Lessons learned from implementing ALEKS learning software as a review tool in College Calculus

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Project Summary

Incoming students to college calculus can have differential backgrounds in their understanding of mathematical concepts. This can lead to frustration when faced with college level mathematics. We explored using ALEKS (Assessment and LEarning in Knowledge Spaces) learning software as a tool to help students better prepare for college calculus at Madison Area Technical College (MATC). We found that using the software can initially have mixed results, but can have a positive impact long term. This Teaching-As-Research (TAR) project was performed as part of the DELTA Internship Program.

Introduction

The Challenge

Incoming students to a college calculus course have differential backgrounds in their learning and understanding of basic mathematical concepts. This can make learning calculus challenging as conceptual knowledge gaps can lead to student frustration and impaired learning as they struggle to catch up. This is an exploratory project where we will be evaluating the use of ALEKS (Assessment and LEarning in Knowledge Spaces) learning software as a possible tool to help students better prepare for college calculus at Madison Area Technical College (MATC). ALEKS is an artificial intelligence adaptive program that molds itself to individual student needs by evaluating what concepts a student knows and doesn’t know, and focusing on the areas students require more review or practice. After an initial assessment quiz, ALEKS will provide the user with a pie chart illustrating student knowledge on different topics. Students can then choose which topics to learn, with ALEKS providing review instruction and practice problems. According to ALEKS software providers, problems have such variability that a student can only get them consistently correct by truly understanding the core principle rather than memorizing a process (ALEKS, 2014). ALEKS will keep track of the student’s progress and periodically reassess topics a student has already completed to ensure mastery of the subject.

Teaching-As-Research question

Will the implementation of ALEKS software for the calculus course review week successfully address the initial differential in mathematics background and lead to overall improved scores in college calculus?

Hypothesis

Using ALEKS learning software as an intervention on an incoming calculus class will lead to better performance and increased motivation in the refresher quiz and calculus course due to its focus on addressing individual student’s knowledge gaps as assessed by motivation surveys and pre- and post-intervention quiz.

Methodology & Timeline

Table 1. Demographic breakdown of Calculus and Analytical Geometry participating groups. All data is self-reported and was collected in the initial survey at the end of the first week.

![Figure 4. Course Analysis by Review Group.](image)

Figure 4. Course Analysis by Review Group. Individual trends for quizzes, test, and final grade for the Calculus groups that used (A) ALEKS and (B) Paper Packet in their review. Average performance analysis of quizzes, test, and final grade for the Calculus groups that used (C) ALEKS and (D) Paper Packet for their review. Statistics were calculated by One-Way ANOVA using GraphPad PRISM version 7.0c. Data is not significant unless otherwise stated; significance values are indicated as * p-value ≤ 0.05, ** p-value ≤ 0.01, *** p-value ≤ 0.001.

A. B.

Table 2. Demographic breakdown of Calculus and Analytical Geometry groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>ALEKS Group</th>
<th>Paper Packet</th>
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</table>

![Figure 1. Project Timeline.](image)

Figure 1. Project Timeline. This study looked at two groups of students enrolled in Calculus and Analytical Geometry at MATC. Each group was given course preparatory material 1–2 weeks before the course officially started. On the first day of class, students were introduced to the project and given a “Knowledge Check” paper quiz. During the first week, students could review using either ALEKS software, or a paper packet designed by the instructors depending on their section. At the end of the first school week, students were given a quiz to test review topics and a survey on their review experience. Students were followed throughout the semester by looking at their test grades. Finally, students were given a final survey where they evaluated their course experience and commented on the relevance and usefulness of their initial review technique.

A. B.

A Closer Look at ALEKS

Figure 3. Analysis of ALEKS Group. Comparison between (A) review completion vs. quiz grade, (B) hours of study vs. quiz grade, (C) and review enjoyment vs. review completion. Data presented as linear regression calculated for identified variables of ALEKS group. Analysis was performed using GraphPad PRISM version 7.0c. Dashed line represent 95% Confidence interval. Data is not significant unless otherwise stated.

![Figure 2. Week 1 Review Results: Paired and Unpaired.](image)

Figure 2. Week 1 Review Results: Paired and Unpaired. Paired comparison of “Knowledge Check” and “End of Review” quizzes for the Calculus groups that used ALEKS (A) and Paper Packet (B) for their review. Unpaired group comparison of “Knowledge Check” and “End of Review” quizzes for the Calculus groups that used ALEKS (C) and Paper Packet (D) for their review. Statistics were calculated by Student’s t-test for paired and unpaired groups using GraphPad PRISM version 7.0c.

Final Course Breakdown

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References