ASSESSMENT OF INTERACTIVE E-LEARNING PLATFORMS FOR BUSINESS STATISTICS AND ANALYTICS

ABSTRACT

While eLearning digital homework platforms have been around for several years, it was only during the COVID pandemic that they moved to the mainstream as face-to-face teaching was replaced by hybrid and even fully online course delivery. Teachers have used the eLearning platforms to reach students remotely yet there has been little research on their success and use as classes resume their normal delivery methods post pandemic. The two major players in the eLearning marketplace for Business Statistics and Analytics are Pearson and Cengage.

Anonymous student outcome performance data was collected over several academic years from direct student performance on each of the course learning outcomes. To master the statistical and analytics topics covered in the course, students solve homework problems from each chapter which assess their comprehension of the chapter's topics along with Excel assignments which afford students the ability to master hands-on problem solving and critical thinking skills using Excel spreadsheets.

There has been little research on these specific eLearning platforms and almost no comparative research; this research will add to the existing research on eLearning platforms and allow faculty to compare the achievement of student outcomes using these platforms. Since assurance of learning and assessment of student outcomes is required for accreditation, the research findings will be applicable to all institutions who are working on or pursuing continuing accreditation. This research will explore two major eLearning platforms and the extent to which achievement of student learning outcomes is achieved with respect to assurance of learning.

Keywords: *Statistics, analytics, business, e-Learning, assessment, assurance of learning, Cengage, WebAssign, Pearson, MyLab*

INTRODUCTION

eLearning platforms, despite being around for more than a decade, have only recently experienced significant growth and usage in academia. The COVID pandemic of 2020-22 was the catalyst for their gain in popularity as faculty and institutions scrambled to move traditional face-to-face classes online in the wake of closures and statewide mandates. eLearning platforms' ability to quickly adapt to this need was of paramount importance to educators. The tried-and-true classroom methods needed to be quickly updated and implemented for asynchronous learning, something that many faculty were unaccustomed to doing.

These e-Learning platforms permit faculty to offer students multiple pathways to success which can replace traditional lectures. Videos, homework applications and online testing all contributed to the successful deployment of classes in an online environment. Exams could be given in several formats—synchronously using live proctoring or asynchronously using video-taped exam sessions which could be viewed later by faculty to determine whether any academic integrity issues occurred during the exams. Similarly, e-books have largely replaced heavy, costly paper books. Students prefer electronic texts that can be viewed on laptops, iPads or even their cell phones. The ability to access materials anytime and anyplace is viewed as a benefit by students.

Accreditation agencies require the assessment and review of student learning outcomes to properly assess if students are mastering course and program outcomes. e-Learning platforms can track student progress across numerous types of outcomes—homework, quizzes, projects, and exams. Pearson's MyLab and Cengage's WebAssign, for example, offer extensive student feedback and performance tracking options which allow faculty to quickly spot trouble areas and assist students who may be experiencing difficulties in a particular area before it's too late to intervene and help. Assessment and tracking tools can also be used by students to monitor their progress and even create self-study materials like quizzes and assignments through which they can practice the learning outcomes until they feel comfortable with their performance.

BACKGROUND

There has been relatively little research on these eLearning platforms and almost no comparative research. This research will attempt to investigate the similarities and differences of these eLearning platforms with a focus on satisfaction of learning outcomes and course assessment.

eLearning has many definitions in that it permits students to increase their knowledge and practice the skills needed to achieve course learning objectives. The Internet plays a large role in the development and application of eLearning (Cross, 2004) since it allows students to access content "anywhere, anytime and anyplace." (Kirange and Sawai, 2021, 194). Activities of eLearning can be synchronous or asynchronous and student assessment tools such as online homework, quizzes, proctored tests, and hands-on application exercises can all be used to assess knowledge gain (Beaudin, 2016; Uzma et al., 2022). Online learning continues to evolve and now incorporates gaming, virtual and augmented reality, artificial intelligence and big data (Kirange and Sawai, 2021).

eLearning platforms have been used in a variety of disciplines, ranging from business to the sciences to psychology (Chow, 2014; Fatemi, D. et al., 2014; Mafunda and Swart, 2020; Cramer, 2012). The recent movement away from traditional face-to-face teaching to online environments

because of the COVID pandemic of the early 2020's has piqued the interest of faculty who are looking for innovative ways to deliver content and address student learning outcomes (Kim, et. al, 2021).

