

Comparing College Math Courses with and without ALEKS

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What are intelligent tutors?

Intelligent/**adaptive**/cognitive tutors are online systems that strive to:

1. Figure out what student knows.
2. Figure out what student still needs to learn.
3. Offer practice and assessments.
4. Provide immediate feedback and report on overall student progress.

Intelligent tutors contain artificial intelligence components in order to accomplish this.

How do intelligent tutors look like?

The interface depends on the students' audience and topics.

For kids, intelligent tutors often take the form of educational games.

For adults, the interfaces are explicitly related to the content.

This study is about intelligent tutor **ALEKS** applied in remedial math college courses.

How ALEKS was developed

The theory of knowledge spaces is developed by Falmagne and Doignon in 1985. It is focused on representing knowledge states in a structure and then determining what student knows upon the evaluation of the student responses.

The structure is created initially by experts in the field, and then it is refined by the evaluation of great number of student responses.

This theory is a base for **ALEKS**:
Assessment and
Learning in
Knowledge
Spaces

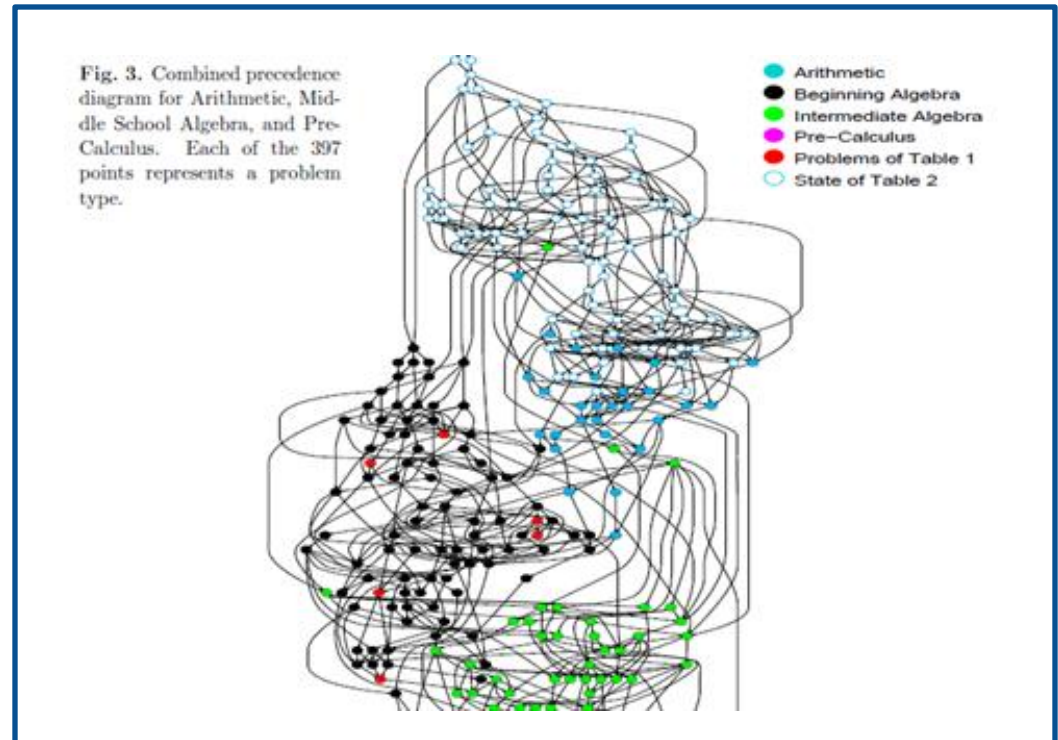


Figure 3 from Falmagne, J-C., Cosyn E., Doignon, J-P. & Thiery, N. (2003). The assessment of knowledge, in theory and in practice, *International Conference on Integration of Knowledge Intensive Multi-Agent Systems*, pp. 609-615

As student population grows so does the demand for remedial (developmental) math courses.

