

**Redesigning Exams During a Pandemic:
A Design Case for Authentic Assessment**

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Introduction

During the Fall 2020 term, as an Instructor at The British Columbia Institute of Technology (BCIT), I switched from in-person, closed-book, multiple-choice and short-answer paper exam format to an online, open-book, practical and authentic exam assessment. In this design case, I will be presenting the motivation and rationale for, a brief description of, and the considerations and a discussion of this significant change to my course design.

Background

BCIT, like many higher educational institutions, has been forced to take many of their programs online during the COVID-19 pandemic, starting in March, 2020 (Adnan & Anwar, 2020; Allo, 2020; Baber, 2020; Basilaia & Kvavadze, 2020). Maintaining a high level of academic integrity and excellence in instruction are key concerns with the move to an online environment (Jamieson, 2020), with plagiarism - particularly with the ease of sharing answers digitally - being top of mind. The nearby University of British Columbia struggles with online plagiarism, recently having a number of exams with widespread cheating in their first-year math (Hurst, 2020) and chemistry (Kotyk, 2020) classes. There is a fair amount of research around the topic of plagiarism in online environments (Golden & Kohlbeck, 2020; Harmon & Lambrinos, 2008) with various proctoring software being investigated as possible solutions (Milone et al., 2017; Wuthisatian, 2020). Proctoring software, however, while in an attempt to prevent plagiarism, may have a negative impact on the performance of students, adding confusion and intrusiveness to an already stressful examination experience (Wuthisatian, 2020). These are some of the reasons why I decided to take a different approach to mitigate the risk of plagiarism and decreased exam performance.

I have heard from many fellow BCIT instructors of their desire to incorporate more authentic assessment into their classrooms. It is natural for many new instructors, who have limited time, to resort to multiple-choice exams because they afford many advantages such as fast and efficient machine

grading, creating multiple versions to control cheating, and the ability to cover a wide range of material (Koh, 2017; Simkin & Kuechler, 2005). I was no exception; I used paper-based exams to reduce cheating - because if properly invigilated, during an in-person exam, copying answers becomes difficult. However, multiple-choice exams are not always an accurate "indicator of student understanding" (Simkin & Kuechler, 2005). As an alternative to multiple-choice, I have chosen to look at authentic assessment. According to Koh (2017): "authentic assessment is an effective measure of intellectual achievement or ability because it requires students to demonstrate their deep understanding, higher-order thinking, and complex problem solving through the performance of exemplary tasks" (p. 1). The coronavirus pandemic forcing BCIT to teach online was the catalyst that accelerated my timeline to implement authentic exam assessment.

Design/Innovation Process

The exam I was converting from multiple-choice to practical format was for a database computing class that I teach in higher education. Some of the learning outcomes my students are expected to do are: apply database access control and administer user accounts, roles, and privileges; describe database concurrency control, locks application, and resolution of lock conflicts; and identify potential key causes of database failures. I took groups of multiple-choice and short answer questions from the old format and grouped them by topic, such as "access control", "resolution of lock conflicts", and "database backups" which, I designed to align well with the learning outcomes. For each topic, I created a task for students to accomplish that would demonstrate they had learned the required knowledge and that they were proficient and able to implement the required changes to the database to achieve the task. A single task would often replace several multiple-choice questions on the same topic. Figure 1 shows an example question in multiple-choice format and Figure 2 shows an equivalent task in practical exam format.

Figure 1

An example multiple-choice question.

12. Assuming these commands are run on an InnoDB table:

Step	Terminal Window 1	Step	Terminal Window 2
1	START TRANSACTION;		
		2	START TRANSACTION;
3	UPDATE tbl SET Value = 123 WHERE ID = 3;		
4	UPDATE tbl SET Value = 201 WHERE ID = 2;		
		5	UPDATE tbl SET Value = 443 WHERE ID = 4;
6	UPDATE tbl SET Value = 350 WHERE ID = 2;		
		7	UPDATE tbl SET Value = 591 WHERE ID = 2;
8	UPDATE tbl SET Value = 373 WHERE ID = 1;		
		9	UPDATE tbl SET Value = 679 WHERE ID = 1;
10	UPDATE tbl SET Value = 288 WHERE ID = 4;		
		11	UPDATE tbl SET Value = 679 WHERE ID = 4;

Which step will generate a deadlock?

