

# Pathways through Algebra

The *Pathways through Algebra* project was conducted by a group of community college mathematics leaders seeking to evaluate road blocks to student success, and funded by multi-year grants from the National Science Foundation (NSF) and the Lumina Foundation.

# COMPUTER ASSISTED LEARNING

## Computer Assisted Learning Software Intervention

By Wade Ellis, Jr.  
West Valley College

As part of the *Pathways* project Santa Barbara City College and West Valley College were involved in using Assessment and LEarning in Knowledge Spaces system (ALEKS) as an intervention in Beginning Algebra courses. Santa Barbara City College offers between 20 and 25 sections of Elementary Algebra each semester and West Valley College offers 15 or 16 sections of Beginning Algebra.

### ALEKS Use Early in the Course

At West Valley College, students were required to attain an 80% level of proficiency in the Pre-Algebra module of ALEKS or complete 16 hours using ALEKS by the sixth week of class.

#### BENEFITS:

- ALEKS allows students to review only those topics in Pre-Algebra that they need to review.
- Students returning to Algebra from a previous course are able to use the module to recall needed information.

#### OBSTACLES:

- Students found it difficult to find time to use ALEKS.
- Some students did not believe that ALEKS would affect their grade and thus did not take it seriously.
- The class at West Valley College was a review of Elementary Algebra that assumed students had successfully completed such a course sometime in the past when, in fact, many had not.

**OUTCOME:** Students who attained the 80% level or higher, or completed 16 hours on

ALEKS were successful if they completed the course. The success rate for this course was about 50% (higher than the success rates in the regular sections). Follow-up studies need to be completed to determine the long-term benefits of success in beginning algebra with or without ALEKS.

### ALEKS Use Prior to Class

West Valley College offered a refresher course using ALEKS before the beginning of the semester.

#### BENEFITS:

- Students learn in a short period of time what course level they should take during the semester.
- Some students who use ALEKS in this format, are more likely to continue to use ALEKS throughout the next course they take.

#### OBSTACLES:

- Some students were discouraged by the difficulty of the material that they were expected to master.

**OUTCOME:** Students were placed in the appropriate class and well prepared for the classes that they took. Having an instructor available to assist students with the material at all times helped some students feel comfortable with the subject matter and allowed them to succeed with ALEKS and in the semester length course that followed.

### ALEKS as Integral Part of Course

Santa Barbara City College has used the Assessment and LEarning in Knowledge Spaces system as a mandatory component of the Basic Mathematics (Arithmetic) courses since 2004. Over the last two years, ALEKS was used as an integral part of Elementary Algebra courses

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

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where students were asked to complete work on ALEKS at home or in a computer laboratory. This use occurred both in a face-to-face class and in online classes. (See page 10 for case study by Ignacio Alarcón.)

## **BENEFITS:**

- Students who complete 15 hours of work on ALEKS during the first 8 weeks of the semester were more likely to finish their beginning algebra work on ALEKS and be successful in the course.
- When class time is dedicated to ALEKS in a computer laboratory, the results are much better in terms of students' buy-in and motivation to consistently use ALEKS. In this situation, students see ALEKS as central to the course, instead of a non-integrated add-on.

## **OBSTACLES:**

- Students in the ALEKS sections were initially dissatisfied because the system was perceived to be an extra burden.
- Students must work at least 2 hours per week on ALEKS to receive the benefits.
- ALEKS is going up in price and even with special bundles may soon become prohibitively expensive.

**OUTCOME:** Over the last two years, ALEKS has become an integral part of the courses in which it is used. The Santa Barbara City College reports an increase in student success over the college-wide Elementary Algebra average. The school is in the process of evaluating the last three years of ALEKS use with Elementary Algebra students. This includes exploring the total number of hours spent on ALEKS during the semester and following up what students proceeded to do next in their math courses. Santa Barbara City College's math department is also expanding their use of this system by developing refreshers for other algebra courses.