This study compared two remedial math college courses, each delivered in two different ways:

- ALEKS based “Basic Algebra I” and “Basic Algebra II” (new method)
- Lecture based “Basic Algebra I” and “Basic Algebra II” (old method)

The research question is: **Is there a statistical difference in student achievement between the two methods?**

The challenges of remedial math courses:

- Students’ underdeveloped time management and study skills
- Learned helplessness - students do not believe that they can be good at math
- Familiarity with the material - students do not pay attention to familiar topics
- Poor math writing and literacy

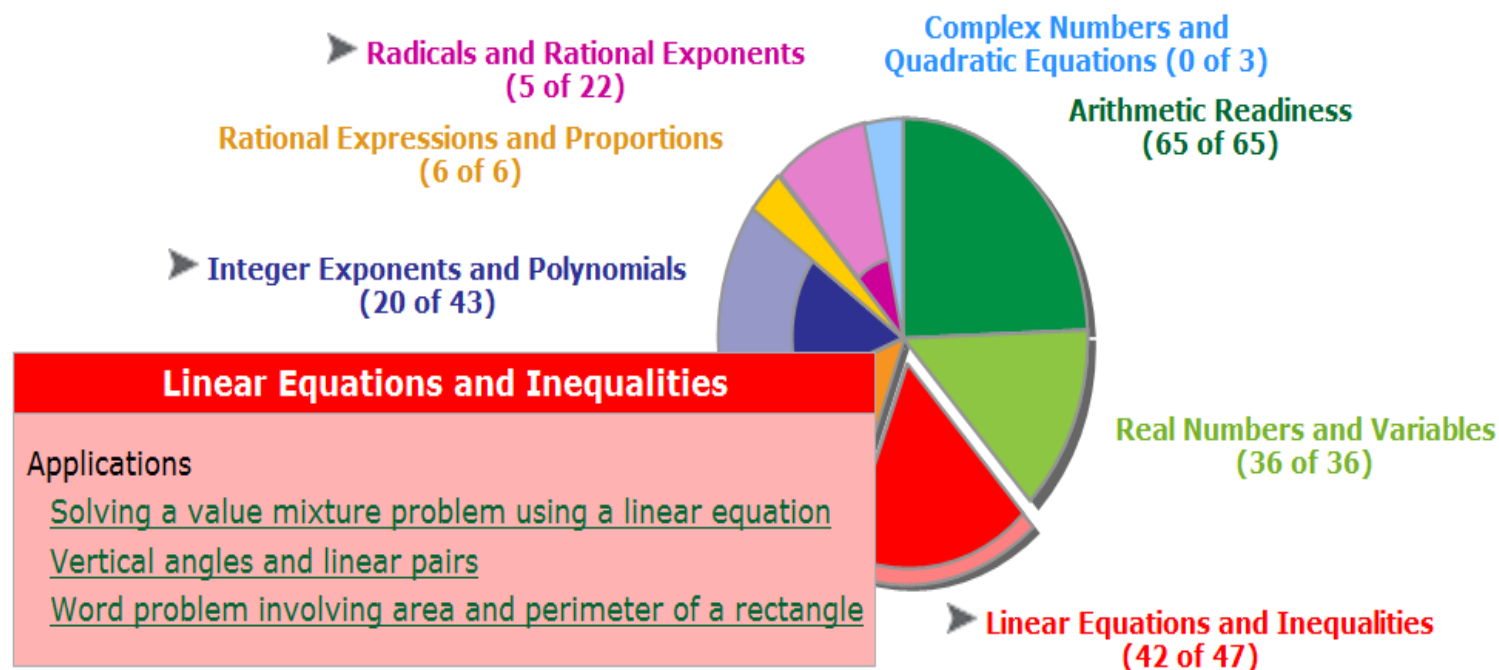
ALEKS: Student's "Pie"

Last login: 12/02/2011
Enroll date: 08/29/2011
Total Hours: 79 hours 43 minutes (34 hours 43 minutes from college)
Total Hours in this course: 34 hours 49 minutes (14 hours 1 minute from college)

Hours/week: 5.9 (2.6 from college)









78% Mastery

Course Mastery
(199 of 256 Topics)



ALEKS: Student's Progress Report

Last login: 12/02/2011
Enroll date: 08/29/2011 **Hours/week:** 5.9 (2.6 from college)
Total Hours: 79 hours 43 minutes (34 hours 43 minutes from college)
Total Hours in this course: 34 hours 49 minutes (14 hours 1 minute from college)

	Last assessment	Assessment performance Course Mastery	Learning data since last assessment		
			Topics learned since last assessment	Hours in ALEKS since last assessment	Topic per since las
Login Time Assessment	<u>12/01/2011</u>	 71 +7 %	18	3.4	
 Requested Assessment 4	<u>11/19/2011</u>	 68 +7 %	17	10.3	
 Requested Assessment 2	<u>11/08/2011</u>	 62 +8 %	19	5.6	
 Requested Assessment 1	<u>10/29/2011</u>	 59 +6 %	14	2.9	
Requested Assessment (at School)	<u>10/14/2011</u>	 56 +7 %	19	6.4	

Both ALEKS and lecture courses followed the departmental syllabus and schedule.