Traditional supplemental materials that accompanied most textbooks were simple "solution manuals to practice problems at the end of each section. As the technology has changed rapidly in recent years, many textbook authors and publishers have developed various resources in different formats, such as online homework systems, course videos, step-by-step processes, and animations to demonstrate important concepts to students." (Kao and Burch, 2012, 1).

Online and web-based learning platforms are invaluable for instructors since they reduce the time spent with mundane grading of exercises, permit close monitoring of student progress, and provide instructors with opportunities to provide detailed feedback and guidance when students experience difficulties with the exercises and/or assignments. Students appreciate the immediate feedback provided by these systems—something echoed by my own students many times—and as found in the literature (Davis, et al., 2016; Lunsford & Pendergrass, 2016; Kao and Burch, 2012). These platforms also allow for proctored exams as well as algorithmic exercises to alleviate academic integrity concerns (Bonham, et al., 2001; Kortemeyer, 2015). It is precisely the ability to use algorithmic exercises that I recently switched platforms from Pearson to Cengage. Algorithmic exercises, both for homework problems and Excel exercises, all but eliminate academic integrity issues. Coupled with the use of third-party application Respondus Monitor (2024) to proctor exams, cheating has all but disappeared in my online classes.

Cengage's WebAssign and Pearson's MyLab are two of the primary platforms used to deliver asynchronous learning in the field of statistics and analytics. Kao and Burch (2012) offer a detailed comparison and contrast of these two major platforms. Online homework in these platforms permit instructors to choose specific problems which correspond to course learning objectives and when these problems are algorithmic in nature, students can work (and learn) together, but not copy each other's answers (Dillard-Eggers, et al., 2008; Stewart, 2022). Cengage offers students the opportunity to "Practice Another Version" to build their confidence and ability to solve problems (Papp, 2024; Study Tools, 2024). Pearson, by comparison, offers "Help Me Solve This" whereby it provides students with a step-by-step process to solve the problem and "View An Example" where the problem is solved for them—like in the textbook (Question Help, 2024; Reynen, 2024). These tools, while popular with students, provide too much of a crutch and, when not available on the exam, students are unable to solve the problem without them. Cengage offers a much more elegant solution in their "Master It" approach. Students complete the problems in a very structured step-by-step way and learn each of the individual steps to arrive at the correct answer. Exams can then either incorporate this step-by-step approach or simply ask them to arrive at the correct final solution. Both platforms provide a means to interact with the instructor and/or the publisher. Cengage also offers a "My Notes" option where students can compose their own notes, hints, and strategies to solve the problems (Swanson, 2024).

Specific platforms notwithstanding, the primary goal of student achievement of course learning outcomes is important with respect to assurance of learning. The collection and assessment of student learning outcomes are required by accreditation agencies such as AACSB and ABET.

METHODOLOGY

Anonymous student course outcome performance data was collected during the 2022-2024 academic years including Summer 2023 and 2024 from direct student performance on each of the course learning outcomes. To master the statistical and analytics topics covered in the course, students solve homework problems from each chapter (on topics such as Descriptive statistics, Discrete and Continuous Probability, Sampling, Confidence Intervals, Hypothesis Testing, Simple Linear Regression and Forecasting) which assess their comprehension of the chapter's topics along with specific Excel assignments which afford students the ability to master hands-on problem solving and critical thinking skills using Excel spreadsheets, something required of them by the firms which hire graduates. Finally, student performance on unit exams were assessed and compared to course objectives to assess the level of mastery of each of the course and chapter learning outcomes. Student performance was then compared and mapped with respect to each of these eLearning platforms, Pearson's MyLab and Cengage's WebAssign and MindTap. Pearson was used during the 2022-23 academic year, including summer 2023 and Cengage was used in the 2023-24 academic year.

