Educator Study with Achieve for Calculus Fall 2021

COURSE:	PreCalculus, delivered face-to-face
PRODUCT USED:	Achieve for Calculus Book: Preparation for Calculus: Functions and How They Change by Crauder, Evans, and Noell
STUDY DESIGN:	Implementation study with descriptive and correlational analyses

How Achieve for Calculus supports student academic performance in an average-sized PreCalculus classroom at a four-year university

Institutional and Course Context

Penn State University is a public four-year college offering bachelor's, master's and Doctorate degrees. The institution serves over 74,000 undergraduate students. The instructor who partnered with us on this study taught 45 students in face-to-face formatted instruction. This instructor has been teaching for over 10 years. The instructor reported being comfortable implementing digital tools in this course.

Instructor Implementation

The instructor used Achieve throughout the Fall 2021 semester. During this study the instructor assigned homework assignments and LearningCurve adaptive quizzes.

"The textbook is very clear in its approach and I believe that Achieve helps drive the narrative of the text. However, there are things to improve on Achieve such as LearningCurve by section instead of the entire chapter, the Desmos figures, and the ability to accept equivalent answers." —Professor Benkiran

Course and Digital Learning Goals

This instructor's primary motivation for using Achieve was to increase efficiency, as well as increase available resources. He also emphasized the importance of ease of use.

Study Design

This study examined whether use of Achieve was related to student outcomes. In addition, information about instructor and student perceptions of Achieve was gathered. Achieve usage was documented through analysis of platform data. Student learning data were collected at the end of the semester via course records shared by the instructor. End-of-semester surveys were used to gather data on instructor and student perceptions of the product, along with student engagement. Data were matched across sources, and descriptive and correlational analyses were conducted.

Results

Achieve is engaging. The instructor reported that students were engaged in their class. Students also reported they found Achieve engaging. They added that Achieve helped them prepare for class.

- 89% reported being engaged in the course this semester.
- 61% reported being actively engaged in classroom discussions.
- 89% reported the pre-lecture activities within Achieve as engaging.

- 83% reported the homework within Achieve as engaging.

Achieve encourages active learning. The instructor reported observing a less than typical amount of active learning in their course.

Students reported active learning.

- 94% reported engaging in active learning in the course this semester.
- 83% reported that Achieve helped support their learning.
- 94% reported pre-lecture activities in Achieve helped them stay on track during class discussions.
- 89% reported pre-lecture activities in Achieve helped them actively learn in the classroom.

Achieve is easy to use. The instructor reported that Achieve was easy to use and they were comfortable using Achieve in virtual classroom environments.

Students reported Achieve was easy to use and to navigate.

- 72% reported they were comfortable using Achieve.
- 72% reported that Achieve was easy to use.
- 61% reported feeling very confident using Achieve.
- 78% reported they would recommend taking a course using Achieve to a friend.

Achieve supports student comprehension of classroom material. The instructor reported that the tools within Achieve helped them understand where their students had gaps in their knowledge and also enhanced their pedagogical framework.

Students reported comprehension of material.

- 83% reported that Achieve was effective in supporting their learning over the semester.
- 89% reported that using Achieve helped them gain a better mastery of the course content than courses without Achieve.
- 72% reported that homework within Achieve helped fill gaps in their knowledge.
- 83% reported that homework within Achieve fostered deeper insights into the class content.
- 89% reported the pre-lecture activities also helped fill gaps in their knowledge.

- 72% reported they often comprehended the material.

"Best part about using Achieve was that it actually helped me learn and was very easy to navigate." —Student

Student engagement in Achieve appears to be related to student academic achievement. Activity completion in Achieve is shown below. Here students are grouped by completion of the overall class median (mid-point). The median was equal to 43 assignments across one class section. The graph below indicates that most students completed slightly below or at the median amount of assignments in Achieve. Activity completion in Achieve was significantly related to student achievement. There was a statistically significant relationship between how many activities students finished within Achieve (as a percentage of how many were assigned in the course) and their final grade in the course. This relationship remained significant even while controlling for students reported high school GPA, $p < .05$. The graph below shows the relationship between activity completion and final grade. This graph indicates that the more activities students completed, the better they performed in the class overall.

