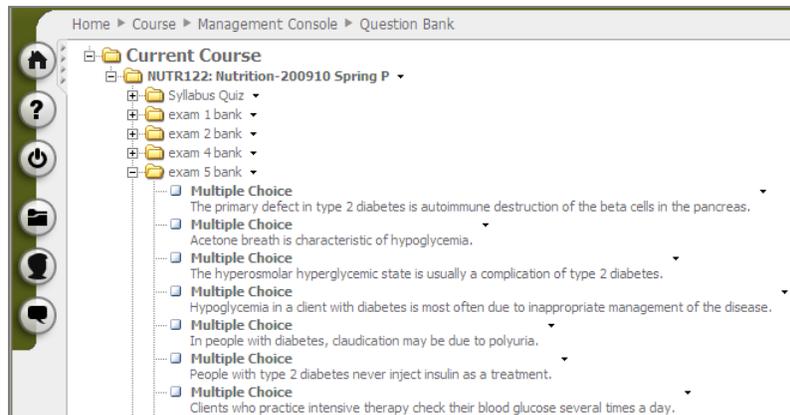


Figure 1. Test Bank Pool Interface.

The testing feature offered by the ALMS allows the instructional designers to create five exam folders in the system. Then the instructor prepared about 150 multiple-choice questions for each exam. The instructional designers formatted the questions and uploaded them in the ALMS (see *Figure 1*).

Typically the instructor gave a couple of days of time frame for the students to take the test. This was done by adjusting the time setting of the exam in the Angel LMS (see *Figure 2*). Students took the exam at their own scheduled time, typically at home setting, provided they had computer and Internet service at home.

Exam 1
Settings: Normal Advanced

Content Access **Interaction** Review Automate Assignment

Delivery Settings

Date Enabled January 27, 2010 AM 08:00

Date Disabled February 1, 2010 PM 06:00

Display Settings

Display Mode

All at once
All questions are displayed in a simple list on a single page.

Question set at a time
Questions displayed one question set at a time.

Question at a time
Display questions one at a time.

Show question titles

Question Set Defaults

Randomize the order in which questions are delivered

Randomize the order of each question's answer options

Don't allow backtrack

Display feedback after each question

Correct answer must be selected before next question is presented

Figure 2. Test Timeframe Setup.

Time
Assessment: 00:59:53

- Diets lacking in carbohydrate:
 - A) cause amino acids to be converted to fatty acids.
 - B) necessitate the conversion of amino acids to glucose.
 - C) require more fluid intake.
 - D) necessitate the conversion of glucose to amino acids.
- Which mineral is a principal component of cell membranes?
 - A) phosphorous
 - B) potassium
 - C) iron
 - D) iodine
- Vitamin A plays a role in gene expression. What does this mean?
 - A) It aids in differentiating between fat- and water-soluble vitamins.
 - B) It helps to activate or deactivate certain genes and affects the production of specific proteins.
 - C) It promotes the storage of fat-soluble vitamins.
 - D) It helps cells differentiate between the vitamins.
- A high-carbohydrate diet enhances an athlete's endurance by:
 - A) ensuring ample glycogen stores.
 - B) providing plenty of fiber.
 - C) improving oxygen uptake.
 - D) ensuring ample stores of fatty acids.
- Which of the following is an example of the link between food behavior and emotions?

Figure 3. Student Interface (All Questions Displayed At Once).

The exam was set to open in a medium security browser setting, in which right click and print functions are disabled so that students can't print or save the exam. This helps decrease the chance of cheating. As the testing program generates tests in random, each student got a different test with 50 randomized questions/items, and the answer choices are randomly ordered as well. Statistically, students still shared the same 1/3 of the 50 questions items. Depending on the instructor's preference, questions can be presented to the students in "all at once" mode (Figure 3) or "one question at a time" mode. After the students submitted the test, the text was automatically graded and their grades were recorded in the grade book in ALMS.

METHODS

PARTICIPANTS

The participants from this case study were students from two sections of the same course *Nutrition* taught by the same instructor in the spring of 2010 from a private college in southeastern United States. A total of 81 students were enrolled in those two classes. 63 of 81 students responded to the survey (78% response rate). 51% of them were identified as Caucasian, 24% identified as Hispanic, 20% as African American and 6% as Asian. The average age of the participants was 33.

At the beginning of the class, all participants were verified to have a personal computer with Internet service at home. All participants had access to Angel learning management system where both the tests and survey are hosted.

INSTRUMENTS

A survey was developed asking for students' perceptions on computerized take-home testing and their experiences. The survey had nine questions, four of them were multiple-choice questions and five were open-ended essay questions. The multiple-choice questions used Likert-scale rating and the items were rated from 1 to 5 (1 = strongly disagree, 5 = strongly agree), with higher score indicating more positive experiences. The first two multiple choice questions in the perception survey asked students' overall experience of this computerized take-home testing and whether they had any technical glitches. The second two multiple-choice questions in the survey assessed the fairness of the testing program and whether the goal of having more classroom interaction time was reached or not.