The course was largely taught the same way with homework problems assigned at the conclusion of each chapter which mapped to the chapter and course learning outcomes. Students could complete the homework problems as many times as they wanted before the due date. Both platforms offer algorithmic homework exercises so students get a new set of data for each attempt and cannot work together and directly copy each other's answers. These homework problems are then used as the basis for the unit exams which cover three chapters. The rationale is that if students practice the homework problems to the point of mastery, this should translate into good performance on exams. This is indeed true for students who prepare; however, some students do not take advantage of the ability to work on problems until mastery and this is reflected in lower exam scores. In face-to-face classes, students who are frequently absent also have poor exam scores. Since students complete the homework problems outside of class on their own, there is a possibility that they seek external assistance (cheat). While I have no proof of their actions, when someone gets a 100% on all chapter homework exercises and then subsequently fails the exam (which is based 100% on the homework), the student and I have a meeting in my office which usually results in an admission of wrong-doing by the student and the problem rarely ever occurs again; they learn quickly that they can't cheat and expect to pass!

Using Cengage's WebAssign platform (Assignments, 2024; Study Tools, 2024), exams can be highly customized to include (or not) help tools ("Practice Another Version", answer keys and step-by-step solutions), display questions one-at-a-time or all-at-once, vary the number of submissions and adjust due dates and times (when student disability service accommodations mandate). The use of the Cengage LockDown browser in both face-to-face classroom settings as well as online prevents access to any site other than the exam and monitors the IP address and the use of external devices, instant messaging and printing (Lockdown Browser, 2024). Coupled with the recording features found in Respondus Monitor, exams are recorded for viewing at any time by instructors (Respondus Monitor, 2024). This is virtually eliminated cheating on exams.

