

Integrating of Learning Software into Introductory Level College Mathematics Courses

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Abstract. The low rate of retention and success for students enrolled in entry-level courses in mathematics such as College Algebra is an indication that things have not been working the way we would like them. Placing ALEKS tutorial as a main part of a class make class continuous and consistent on the basis of students' achievement, even in a diverse mathematical background. In this presentation, we discuss how ALEKS was integrated into a class and change in students' retention and success before and after introducing ALEKS.

Introduction. It is widely recognized a low success rate of introductory-level mathematics courses. MATH 1314 College Algebra of Texas A&M International University (TAMIU) is no exceptions. It was reported in our previous report [1] that TAMIU has started a study of a redesign of the course by introducing a common evaluation system, learning software and hardware, and supplemental instruction (SI) sessions into all sections of College Algebra in Fall 2008. There are many learning softwares, we chose ALEKS. ALEKS fees have been paid by Title V office. It also offers a Technology and Enrichment in Mathematics (TEMA) Computer Lab and Title V tutors. In Fall 2009, the office added Title V-Teaching Technology & Learning Center (TTLC). A set of SmartBoard is equipped in both labs and a video conference between two labs are available. SI has been supported by University Learning Center (ULC). In addition, Department of Engineering, Mathematics, and Physics offered College Algebra Support Program (CASP) and have sent CASP tutors to help instructors.

Midterm and final assessments (10% each of the course grade), working hours (7.5%), and tutorial (7.5%) of ALEKS were assessed in Fall 2008. Final assessment (10%), working hours (5%), and tutorial (10%) of ALEKS were assessed in Spring 2009. We found a difficulty to schedule midterm assessment, we stop assigning the midterm assessment in Spring 2009. To encourage students to work ALEKS problem actually, we changed the percentage of hours and tutorial. We mainly use ALEKS as a supplemental resources.

After starting the redesign, the passing rate of MATH1314 College Algebra has dramatically increased (Figure 1).

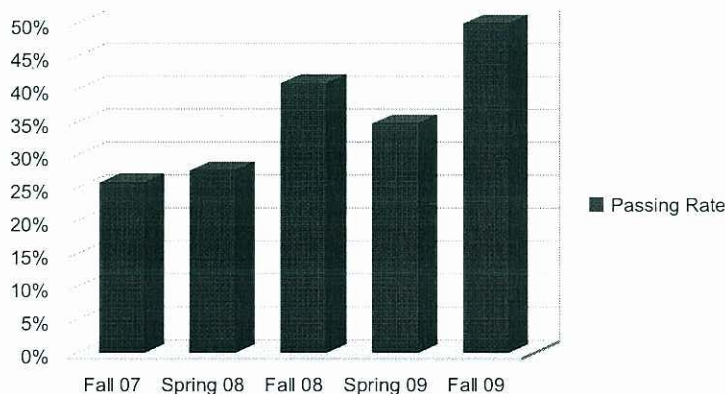


Figure 1. Change of Passing Rate of College Algebra

It is better to mention that ALEKS final assessment grades and final course grades of students were strongly correlated ([1]).

MATH1324 Business Mathematics I in TAMIU requires MATH1314 College Algebra as prerequisite. The diagnostic test in Business Mathematics I measures students' knowledges and skills of basic mathematics and covers some topics from College Algebra. The next table shows the comparison of the performances of students who took MATH1314 in 2008-9 at TAMIU and students who did not, including transfer students. The average of the first group much higher than the second group. This shows our reform helps students prepare in mathematics courses that follows College Algebra.

	Number of students	Score
Students who took MATH1314 in 2008-9 at TAMIU	29	52%
Others	25	22%

Table 2. Comparison of the Diagnostic Test

Students commented that ALEKS was good to recall what they studied in high school. However, our surveys conducted in Fall 2008 and Spring 2009 showed that 40% of students feel that ALEKS does not help to improve their performances in College Algebra and ALEKS is the least helpful resource to assist students success. More than 25% of students commented to stop using ALEKS. Some instructor also complained that they were not able to work some problems in ALEKS in spite that they covered in class.