## **SUMMARY:**

ALEKS, when used in a targeted way with close supervision of student progress, can be very successful for some students in both face-to-face and online classes. Student buy-in in using ALEKS is essential and it appears that getting students to use ALEKS initially (in the first week or two) is crucial to their success.

Students will continue with ALEKS when they begin to see themselves as independent learners. Students who have not become, at least to some extent, independent learners have difficulty with the computer assisted learning format. This observation corresponds to situations that occur with other interventions, all of which must encourage students to be motivated, consistent and persistent in their work with mathematics.

There are other computer assisted learning programs have been successful in California community colleges. These include Academic Systems (now owned by PLATO), Enable used by DeAnza College, and Quant Systems, which has been used successfully at American River College.

Perhaps these computer software intervention modalities should be thought of in the context of other interventions. It is highly recommended that a learning community that emphasizes study skills be linked with a course that includes computer software. Faculty professional development will also be needed if interventions are to be successful. Bringing interventions to the large numbers of students who need development mathematics courses will require informed instructors who are aware of the benefits and pitfalls of the various strategies, and an attitude that students in these courses can be successful.

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## ALEKS Case Study

By Ignacio Alarcón  
Santa Barbara City College

**Mentors:** Wade Ellis, West Valley College, and  
Terrie Teegarden, San Diego Mesa College

Santa Barbara City College began using the Assessment and LEarning in Knowledge Spaces (ALEKS) system as a mandatory component of the Basic Mathematics (Arithmetic) courses in 2004. This course had the lowest success rates, about 30%. With ALEKS, success rates are now consistently above 40% and sometimes close to 50%. SBCC is also setting up a follow-up study to track the progress of these students.

Anecdotal evidence indicates that some of the students that complete Basic Mathematics in this modality continue to Pre-Algebra and Elementary Algebra. In the past Basic Mathematics students would rarely continue to other math courses.

Due to the success of ALEKS as part of the Basic Mathematics courses, in 2005 four full-time instructors began using ALEKS in our Elementary Algebra courses. I have used ALEKS both in the face-to-face format and in an online class offered every semester.

Originally a different book was being used by the instructors utilizing ALEKS and the other beginning algebra instructors. Effective 2006, all Elementary Algebra courses use the same text, although only a handful of us use ALEKS.

The Elementary Algebra courses that utilize ALEKS are not distinguished from the others in the class schedule. Offering the two course formats has resulted in an element of dissatisfaction among students who register for

the computer assisted learning courses and learn that some of their peers do not have to use ALEKS. At the beginning of the semester most students perceive ALEKS as an extra burden. However, this helps anonymity ensure enrollment is equally distributed between the two styles, which makes the study more random and strengthens the significance of the results.

In my early attempts I was using ALEKS as an “add-on” and the results were not very successful. After conversations with Wade Ellis, West Valley College, I tried a different approach. Over the last two years, I have made ALEKS a more integral part of the course. When some of the class time is dedicated to ALEKS in a computer lab, the results are much better in terms of student buy-in and motivation to use the system consistently. In this situation, students see ALEKS as central to the course, instead of a non-integrated addition. In my face-to-face class, in Spring 2007, the success rate was 57%, while in my online class the success rate was 46%. The college-wide success rate for Elementary Algebra that semester was 45%. These figures are encouraging, although they reflect only one semester worth of information.

Initially there were some topics assigned on ALEKS that were not covered during class. Recently several faculty members spent a significant amount of time tailoring the topics specifically to our text and course, and ALEKS designed a course just for SBCC based on their work. It was piloted Summer 2007 and the faculty reported that the topics matched very well.

