AC 2009-1783: THE IMPLEMENTATION OF AN ONLINE MATHEMATICS PLACEMENT EXAM AND ITS EFFECTS ON STUDENT SUCCESS IN PRECALCULUS AND CALCULUS

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The Implementation of an Online Mathematics Placement Exam and its Effects on Student Success in Precalculus and Calculus

Introduction

Engineering education research on the impact of freshman engineering courses reveals a close connection between graduation rate and first semester GPA.[1] The same research also explains the importance of first-semester math placement, so as to provide students with the necessary background for success. For example, students at Purdue University that earned a grade of A in a pre-calculus course in the first semester had the same engineering retention rate as students who earned a B in the first semester calculus class.[1] Yet, if those same students are placed based on their SAT math scores, such students would probably fail calculus if taken in their first semester.[1] A recent study on parameters that affect student success indicated that the grade earned in a student's first college level mathematics class was significantly correlated to whether or not those students persisted in engineering, while the level at which they began mathematics study at the university was not.[2] French, et al. conclude in their study of indicators of engineering students' success and persistence, that achievement of good grades at the student's university is an indicator of persistence, and suggests that retention programs focus on academic achievement.[3] These studies highlight the importance of timely and accurate student placement in mathematics in terms of success in engineering programs.

A number of different math assessment tools are widely used by universities for student placement in mathematics courses. These tools include the mathematics portions of the ACT [4] and SAT,[5] the mathematics AP exams,[4] COMPASS[4] examinations and CLEP[5]exams. Many universities and mathematics departments also have internal exams used for math placement that they have developed over the years and routinely administer. Student scores on the ACT and SAT exams are also used by most universities as part of their admissions criteria, and it is common practice to record and use for both admissions and placement the highest score achieved by students on these examinations. Thus, information about what students know, or presumably knew at some point in their history, is available in the form of ACT or SAT or both to mathematics departments. These scores are frequently used for first semester mathematics placement at the precalculus and calculus levels. However, the ACT/SAT information does not provide a *current* measure of a student's knowledge in mathematics. Thus, for example, if a student last took either of these examinations in the middle of their junior year of high school, and then did not take mathematics during their senior year, a significant change in current math knowledge would be expected to occur. Also, students who continued in their mathematics instruction in their senior year of high school but did not retake the SAT or ACT examination would be placed too low. At Boise State University, which is an accessible metropolitan university, it is not uncommon to encounter students that took the ACT or SAT one time only. For example, in fall 2008, among first-time first semester freshmen, 34% of engineering students at Boise State University took one of the exams (ACT or SAT) one time only, most likely during their junior year of high school.

This paper reports on a novel online math assessment strategy originally developed and deployed in fall 2007 at the University of Illinois, where it was administered to approximately 3500 students, and which now requires it as a math placement exam for all incoming first-year students. The methodology by which the assessment method was rapidly implemented at both the University of Illinois and by Boise State University is presented, together with some faculty perceptions associated with the implementation.

Online Mathematics Assessment: ALEKS

ALEKS (Assessment and Learning in Knowledge Spaces)[6] is a web-based, artificially intelligent assessment and learning system that uses adaptive questioning to determine what a student knows and what they do not yet know in a course. ALEKS was developed from an assessment and teaching system for arithmetic that was based on Knowledge Space Theory.[7] The early development was funded by the National Science Foundation in 1992. It is now a commercial system that is used by individuals and institutions to learn many levels of Mathematics. ALEKS is accessible from any computer with web access and a java-enabled web browser. Students are required to work problems and enter the solution; there are very few multiple choice answers associated with the system. In 2006, Carpenter, et al.[8] showed that student preparedness in Calculus could be predicted with ALEKS, a study that prompted several other universities to deploy ALEKS as an instructional tool to assist with Precalculus and Calculus learning.[9-11]

This study reports on the use of ALEKS as an assessment tool only – that is, the assessment aspect of ALEKS is separated from the teaching system aspect of ALEKS in this study. The application of this unproctored, internet-based system as an assessment tool is novel. Being internet-based, the system provides significant benefits to students as a result of the easily accessed remediation aspect, which is optional for students. It also provides unlimited opportunity for re-assessment. The course product that student knowledge is assessed within for this study is termed "Preparation for Calculus," which if accessed in learning mode, contains 251 topics divided as shown in Table 1. A typical assessment asks between 29 and 32 questions.

Table 1: Preparation for Calculus Curriculum (ALEKS)

Curriculum Area in ALEKS	Number of Topics
Real Numbers	30
Equations & Inequalities	30
Linear & Quadratic Functions	41
Exponents & Polynomials	30
Rational Expressions	27
Radical Expressions	21
Exponents & Polynomials	21
Geometry & Trigonometry	51

