The impact of using publisher-platform learning site and synchronous video conferencing on exam and homework grades in an online graduate course

Dr. Majid Nabavi, University of Nebraska - Lincoln

Dr. Majid Nabavi received his Ph.D. at the University of Nebraska-Lincoln in 2006. He earned his MBA in Computer Science and Management at University of Nebraska-Lincoln in 2002 and Master of Engineering from University of Tehran in 1992. He joined the University of Nebraska-Lincoln College of Business in 2015. Dr. Nabavi' s teaching and research interests include pedagogical studies, business analytics, database systems, and application of analytical models for business problem solving, and operations management. He has published data analysis textbooks, research articles in Quality Management Journal, and Journal of Brand Strategy.

Dr. Jena Shafai Asgarpoor, University of Nebraska - Lincoln

Dr. Jena Asgarpoor is a Professor of Practice at the University of Nebraska – Lincoln and the Director for the Master of Engineering Management Program in the College of Engineering. She received her Ph. D. and M.S. in Industrial Engineering, specializing in Engineering Management, from Texas A&M University in College Station where she had previously earned a B.A. in Political Science (Summa Cum Laude). Prior to UNL, she was a professor at Bellevue University for 26 years, where in 1994 as part of her teaching portfolio she developed and taught the first fully online asynchronous web-based course offered by that institution. Her interests lie in engineering management, quality management, pedagogy, and assessment of teaching and learning, particularly in the online space. She is active in the American Society for Engineering Management (ASEM) and the American Society for Engineering Education (ASEE). In recent years she has President of the Council of Engineering Management Academic Leaders (CEMAL) and Program Chair and Chair of the Engineering Management Division (EMD) of ASEE. Dr. Asgarpoor is currently serving as President of the American Society for Engineering Management (ASEM).

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This study examines student engagement in online class discussions and the use of publisher-provided exercise platforms as factors influencing the student learning outcomes in an online master's level business analytics course. Individual course assignments and exams are variables of interest. Scores of 212 students in seven course sections were collected and compared. Statistical methods were used to analyze the data looking for significance of difference between the mean outcomes from different sections. One section of this course used a publisher-provided platform for students to study and perform practice exercise of course topics, while the other sections used assignments and exercises provided by their professor. While engaging in class discussion forum is a required and graded activity in this course, one section was exempt from this activity. The instructor encouraged students in this section to join regular video conferencing sessions for discussion and asking questions. After collecting the homework and exam data from all students, we compared the learning outcomes of all sections against the one class that used the publisher material. In another part of the study, we compared the student performance in all sections with the one section where discussion board participation was not required.

Literature Review

In 2014, University of Marylan Global Campus [1] decided to use open educational resources (OER) in statistics and college algebra courses, and pilot tested Pearson MyLab in a few sections of a course and compared the outcomes. They have reported positive outcomes since using MyLab, including a substantial increase in student success. The success rate changed from 60% to 80% in statistics and 50% to 80% in algebra. Faculty evaluations also improved since they were spending more time on student-teacher relationships rather than grading the assignments.

A study from 2008 [2] compared the effectiveness of computer-generated interactive math homework with traditional instructor-generated homework. Authors discerned the effectiveness of assignment design using MyMathLab. The impact of homework on student learning and the use of technology were examined. Details about MyMathLab and the College Algebra course used in the study are provided and the results of the study are also analyzed which provided mixed results. While students who used computer-based assignments were more likely to use an algebraic procedure to solve the problem correctly compared to students in face-to-face classes, they were less likely to recognize the impact of the result in a case study context. These results indicate that more research is needed to explore the impact of computer-based interactive study programs.