I have also found that there is a direct correlation between the amount of time students spend using the program and success. When students complete 15 hours of ALEKS during the first 8

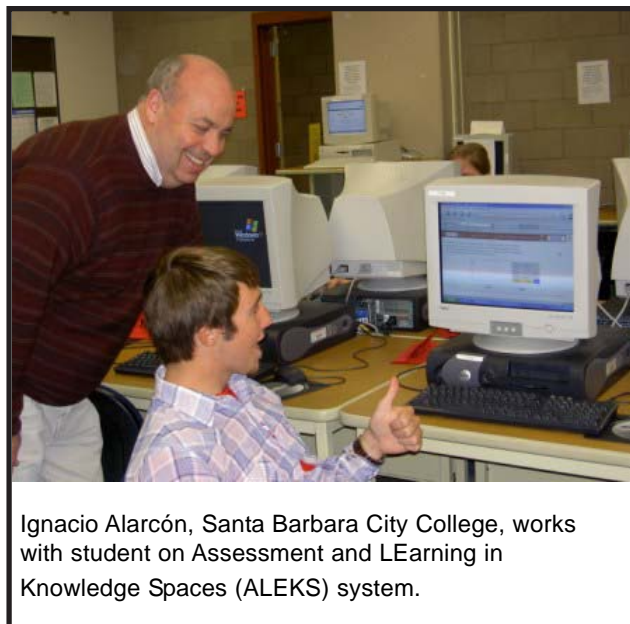
$$P(t) = P_0 e^{kt}$$

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weeks of the semester, they are more likely to finish their beginning algebra pie on ALEKS and be successful in the course. Students that do not work at least 2 hours per week on ALEKS do not get its benefit.

With our Institutional Research Office, we are in the process of evaluating the last three years of ALEKS use with Elementary Algebra students, even going to the level of detail of total number of hours spent on ALEKS during the semester. We also hope to track what students proceeded to do next in their math courses.

Another ALEKS project in the works in Santa Barbara City College's math department is the development of refresher courses for Pre-Algebra, Beginning and Intermediate Algebra. These are modeled after the experience at San Diego Mesa College, initiated by Terrie Teegarden as part of the *Pathways* project. We anticipate starting these courses in the 2008 Spring semester.



Ignacio Alarcón, Santa Barbara City College, works with student on Assessment and LEarning in Knowledge Spaces (ALEKS) system.

The system has been found to be beneficial to students, and so I intend to continue using ALEKS in my Elementary Algebra classes. I also look forward to continuing discussions and sharing results with other faculty who use the system and believe in its potential.

## Santa Barbara City College Successful Course Completion Rates for ALEKS

The following tables show the Elementary Algebra course completion rates based on the number of hours students spent using ALEKS during the semester.

### FALL 2006

<b>Time Spent</b>	<b><u>Successful</u></b>	<b><u>Unsuccessful</u></b>	<b><u>Withdrawal</u></b>	<b>Total</b>	
None	0.0%	23.3%	76.7%	30	20.1%
Less than 4 hours	0.0%	52.6%	47.4%	19	12.8%
4 - 9.9 hours	21.7%	47.8%	30.4%	23	15.4%
10 - 19.9 hours	44.0%	44.0%	12.0%	25	16.8%
20 - 39.9 hours	57.6%	42.4%	0.0%	33	22.1%
40+ hours	63.2%	36.8%	0.0%	19	12.8%
<b>Total</b>	<b>31.5%</b>	<b>40.3%</b>	<b>28.2%</b>	<b>149</b>	

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## SPRING 2007

<b>Time Spent</b>	<b><u>Successful</u></b>	<b><u>Unsuccessful</u></b>	<b><u>Withdrawal</u></b>	<b>Total</b>	
None	0.0%	5.3%	94.7%	19	17.6%
Less than 4 hours	0.0%	20.0%	80.0%	5	4.6%
4 - 9.9 hours	0.0%	77.8%	22.2%	9	8.3%
10 - 19.9 hours	33.3%	61.1%	5.6%	18	16.7%
20 - 39.9 hours	58.1%	38.7%	3.2%	31	28.7%
40+ hours	73.1%	26.9%	0.0%	26	24.1%
<b>Total</b>	<b>39.8%</b>	<b>36.1%</b>	<b>24.1%</b>	<b>108</b>	

Students that spend at least 20 hours in a semester on ALEKS have much higher course completion rates than the average success rates for all Math 100 courses (59.6% vs. 43.3% for Fall 2006, 66.1% vs. 45.7% for Spring 2007). Another noticeable result is the number of students that withdraw from the ALEKS sections. This may be due to the students' initial lack of understanding about the benefits of using ALEKS. Since the system was not being used in all Elementary Algebra courses, many student perceived it to be additional work.

