

HOW TO TURN MATH DUDS INTO MATH STUDS

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In response to dismal pass rates in Intermediate Algebra (MATH 0213) and low success rates of remediated students in College Algebra (MATH 1513), the Math Department at East Central University (ECU) fully implemented the new course format called Assessment and LEarning in Knowledge Spaces (ALEKS) during the Fall 2002 semester. The new course combined the old Beginning Algebra (MATH 0113) and Intermediate Algebra (MATH 0213) courses into a single four-hour zero-level course named Intermediate Algebra (MATH 0214). This internet-based course allows students to log onto a web site to complete class assignments. Consequently, course assignments can be completed off campus at a time that is convenient for the individual student. Given the large number of non-traditional students who commute to ECU, the Math Department believes the new course format will address the leading cause for students withdrawing from Math 0213: inability to attend class regularly. The following table (Figure 1) compares pass, failure, and withdrawal rates in classes using a traditional lecture format versus those using the ALEKS format.

Intermediate Algebra Grade Distribution Comparison								
ALEKS Format Fall '02-Spring '04 vs. Lecture Format Fall '00-Spring '02								
Course Format	Passed		Failed		Withdrew		Total	
	#	%	#	%	#	%	#	%
Lecture	240	61	60	15	92	24	392	100
ALEKS	520	67	126	16	134	17	780	100

Figure 1

Notice how the pass rate in Intermediate Algebra has increased by 6% while the withdrawal rate has decreased by 7% with the ALEKS format. These data suggest the ALEKS format addresses the time constraint that results in so many withdrawals, given the lower drop-out rate for the ALEKS sections. The higher pass rate and lower withdrawal rate represent an improvement in the math remediation process. Even if students who passed the ALEKS Intermediate Algebra course perform no better than those who passed the lecture format course, the remediation process will be improved. This point will be addressed shortly. First, however, we should consider the effects of combining the former two remedial mathematics courses into one. Under the old two-

course system, a portion of the students taking Intermediate Algebra were required to first take Beginning Algebra. The remediation process will be improved if this subgroup of students tends to fare better under the revised single-course system.

How many students who were required to take both Beginning and Intermediate Algebra in the traditional lecture format actually passed both courses? How does this pass rate compare to the pass rate of students who would have been required to take the traditional 2-course sequence but now take the new ALEKS course? (See Figure 2.)

Pass Rates for students required to take both Beginning and Intermediate Algebra	%
Spring 2000 – Spring 2002	38
Fall 2002 – Fall 2003	62

Figure 2

Note that in Spring 2000-Spring 2002, when the old two-course system of Beginning Algebra and Intermediate Algebra was taught using the traditional lecture format, only 38% of the students who were required to enroll in Beginning Algebra actually passed both it and Intermediate Algebra. In Fall 2002-Fall 2003, however, the ALEKS format was in use with a single remedial course. Note that 62% of the students who would have been required to enroll in Beginning Algebra actually passed the new ALEKS course, which is equivalent to passing both the former Beginning and Intermediate courses. This represents a *24% absolute improvement and a 63% relative improvement* in the number of students successfully completing the math remediation process. Furthermore, students who would have been required to take a minimum of two semesters of remedial math under the former system are now being prepared for College Algebra in only one semester. Thus, the time frame portion of the remediation process has been *dramatically* improved. However, remediation cannot be considered a success unless the students are able to successfully complete College Algebra.

Does successful completion of the new ALEKS course lead to a higher pass rate in College Algebra than successful completion of the traditional Intermediate Algebra course?

To answer this question it was necessary to cull remediated students from the pool of College Algebra students. Remediated students fell into two groups: those remediated under the lecture format and those remediated using the ALEKS format. The ALEKS-remediated students were further divided into subgroups: those students remediated in Fall 2002-Spring 2003 and those remediated in Summer 2003-Spring 2004. (See Figure 3.) These data suggest a mixed bag of results. For example, the ALEKS-remediated students from Fall 2002-Spring 2003 show a dramatic increase (10%) in pass rate in College Algebra over their lecture format counterparts. At the same time the ALEKS-remediated students show a 1% decrease in failure rate and an 8% decrease in withdrawal rate compared to the students remediated under the lecture format. The data for Summer 2003-Spring 2004, however, show a reversal of these trends.