A study in 2015 [3] compared the effectiveness of web-based homework (WBHW) to traditional methods of using pen and paper. The study was conducted when many schools were under pressure to implement classroom technologies. To determine the effectiveness of WBHW, student outcome measures were calculated from pre- and post-test scores for 62 students. The learning gains were compared to those of traditional methods and those who did not complete the

homework over four units in a high school chemistry class. As expected, students that completed either type of homework had significantly higher learning gains than those who did not complete their homework. Students assigned traditional methods were more likely to complete their homework (86.7%) versus those assigned computer-based (64.4%). These results show the importance of assigning meaningful homework in a method that students are likely to complete. In a correlational survey study in 2022 [4], the effects of students' online homework learning outcomes on their self-efficacy, perceived responsibility, and motivation levels were measured and analyzed. The study found meaningful correlations between self-efficacy and perceived responsibility, also between self-efficacy and motivation levels. No correlation was observed between students' online homework performance and self-efficacy, perceived responsibility, and motivation.

In 2003 a web-based interactive, automated homework quiz and tutorial package was used to improve the learning of first-year undergraduate chemistry students [5]. This system produced randomly generated quizzes, returning grade and feedback immediately. The feedback included a fully worked-out solution. Success in these quizzes was required before taking proctored tests. Researchers found a positive correlation at the p= 0.1 level (90%) between voluntary extra use of the quizzes in the interactive package and the final course grade. Students used the system more than the base course requirements, even though the quiz grades were not included in total grade calculation. This study concludes that students were motivated to pursue additional practice with the quizzes and associated tutorial information as they perceived some benefit in this student-centered study tool.

Kendricks [6] reports results of a computer-based learning system in mathematics classroom, creating a complementary supportive environment that increased student success by 15%, compared to national gains of 10% for computer-based classrooms having no formal supportive learning environment. This case study shows that using computer-based learning combined with a dynamic environment like a learning community, teacher support, cooperative learning, tutors, and professional development availability, creates positive results in student learning and retention. Higher homework completion rates and mandatory tutoring sessions are correlated with the student success rates which was a 75% pass-rate of College Algebra with a grade of "C" or higher.

Methodology

We tested different combinations of learning methods in seven sections of 8-week, online graduate level, business analytics classes with a total of 212 students. These classes are all online and the content is quantitative. Students are primarily working adults, pursuing a master's degree on a part-time basis. Assignments require using software, visualizing and analyzing data to return numerical answers. One class section used a publisher-provided assignment and exercise system. Weekly student assignments are a select set of questions from a question pool and students can re-take the assignment 10 times. After each try, feedback is provided immediately by the publisher system, including solutions and answers for missed questions. Students can try the assignment again, but each time the system randomizes numbers.

Classes that use instructor-provided assignments receive questions at the same level of challenge as the section using publisher-provided assignments. These students are also allowed to try each

homework 10 times. Instead of completing the assignment at the publisher site, the homework is accessed through the university's Learning Management System (LMS), which also returns immediate feedback to students, marking the correct and missed questions. However, the LMS does not provide the correct answers nor the solutions to the students. Students may repeat the assignment, trying to provide answers that fit in the correct range. All sections have a discussion forum for asking and answering questions. Students and instructors alike can answer questions and share content-related material in this forum. These forums are graded as part of the total student grade to encourage participation. This class, along with five other classes, used a graded discussion forum. In one section that used instructor-provided assignments, the discussion forum activity is optional. Students in this section were invited to live video sessions with the instructor to ask their questions and observe the instructor interact with other students.

We collected the assignments and exam results from all sections and used appropriate test of means to compare student performance in 3 different ways: assignments, exams, and total. Each student is asked to complete and submit a survey, rating themselves on overall knowledge of statistics and their familiarity with the tools used in this course on a scale of 1-5. Data from these surveys were collected and analyzed to provide information for professors and compare the overall level of student knowledge and preparedness before starting this class. Shapiro-Wilk test of normality did not provide evidence of significant deviation from normal distribution except for one section (section 6) which had a left-skewed distribution, and Levene's test of variance did not indicate significant difference between average class rating variances. An ANOVA test of mean ($p = 0.264$) also did not provide evidence to reject the null hypothesis of significant differences between the mean ratings of all classes. We did not consider the base knowledge of all classes to be significantly different in this study.