Prior Assessment Strategies

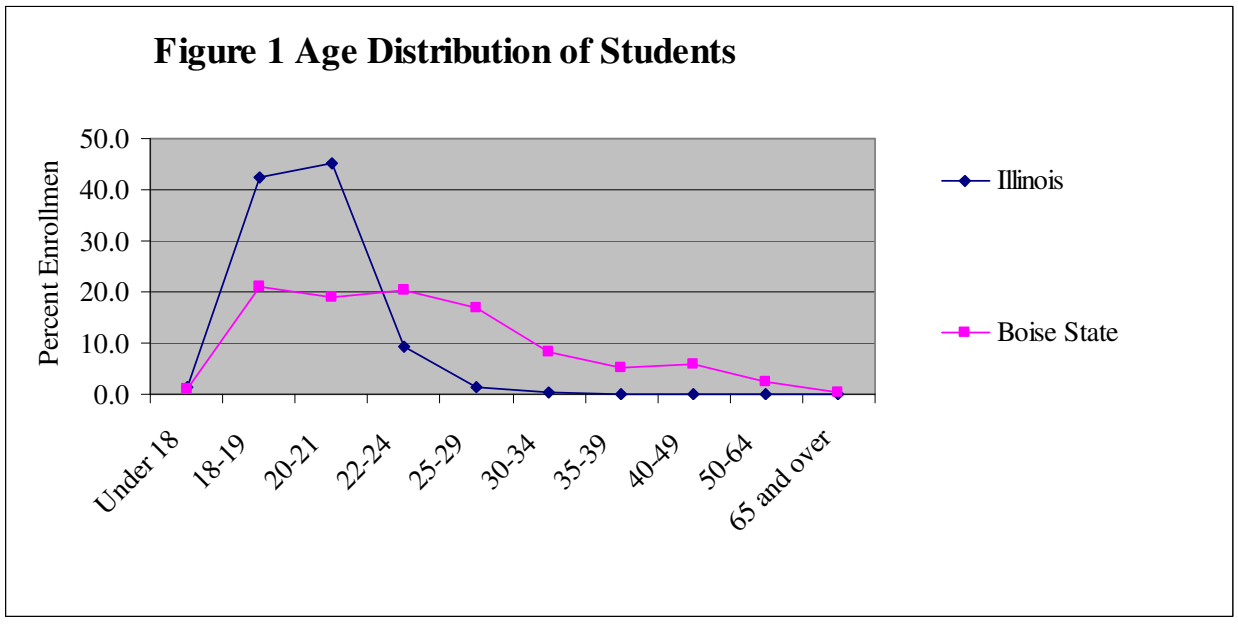
Boise State University uses a variety of indicators of student knowledge in mathematics in order to place students in Precalculus and Calculus courses. These indicators include the Math ACT and SAT, the AP Calculus AB exam and the COMPASS examination, see Table 2. The minimum scores necessary to place into Precalculus and into Calculus are shown, together with the ALEKS assessment benchmarks used in this study.

Table 2: Math Placement at Boise State University

Math Level	ACT score	SAT score	COMPASS	AP Exam (AB)	ALEKS
Precalculus	23	540	61 (ALGP)	N/A	40%
Calculus	29	650	51 (TRIG)	3	70%

Institutional Information:

University of Illinois is a very large urban campus that awarded more than 1200 bachelor's degrees in engineering and computer science in 2007. The total undergraduate enrollment in fall 2007 was 30,895, including 6,940 first-time freshmen. By contrast, Boise State University has approximately half the total enrollment of University of Illinois, with a total of 17,574 undergraduate students in fall 2008, and a full-time equivalent enrollment of 14,608. Its engineering college is young, having been formed in 1997, and approximately 130 engineering bachelor's degrees were awarded in 2007. There were 1900 first-time full time freshmen in fall of 2007. The enrollment distribution, by age, for both universities that deployed the online ALEKS assessment is shown in Figure 1, which illustrates the need for a *current* measure of mathematics knowledge for Boise State University students, many of whom are years beyond high school.



Both universities that deployed the ALEKS assessment strategy focused on two math levels, Precalculus and Calculus I. At the University of Illinois enrollment in these two courses in fall 2007 was approximately 3500. At Boise State University enrollment in these two courses in fall 2008 was approximately 750. This study presents the implementation strategy used at both universities that enabled the system to be rapidly deployed and institutionalized, together with first semester results from Boise State University.

Implementation Strategy:

The University of Illinois developed the following implementation strategy during their first deployment of the ALEKS assessment system in fall 2007. Boise State University adopted a nearly identical strategy for their deployment in fall 2008. The strategy required a benchmark score within the ALEKS Preparation for Calculus curriculum, prior to the end of the open enrollment period at the beginning of the semester (add/drop). This benchmark score was set at 40% of the curriculum for the Precalculus course and 70% for the Calculus course. The personal motivation for students to take the assessment and to achieve the benchmark was based on the fact that achievement of the benchmark score would consist of 10% of their grade in their upcoming course. In other words, each student's first assignment for their course, due by end of add/drop, was to achieve either 40% or 70%, depending on which course they were enrolled in. If this benchmark was not achieved, the premise was that students would self-select down one math level rather than get a zero on such a large portion of their grade. This premise proved true, and there was approximately 99% compliance with student self-selection of courses. At University of Illinois, less than 1% of students altogether elected to remain in the course without the benchmark score in fall 2007. At Boise State University only 1.5% of students (out of 733) elected to remain in the course without the benchmark score in fall 2008.

