

Assignment Of Grades And Student Performance In A Hybrid Operations Management Course: What Works And Ideas For Improvements

Lisa M. Houts, California State University, Fresno
James C. Taylor, California State University, Fresno

ABSTRACT

The production and operations management class offered at California State University, Fresno underwent a transformation from being a four-unit, face-to-face course to a hybrid course. This hybrid course, which is required for all students in the Craig School of Business, includes two units of face-to-face instruction each week, with some coverage of conceptual material as well as review and practice of the mathematical material presented online. There are also two units of online streaming lecture instruction created and delivered by the course coordinator covering primarily quantitative material with some coverage of conceptual material for some chapters. This second component translates into about ten hours of online related activities during the week for the students, requiring a large amount of self-discipline as they study and learn complex mathematical concepts applied to production management. Students are expected to work through this material and complete corresponding quantitative worksheets prior to coming to class. This paper compares the proportions of assigned grades of 116 students in four sections of the hybrid production and operations management class in the fall of 2006 to the proportions of assigned grades of 76 students in three sections of the course conducted in the spring of 2001, one of the last semesters that it was taught entirely in the classroom. Changes that have taken place in the delivery of the course will be described, as well as suggestions for making the instructor's delivery of the course more effective in the future. Fisher's exact test and chi-square analysis will be performed to determine if there was a significant change in the proportions of assigned grades between the face-to-face format and the hybrid course. One item of particular interest is the proportion of assigned grades on the comprehensive, final exam, the content of which was virtually the same in 2001 as in 2006. Thus, it provides a consistent measure of the students' overall understanding of both conceptual and mathematical material at the end of the semester.

INTRODUCTION

The production and operations management class offered at California State University, Fresno underwent a transformation from being a four-unit, face-to-face course to a hybrid course. This hybrid class, which is an upper division requirement for all students in the Craig School of Business, involves two units of face-to-face instruction each week with some coverage of conceptual material as well as review and practice of the mathematical material presented online. There are also two units of online streaming lecture instruction created and delivered by the course coordinator covering primarily quantitative material, with some coverage of conceptual material for some chapters. This second component translates into about ten hours of online related activities during the week for the students, requiring a large amount of self-discipline as they study

and learn complex mathematical concepts applied to operations management. Students are expected to work through this material and complete corresponding quantitative worksheets prior to coming to class.

This paper compares the proportions of assigned grades of 116 students in four sections of the hybrid production and operations management class in the fall of 2006 to the proportions of assigned grades of 76 students in three sections of the course conducted in the spring of 2001, one of the last semesters in which the course was taught entirely in the classroom. The course content has remained similar in terms of graded activities, although some differences in material covered has taken place. In the spring of 2001, tests were weighted more heavily, being worth 70 percent of the overall grade, as opposed to only 57 percent in the fall of 2006. In both semesters, students played a highly competitive online simulation involving aggregate planning and MRP which was worth about 20 percent of their grade. In the hybrid course, students also submit six online homework assignments which cover virtually all of the quantitative techniques learned during the semester. These homework assignments are customized for each student, resulting in a unique set of answers for each one, thus making it more difficult for them to cheat. The homework assignments have proven very useful for keeping the students on track with the schedule for viewing and completing the online material. It is primarily to create points for these assignments that the tests have been weighed less heavily than they were in the spring of 2001. The remaining points are allocated between attendance and a writing assignment for the students, similarly to how they were used in the spring of 2001.

Fisher's exact test and chi-square analysis will be performed to determine if there was a significant change in the proportions of assigned grades between the face-to-face format and the hybrid course. One item of particular interest is the proportion of assigned grades on the comprehensive, final exam, the content of which was virtually the same in 2001 as in 2006. Thus, it provides a consistent measure of the students' overall understanding of both conceptual and mathematical material at the end of the semester.

Anecdotal evidence suggests that while students do like having a portion of the material presented online, they also feel that a significant amount of class time should be devoted to reviewing and practicing the mathematical techniques. It is not uncommon for them to state that they wish that they had additional face-to-face class time to further review and practice the materials with the instructor.