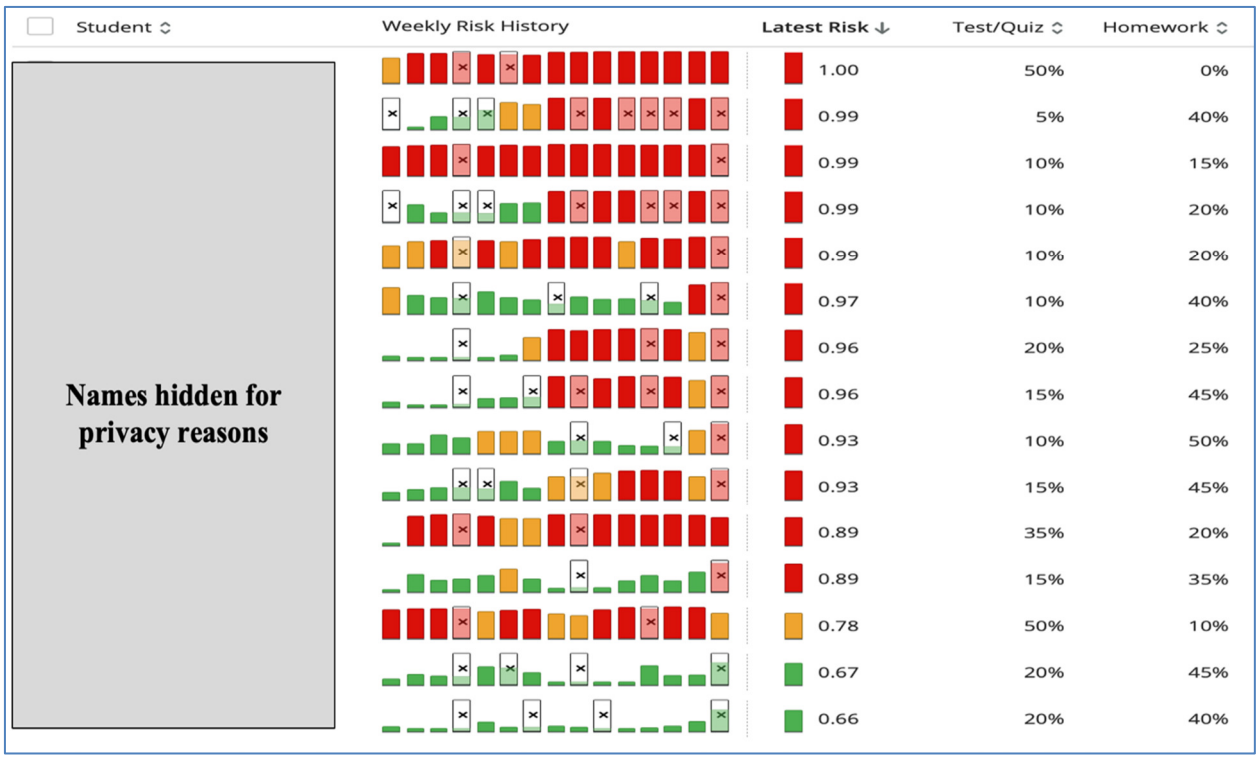

Figure 1: Cengage Student Performance Analytics

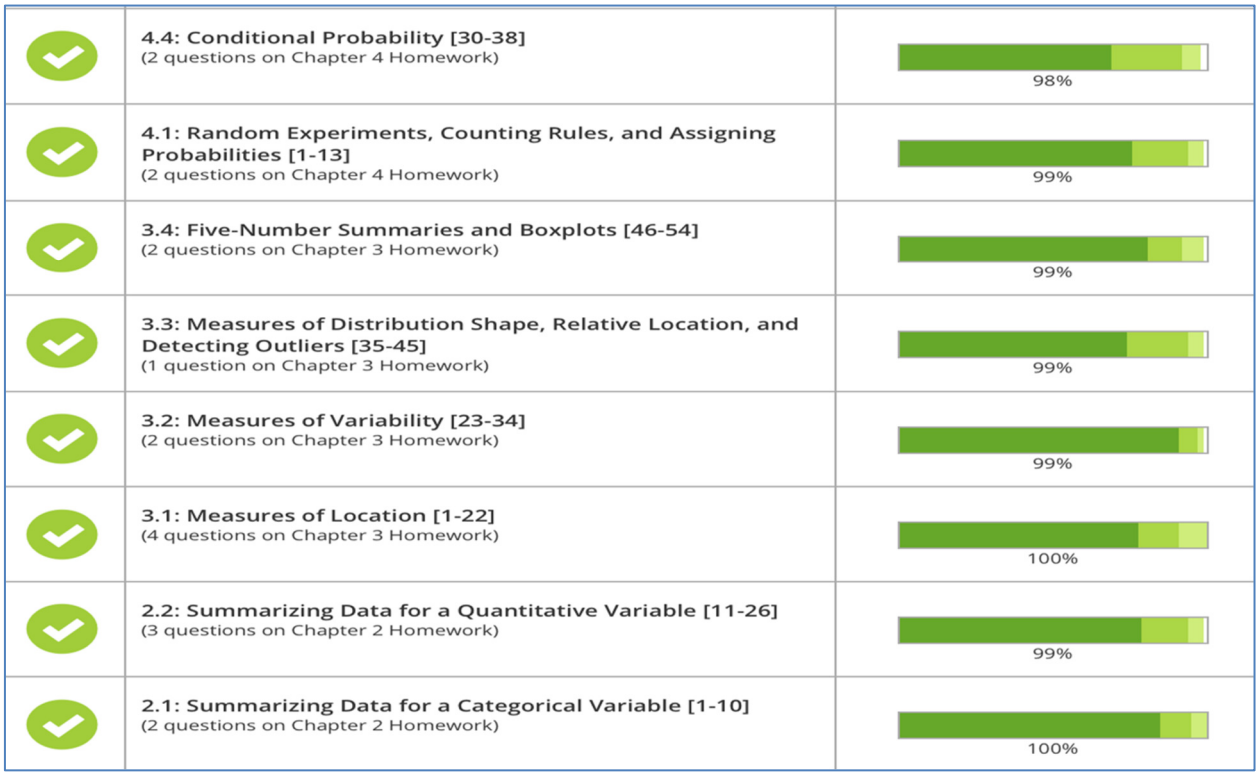

Figure 2: Cengage Student Performance Analytics

The other major deliverable in class is the use of hands-on Excel exercises. Students like working with Excel since they know they will be expected to demonstrate capability in both their upper division classes as well as on the job. The primary impetus in my switch to the Cengage platform was its ability to offer algorithmic exercises in Excel, something Pearson's MyLab did not offer. This may change in the near future as the publishers are constantly adapting and enhancing these e-learning platforms. Students were well-aware of this shortcoming in Pearson and copied each other's spreadsheets which resulted in only some students gaining mastery of Excel and others not so much. Grading was also very time-consuming as the instructor had to carefully compare spreadsheets to assess if cheating occurred. By using algorithmic Excel exercises, students are prevented from copying or sending each other their spreadsheets, reducing academic integrity issues and ensuring each student masters the required Excel assignments and corresponding course learning objectives (Cengage, 2024; Question Variation, 2024).

Results from this study will be used by and shared with department faculty to determine which platform allows optimum achievement of course learning outcomes. Complete comparative assessment results may be found in the Appendix.

RESULTS

Over a two-year period, data was collected for each of the semesters and assessed anonymously from student performance in eLearning platforms during the 2022-24 academic years as well as during Summer 2023 and 2024 from direct student performance on each of the course learning outcomes. In each of the academic year semesters, Fall 2022, Spring 2023, Fall 2023 and Spring 2024 approximately 90 students used either Cengage's WebAssign or Pearson's MyLab. These Fall and Spring classes were all conducted face-to-face. The summer terms had approximately 50 students each and were 100% asynchronous, necessitating the use of proctored exams and algorithmic exercises.

Academic Semester	Platform Used	Number of Students	Homework Score	Excel Score	Exam Score
Fall 2022	Pearson	99	90	89	69
Spring 2023	Pearson	101	94	94	79