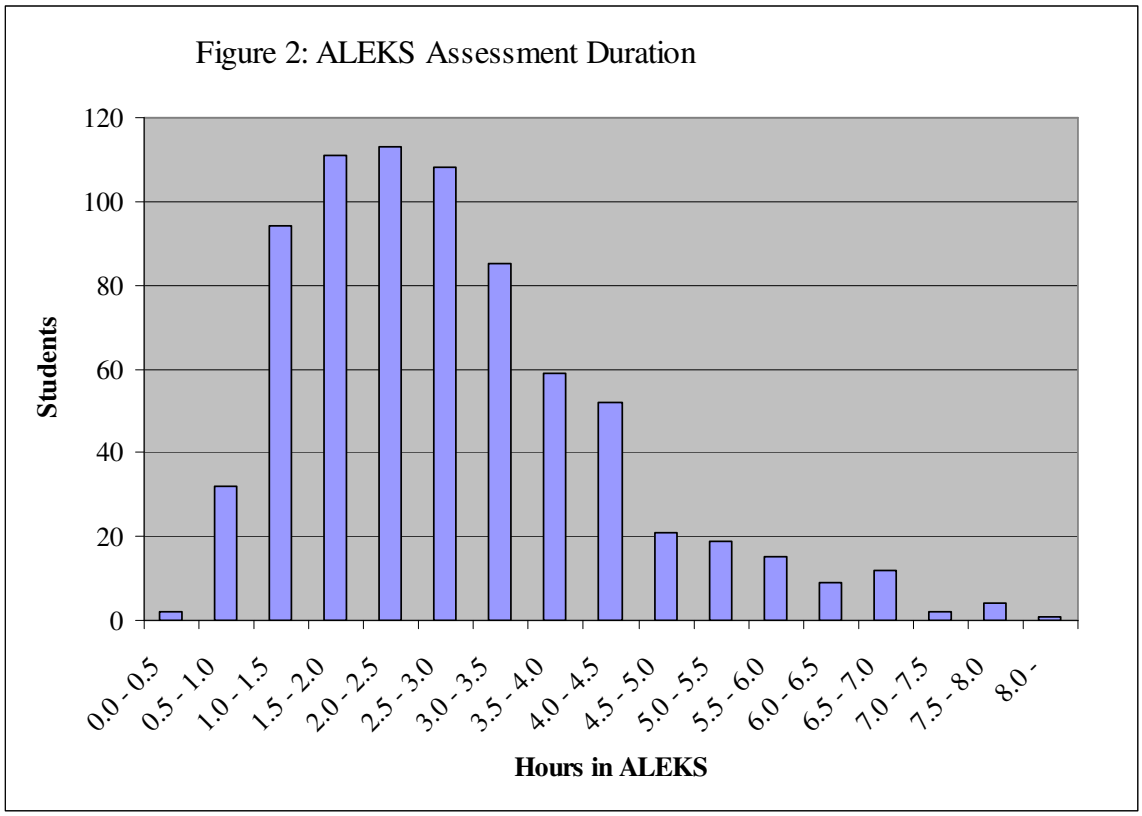
At both universities all students that registered for the course, whether during the summer or prior to that if returning students, were notified electronically of this important first assignment, and sent a hyperlink to the assignment at least five times prior to the start of classes. Each university maintained their own website containing up-to-date information including FAQs and detailed instructions. Students first went to the university website to obtain the instructions, and then began the assessment through the ALEKS website. Students entered a particular "course number" that identified their university to the ALEKS system, and also entered their university student identification number. This enabled the results to be archived by ALEKS and available in various downloadable formats to each university. Assessment licenses, enough for one per student taking the assessment, were purchased by each institution by their respective Provosts' offices. This allowed each student to be assessed once at no cost to them and was essential to the rapid implementation of the new assessment strategy at each institution. Students could elect, at their own expense, to take additional assessments for $3.60 (fall 2008 pricing information). Alternatively, students could elect to purchase an assessment and learning module ($36.90 fall 2008 pricing) which provided automatic and nearly unlimited reassessment to students for six weeks. As a further incentive, at Boise State University the Provost provided funds to reimburse 50% of the purchase price for any student who used the Learning Module to successfully meet the benchmark. Approximately 5% of students took advantage of this offer.

Results at Boise State University

Assessment Data

A total of approximately 750 students took the ALEKS assessment. An average time of 160 ± 90 minutes was spent; approximately 15 minutes of this time would have involved learning to use the methods of entering answers within the ALEKS tutorial which is launched prior to any assessment questions. Figure 2 shows a histogram of time spent doing the assessment for all students that took the assessment at Boise State University in fall 2008.

Figure 2: ALEKS Assessment Duration



Effect of Assessment on Student Success

We seek to answer the question "What effect did the ALEKS requirement have on student success rates." No answer is possible without a definition of *success.* Both Calculus and Precalculus at Boise State University are taught in individual sections with individual instructors solely responsible for all exams, assessments, grading rubrics, and final letter grades. There are no pre-determined learning outcomes, and even if there were, there are no standardized or even commonly agreed upon assessments that could be used to indicate *success.* The only measurement we have available is the Pass Rate, defined as follows:

- ABC = number of A's, B's and C's, including plus/minus grades

- DWF = number of D's, F's and W's, including plus/minus and CW grades.
- Pass Rate = ABC / (ABC + DWF)

Note that the denominator may not always match enrollment, since there are a small number of audits and unresolved incompletes. These grades are appropriately not part of pass rate computation.

Enrollment trends

There are two ways that the ALEKS assessment could reasonably influence success rates.

1. Primarily, we expect students who do not meet the minimum assessment to drop the class before the 10th day of enrollment (Sept 8, 2008).
2. Less significantly, some students may discover their lack of preparation and self-remediate through ALEKS.

This first of these should be visible in enrollment data, and indeed this was the case for fall 2008. Historically we see nearly full enrollment at the beginning of the term followed by a decline of approximately 5% across the first 10 days. Expected versus actual enrollments are shown in Table 3.

Table 3: Enrollment, Fall 2008 at Boise State University

	Precalculus		Calculus	
Peak enrollment	434	100%	309	100%
Predicted 10th day	412	95%	294	95%
Actual 10th day	367	85%	278	90%
Forced out by ALEKS?	45	10%	16	5%

The last row of the table is a rough calculation. However, the ALEKS assessment requirement had a clear impact on enrollments. The day-to-day changes in enrollment are shown below. The converging graphs are total enrollment and successful ALEKS assessment. The sharp change on Aug 29 corresponds to the official deadline for completing the ALEKS assessment. Late assessments were allowed for a few students who added after the first day of class.