How did ALEKS and lecture courses differ?

ALEKS courses:

- Online book, practice problems, assessments and progress reports.
- The students worked on the topics in any order.
- No lectures.

Lecture courses:

- Online book, class notes, practice problems and final exam; paper midterm and graded homework assignments;
- The students worked on the topics in order of lectures.
- Lectures.

The four sections have been compared on gender, age, PC use and, for “Basic Algebra I”, the year of last math course taken.

No significant difference between sections has been found.

Students’ final grades have been compared using a two-way ANOVA:

Two-way ANOVA model		
Method/Course level	Basic Algebra I	Basic Algebra II
ALEKS	BA_I_ALEKS	BA_II_ALEKS
Lecture	BA_I_Lecture	BA_II_Lecture

The normality of final grades was violated for the BA_I_Lecture.

Homogeneity of variance was not violated.

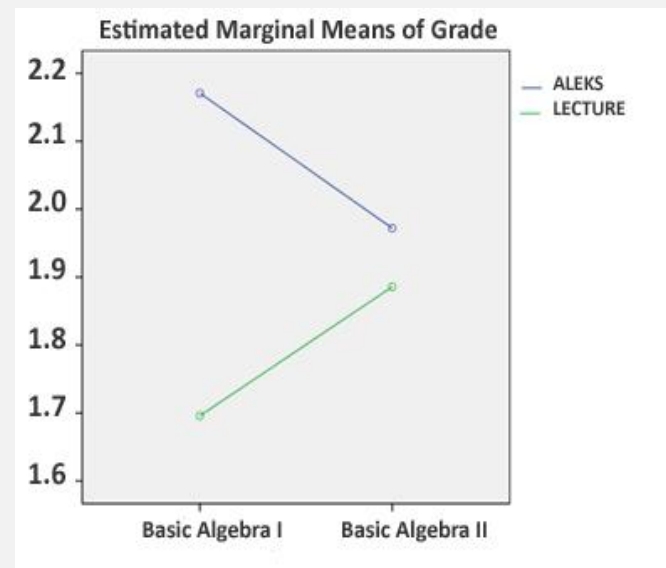
The interaction between instructional method and course level was not significant ,
 $F(1,83)=0.417, p=0.520$.

Main effect for method was not significant. $F(1,83)=0.869, p=0.354$

Main effect for course level was not significant. $F(1,83)=0.001, p=0.988$

The results for four Basic Algebra sections

Course/section	Number of participants	Withdrawn	Number of participants statistically processed	Passed	Average grade*
BA_I_ALEKS	24	0	24	13 (54%)	2.17
BA_I_Lecture	26	2 (7%)	24	11 (42%)	1.70
BA_II_ALEKS	25	0	25	16 (64%)	1.97
BA_II_Lecture	17	3 (17%)	14	8 (57%)	1.89



* Average grade is on the scale 0-4. Passing grade is 2 and above (73% or above).

Although the statistical difference was not found between ALEKS and lecture sections, this is a positive finding for ALEKS because as a new approach it has a great potential for improvement while the material for lectures has been organized and improved over the years.

How are the challenges of developmental courses addressed in ALEKS:

- **Weak time management and study skills** - is addressed by reports but that is not enough. Detailed daily schedule may help some more in this area.
- Learned helplessness – is addressed by offering only topics that student is ready to learn.
- Familiarity with the material – is addressed by offering only topics that student does not know.
- **Poor math writing and literacy** - is not addressed. It is up to the instructor to correct student writing.

New challenges in ALEKS:

- Students do not ask for help when they need it.
- **Students can (and do) jump between topics creating unorganized notes** - short intros to topics may provide some structure and reduce jumping.
- **Students are not interested in wider explanation of the topic** - more problems that require understanding of math theory can be added by math department.
- Security concerns – this is a concern with any software. Ongoing reviews are recommended.

Some questions to answer in the future research:

- Will the detailed daily schedule and short intros to topics reduce jumping between topics and improve student achievement?
- How do the students perform once they switch from ALEKS to lecture math classes?
- How the instructor role changes? What are the obsolete tasks and what are the new responsibilities?

Thank you for your attention.

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