Given the limited amount of time in class and the large amount of material this course covers, the instructor must plan carefully to give the students the reinforcement that they want for the quantitative material and still have time to cover the conceptual material. Also, typically about 50 percent of the students have never been in a manufacturing facility, and this operations course is the only one offered regularly at CSUF. This suggests that the material covered in the class is likely to be unfamiliar to many students and in some instances appears difficult for them to conceptualize. Furthermore, many of the students at CSUF seem to lack some of the mathematical skills necessary for success in a course such as this. Whereas students who have performed well in their prerequisites for the class, such as statistics, may feel comfortable learning the mathematical material in an online format, this approach seems to create an additional hurdle for those who have struggled with mathematics in the past. As a result, more class time has been shifted to reinforcing the mathematics than might otherwise be needed, and less time has been available to explore cases studies in business manufacturing.

METHODOLOGY

Fisher's exact test and chi-square tests were employed to test the proportion of assigned grades between the spring of 2001, when the course was still taught in the four-unit, face-to-face format, and the fall of 2006, when it was taught as a hybrid course with two units face-to-face and two units online. Sample sizes ranged from 76 to 80 students in the spring of 2001 and from 116 to 122 for the fall of 2006. The slight differences are due to the fact that not every student took every test and not every student who began the class completed it. The proportions of assigned letter grades for the first and second exams, the comprehensive final, and the final course grade were compiled and analyzed to determine whether there was a significant difference in these measures given the changes in how the class was being delivered. None of the results were statistically significant at the 95% confidence level, suggesting that the material can be conveyed through both formats and yield similar grading outputs. Charts 1 and

2, shown below, summarize the Fisher’s exact test and chi-square test findings. Following the charts, each item will be discussed along with a table that depicts the proportion of assigned grades for that component of the course.

Chart 1: Fisher's Exact Test Results

Fisher's Exact test	p-value
Final Exam	0.068

Chart 2: Chi-square Results

Chi-square test	Chi-square	degrees of freedom	p-value
Exam 1	4.29	4	0.368
Exam 2	3.68	4	0.451
Course Grade	3.86	4	0.425

First And Second Exam Results

The first and second exams each consist of 25 multiple choice questions. About one-third of these are conceptual and two-thirds are quantitative. However, the tests were weighted differently in the two semesters being compared. In the spring of 2001, each of the first two exams was worth 200 points, which was 20 percent of the overall grade, whereas in the fall of 2006 each was worth 160 points, or 16% of the grade. After the exam, during the next class meeting, students participate in “exam review,” where they work in groups of five or six students and solve the test problems again, using open books and open notes and while having their own calculations from the test in front of them. Depending on how the team scores, each student can add between zero to 20 points to their individual exam scores. In addition, students can replace either of the first two exams with the final if their percentage score on the final is better. The letter grades depicted in Tables 1 and 2 reflect the original exam scores including bonus points, whereas the final letter grade calculations shown in Table 4 include the replacement factor.

In the spring of 2001, the mean score for the first exam was 78.81%, while the mean for the first exam in the fall of 2006 was 74.78%. For the second exam, the mean in the spring of 2001 was 72.63%, while the mean for the second exam was 69.69%. Over the years students have typically performed better on the first exam than the second. The most likely explanation is that students seem to find the quantitative material on the second exam to be more difficult than that which was on the first.

The distributions by letter grade are shown below in Tables 1 and 2. In all of the tables which follow, the number of students with each letter grade has been converted to a percent to facilitate comparison, since the sample sizes themselves were not the same.