There were five open-end questions in the survey (see Table 1), aiming at collecting students' detailed reflections and feedback from their computerized take-home testing experience.

Table 1. *Open-end Survey Questions*

#	Questions
1	What conveniences does this computerized take-home testing bring to you?
2	Did you experience any technical glitches during those tests?
3	Did you witness or hear about cheating activities during those tests? (Your input is anonymous)
4	As a result of this take-home testing, did you have more time to interact with your instructor?
5	Please give us extra comments on this computerized take-home testing.

PROCEDURES

The nutrition class had two sections A and B for the spring 2010 term. Class A had 46 students and class B had 35 students. All students were informed about the computerized take-home program at the beginning of the term. Four unit exams and the final exam were uploaded into the Angel Learning Management System (ALMS) for students to access. Students were given three days window to take each test at their most convenient time outside of the classroom setting. All the tests were timed and all questions appeared on the computer screen at once. Students were also told that if they experienced technical glitches during the testing and were not able to submit their tests, another attempt would be given.

After the final exam was administered, a survey was presented to the students for them to fill out in the ALMS. In addition, instructor interviewed 10 participants for detailed feedback regarding technical glitches and cheating activities. Data from the survey and the interviews were then analyzed and reported.

DATA ANALYSIS

Data collected from the survey were exported from the ALMS and analyzed. Descriptive statistics such as mean scores and percentages were reported. Qualitative data from both the survey and interviews were combined for analysis. Patterns and themes were identified, analyzed, and reported to provide a greater depth of understanding that supplements the descriptive statistics findings.

RESULTS

QUANTITATIVE RESULTS

After a detailed review of the survey data (Table 2), students’ overall perception of using computerized take-home testing as an instructional strategy was positive. A total of 46 (74%) students were in favor of this computerized take-home testing program and 79% of the students didn’t experience computer glitches during their tests.

Table 2. Survey Results for Overall Perception

Survey Questions	Mean	1	2	3	4	5
I enjoyed the convenience that computerized take-home testing brought to me.	3.85	8%	10%	8%	37%	37%
I didn’t experience any technical glitches during those take-home tests.	4.09	3%	8%	10%	35%	44%

Note: N=63. Strongly Disagree=1; Disagree=2; Unsure=3; Agree=4; Strongly Agree=5.

In terms of fairness (Table 3), a total of 47 (75%) students reported their perception of the testing program was fair, even though the test was randomized and some students might get hard question in the beginning of the test, which could potentially increase some students’ anxiety level. The possible reason was that the tests were set in a way that all the questions were shown in one screen and students could go back and forth to change answers. In terms of saving classroom time, a total of 48 (76%) students agreed

that the computerized take-home testing program reached the original goal to save class time for more interactions and discussions.

Table 3. *Survey Results for Fairness and Saving Classroom Time*

Survey Questions	Mean	1	2	3	4	5
Although 2/3 of the testing items are different from each other and they are scrambled, but overall this testing program is still fair.	4.71	6%	5%	14%	40%	35%
One of the goals of this computerized take-home testing program is to save classroom time for lecture and more interactions. This goal has been achieved.	4.22	6%	8%	10%	10%	66%

Note: $N=63$. Strongly Disagree=1; Disagree=2; Unsure=3; Agree=4; Strongly Agree=5.

QUALITATIVE RESULTS

The above preliminary data analysis together with the detailed analysis of open-end questions revealed four major benefits of computerized take-home testing:

1. Bring Convenience to Both Students and Instructor

Computerized take-home testing brought convenience to students in this case study. Students could take the test at their own time at anywhere, provided there was computer and Internet service. One student made the following remarks in the survey: "I like it because it brings a lot of convenience and it gives us time to prepare ourselves a little bit more and also because the instructor gives us plenty of time to take it." And another student echoed: "I am able to take the test when it is most convenient with my schedule. Also I am able to prepare as much as I can before I take the test."

It also brought convenience to the instructor, as he didn't have to print the paper test, collect them when they are done, and use the Scantron to read the results. In this computerized take-home testing program, grades were automatically recorded in the grade book in ALMS.

2. Create a More Relaxing Testing Environment

Compared with in-class testing, this take-home testing created a more relaxing testing environment. As two students reflected in the survey: "It is more comfortable setting, and I don't have all the distractions such as people talking and finishing early;" "I like this format because I feel relaxed to take it at home, and it is user friendly because there are a few days given to complete the test at our own pace when we are ready."

3. Leave More Classroom Time for Interaction

By implementing the computerized take-home testing program, the instructor had more classroom time for interactions, instead of using the class time to administer the exams. Students can also focus more on learning in the class. Here is what a student wrote in the survey: "I like it because it gives us the opportunity to maximize our class time, allowing us to ask the professor questions that might later on aid us on our test." Another student responded in a similar way: "I like this computerized testing as it allows us to take the exam at home so that we can focus on learning in class, instead of worrying about the exams."