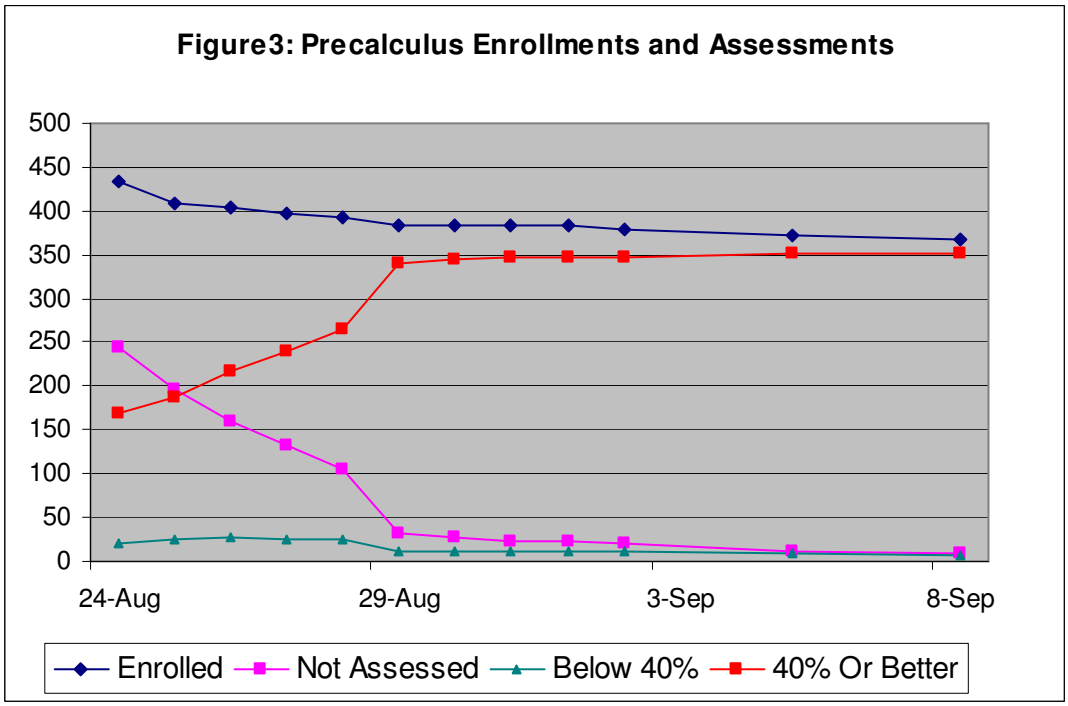


Figure3: Precalculus Enrollments and Assessments
500
450
400
350
300
250
200
150
100
50
0
24-Aug
29-Aug
3-Sep
8-Sep
Enrolled
Not Assessed
Below 40%
40% Or Better

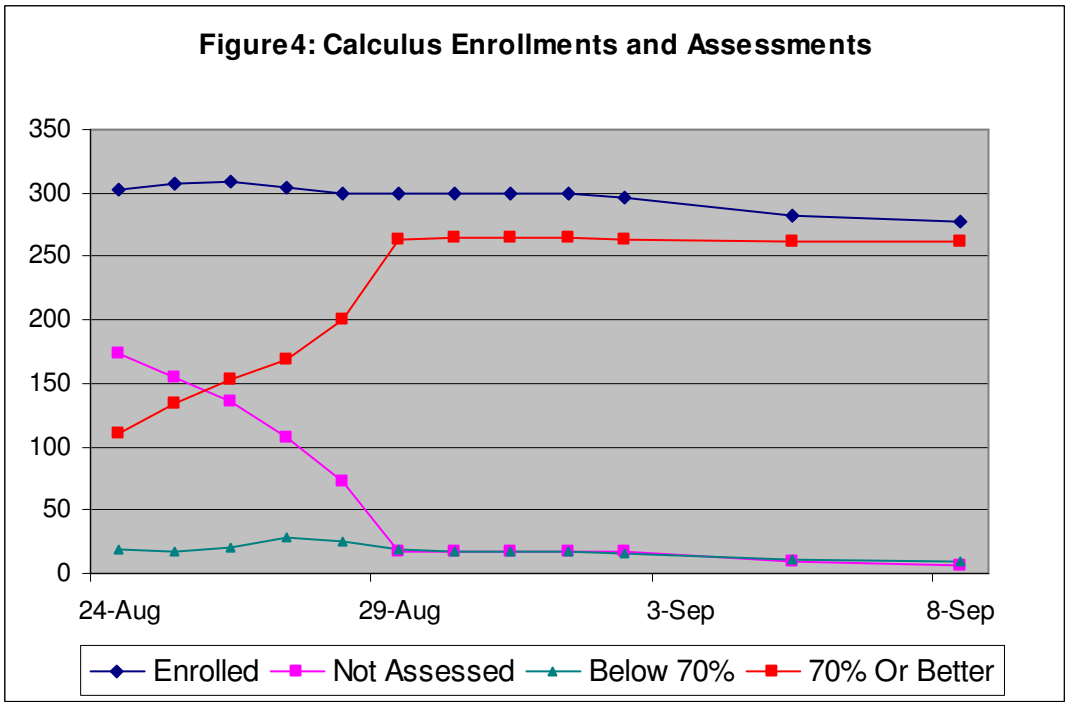
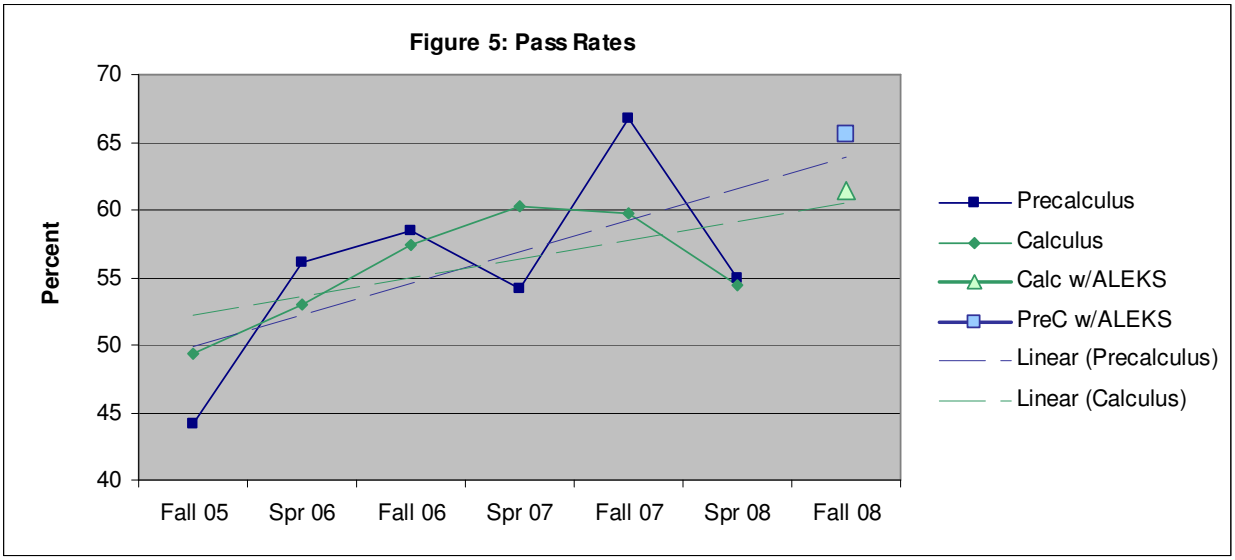


Figure4: Calculus Enrollments and Assessments
350
300
250
200
150
100
50
0
24-Aug
29-Aug
3-Sep
8-Sep
Enrolled
Not Assessed
Below 70%
70% Or Better