Table 1: Comparison of Grades on the First Exam

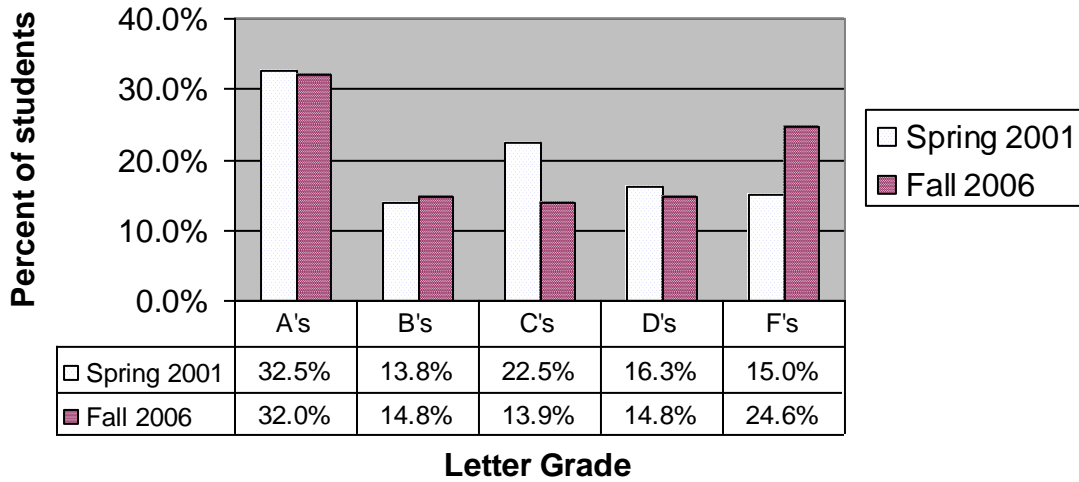