We analyzed student's comments further and found that many students felt that there were too many assignments: homework from the textbook and tutorials on ALEKS. In addition to about 30 exercise problems per week, students are required at least 3 hours of ALEKS tutorial per week. In the last month of the semester, some students work only ALEKS and others concentrate only class works. Students also worried if lower grades of their ALEKS assessments makes their grade lower. Some students complaint that ALEKS lets them back to earlier stage and repeat the problems if they did not answer correctly in the assessment. Instructors also complained some topics can not be covered by ALEKS in spite that it was covered in class. We find ALEKS items are ordered in a different way of the textbook. In order to further improvement, we planned two pilot projects that make use of ALEKS potential by (1) giving homework through ALEKS only and (2) changing the order of topics.

Procedure. A. In the Summer 2009 semester, the percentage of ALEKS was set to 50%. In addition to ALEKS assessments (12%), a part of midterm exams were administrated on ALEKS (20%). Homework is working designated ALEKS (10%) item and Quizzes were assigned by ALEKS (8%). ALEKS hours no longer counted for the course grade. Though no paper based homework is assigned, a writing project was assigned. The order of contents has been changed so that it matches to the structure of ALEKS items. The group was compared with the sections of the same instructor on Fall 2008 and Spring 2009 (Control Group 1).

B. In the Fall 2009 semester, three different pilot projects were administrated. The first group (Pilot Group 1) adopted MyMathLab. The second group (Pilot Group 2) mainly used ALEKS including homework and midterm exams. The third group (Pilot Group 3) used ALEKS as supplemental resources as in the Fall 2008 and Spring 2009 semester. These groups were compared with the rest of the sections (Control Group 2). The common final exam (25%) was assigned to all sections. For all ALEKS section, the common final assessment and homework were required. The percentage of

ALEKS were 75% for Pilot Group 2, 25% for Pilot Group 3, and 50% for Control Group 2. The percentage of MyMathLab was 60%. It is better to mention that in Pilot Group 3, ALEKS was used as the textbook.

Pilot Group 1 is compared with the group combined all sections using ALEKS (Control Group 1) by measuring the grade of the common final exam and the survey. Pilot Groups 2 and 3 are compared with Control Group 2 by measuring of the grade of the common final exam, that of the ALEKS final exam, the hours students spend on ALEKS, and the ALEKS items they mastered during the semester as well as the survey.

Results. A. As shown in Table 1, the passing rate of Summer 2009 was significantly improved from the ones in the past two semesters. It is better to mention that we can cover more topics in summer 2009 than in fall 2008 and spring 2009. New topics include matrices, sequences, and mathematical induction.

	Control Group 1 Fall 2008	Control Group 2 Spring 2009	Pilot Group 1 Summer 2009
Pass rate without W	49%	42%	58%
Pass rate with W	41%	35%	52%

Table 1. Comparison of Pass Rate

Table 2 shows that ALEKS hours, Number of ALEKS items mastered, and ALEKS Final Average in summer 2009 are significantly higher than in fall 2008 and spring 2009. Because all homework was assigned via ALEKS, students spent more hours to work ALEKS.

	Control Group 1 Fall 2008	Control Group 2 Spring 2009	Pilot Group 1 Summer 2009
Number of hours students spent to work ALEKS	15.6	20.4	44.2
Number of ALEKS items students mastered	23.3	31.6	44.5
Average of ALEKS final grade	55.5	69.1	86.7

Table 2. Comparison of ALEKS hours, mastered ALEKS items, and ALEKS final

More than 80% of students in this Pilot Group answered that ALEKS assists students successfully complete College Algebra and ALEKS is the most helpful resources that assist students successfully complete College Algebra. Some students told that ALEKS tutorial reminded them mathematics knowledges and skills they learned high school several years ago.

B. Table 3 shows the average of the common final exam and common ALEKS final exam in each groups. In the final exam ALEKS groups showed slightly better grade than the MyMathLab group. The average of Pilot Group 3 was much higher than other groups. But it conducted a special review session for the final exam. We can not ignore the effect of the session. Contrary in the ALEKS final exam, the average of Pilot Group 3 was the lowest.