Test Results and Discussion

We compared the average of student homework scores across all sections. When comparing all sections, analysis of variance (ANOVA) results shows a significant difference between the average homework scores for one class (i.e., Group 2) compared to other classes. This class also had the highest variance in homework scores. Group 2 had the discussion board participation requirements and instructor-provided homework questions, just like groups 3 – 5, and 7 and to our knowledge, the student profile in Group 2 was like the rest of the sections in this study (full-time employed adult student, enrolled on a part-time basis), Therefore, we cannot explain why the average Homework score for group 2 is significantly lower than the other groups with the same format. The only other observation to be made is that Group 2 had the lowest enrollment count compared to the other groups. It is possible that low performers in this group had a pronounced impact on the overall performance of the group when focusing on mean scores. We removed the outlier section (group 2) from the analysis. This resulted in no statistically significant difference between the student performance of the remaining six sections ($p=0.747$).

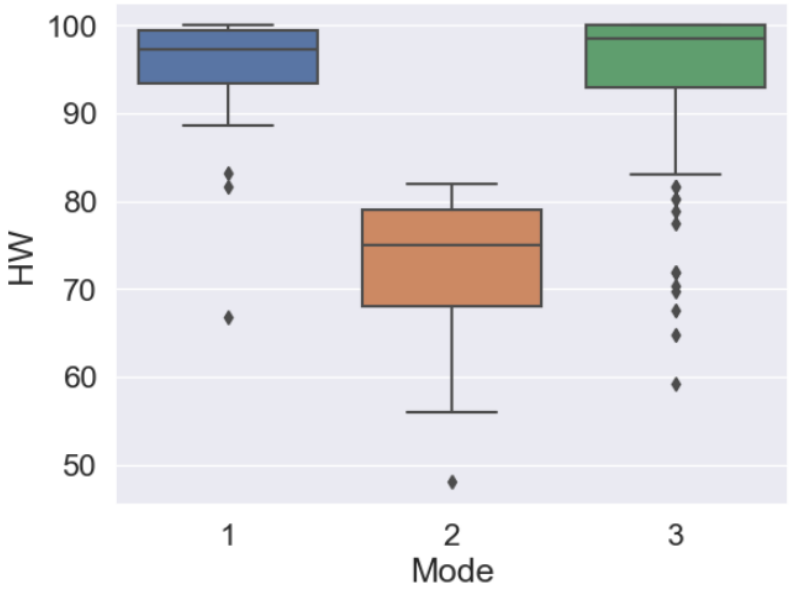
In Exhibit 1 group "1" used the publisher-provided, automated homework system. Also, discussion board participation in group "6" was optional and not included in the students' total grade. This class had regular live video conferencing with the instructor.

Exhibit 1: Student HW Average

Groups	*Count*	*Sum*	*Average HW grades*	*Variance*	All sections offered video conferencing and instructor-recorded videos
1	33	3132.96	94.94	47.57	Publisher-provided HW system Discussion **required**
2	19	1360	71.58	93.70	Instructor-provided HW system Discussion **required** **Outlier section;** HW grades much lower than others
3	43	4111.27	95.61	53.20	Instructor-provided HW system Discussion **required**
4	26	2507.04	96.42	72.72	Instructor-provided HW system Discussion **required**
5	32	3001.41	93.79	80.80	Instructor-provided HW system Discussion **required**
6	25	2375.35	95.01	62.65	Instructor-provided HW system Discussion **optional** encouraged to attend video conferencing
7	34	3250	95.59	52.22	Instructor-provided HW system Discussion **required**