Engagement & Grades
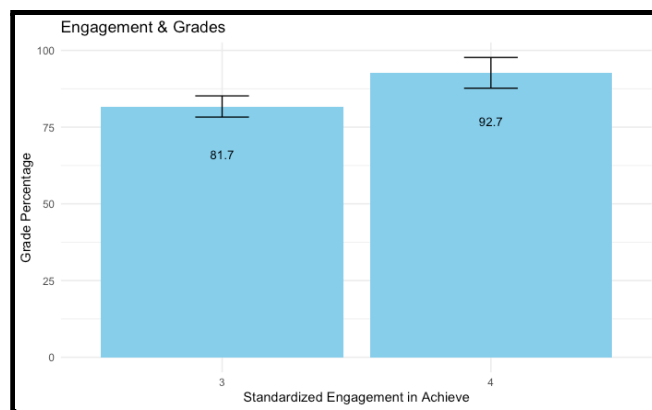
Note. The standardized engagement levels are defined as follows:
0 = no activities completed,
1 = less than 50% of the overall median completed,
2 = 50%-75% of the overall median completed,
3 = 75%-100% of the overall median completed,
4 = greater than the median.

Insights for Optimization

The instructor and students provided insightful feedback on features of Achieve. The instructor suggested improving the integrated Desmos graphing figures, as well as accepting equivalent answers for some questions. They also suggested including videos as feedback for homework questions.

Students mentioned they had issues with graphing questions and would like to see those issues resolved. Students also

suggested better hints and feedback would be helpful when they're stuck on a problem. A few students also mentioned that linking between homework problems and the specific section of the book on that topic area would be helpful.

Overall, the results of this study have generated valuable recommendations for the Achieve product team. The positive results support that Achieve has positive outcomes on students' achievement and warrant a larger quasi-experimental study to determine the magnitude of the effects.

Insights for Instructors

One of the most important insights is how students and the instructor reported that homework, and specifically the feedback provided in homework assignments, reinforced learning. Students also reported that Achieve was easy to use and helped them better understand class material. Therefore, instructors in similar educational contexts might consider implementing pre-class materials and homework in Achieve to increase overall student performance.

Study Limitations

Although the data are rich and the findings important for product optimization and insights for instructors, they are specific to this course and cannot be generalized to all instructors who use Achieve. The results are also descriptive and correlational and should not be used to infer causation.

Ethics and Data Privacy

Prior to data collection, this study and the associated consent forms and instruments were reviewed and approved (found exempt) by the Human Resources Research Organization (HumRRO). HumRRO is an accredited (00009492) third-party Institutional Review Board organization with no affiliation with Macmillan Learning. Macmillan Learning seeks third-party review to eliminate any bias in the decision of the exemption. The data in this study, which are provided by the instructor and consenting students, are initially identifiable. However, once a random identifier is generated identifiable data are destroyed. Data are provided in secure storage locations, and access is permitted only to the primary investigator in the study. For full details of our data handling and storage privacy procedures, contact marcy.baughman@macmillan.com.

Acknowledgments

At Macmillan Learning we are committed to developing learning solutions that help instructors and their students to achieve their full potential. We go about this by co-designing with students, collaborating with leading educators and learning scientists, and partnering with colleges and instructors to research effectiveness and efficacy and share insights for success.

Our goal is to help advance teaching and learning by enabling evidence-based decision making and to contribute to research into educational technology. To these ends, we take a comprehensive approach to measuring the effectiveness and efficacy of the digital learning tools that we produce. This report represents one study that makes up the larger body of efficacy research into Achieve. We thank the incredible instructor and their students who partnered with us on this research: Amine Benkiran - Penn State University.