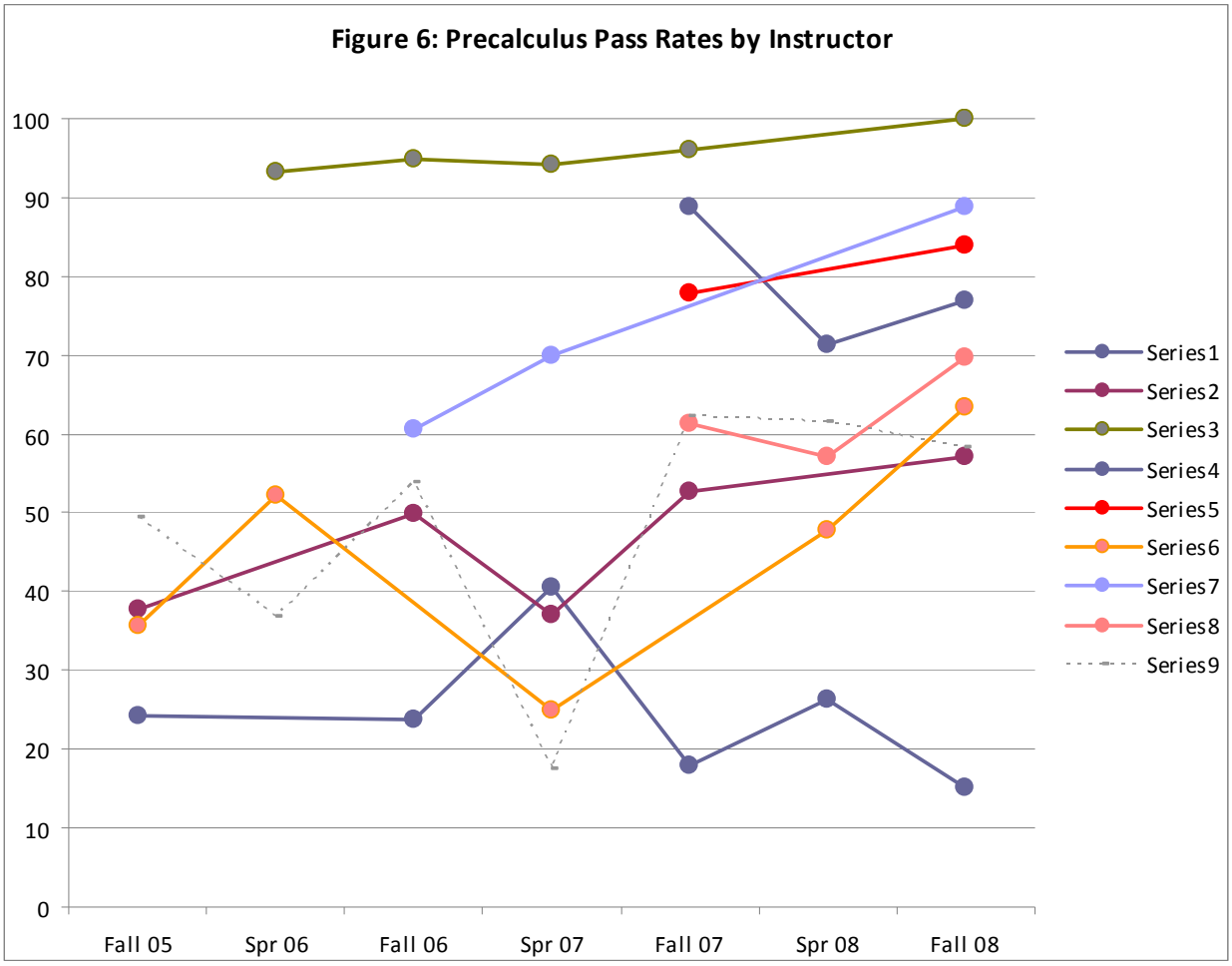
Pass Rates

The simplest measurement of the impact of the ALEKS assessment is to compare historical pass rates to pass rates in fall 2008. The chart below shows pass rates across the university from fall 2005 through fall 2008. From fall 2005 through spring 2008 there is a slight positive trend, indicated with a dashed trendline. The effect of ALEKS in fall 2008 is a barely perceptible bump above the projected trend. This fails to control for any factors except the historical trend. In particular, it does not attempt to control for influence of individual instructors.



Instructor Influence on Precalculus Pass Rates

To examine the effect of ALEKS on individual instructors we first discard any instructors who did not teach Precalculus in both fall 2008 and at least one prior semester. This removes 13 instructors and 40% of the student data (860 of 2106 records). Pass rate data for the remaining eight instructors are shown below. (The dashed line represents the aggregate pass rate seen in the discarded data. We include this to point out that its removal is not unduly sanitizing.)



Clearly there is enormous and persistent variability from instructor to instructor. Rather than analyze the effect of ALEKS across all sections, we compute the effect on each instructor using three different methodologies.

1. **Year-over-Year**: defined as fall 08 pass rate minus fall 07 pass rate. This seeks to control for the effects of changes in the student body, both over time and from fall to spring.
2. **Before-After**: defined as fall 08 pass rate minus aggregate pass rate from prior semesters (fall 2005 to spring 2008). This does not control for possible trends in the student body, but does give a much larger data set. We consider this the weakest measure.
3. **Trend**: defined as fall 08 pass rate minus the pass rate predicted by a best fit regression over prior semesters. This would theoretically give the best control over both changes in student body and changes in the instructor's pedagogy or methods. However the data are extremely sparse and short time series will often give hugely misleading predictions.

For some instructors it is not possible to do all three of these – two did not teach in fall 07, and four have very short trends (either one or two prior semesters). Results are shown in Table 4.