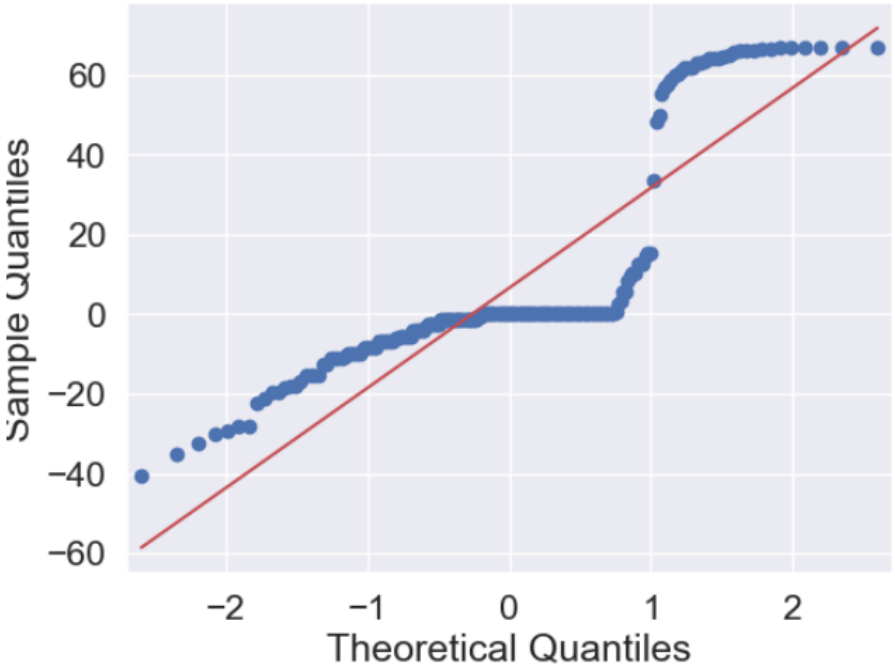
Exhibit 2 demonstrates the grade distribution for assignments in the class that used publisher system (mode 1), the outlier class (mode 2), and other classes that used instructor-provided assignment system (mode 3).

Exhibit 2: Grade distribution for 3 groups of students



We later assessed the validity of ANOVA tests by checking its basic assumptions: independent sampling, normal distribution, and homogeneity of variances. Since the measurements were independent, we tested the other two assumptions: normality and homogeneity of variances. Quantile-Quantile plot and Shapiro-Wilk tests were used to verify and demonstrate the normality of distributions for all seven classes. Shapiro-Wilk test p-value of 6.88e-19 indicates severe deviation from normal distribution. Exhibit 3 shows a Q-Q plot of residuals to visualize the skewness of grade distribution to show the data non-normality.

Exhibit 3 – Q-Q plot for assignment grade distribution.



Additionally, we performed a Levene's test to inspect the homogeneity of variances. The p-value of 0.25 indicates no statistically significant difference between the variances of all classes. Although the normality of sample distributions for ANOVA has been a point of discussion among statisticians [7], we decided to repeat the test of means using the nonparametric, Kruskal-Wallis test. A test of all classes returned a p-value of 1.31e-11 indicating significant differences among the means for at least one class among the samples. After removing the outlier class, the Kruskal-Wallis test p-value rises to 0.048, still indicating a statistically significant difference between the means, which is likely due to the 2-point difference between the averages tested. Some classes with instructor-provided assignments scored higher and some lower than the class using publisher-provided HW system. These results do not provide a clear advantage of one method over another, given the expected variation of different groups of students.