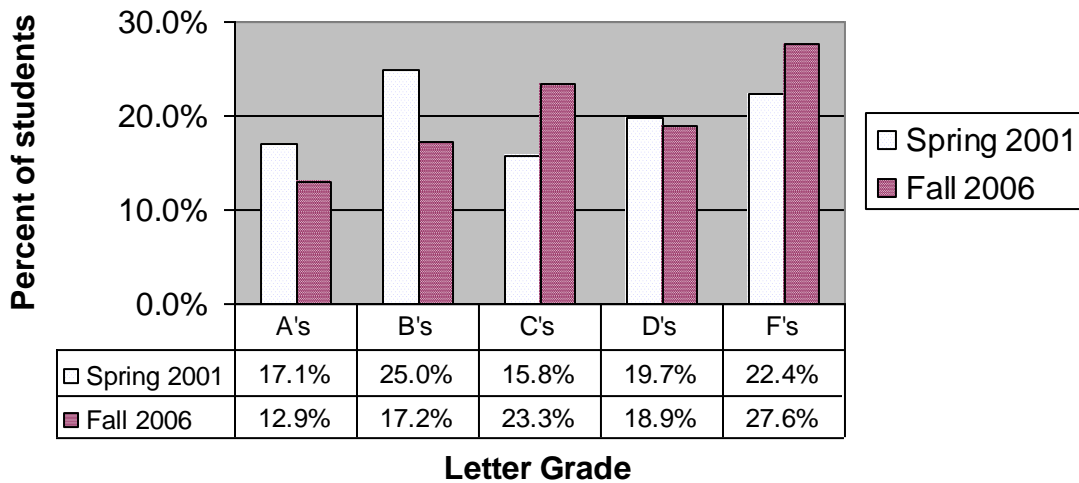
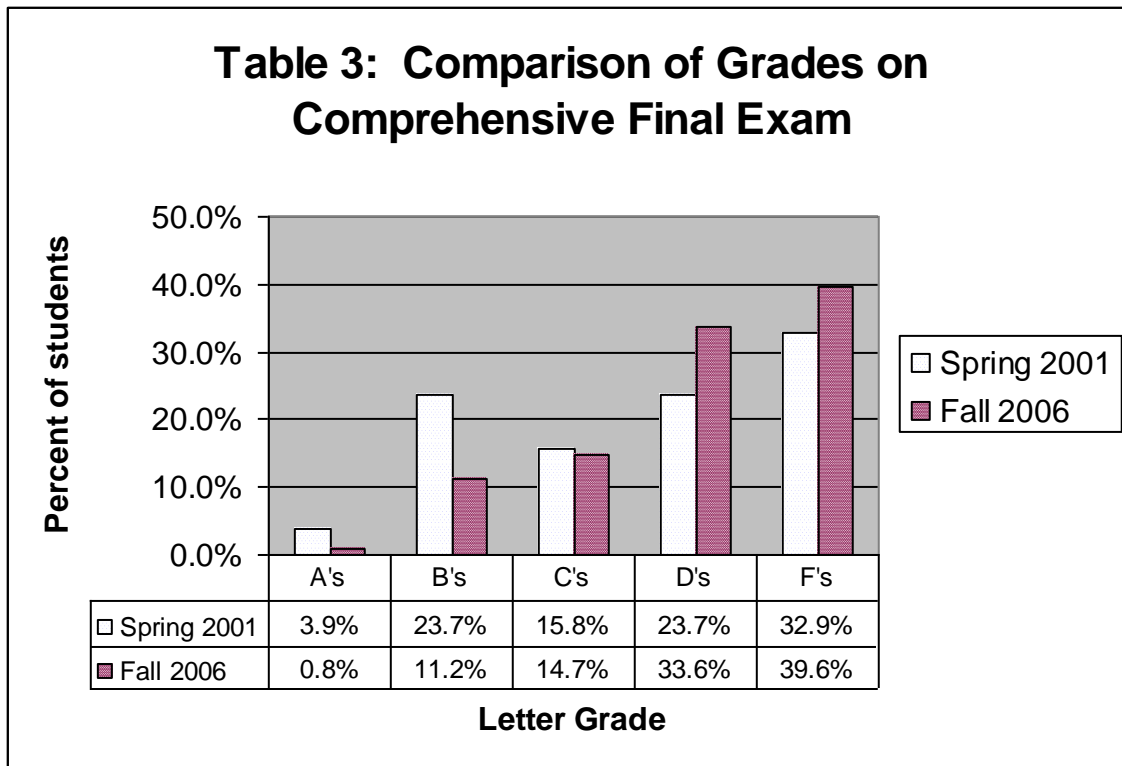


