

Product Name MasteringChemistry

Course Name General Chemistry, Fall 2008

Key Results Assigning MasteringChemistry had a significant, positive impact on student performance as measured by exam scores. The improvement was seen for students at each of the score quartiles.

Study Design

In the years 2004–07 online homework was not used in General Chemistry courses. In fall 2008 MasteringChemistry was introduced for credit for online homework in the course. Historical comparisons were feasible since the course coverage and instructional components were comparable over the years. Fall semester final exam scores for the years 2004, 2005, 2007 (without MasteringChemistry), and 2008 (with MasteringChemistry) were compared for students who completed the course within a given semester.¹ The number of students in the course in a given year ranged from 912 to 1,125.

Results and Data

Students who used MasteringChemistry in fall 2008 showed an improvement of 0.5 in effect size in the final exam in comparison to the years 2004, 2005, and 2007, in which MasteringChemistry was not used. The average student who used MasteringChemistry in 2008 is at the 69th percentile. In terms of percentile points, there is a 19-percentile-point improvement in the final exam score, on average, when students were assigned homework in MasteringChemistry.² See figure 1.

More remarkable, students at each of the score quartiles (25th, 50th, and 75th percentiles) were positively affected by the use of MasteringChemistry in fall 2008 relative to the previous

years. In particular, the probability that a student at the 25th percentile of the class would obtain a final exam score of 50 or above is 81%. That probability is less than 50% in the previous years (42% in 2004, 26% in 2005, and 17% in 2007) in which MasteringChemistry was not used. See figures 2–4.

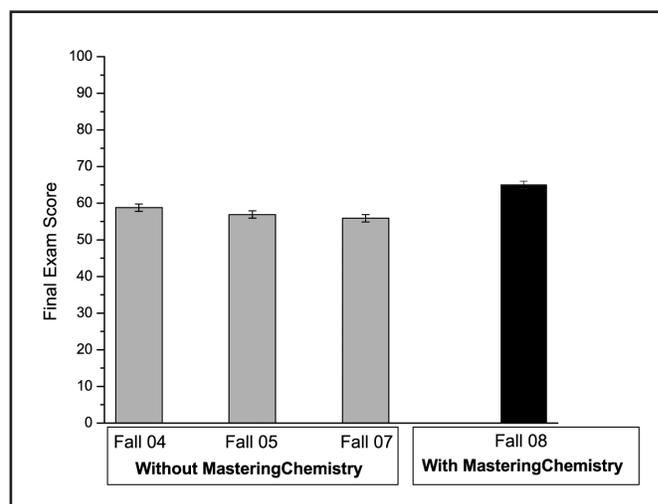


Figure 1. The final exam score (historical) comparisons of students who did not use MasteringChemistry in the years 2004, 2005, and 2007 to students who used MasteringChemistry in 2008. The errors shown are the 95% confidence interval of the standard error of the mean. The final exam scores are scaled to a maximum of 100%.

¹ The difficulty levels of the final exams across the years were assumed to be comparable. This is a reasonable assumption though it cannot be rigorously proven. The fall 2006 final exam scores were lower by about 0.6 standard deviations compared with the other non-MasteringChemistry years 2004, 2005, and 2007, and hence are not included in the analysis. According to the instructor, this may be due to an ice storm that hit the campus area on the day of the first exam, which led to its cancellation. This also deprived students from study for about two weeks. Though the ice storm did not occur

during the final exam, it may have had a ripple effect as reflected in the low final exam scores. The lower scores in 2006 may further support the argument that the final exams had comparable difficulties, since an easier exam to compensate for the ice storm would not have resulted in such a decrease.

² It is difficult to adjust the observed effect size (0.5) for individual teacher influences in 2008 over and above teacher effects for the years 2004, 2005, and 2007. According to some research findings an effect size of about 0.2 is attributable to the teacher in a traditional

classroom setting, while various other teacher influences such as reinforcement, peer tutoring, class environment, and questioning would result in an average effect size of about 0.4 (Ref: Influences on student learning, J. Hattie, Inaugural Professional Lecture, University of Auckland). Thus, if the latter teaching methodologies were employed in 2008 in addition to the traditional settings in the previous years the teacher effect would account for 0.2 of the observed effect size. The resulting effect size attributable to MasteringChemistry would then be about 0.3, which would place the average student at the 62nd percentile.

