

Integrating ALEKS in a First-Year, First-Semester Math Course

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Outline

1. Introduction of ALEKS, institution, students
2. Integrating ALEKS into a first-year math course
3. Data and results from the quasi-experimental study.

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2. Integrating ALEKS into a first-year math course
3. Data and results from the quasi-experimental study.
4. Results:
 - Better performance on ALEKS precalculus correlated with better performance in calculus.
 - Students reported a positive learning experience with ALEKS.
 - Female and ESL students were more likely to report an increase in confidence.

Institutional Challenges

- Our ECON majors often display difficulty with fundamental skills:
 - performing algebraic calculations quickly and accurately,
 - solving problems with multiple steps,
 - defining a function, limit, or logarithm.
- Intervention: integrated ALEKS, and Adaptive Learning Software (ALS), a first-year math for economics course.

ALS and Learning Math

“Good remote technologies that can teach math exist, but somebody has to get the [students] to do it.”

-Steven Levitt, Professor of Economics at the University of Chicago, author of
Freakonomics

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- VanLehn [2011] completed a meta-review and found that a human tutor increased student performance by 0.79 standard deviations, but ALS increased performance by 0.76.
- Cowen and Tabarrok [2014] observed ALS can help students at low-cost, scale.
- Kulik and Fletcher [2016] reviewed 50 studies and found ALEKS increased student performance by 0.66 standard deviations.
- Sun et al. [2021] studied samples covering 9,238 students in K-12 and found ALEKS alone was comparable to traditional instruction and became even more effective when combined with traditional instruction.

ALEKS Offers Personalized Remediation

Specifically, ALEKS:

- diagnoses the knowledge of each student through an initial assessment,
- creates a unique learning path for each student,
- gives immediate feedback with detailed solutions,
- progresses students with more knowledge more quickly.

Integrating ALEKS into a First-Year Math Course

- Topics on ALEKS were chosen before class began.
- During the first class, students were instructed to
 - purchase a copy of the ALEKS (\$39 CAD),
 - complete the initial adaptive assessment,
 - work on their unique learning path,
 - complete additional assessments when prompted.
- Students used ALEKS outside class time.

Integrating ALEKS into a First-Year Math Course

To integrate ALEKS fully into the course:

- Matched the course schedule with the sequence of topics on ALEKS.
- Created video lectures to support ALEKS content.
- A summative assessment (term test 1) was written on ALEKS worth 15-25 percent.

Data collection

- Pre-course and post-course student surveys
- Activity on the adaptive software, ALEKS
 - Score on the initial adaptive assessment
 - Score on the final adaptive assessment
 - Time spent on unique learning path
 - Score on precalculus term test
- Calculus Grades
 - Score on Calculus term test 2 and final exam
 - Score on Calculus low-stakes formative assessment scores
- 830 students completed term test 1 and pre-course survey.
- 593 students submitted a post-course survey.
- Only students who gave consent are included.

Qualitative and Quantitative Results

1. Students with higher performance on the adaptive software also achieved higher performance in calculus

Our Methodology

- Regression analysis with two different dependent variables:
 - i) precalculus test score (term test 1),
 - ii) calculus summative assessments mean score.

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- Regression analysis with two different dependent variables:
 - i) precalculus test score (term test 1),
 - ii) calculus summative assessments mean score.
- Normalized grade scores.
- Controls include age, academic stage, language, gender, and other self-reported information.
- Fixed effects for term and instructor.

1. Performance on Adaptive Assessment, Precalculus and Calculus

Table: Regression Analysis – Abbreviated

Dependent Variable	i. Precalculus		ii. Calculus		ii. Calculus	
Fixed Effects	Yes					
Controls	Yes					
Adj. R ²	0.326					
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
HS Calculus (Yes=1)	-0.803**	0.282				
HS Calculus Grade	0.012**	0.004				
Initial Knowledge Score	0.002	0.107				
Final Knowledge Score	0.456**	0.122				
Time on Software	0.002	0.004				
i. Precalculus	–	–				

✓ , *, ** represent statistical significance at the 10, 5, 1 percent level, respectively,