Several Santa Barbara City College faculty members attended an ALEKS summit in which colleges that have used ALEKS with success shared their methods. Across the board, the key seemed to be to have it fully integrated into the course by taking students to the lab regularly and using it to determine a good portion of the grade. In the past, it was assigned as homework. Summer 2007 three faculty members integrated it into the course and took their students to the lab almost daily. This will be continued in the Fall, and there will be an increase in the number of instructors using ALEKS.

The following data show course completion rates based on the percent of material completed in ALEKS.

## FALL 2006

<b>Percent Completed</b>	<b><u>Successful</u></b>	<b><u>Unsuccessful</u></b>	<b><u>Withdrawal</u></b>	<b>Total</b>	
None	0.0%	23.5%	76.5%	34	22.8%
Less than 50%	6.1%	65.3%	28.6%	49	32.9%
50% - 74%	58.7%	37.0%	4.3%	46	30.9%
75% or more	85.0%	15.0%	0.0%	20	13.4%
<b>Total</b>	<b>31.5%</b>	<b>40.3%</b>	<b>28.2%</b>	<b>149</b>	

$$y = |3x + 5|$$

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## SPRING 2007

	<u>Successful</u>	<u>Unsuccessful</u>	<u>Withdrawal</u>	<b>Total</b>	
<b>Percent Completed</b>					
None	0.0%	5.3%	94.7%	19	17.6%
Less than 50%	5.6%	66.7%	27.8%	18	16.7%
50% - 74%	31.0%	58.6%	10.3%	29	26.9%
75% or more	78.6%	21.4%	0.0%	42	38.9%
<b>Total</b>	<b>39.8%</b>	<b>36.1%</b>	<b>24.1%</b>	<b>108</b>	

A promising result here is that those students that complete at least 75% of the material had success rates close to or more than 80%. However, ALEKS is not the sole component of the course; there are also in-class quizzes, exams, and a final exam.

For Spring 2007, data was also available for the percent gain students made in ALEKS over the course of the semester.

	<u>Successful</u>	<u>Unsuccessful</u>	<u>Withdrawal</u>	<b>Total</b>	
<b>Improvement</b>					
Did not use	0.0%	5.3%	94.7%	19	17.6%
Less than 25 %pts	28.6%	51.4%	20.0%	35	32.4%
25 - 49 %pts	43.8%	53.1%	3.1%	32	29.6%
50 or more %pts	86.4%	13.6%	0.0%	22	20.4%
<b>Total</b>	<b>39.8%</b>	<b>36.1%</b>	<b>24.1%</b>	<b>108</b>	

Notice that 44% of the successful students had a gain of 50 or more percentage points on ALEKS. This indicates that students that come into the class with a lot of prior knowledge of the material are not the only ones successfully completing the course.

With a majority of Elementary Algebra instructors using ALEKS in the Fall 2007, more data will be available to compare and hopefully to see more promising results.

The Santa Barbara City College math department is also working on short refresher courses for Math 4, Math 100 and Math 107. These courses are intended for students who have already completed these courses and need a refresher before taking the subsequent course; students who attempted a higher course unsuccessfully and need review of the prerequisite material; and students who are unhappy with their assessment level. ALEKS will be used in these courses as well and is offered at a 6-week price of close to \$20. The hope is to have these courses ready to go beginning Spring 2007. We plan to offer them twice each regular semester, so that students who begin in one course unsuccessfully would have a place to go to stay on track. This idea came from discussions with San Diego Mesa College which has been using ALEKS for five years.