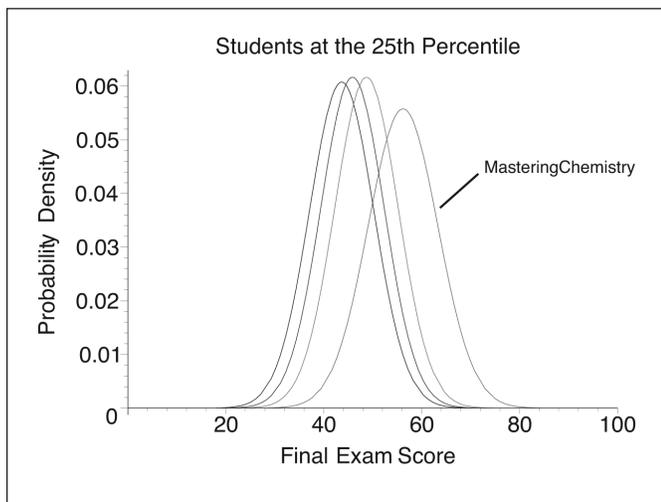


Figure 2. The final exam score (probability) distributions for a student at the 25th percentile. The probability that a student at the 25th percentile of the MasteringChemistry class in 2008 would obtain a score of 50 or above is 81%. That probability is less than 50% in the previous years (42% in 2004, 26% in 2005, and 17% in 2007) in which MasteringChemistry was not used. Graph legend: MasteringChemistry (2008) is on the far right. The remaining years (2004, 2005, and 2007) are on the left.

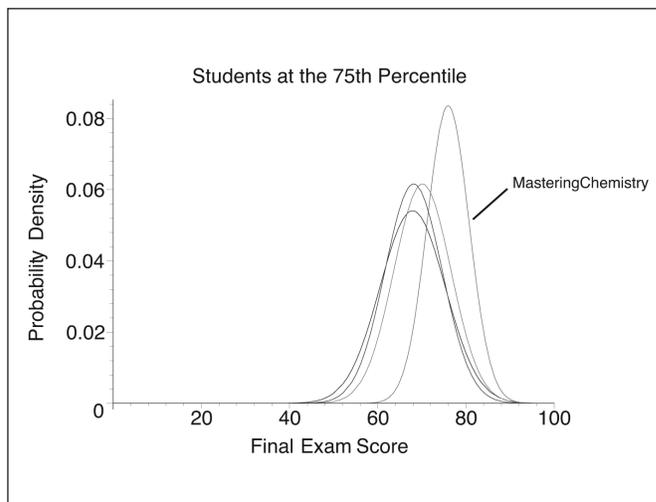


Figure 4. The final exam score (probability) distributions for a student at the 75th percentile. The probability that a student at the 75th percentile of the MasteringChemistry class in 2008 would obtain a score of 85 or above is 3%. That probability is three times as less in the previous years (1% in 2004, 0.5% in 2005, and 1% in 2007) in which MasteringChemistry was not used. Graph legend: MasteringChemistry (2008) is on the far right. The remaining years (2004, 2005, and 2007) are on the left.

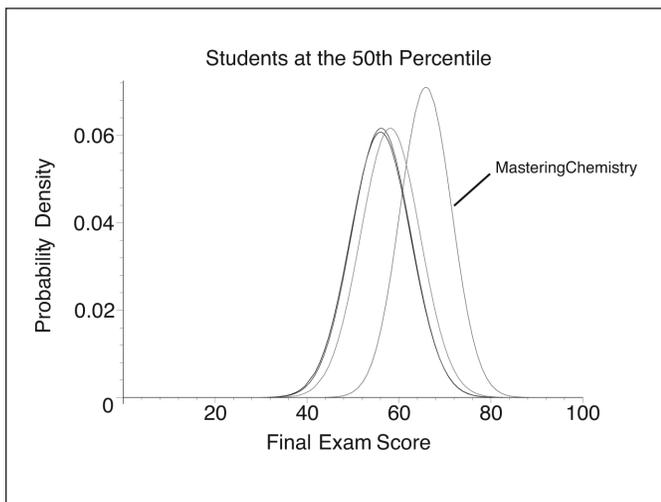


Figure 3. The final exam score (probability) distributions for a student at the 50th percentile. The probability that a student at the 50th percentile of the MasteringChemistry class in 2008 would obtain a score of 70 or above is 23%. That probability is less than 10% in the previous years (3% in 2004, 2% in 2005, and 2% in 2007) in which MasteringChemistry was not used. Graph legend: MasteringChemistry (2008) is on the far right. The remaining years (2004, 2005, and 2007) are on the left.

Conclusion

The use of MasteringChemistry in the General Chemistry course in fall 2008 resulted in 0.5 effect size score gains in the final exam. The average student who used MasteringChemistry can be placed at the 69th percentile in relation to the previous years' score distributions in which MasteringChemistry was not used. Through an observational study, the attribution of score improvements to MasteringChemistry is supported by the observation that the final exam score distributions (mean and variance) remained stable in the years 2004, 2005, and 2007 in which MasteringChemistry was not used. Students at each score quartile were positively affected by the use of MasteringChemistry. For example, the probability that a student at the 25th percentile of the class would earn a final exam score of 50 or above is 81%. That probability is less than 50% in the previous years in which MasteringChemistry was not used. Thus, students who were less skillful or were at risk of failing the course were positively affected by the use of MasteringChemistry. Similarly, a student at the 75th percentile who has used MasteringChemistry has three times as much chance of scoring above 85 than a student at the same percentile level who did not use MasteringChemistry.