1. Performance on Adaptive Assessment, Precalculus and Calculus

Table: Regression Analysis – Abbreviated

Dependent Variable	i. Precalculus		ii. Calculus		ii. Calculus	
Fixed Effects	Yes		Yes		Yes	
Controls	Yes		Yes		Yes	
Adj. R ²	0.326		0.173		0.252	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
HS Calculus (Yes=1)	-0.803**	0.282	-0.373	0.414	0.019	0.024
HS Calculus Grade	0.012**	0.004	0.008	0.005	0.003	0.005
Initial Knowledge Score	0.002	0.107	-0.022	0.072	-0.019	0.066
Final Knowledge Score	0.456**	0.122	0.243**	0.088	0.088	0.084
Time on Software	0.002	0.004	0.003	0.003	0.002	0.003
i. Precalc. Score	–	–	–	–	0.362**	0.046

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2. Students appreciated learning with ALEKS

How helpful was ALEKS in
helping with your overall
learning for this course

Frequency

Percentage

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Frequency

Percentage

Not helpful	14	2.36
Somewhat Not helpful	3	0.51
Neutral	69	11.64
Somewhat helpful	198	33.39
Very helpful	306	51.61

2. Students appreciated learning with ALEKS

Using the ALEKS software has
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Frequency

Percentage

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Frequency Percentage

Strongly disagree	17	2.91
Somewhat disagree	19	3.25
Neither agree nor disagree	139	23.80
Somewhat agree	219	37.50
Strongly agree	187	32.02

2: Students appreciated the learning experience

Would you recommend other
instructors use ALEKS in their
first-year math classes?

	Frequency	Percentage
Yes	489	85.79
No	81	14.21

3: Female and ESL students were more likely to report a positive learning experience

Consider the following mean response scores:

3: Female and ESL students were more likely to report a positive learning experience

Consider the following mean response scores:

1. How helpful was ALEKS in helping with your overall learning for this course?

Female: 4.45

Male: 4.24

3: Female and ESL students were more likely to report a positive learning experience

Consider the following mean response scores:

1. How helpful was ALEKS in helping with your overall learning for this course?

Female: 4.45

Male: 4.24

2. The ALEKS software has increased my likelihood of staying in a math-based program.

ESL: 4.08

English: 3.42

Ordered Probit model with fixed effects and controls confirmed the statistical significance of the above.

Table: Ordered Probit Models (Abbreviated)

Dependent Variable	1. Overall Learning		2. Stay in Math	
	Coef.	P-value	Coef.	P-value
HS Calculus (Yes=1)	0.759	0.141	-0.275	0.007
HS Calculus Grade	-0.009	0.148	0.003	0.561
English Not Spoken at Home	0.122	0.481	0.642**	0.000
Softmore	0.190	0.111	-0.082	0.461
Junior	-0.344 [✓]	0.056	-0.016	0.931
Senior	0.044	0.850	-0.220	0.305
Female	0.269*	0.015	0.063	0.542
Previous College Attended	-0.045	0.765	-0.314*	0.024
International	-0.064	0.769	0.130	0.535
International-ESL	0.002	0.994	-0.031	0.900
Age	0.024	0.236	0.020	0.262
B5_Agreeable	-0.011	0.791	0.030	0.444
B5_Conscientious	-0.007	0.857	-0.028	0.422
B5_Extrovert	-0.012	0.740	-0.006	0.856
B5_Neurotic	-0.076**	0.020	-0.082**	0.007
B5_Openness	0.027	0.504	0.015	0.679

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Student Comment

“How did ALEKS encourage or not encourage your overall learning? ”

- *“... [ALEKS] encourage[ed] my overall learning. It is not boring, and I had lots of fun learning through this software. It is very helpful for me.”*

Student Comment

“How did “ALEKS” encourage or not encourage your overall learning?”

- *“I literally don’t know a better way I could have been taught. Its organization was encouraging.”*

What made the integration of ALEKS a success

- Recorded lectures demonstrated how to solve problems on ALEKS.
- Incentivised the students to use ALEKS with grades.
- The topics covered in-class were easily recognized on ALEKS.
- Short, focused intervention – ALEKS was used for just four weeks.

References

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