4. *Prepare Students for Future of Online Learning*

Most of health care related educational programs have professional registry exams that students have to pass in order to practice in the clinical setting, and many of these registry exams are web-based. By using this computerized take-home testing program, students were given the opportunity to practice web-based exams. A student made the following remarks in the survey:

This computerized take-home testing simulates the future of online learning. After I receive my degree in nursing, I plan to take online courses to continue my education, and this experience will be very useful for me in my future online education.

Among the above benefits, data from the survey also showed the following issues with the computerized take-home testing program:

1. *Aberrant Behaviors*

The take-home exams are open book and thus are not highly secured. Although preventative measures were taken such as scrambled testing items and browser settings that prevent printing and saving of the test items, aberrant behaviors among students such as cheating were still discovered from the interviews:

- Take turns to take the tests one after the other and share answers with each other.
- Sit together to share and consult with each other.
- Call others for consultation during the test.
- Record the screen during the test and share with others.
- Open another window to consult Google or Wikipedia during the test.
- Ask a friend or a family member to take the test.

2. *Technical Glitches*

Technical glitches are inevitable in any computerized testing. Although the exams were located inside the ALMS, which the students were using on a regular basis to access the course content and emails, glitches were still reported from the interviews. Some of the common issues included losing Internet connection or sudden computer freeze during the tests. If glitches do happen and the exam is interrupted, instructors have to extend the testing time or give the student a second attempt to finish the exam. However, students can intentionally induce technical glitches so that they can request a second attempt and thus have more exposure to test questions. For example, a few students claimed they had glitches during the tests and requested a second attempt; however the activity reports from the LMS suggested that they never accessed the test.

3. *A “Lackadaisical Approach” Toward Take-Home Tests*

Some students felt they lost motivation to study prior to the tests. They didn't take take-home tests seriously. Student F left this interesting feedback in the survey:

I like the convenience of the take-home tests, but I lost my motivation to study before taking the tests. It was open-book and I took it on my home computer, so I was so relaxed and didn't want to study.

CONCLUSION AND IMPLICATIONS

Overall, students enjoyed the convenience and flexibility of computerized take-home test, which allows them to take it whenever and anywhere they can (Angus & Watson, 2009; Williams & Wong, 2009). Students also welcomed the fact that more classroom

time can be saved for learning and interaction with the instructor (Rogers, 2006). As agreed by other researchers, computerized take-home test also brought benefits to the instructor with convenient delivery and administration as well as immediate scoring and report that provided by the LMS (Niemeyer, 1999; Tippins et al., 2006).

Traditional in-class exams can generate a significant amount of stress and anxiety for the students, which routinely causes poor test performance (Hembree, 1988). Computerized take-home test creates a more relaxed testing environment that allows students to take the exams in a comfortable environment at their own pace without distractions from other.

Along with many benefits computerized take-home testing brings, there are also concerns. Cheating is the most challenging issue as was discovered in the findings. One way to counter cheating is to proctor computerized tests right in the classroom, however this is only implementable for places where most of the students have the access to personal laptops and also access to a robust learning management system where tests are hosted in.

Another effective strategy to counter cheating is to weigh up on the subjective assignments such as projects, presentations, and other class activities and weigh down on the objective multiple-choice tests. For example, for the nutrition course in this case study, exam grades only made up 26% of the overall grade, the rest of 74% went to other activities such as in-class quizzes, student presentations, and class projects. Using this strategy, the instructor reported that there was less motivation for students to cheat on computerized take-home exams.

Consistent with prior research, the findings from this research also indicated the lack of motivation from students. Study has shown that anticipation of an upcoming test in the class with the instructor as a proctor helps learning retention (Haynie, 2003). In other words, when tests are taken in the class with the instructor, students will take them more seriously and study harder. Unlike the conventional format of in-class tests where students tend to study more broadly in order to do well on the tests, students of take-home testing typically consult the course materials and hunt only for the exact information needed to answer the specific questions (Haynie, 2003).

Therefore, if an instructor wishes to use a computerized take-home test, and the goal is to achieve high level of learning retention, special care should be taken to design test questions that the required responses will include all of the important information that the students should learn (Haynie, 2003).

Since take-home testing is deemed as open-book, the question formats actually do matter. As multiple-choice tests are not capable of assessing all cognitive levels, essay questions are great alternatives and can then be utilized to encourage novel information input from students (Walstad, 2001).

Despite the benefits computerized take-home tests can bring to the students and instructors, due to the potential aberrant behaviors from the students, it appears its reliability is still perceived as questionable. While useful for evaluation purposes, in-class testing may still continue to be the mainstream method due to its positive effect on learning retention and minimized cheating activities. However, computerized take-home tests can be used occasionally to supplement the mainstream in-class tests. For example, after the first try-out for computerized take-home testing in the spring term 2011, in the subsequent summer term 2011, the nutrition instructor changed her testing strategy and only gave one take-home test due to her illness, and the rest of the tests are administered in the class.

This study was only conducted in one educational setting in North America and the sample used in this study was unique due to the health science focused campus. Subsequently, the generalizability of the findings from this study is limited. Also, other

associated issues such as the effectiveness of computerized take-home testing were not examined in this study. Further research is needed to better understand the learning benefits of computerized take-home tests.

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