Summer 2023	Pearson	58	93	92	70
Mean Results	**Pearson**	**86**	**92.33**	**91.67**	**72.67**
Fall 2023	Cengage	92	98	94	72
Spring 2024	Cengage	83	94	96	78
Summer 2024	Cengage	52	85	78	70
Mean Results	**Cengage**	**75**	**92.33**	**89.33**	**73.33**

Table 1: Performance by eLearning Platform by Category

A detailed comparative analysis of the two platforms for homework, Excel assignments and exams was performed illustrates that students performed similarly on both homework and exams. The Excel assignments showed a 2.33-point decrease using the Cengage platform. This may be the result of less cheating; anecdotal evidence (academic integrity violations processed by instructors) suggests that fewer students are attempting to copy each other's spreadsheets when Cengage is used but the difference in overall category performance is quite small. As previously mentioned, the primary impetus for the switch between Pearson and Cengage was the latter's ability to provide algorithmic Excel exercises in addition to algorithmic homework problems. While using Pearson's MyLab, instructors at our institution (me included) experienced a high rate of academic integrity issues as students liberally shared their spreadsheets with one another. Nevertheless, it was very difficult to definitively prove that students shared their spreadsheets. Students were smart enough to make minor modifications in hopes they would not be caught. Some, however, were so determined to gain the points from the assignments that they were 100% copies of other student's work. This required extensive, time-consuming analysis of spreadsheets to confirm. What was even more evident was their lack of ability to solve the assignments which, anecdotally, provided at least some proof that only a few students were mastering the application and others were simply benefitting from other student's copied work.

Student performance on unit exams was also assessed and compared to course objectives to assess the level of mastery of each course learning outcome. By directly comparing student performance on homework, Excel assignments and exams, it will be possible to determine which eLearning platform facilitates student achievement of course outcomes since the department agreed on and pre-defined all student learning outcomes for the course irrespective of who teaches it.