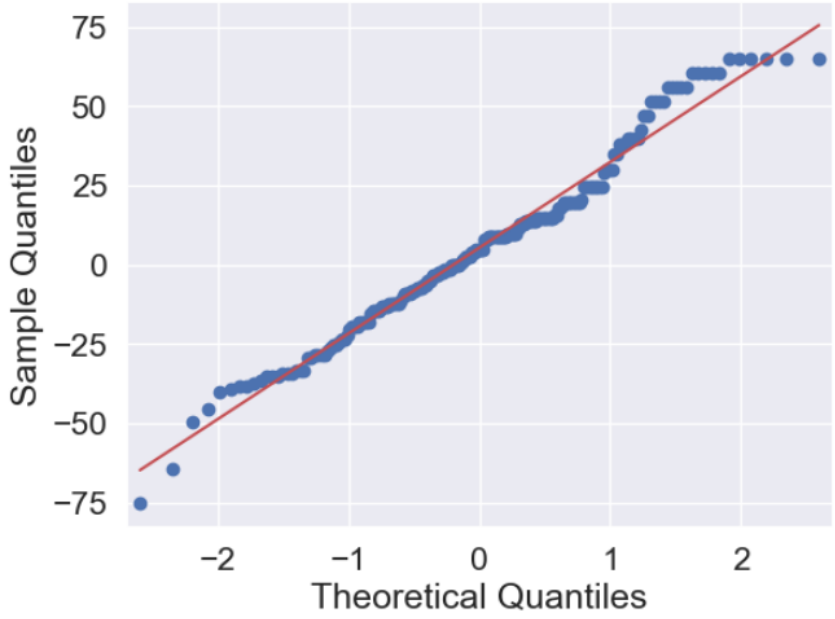
We also compared the means of exam results between different classes. See Exhibit 4 for an initial ANOVA test that shows approximately a 10-point difference between the minimum and maximum class averages. However, the p-value of 0.41 indicates no statistically significant difference among the class means.

Exhibit 4: Summary ANOVA table for class exams
(p-value = 0.41)

Class	*Count*	*Sum*	*Average Exam grades*	*Variance*	All sections offered video conferencing and instructor-recorded videos
1	33	2362.5	71.59	394.07	Publisher-provided HW system Discussion **required**
2	19	1300	68.42	333.48	Instructor-provided HW system Discussion **required** **Outlier section;** HW grades much lower than others
3	43	3158	73.44	339.06	Instructor-provided HW system Discussion **required**
4	24	1708	71.17	277.97	Instructor-provided HW system Discussion **required**
5	32	2084	65.13	356.24	Instructor-provided HW system Discussion **required**
6	25	1725	69	528.17	Instructor-provided HW system Discussion **optional** encouraged to attend video conferencing
7	34	2553	75.09	267.72	Instructor-provided HW system Discussion **required**

We used Q-Q plot and Shapiro-Wilk test to verify normality of the exam distributions. Exhibit 5 demonstrates the Q-Q plot of residuals for exam distributions. This graph indicates a much closer to normal distribution of exam grades, compared to homework.

Exhibit 5 – Q-Q plot of exam distributions



A Shapiro-Wilk test of homework grades returns a p-value of 0.004 and statistically significant deviation from normal distribution. Therefore, we decided to run a nonparametric, Kruskal-Wallis test as well. While Levene's test of homogeneity of variances has a p-value of 0.71 showing no significant differences between variances, the Kruskal-Wallis test of means p-value is 0.718, an indication of no significant differences between mean exam scores of publisher-provided and instructor-provided system classes.

We find that while all course sections had access to a computer-based assignment system, instructor notes and videos, and a discussion forum, the publisher-provided assignment system was equally as effective as the instructor-provided systems with respect to students' exam performance. Some sections that used the instructor-provided HW system achieved slightly higher averages and some slightly lower averages than the section which used the publisher-provided system. Required participation in a graded discussion forum did not make a significant difference in exam performance compared to a section with video conferencing and optional discussion.

Conclusion and future studies

The literature is divided on the efficacy of using publisher-provided assignments. Some praise the outcomes and some report mixed results. Our paper reports mixed results with no significant differences between student performance in sections where publisher-provided assignments were used versus instructor-provided assignment.

Based on results obtained in this study we find that both forms of student engagement, namely required discussion forum and instructor video conferencing, can be similarly effective in student exam scores and overall scores. Therefore, we recommend availing both means of engagement for all future classes. This recommendation has already been implemented in this course where a graded discussion forum and regular, scheduled video conferencing with the instructor are incorporated as course activities.

The instructor-provided assignment system incorporated into Canvas, our institutional LMS, was as effective for student learning as the automated, publisher-provided system. We have decided to continue developing and expanding our own instructor system to reduce for the students the financial burden of publisher-provided course materials.

A limitation of this study is that it involved courses in only one field and discipline of study. We recommend replicating this study for different subject matters and exploring additional methods of student engagement in online classes.

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