Table 2: Comparison of Grades on the Second Exam



Final Exam Results

The final comprehensive exam has remained consistent over the years covered by this study. It consists of 50 multiple choice questions, of which about one-third are conceptual and two-thirds are quantitative. Since it tests the students’ comprehensive understanding of the course material, it appears that students are performing similarly on the test regardless of whether the course is delivered in the old or the new format. The distribution of letter grades is shown below on Table 3.



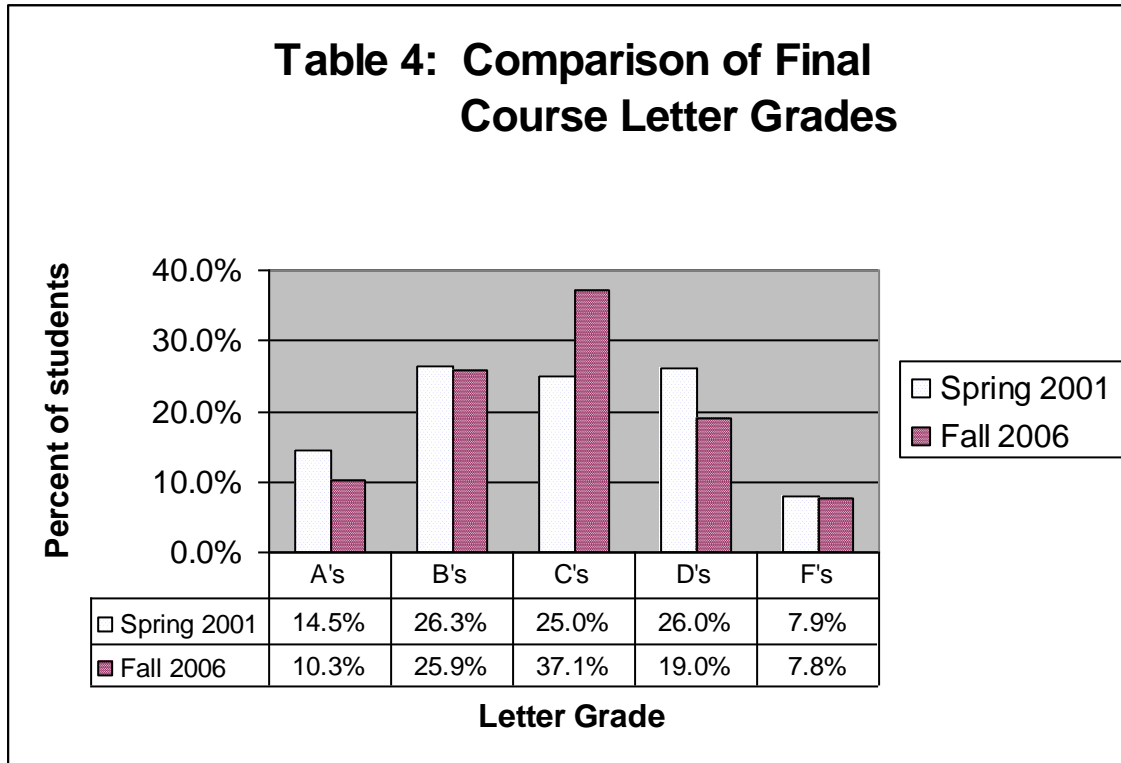
Although the differences in the proportions of assigned grades were not shown to be statistically significant, another issue that needs to be addressed is the distribution. While it is typical for students to score very poorly on the final, it is certainly far from desirable. The mean reveals similar concerns. The mean final exam score in the spring of 2001 was 67.2 percent, while the mean in the fall of 2006 was 61.6 percent. A number of reasons could potentially explain the low scores. First is the lack of incentives. In the spring of 2001, students could still pass the class with a “D.” Since many had accrued ample points in other areas of the class, their motivation to study harder and do better on the final may have been lacking. By the fall of 2006, the scenario was much different. Although a few students were still under old catalogs which allowed them to pass the class with a “D,” the vast majority now needed a “C” to pass the course. However, in the hybrid class, the final was actually worth a smaller percentage of the overall grade (25 percent versus 30 percent) than it was in back in the spring of 2001. Therefore, since many of the students had accrued ample points on other assignments in the hybrid course, such as online graded homework, and since the test was worth fewer points, they did not have to score as well on the final, even though they most likely needed a “C” in the course to pass. In summary, there was no incentive to perform better.

Another possible reason for the low scores on the final exam is that students often underestimate how much studying is required to do well on this test. Although the instructor goes to great lengths to emphasize to the students how much studying it takes to earn even a “C,” students often express great surprise upon learning their scores, remarking that they cannot believe how poorly they did. While most of the students do end up passing the

class, it may be with a lower final grade than what they were anticipating due to their poor performance on the final exam.

Final Course Grade Results

A comparison of final course point totals shows that the mean in the spring of 2001 was 77 percent, despite the fact that students needed only a “D” to pass, and the mean in the fall of 2006 was 75 percent, with the vast majority of students needing a “C” to pass the course. The distribution of letter grades is shown below in Table 4.



FACTORS CONTRIBUTING TO THE SUCCESS OF A HYBRID COURSE

In general, some of the ingredients that appear to have contributed to the success of the hybrid format of the operations management class include the following:

- 1) **High quality, detailed, online streaming lectures which teach the material to the students in a step-by-step, interactive format.**

The online lectures consist of a mix of conceptual and quantitative material, typically ranging in length from 10 to 15 minutes. The lectures include text bubbles which contain all the material which the instructor is saying. The students can listen to and read the material simultaneously, or they can mute the sound. Alternately, if they have a DSL connection, they can advance the lectures more quickly to read at their own pace. The course coordinator has created worksheets for each chapter, which the students download prior to viewing the quantitative streaming lectures. As the students listen to the instructions for the mathematical techniques, they fill out their worksheets along with the instructor. At designated times, the students pause the streaming lecture to complete calculations themselves and then restart the lecture and proceed to check their answers with those on the streaming lecture.

2) **Excellent communication and coordination between the course coordinator and the classroom instructors.**

The course coordinator effectively communicates with the classroom instructors throughout the semester. He is available to assist with questions or problems that arise, and he responds to e-mails from the classroom instructors and students within a matter of hours.