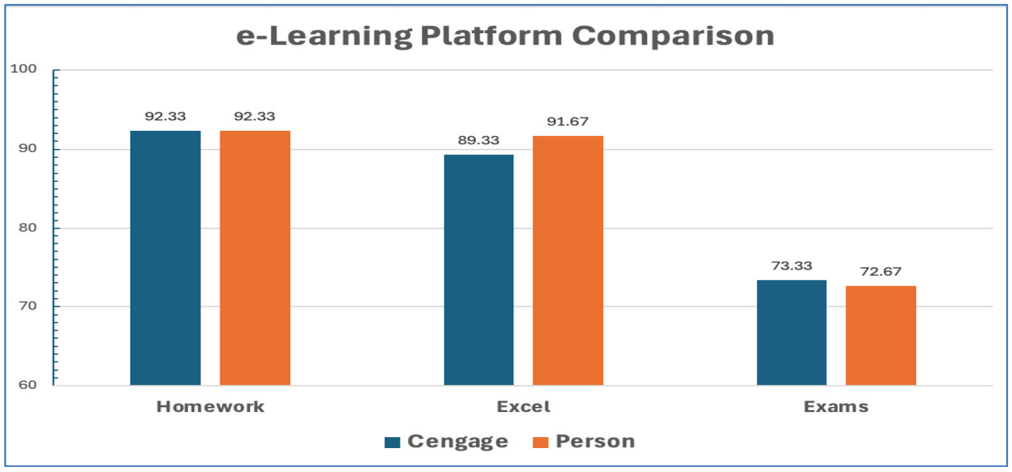

Figure 3: Comparison of e-Learning platform student scores

Assessment of outcome data indicate students performed better using the Cengage WebAssign and MindTap platforms than Pearson's MyLab. While the books are not identical in coverage, statistics is a topic area where there is limited ability to be subjective. There is usually only one way to solve a problem and the formulas, despite some minor differences, are often very similar.

Perhaps the most important take-away from this research was that when algorithmic exercises were used for homework and Excel assignments, student performance and retention increased.

CONCLUSION AND DISCUSSION

With respect to assessment of student learning outcome in the statistics and analytics course, students performed better with the Cengage eLearning platform, particularly with the Excel assignments. While the assignments were not identical to those used in the Pearson MyLab platform, the concepts tested were very similar since we teach to and measure course learning outcomes for accreditation purposes. It appears that students not only performed better in this category overall, but this translated into a higher level of outcome mastery. The most likely cause was that students were forced to do their own work and were unable to share spreadsheets with one another. The algorithmic nature of the problems seems to prevent academic integrity issues and force all students to complete the work on their own.

The findings from this research will be directly applicable and usable by faculty to assess student learning outcome achievement. It will also benefit faculty by providing them with directly measurable metrics on student performance which can be used to tailor and enhance future classes by focusing on areas where student performance is falling short of expectations. This research also adds to the existing literature on eLearning platforms and their use and applicability in accreditation. Since all accreditation agencies now focus on assessment of student learning outcomes, additional research and findings in this area is important to all faculty members teaching in this area. Employers can learn how student outcomes are defined, developed, tested and assessed. eLearning platforms provide the mechanism to do this.

STUDY LIMITATIONS AND FUTURE RESEARCH

This research is somewhat limited in that it only considered a single topical area—statistics and analytics. These eLearning platforms are used in myriad fields and the findings in this research may not be applicable to other fields. Furthermore, only two eLearning platforms were compared for one instructor over a multi-year time frame. It is unclear if there is replicability in this study or what the teaching abilities of a single instructor play on the overall conclusions.

In general, this research will benefit IT departments by providing them with directly measurable metrics on student performance which can be used to tailor and enhance future classes by focusing on areas where student performance is falling short of expectations.

This research will also add to the existing literature on eLearning platforms and their use and applicability in accreditation. Since all accreditation agencies now focus on assessment of student learning outcomes, additional research and findings in this area is important to all faculty members teaching in this area.

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