Table 4: Pass Rate Gains for Individual Precalculus Instructors

Instructor	Before-After Gain	Year-over-Year Gain	Gain against Trend
A	-11.1	-2.7	-10.9
B	-7.1	-12.0	
C	5.3	3.8	3.0
D	6.2	6.2	
E	10.6	8.4	
F	12.7	4.5	6.6
G	20.8		21.2
H	23.4		
Average	7.6	1.4	5.0

Significance

It appears that regardless of methodology, most instructors saw a positive change in their fall 2008 pass rates. This suggests testing the null hypothesis, "Requiring the ALEKS assessment does not affect an individual instructor's pass rate." If true, then the number of instructors who show positive gain follows a binomial distribution. The 5% rejection region would be positive gain by 7 or more instructors. Under normal hypothesis testing parameters of 95% confidence we would have to accept the null hypothesis. The precise probabilities for $n = 8$ are $P(>= 7) = 0.035$ and $P(>= 6) = 0.145$, so we could reject with 85% confidence.

Analysis of Calculus Pass Rates

One might apply the same analysis to Calculus sections. Unlike Precalculus, which is mostly taught by full time lecturers with heavy and repetitive teaching loads, Calculus is taught by a large rotation of research faculty with lighter and more varied loads. Since fall 2005 there have been 27 instructors of Calc I. Of these, only eight taught Calculus in fall 2008 and two of those had no prior experience. Restricting to the remaining six removes 70% of the data (1263 of 1793 records), and leaves few year-over-year or trend comparisons.

Table 5: Pass Rate Gains for Individual Calculus Instructors

Instructor	Before-After Gain	Year-over-Year Gain	Gain against Trend
U	-10.6		
V	-1.9	-1.9	
W	-0.2		-7.7
X	15.2	15.2	
Y	19.7		
Z	29.4		
Average	8.6	6.6	-7.7

These are inconclusive results and only apply to 30% of Calculus students. Even the weak null hypothesis of "ALEKS does not affect instructors' results" is clearly impossible to reject.

An Alternative Analysis

Since instructor level analysis for Calculus gave nearly random results and drastically restricted the data set we propose an alternate analysis, aggregating all pass fail data for various groups of instructors. For each of Precalculus and Calculus there are four reasonable groups:

- Group I: All instructors.
- Group II: Discard from Group I the instructors with the highest and lowest pass rate trends. (Note the two clear outliers in Figure 6.)
- Group III: All instructors who taught in Fall 2008 and at least one applicable prior term.
- Group IV: Group III with outliers removed (as identified in Group II).

For each group one may compare fall 2008 aggregate pass rate against the rate for fall 2007 (Year-over-Year) or against all prior terms (Before-After). "All prior terms" refers to six semesters of data, between fall 2005 and spring 2008, inclusive. The advantage is reasonably large data sets. The disadvantage is failure to control for instructor influence beyond hoping that it averages out. Precalculus results are presented in Table 6. Note the heavy influence of outliers.

Table 6: Precalculus Aggregate Pass Rates						**Percentage Reduction in DWF Rate**
Before-After						
	All prior terms		Fall 2008		Raw Increase	
	Sample Size	Pass Rate	Sample Size	Pass Rate		
Group I	1795	56.2%	353	65.6%	9.4%	**21%**
Group II	1318	51.4%	282	67.0%	15.6%	**32%**
Group III	926	61.2%	274	67.8%	6.8%	**17%**
Group IV	449	52.3%	203	70.4%	18.1%	**38%**
Year-over-Year						
	Fall 2007		Fall 2008		Raw Increase	
	Sample Size	Pass Rate	Sample Size	Pass Rate		
Group I	403	66.7%	353	65.6%	(-1.1%)	**(-3%)**
Group II	297	63.5%	282	67.0%	3.5%	**10%**
Group III	211	70.6%	202	68.2%	(-2.4%)	**(-8%)**
Group IV	105	65.7%	131	72.5%	6.8%	**20%**

Fortunately, individual Calculus instructors do not display such extremes in pass rates. This makes outliers difficult to detect but also lowers their impact. We therefore conclude with results for Calculus with just Group I and Group III.

Table 7: Calculus Aggregate Pass Rates						Percentage Reduction in DWF Rate
Before-After						
	All prior terms		Fall 2008		Raw Increase	
	Sample Size	Pass Rate	Sample Size	Pass Rate		
Group I	1519	55.8%	274	61.4%	5.6%	**13%**
Group III	294	47.6%	236	60.4%	12.8%	**24%**
Year-over-Year						
	Fall 2007		Fall 2008		Raw Increase	
	Sample Size	Pass Rate	Sample Size	Pass Rate		
Group I	302	59.7%	274	61.4%	1.7%	**4%**
Group III	65	57.1%	80	64.6%	7.5%	**17%**

In summary, it appears that the addition of the ALEKS assessment as a course requirement has a positive impact on the pass rates of students in both PreCalculus and Calculus. Year-over-year impacts are less pronounced than historical averages compared to the ALEKS semester. This may reflect other ongoing efforts to improve performance in these two courses at Boise State University, as suggested by the positive trends in overall pass rates prior to fall 2008.

Math Instructor Survey

A survey of mathematics instructors at the Precalculus and Calculus levels was conducted at the end of the fall 2008 at Boise State University, in an effort to capture instructor perceptions of various questions that related to the assessment. Using a scale of 1 to 7, where 1 is "Disagree strongly," 4 is "Neither agree nor disagree," and 7 is "Agree strongly," mathematics instructors at the Precalculus and Calculus levels were surveyed at the close of the fall 2008 semester. Highly experienced instructors (those who had taught the courses seven or more times) agreed strongly (7.0 out of 7.0) that student placement is critical in terms of student success in math courses. They agreed slightly/moderately (5.4) that this semester's students had adequate preparation for the course. They agreed slightly (5.0) that the last semester they taught the course, that students also had adequate preparation for the course. They agreed moderately (5.9) that there was a difference in students' mathematics preparation this semester as opposed to previous semesters, but they agreed only slightly (4.6) that students were significantly more prepared in fall 2008 as compared with previous semesters. They agreed slightly/moderately (5.4) that a greater percentage of students who started the course persevered as opposed to in prior semesters. They neither agreed nor disagreed (3.9) that student performance on quizzes, tests, and other assessments indicated greater mastery of course material this semester as opposed to previous semesters. A total of seven instructors fell into the category of "highly experienced instructors." When the responses of all surveyed instructors were included (15 responses), the same trends were observed but to a slightly lower degree. One unsolicited remark from an instructor indicated, "The main difference I noted was that I was missing the students

who made 10's, 20's or 30's (percents) on the first test. After that first test, I did not really see much difference in the students' work. Many of my students scored 50 or above on ALEKS and did poorly in the course. I see no relationship between their ALEKS score and their performance in Precalculus." This remark highlights the fact that these instructors were aware of their students' ALEKS scores, which may have influenced their survey responses.

