

Mathematical Modeling (MATH 1101) Course Redesign at Fort Valley State University

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This case study presents the case of two piloted courses created as no-cost student resources, functioning as an intervention to improve the declining performance in the Mathematics Modeling class. The approach adopted in this process was to create free effective resources that remained available to the students from the very beginning of the semester to elevate motivation and engagement with the course. It was determined through the case study and pilot studies that offering free resource material early in the semester achieved the desired goal of improving student performance in MATH 1101. The same approach can theoretically be adopted in other courses as an intervention.

STATEMENT OF THE PROBLEM

During the spring semester of 2019, the Mathematical Modeling (MATH 1101) Project was funded by the Alternative Learning USG Grant. The faculty members who were interested in the grant had to explore and create no-cost student resources for students during the spring and summer semester for use during the Fall 2019. The two piloted courses that were created for this project, had students enrolled in these courses, who were given access to the free resources from the very beginning of the semester. Students were surveyed for their experiences to determine the perception of the quantity of the free resources made available to them. The impact of the materials was also determined by students' performance for the course. All students enrolled in these courses took the same midterm and final exams irrespective of their course section. Final grades in the courses were used to measure if there was a difference in students' performance between the piloted sections versus the non-piloted sections.

In recent years, students' course performance in MATH 1101 has not produced good percentages in passing the course with a grade of C or higher, therefore it was selected as a Gateway to Completion course to allow for restructuring and designing the courses. The main focus was to improve every aspect of teaching and to make sure that all students could access the materials from the beginning of the semester to help them with their motivation and performance. One of the greatest challenges undertaken by the MATH 1101 Project team was to make the course materials available free to all students enrolled on the first day of class. Many of the students throughout the campus have been known to not have access to course materials due to financial hardships, which can disrupt their study schedule from the very start. It has also been shown from data that more than 78% of Fort Valley State University's students' population rely on financial aid. Providing students with access to course materials from the beginning of the semester should allow for an overall improvement in student performance in these courses.

METHODS

The goal of the project was to determine the effectiveness of the free materials used in the two piloted sections vs. students purchasing materials normally without an intervention in the six non-piloted courses. While working on this project two questions of focus, relating to the quality and effectiveness of the materials, were used to help with this project.

1. Is there a difference in students' perception between the free resources versus the traditional resources that students had to purchase at the beginning of each semester?
2. Is there a difference in students' performance and final grades between the students in the piloted sections versus the students in the non-piloted sections?

To help answer the first question, a survey was carefully designed. Students in the piloted group were surveyed for their perception and experience of the Open Educational Resources (OER). The survey results of the students also provided valuable feedback on the quality of the materials used.

To address the second question, data was collected based on student performance using the final grades that students earned at the end of the semester. A comparison was made between the participants in the experimental group (n=661) versus the participants in the control group (n=85). To test the null hypothesis that there is no difference between the proportions at a significant level of 5% we ran a two-tailed test using the proportions of students passing the MATH 1101 with a final grade of: A, B, C. The grades were compared in both groups to see if there was a difference between the two proportions.

OUTCOMES

The survey results did show that the overall student opinion about the materials used in the course were positive. When students were asked to respond to the statement, "The materials adequately supported my work done outside of class", the results show that 53 students or 86% of the students agreed or strongly agreed. On the question, "How certain are you that you can enter correct answers in D2L in a way that it will be accepted on the first try?", there were only 31 students or 51% of the students agreed or strongly agreed.

There were 8 sections of the MATH 1101 course that were offered during Fall 2019. There were two piloted sections' grades combined as well as the 7 non-piloted sections' grades. There were 3 As, 17 Bs, 21Cs, 5Ds, 9Fs and 6Ws with a total of 61 students in the piloted sections. There were 4As, 14Bs, 25Cs, 9Ds, 24Fs, 4Ws and 5WFs. The grade data was provided by the Fort Valley State University's Office of Institutional Research.

In the two piloted sections, there were 41 students passing with A, B, and C. There were 20 students who were not successful. That is earning grades of D, F, WF, and W. In the six non-piloted sections, there were 43 students passing with A, B, and C. There were 42 students who were not successful earning grades of D, F, WF, and W.

We performed a Chi-squared test for the comparison of two proportions (from independent samples), expressed as a percentage. That is and using the N-1 Chi-squared test as recommended by Campbell (2007) and Richardson (2011).

Our calculations were aligned with the recommended method illustrated by Altman et al. (2000). We found that there was a difference between the two proportions and a 95% confidence interval (CI). That is, we used the Chi-squared test and P-value: we saw that the P-value was less than 0.05 and conclude that the two proportions differ significantly.

We used a two-tailed test at a significance level of $\alpha=0.05$. We hypothesized that there is no difference between the proportions: $P(\text{piloted})=41/61$ and $P(\text{non-piloted})=43/85$.

There is a difference between the sample proportions as extreme as 0.16 4.83% of the time under the null hypothesis. Since 4.83% is less than 5.00%, there is sufficient evidence to reject the null hypothesis that there is no difference at all.

PLANS FOR CONTINUATION AND EXPANSION

At the end of Spring 2021, the MATH 1101 Project Team decided to encourage departmental-wide adoption of free resources with the hope of improving student performance and student readiness for our students who were financially struggling across all courses. We plan to first meet with all of the mathematics faculty who regularly instruct mathematical modeling courses to explore the possibility of moving to department-wide adoption with the use of free resources for all the students who would be enrolling in mathematical modeling courses in the future.

The purpose of these meetings would be to encourage faculty members to consider using the Open Educational Resources (OER) and exploring the kinds of resource materials that would make the transition to the OER resources seamless. At the meetings in the future, we intend to share our experiences and update faculty members on what ideas worked and what did not work as well as to showcase all the free resource materials we were able to use. To

get faculty on board with this project, we plan on using a summary of what faculty members may be comfortable using the free resource materials and use that information to create ideas and write a proposal for a Continuation Grant. A grant that can be used to not only further improve the quality of the materials but also to create a partial or complete renovation of the course to attain the goal of department wide OER adoption for the teaching and learning of mathematical modeling.

LESSONS LEARNED AND POTENTIAL IMPLICATIONS

Our course redesign is an ongoing process. The results also showed that there was a difference in the way students perceived free resources with those students who purchased materials for their classes. The belief that students who have access to class materials from the first day of class tend to do better appears to be true. This is because more students tend to complete the assignments on or before their due dates thereby avoiding late submission penalties.

Based on the research on finding and using free resources, in many cases, it was discovered that when a suitable textbook was found, it did not have any supplemental materials that were free. The author would usually point towards a website that would provide homework with a cost.

It was also discovered that several free resources could be modified to meet the textbook needs, but this only occurred with sections in the textbook. The need to have only one textbook to use for a course may not be the best option if the free resources can be merged into one document to have access to more free materials for students and faculty to organize for course supplements.

REFERENCES

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