- Step 6
- Step 7
- Step 8
- Step 9
- Step 10
- Step 11

Figure 2

A practical authentic task (equivalent to the multiple-choice question from Figure 1).

SECTION 2: Deadlock

There are 2 tables in the `deadlock` database:

1. `tx_innodb` (table storage engine: InnoDB)
2. `tx_myisam` (table storage engine: MyISAM)

Use any or all of the above tables to demonstrate how deadlocks can occur.

Step 1: Force a deadlock to occur. Determine and execute a sequence of commands that will force a deadlock to occur.

Note. Notice how the topic is the same ("what causes database deadlocks?"), but the student expectations are very different. For the multiple-choice question (Figure 1), students are expected to **remember** what a deadlock is, **recognize** where it will occur and mark the appropriate choice (a. to f.). For the practical question (Figure 2), students need to **understand** what causes a deadlock, **analyze** the given database structure, and **apply** their knowledge to **create** a deadlock.

Since "authentic tasks need to be designed to replicate the authentic intellectual challenges and standards facing experts or professionals in the field" (Koh, 2017, p. 5), I created these tasks to mimic real-life scenarios students might need to do once they enter the workforce after they graduate.

There was a technical challenge to overcome, however, before I could proceed with this practical and authentic exam format - I needed students to have full control of a controlled database system that was isolated from other students' systems. Each system needed to be setup in advance so that it would not cut into the allotted exam time. I created a computer instance using Amazon cloud hosting services with all the required software, and then cloned it and customized it for each student. Each was customized in an effort to mitigate solutions being shared between students. By making the

database data slightly different, each student would be given a slightly different variant of each task preventing the direct copying of answers. Creating these instances by hand is a slow and error-prone process. As a computer programmer and IT specialist, I was able to create a program that could automate the creation and customization of the required 58 computer systems, one for each student that would login to complete the exam. This program I created is innovative since it uses Amazon's clouding computing, a new API released by Amazon within the last 5 years (in 2015) and custom code written by me for the specific purpose of creating these virtual computer systems. The concept of authentic assessment, however, is not entirely innovative since it "was first coined in 1989 by Grand Wiggins" (Koh, 2017, p. 2) and has "become increasingly in demand in colleges and workplaces" (Koh, 2017, p. 2).

From the perspective of the students during the exam, they were able to login to their own virtual computer system, run the required commands to demonstrate their database skills learned within the course. Students submitted a combination of screenshots and the commands that they ran to achieve the required objectives. From the instructor's point of view of marking, if the students handed in the screenshots displaying the correct results, they would get the marks for achieving that task. According to Koh (2017, p. 14), an important criteria for authentic assessment is for teachers to provide "clear expectations for students' performance and the marking criteria are made explicitly clear to the students" (p. 14) and so students were provided a clear rubric along with the instructions for the practical exam.

My design choice to include an authentic assessment approach would mitigate plagiarism, since if students cannot demonstrate the required knowledge and skills, they would not be able to complete the practical exam, and copying one another's exams is worthless because each exam is unique. "There is no point in copying another student, as everyone is working on different things" (MacAndrew & Edwards, 2002, p. 135).

Evaluation

Despite the fact that the design decision to convert my in-person multiple-choice exams to an online authentic practical format did not formally follow a conventional instructional design model such as ADDIE, I did informally follow an agile programming methodology to create my program to automate the creation on the database systems. Also, I am always interested in evaluating the results of new design choices (and evaluation is often a key portion of many conventional instruction design models). As part of that evaluation process, I surveyed students before they left the exam and many appreciated the new practical format saying they liked the real-world scenarios and preferred it to multiple-choice. However, despite most of the feedback being generally positive, there were a few students with suggestions and comments for improvement. The two main areas for potential improvement were the lack of assessment on theoretical concepts and the exam being not as challenging as they expected.