Discussion

The ALEKS Assessment: Accessible and Unproctored

The ALEKS assessment strategy is online, enabling the assessment to be widely accessible – anywhere, anytime. Both universities elected to conduct the assessment in an unproctored environment. The rationale for this included first and foremost, the fact that placement into a particular Precalculus or Calculus course did not eliminate any university requirements. That is, students did not receive "credit" for the prerequisite course by receiving a certain score on the ALEKS assessment. Rather, they simply placed into the appropriate level that they showed themselves to be ready for. Second, it was not deemed inappropriate for students to use the assessment process as part of a personal review of mathematics. That is, if students took a long time to answer questions (while they looked up or remembered how to solve various problems), it was considered time well spent in review. In fact, following their initial assessment, approximately 5% of students at Boise State University went on to purchase the online assessment and learning module, on which they spent an average of 18 hours. Finally, if students received personal assistance during the assessment, it clearly was a self-limiting behavior that would result in subsequent poor academic performance in the student's mathematics course.

Upward Mobility

An interesting outcome of using the ALEKS assessment strategy was that it gave students whose SAT or ACT scores placed them in Precalculus an opportunity to enroll in Calculus, and those that placed at College Algebra or lower, an opportunity to enroll in Precalculus. A remark frequently heard from engineering students during summer orientation at Boise State University, was, "I took Calculus in high school, why do I need to enroll in Precalculus again?" The ALEKS assessment strategy gave those students a chance to demonstrate, to themselves as well as to the mathematics department, that they were indeed ready for Calculus. The Chair of Mathematics at Boise State University personally interviewed each student that did not have the required ACT/SAT/COMPASS/AP scores (according to Table 2), but that did realize sufficient ALEKS scores. A total of 37 students (about 5%) fell into this category; 7 of them placed into Precalculus, 24 enrolled in Calculus, and three others enrolled in other mathematics courses. Although the sample sizes are too small for meaningful analysis, the pass rate for these Precalculus students was about the same as for the Precalculus students with the same instructor group, and the pass rate for these Calculus students was slightly lower (8%) than Calculus students with the same instructor group.

Summary

A novel online assessment strategy for assessing current student knowledge in the Preparation for Calculus curriculum was deployed in an unproctored environment at two universities. This strategy consisted of requiring benchmark assessment scores in the curriculum that is offered in an online environment through the ALEKS Corporation. Students were highly motivated to comply with the assessment requirement because 10% of their grade was based on their achievement of the benchmark assessment level set for their course. These levels were 40% for Precalculus and 70% for Calculus. Each university paid for one assessment for the students, and students were allowed to re-assess as many times as they wished. Analysis of the data from Boise State University yields the conclusion that the addition of ALEKS assessment as a course requirement has a positive impact on student pass rates. Depending on the analysis selected, whether before-after, or year-over-year, these improvements demonstrated a raw increase in pass rate for Calculus of (5.6, 12.8, 1.7 and 7.5%), which corresponded to percentage reductions in DWF rates of (13, 24, 4 and 17%). For Precalculus, if all instructors are included, raw increases in pass rate of (9.4, 6.8, -1.1 and -2.4%) are seen, corresponding to percentage reductions in DWF rates of (21, 17, -3 and -8%). If the Precalculus instructors with the highest and lowest pass rates are not included in the analysis, raw increases in pass rate of (15.6, 18.1, 3.5 and 6.8%) are seen, corresponding to percentage reductions in DWF rates of (32, 38, 10 and 20%). All in all, the ALEKS online assessment strategy is an excellent tool for assessing current student knowledge so as to assure proper placement in Precalculus and Calculus.

Future Work:

The absence of any definition of success other than a pass rate that is heavily dependent on individual instructors makes analysis of any other variable difficult. Fortunately, longitudinal analysis allows other measures. Success in subsequent courses (although equally skewed by instructor variation) is a possible measure. Another valuable measure will be the ALEKS assessments taken by students entering Calculus in spring 2009 and future semesters. This will function as a post test for students who completed Precalculus in the prior term. Longitudinal analysis can allow for recalibration of data discussed in this paper. It will also provide an additional comparison of various cohorts of students after they complete the full sequence of Precalculus, Calculus I and Calculus II.