Average score	Pilot Group 1 MyMath Lab	Control Group 1 All ALEKS	Pilot Group 2 75% ALEKS	Pilot Group 3 25% ALEKS	Control Group 2 50% ALEKS
Common Final	60%	63%	56%	68%	61%
ALEKS/MML Final			69%	56%	70%
Total			60%	65%	64%

Table 3. Comparison of Final Exam and ALEKS Final averages.

Table 4 shows the ALEKS performances in ALEKS groups. Except Pilot Group 3, all three factors were improved from the Summer 2009 semester. Those in Pilot Group 3 were also improved from the Spring 2009 semester. However, we have to say that the more work on ALEKS did not imply the better grade. Although students in Pilot Group 2 mastered more items than students in Control Group 2, but the the average of ALEKS final exam grade of Pilot Group 2 is slightly lower than that of Control Group 2. It would appear that change of the order of contents gave good results in Control Group 2. There is no wonder Pilot Group 3 has the least in the ALEKS final.

Since the lengths of the summer semester and fall semester are different, we can not directly compare, however, although average ALEKS hours in Summer 2009 is less that Pilot Group 2 and Control Group 2 in Fall 2009, the average ALEKS final assessment score in summer is much higher than fall semester.

	Pilot Group 2 75% ALEKS	Pilot Group 3 25% ALEKS	Control Group 2 50% ALEKS
Number of hours students spent to work ALEKS	66	31	52
Number of ALEKS items students mastered	87	42	61
Average of ALEKS final grade	68.8	56.1	70.0

Table 4. Comparison of ALEKS hours, mastered ALEKS items, and ALEKS final

Table 5 shows how students like learning software. 70% of students considered MyMathLab is an effective means of assisting students successfully complete College Algebra, whereas only 23% considered ALEKS is an effective means. 70% of MyMathLab users answered that they want to use MyMathLab in a mathematics course that follows MATH1314 College Algebra, but only 10% of ALEKS users answered so. 50% ALEKS group shows better than other ALEKS.

	Pilot Group 1 MyMath Lab	Control Group 1 All ALEKS	Pilot Group 2 75% ALEKS	Pilot Group 3 25% ALEKS	Control Group 2 50% ALEKS
Effective	70%	23%	20%	17%	36%
Want in next cours	70%	10%	13%	6%	21%

Table 5: How students like ALEKS/MyMathLab

In spite that students' favorability rating to ALEKS increased in the Summer 2009 semester, in the Fall 2009 semester, it decreases back to the same level as in the Spring 2009 semester. Most students in Pilot Groups 2 and 3 comments ALEKS negatively. It is curious that 60% students in the MyMathLab Group considered MyMathLab problems are reasonable, but 60% students in ALEKS

Groups felt that ALEKS problems are difficult. In Pilot Groups 2 and 3, the percentage of the students who felt ALEKS problems are difficult increased to 80%. There is no doubt to conclude that ALEKS problems should be covered more in class. It is also considered that the order of contents is important for students' success in using ALEKS. To master an ALEKS item, students must solve at least two problem in the item without any help. Quite a few students pointed out this system kept them away from working ALEKS. Indeed, a students spent more than three hours but the student did not master any item.

Conclusion. The results of the quantitative data indicate that ALEKS certainly improves students' mathematical knowledge and skills as well as passing rate of College Algebra. The results also suggest that the success are not dependent on learning software, but in the way of integrating ALEKS with classes. Indeed, it is not good to use ALEKS simply as a homework generator or grader. We should cover of ALEKS problems more in class. In addition, the order of contents is necessarily rearranged so that it fits to ALEKS structure. Whereas, it is not considered to be good using ALEKS itself as a textbook. The comparison of summer and fall semester may indicate the effectiveness of ALEKS in a short time period.

The next phase in this process is not only to increase the number of hours students work on ALEKS but also to improve of effectiveness of mastering ALEKS items.

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Reference.

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- [3] ALEKS, <http://www.aleks.com>.
- [4] MyMathLab, <http://coursecompass.com>.