Some students felt the practical exam lacked some of the theoretical and background knowledge they had learned during the course and did not demonstrate during the exam. Figure 3 is an example of a question that was difficult to convert to a practical exam format and thus was not included.

Figure 3

An example of a short-answer question that is primarily theoretical in nature.

23. Explain what MVCC is and how it differentiates InnoDB from MyISAM. [/ 2 marks]

Note. This question is difficult to convert to practical format due to the theory behind knowing what MVCC (Multi-Version Concurrency Control) is and how it differentiates the InnoDB and MyISAM table types. If this question were converted to a practical demonstrated question, students might achieve high scores by successfully achieving the required task, despite not knowing what MVCC is and/or not knowing the difference between InnoDB and MyISAM.

The student feedback regarding the exam being not as challenging as expected, is a discussion point regarding authentic assessment that has been noted in academic literature. As stated by MacAndrew and Edwards (2002) "anyone could get an 'A' so long as they fulfil the assessment criteria. Since the student is aware of the criteria for each grade in advance, their goals in completing the work should be clear" (p. 135). My suggestion for addressing this concern is to further limit the time required for the exam or to add additional tasks with increased difficulty and novelty - giving students tasks they have not seen before that are slightly beyond what they had achieved in-class.

Table 1 provides a comparison of multiple-choice and authentic practical formats.

Table 1

Summary of Advantages and Disadvantages of Multiple-Choice / Short-Answer versus Authentic Practical Exam Formats

Comparison	Multiple Choice / Short Answer Format	Authentic Practical Format
Type of Knowledge	More theoretical	More practical
Number of Questions	More questions (less time required for each)	Fewer questions (more time required for each)
Blooms Taxonomy	Remember, Understand, Apply	Understand, Apply, Analyze, Create
Exam Creation Effort	Moderate - Low	High (specialized software created)
Marking Time	Slower to mark (paper exams slow to mark, tally, and enter grades)	Quicker to mark (fewer questions)
Grade Distribution	Standard bell-shaped curve	Less Variance/Deviation
Class Averages	Lower	Higher (rubric is known)
Instructor Involvement During Exam	Low (invigilation to prevent cheating; clarifying meaning of questions)	High (Troubleshooting technology; fixing broken computer systems)
Preparation Requirement	Low (Printing paper exams)	High (Setup of personal computer instances)
Additional Advantage		Automation allows for making each exam unique (Protects against plagiarism)
Plagiarism Observed	None observed	None observed

One of the unforeseen benefits of implementing authentic practical exams is the increase in the depth of knowledge as explained in the Revised Bloom's Taxonomy for the Cognitive Domain. The multiple-choice exam relied more on remembering and understanding with a little bit of applying; whereas the practical exam relied more on applying, analyzing, and creating. I see this deeper knowledge a benefit to students, helping them better apply their knowledge to future real-world situations and to be critical thinkers.

Since the primary driving force for the conversion to an authentic practical exam was to maintain a high level of academic integrity in an online environment, it is important to note that no notable cases of cheating were detected. Student answers were compared against each other in an attempt to find duplicates - none were found. Since each student's exam was unique it was easy to tell that there were also no incidences of students submitting answers to another student's exam.

It is because of this overall success in my results using authentic assessment that I will be continuing to use authentic practical exams in the future, even when the COVID pandemic no longer requires an online teaching environment. I will be looking at including more challenging tasks to encourage students to push passed their current ability and include more theory into tasks for where possible. As observed by Gao and Grisham-Brown (2011), "time-consuming was listed by all teachers among one of the disadvantages of authentic assessment" (p. 48), however, I still see the benefit of this extra time spent as a worthwhile investment into the students' quality of instruction.

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