Acknowledgments

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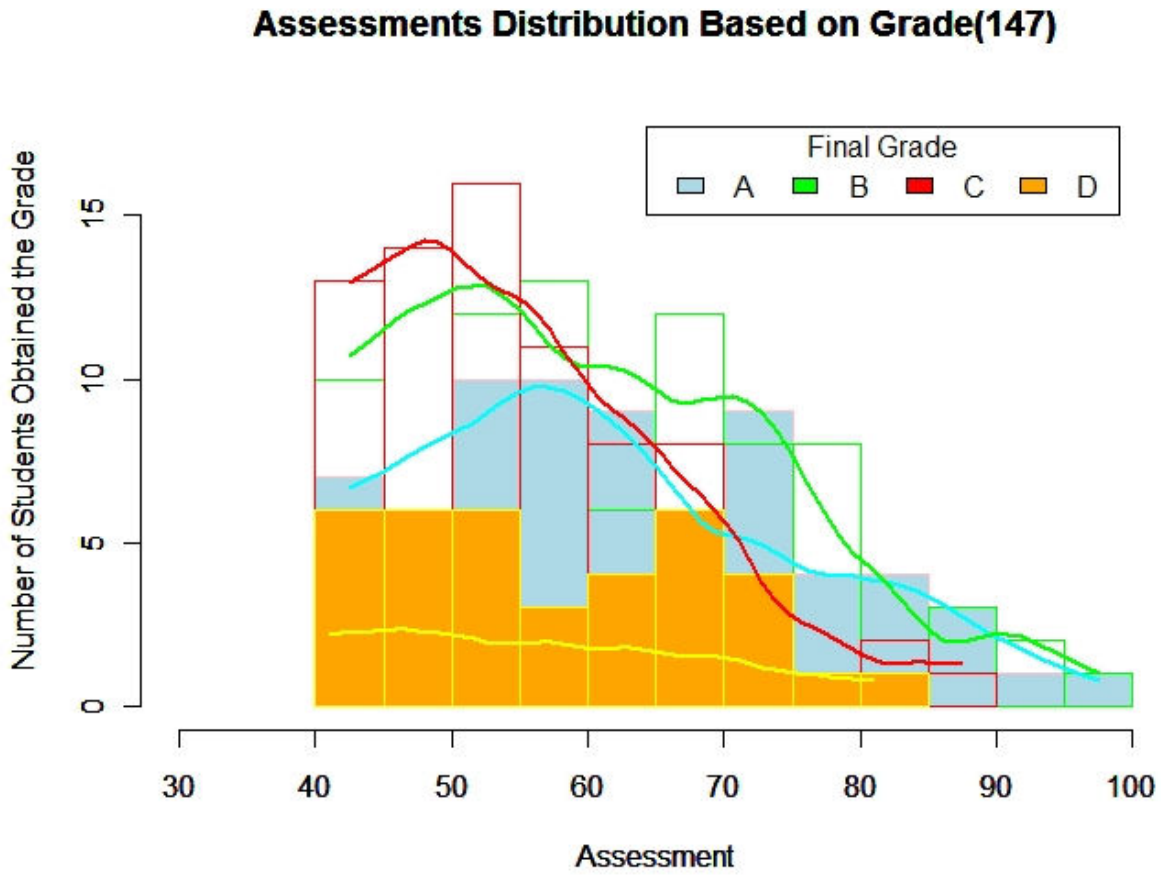
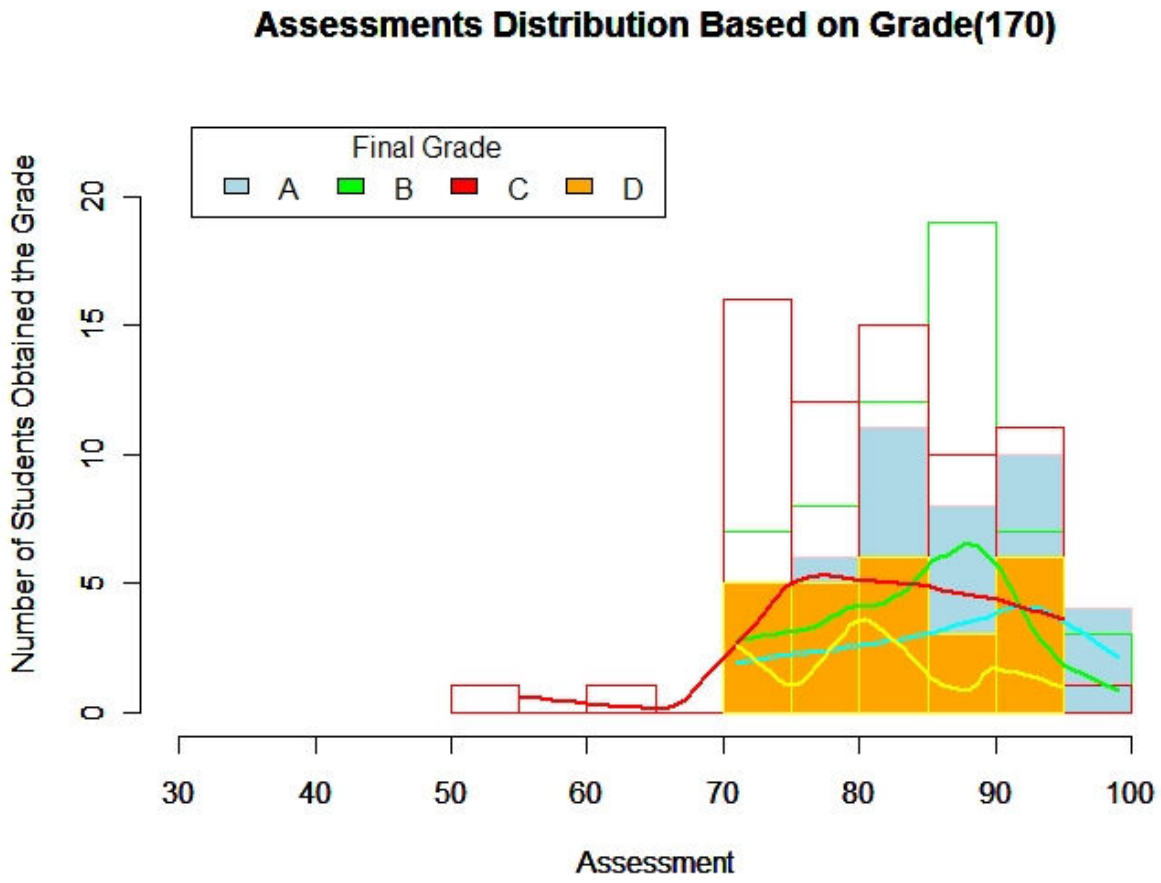
Added in Proof, ALEKS and course grades.

During the review period after this paper was submitted, we completed additional analysis of the correlation between ALEKS score and final grades at Boise State University. For each course, Calculus and Precalulus, the data set was scrubbed of all grades except A, B, C or D. These were assigned weights of 4, 3, 2 and 1 respectively, and the least squares regression was computed with independent variable ALEKS score and dependent variable final grade. The regression slope was positive but quite small. However, in both classes we were able to reject the null hypothesis, "Slope is 0" with p-value < 0.1. In other words, there is 90% confidence that letter grades are positively correlated with ALEKS score. The data may be visualized in the following histograms. Math 147 is Precalculus. Math 170 is Calculus.




Assessments Distribution Based on Grade(170)
Final Grade
A
B
C
D
Number of Students Obtained the Grade
0
5
10
15
20
30
40
50
60
70
80
90
100
Assessment

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