3) **Quick and efficient grading of online assignments and delivery of results to students and instructors, supported by office hour availability of classroom instructors.**

Online assignments, such as the six homework assignments, are graded by the course coordinator and returned to students within about 12 hours. This is true, even though there are over 300 students enrolled in the 10 sections of the class, and the homework assignments are unique for each student. Students receive their grades as well as the correct answers for the problems online. If they need further assistance with the work, they can seek out their classroom instructor during office hours.

4) **Careful creation and monitoring of online and classroom assignments to minimize problems with cheating, and serious consequences when it does occur.**

The online coordinator monitors the homework assignments and the online simulation game, looking for correlations between student answers and other key indicators that cheating may be occurring. It is not uncommon in a typical semester for him to find between five to ten incidents of cheating among the over 300 students in the course, and most of these incidents result in an “F” in the course. Administering the tests exclusively in the classroom, using multiple versions of the exam, and requiring the students to use simple four-function calculators that cannot store formulas also help to minimize cheating.

IDEAS FOR IMPROVEMENT

Since about half of the students in a typical operations management course at CSUF have never been in a manufacturing facility, one of the challenges is to help them visualize and understand conceptually the things that they are reading about in their books or hearing about in lecture. Because a common final exam format is used to maintain consistency between instructors, and since by the time of the final, many students have accrued enough points to pass the class even if they score poorly on the exam, another issue for the instructor becomes how to help the students exit the course with a more comprehensive understanding of the subject matter that will be retained over an extended period of time.

Perhaps the answer to both of the above issues lies in being able to spend more time analyzing case studies of real manufacturing environments. This could be done by utilizing online plant tours that are a part of the supplemental materials for the textbook, by using other videos or DVD’s that depict issues faced by manufacturers, by discussing case studies presented in the textbook, or by inviting guest speakers from local manufacturing businesses. The primary constraint in doing any of these things with the hybrid class is time. With only two fifty-minute class periods each week, it is a challenge to reinforce or present for the first time conceptual material from the book, answer questions and reinforce the mathematical tools, and still have time to use the teaching techniques suggested above. It would necessitate reducing the amount of time spent reinforcing quantitative approaches, which could result in a certain amount of student frustration. Perhaps, some of the less difficult quantitative material could be cut to make this work reasonably well. In spite of this, students may still perceive this whole idea as a waste of time, since only about eight of the 25 questions on each of the first two exams will be conceptual. Many students seem to feel that they would rather learn the math well and then guess their way through the conceptual questions. To spend significantly more time on conceptual material in class without being able to add more conceptual questions to the test, therefore, may not be well-received by the students.

To resolve this dilemma, the exam could be split over two class periods. Since many students struggle to complete the exam in 50 minutes, this solution would address this problem as well. On the first exam date, the

students could be tested on the mathematical material only. To keep the proportion of questions asked the same as before, which is required by the business school, more questions could be added at various steps of the math problems, which would not significantly add to the time needed to complete the work. The following class period, the students could be tested over conceptual material for 20-30 minutes, with the remaining time being used for lecture. Short answer bonus questions could reflect the business manufacturing examples that have been added to the curriculum, and exam review, which used to consume the second class testing period, could be eliminated. This would help the students to feel that learning this “extra” material is worthwhile, since they earn bonus points for doing so. While the exam review process does have value, this new approach would hopefully broaden the students’ understanding of the material to an extent that would make it worthwhile. Although the proportion of problems would remain the same under the new testing format (one-third conceptual and two-thirds quantitative), since the number of problems would increase from 25 to 40, students would likely perceive there being a greater need to study the conceptual topics in order to do well on that part of the test. The final exam could initially remain the same, although changes could later be made there as well.

CONCLUSION

No statistically significant difference was found between the proportions of assigned grades between students who took the class in a traditional, face-to-face format versus a hybrid format, suggesting that the material can be conveyed through both formats and yield similar grading outputs. Steps can be taken, however, to increase the overall learning that is taking place in the course. By redesigning the testing format and introducing more real world examples of manufacturing or service business to the curriculum, students may exit the course with a richer and fuller understanding of the subject of operations management while still being able to master the quantitative tools that are taught.