College Algebra Grade Distribution Comparison								
Students who took Lecture Format Intermediate Algebra Fall '00-Spr '02 vs.								
Students who took ALEKS Format Intermediate Algebra Fall '02-Spr '03 vs.								
Students who took ALEKS Format Intermediate Algebra Sum '03-Spr '04								
Course Format	Grade Earned				Withdrawals		Total	
	D & above		F		W and AW			
	#	%	#	%	#	%	#	%
Lecture Fall00-Spr02	34	69	3	6	12	24	49	100
ALEKS Fall02-Spr03	44	79	3	5	9	16	56	100
ALEKS Sum03-Spr04	72	53	14	11	49	36	135	100

Figure 3

A cursory look at the data suggests that remediation via ALEKS is no longer adequately preparing this group of students for College Algebra. However, a more detailed grade analysis of all College Algebra students suggests the decline in performance of the remediated students seen in Summer 2003-Spring 2004 is indicative of a trend existing among all College Algebra students during this time frame. The following table (Figure 4) shows a comparison of pass, failure, and withdrawal rates for non-remediated College Algebra students during two time periods: Spring 1999-Spring 2003 versus Spring 2004.

College Algebra Grade Distribution Comparison for Non-remediated Students								
Spring semesters in 1999 through 2003 vs. Spring semester 2004								
Semester	Grade Earned				Withdrawals		Total	
	D & above		F		W and AW			
	#	%	#	%	#	%	#	%
Spring '99-'03	350	65	17	3	171	32	538	100
Spring '04	39	41	4	4	52	55	135	100

Figure 4

With a decrease of 25% in their pass rate and an increase of 23% in withdrawal rate, these data suggest that non-remediated College Algebra students in Spring 2004 performed much worse than their counterparts during the previous 5 years. These changes are very similar, in fact almost identical, to the changes seen in the 2003-04 "remediated" College Algebra data above. As a result, the decrease in performance in College Algebra seen in the group of ALEKS-remediated students cannot be attributed to the ALEKS curriculum. There are other unexplained factors that account for the decrease, since the decrease occurred across the board for both remediated and non-remediated students. The performance of both groups of students in College Algebra in Spring 2004 was worse than that in past semesters. It appears that the performance of ALEKS-remediated students in College Algebra is no worse than, and in some instances better than, the performance of students remediated under the traditional lecture format.

The Big News. These results suggest the new course format is superior to the traditional lecture format because with the ALEKS delivery method:

- **Students have the flexibility to do course work off campus at times convenient for them.**
- **Students *most* in need of remediation are being prepared for College Algebra in a single semester.**
- **Remediated students' pass and retention rates in College Algebra have increased.**

Clearly, the efficiency and overall effectiveness of this new instructional format has the potential to dramatically improve long-term retention rates.

Qualitative Data. Data from exit surveys, completed by 462 students from the Fall 2002 through Fall 2003 semesters, is summarized below:

Survey: "Describe your first impressions of the course format as it was presented to you at the beginning of the semester."

Responses: 50% positive impression, 33% negative impression, 6% mixed, 6% neutral

Student Comments:

Positive

- I felt that this would be a good class format, especially everyone working at their own pace. It was the one thing that made me comfortable working with students right out of high school, when I hadn't had a math class in over 20 years.

Negative

- I thought it was weird because you're doing homework on the computer instead of paper.
- It seemed overwhelming because I'm not good with computers.

Survey: "What are your impressions of the course format now?" (End of semester)

Responses: 74% positive impression (increase of 24%), 9% negative impression (decrease of 24%), 9% mixed (increase of 3%), 5% neutral (decrease of 1%)

Student Comments:

Positive

- If you put in the time you have nothing to worry about. You can even finish early if you choose that option.
- I like it better than using a book.
- It helped me because in a traditional class I could not do the problems as many times as I need to in order to learn them.
- Wow, not only have I learned a lot, my self confidence has grown a lot.

Negative

- I think it's a little hard to get focused to do all of your work on the computer. It gets boring.
- It is very frustrating. I'd rather take a lecture class.
- I think it would be easier to learn if you used a text book.

Mixed

- I think it was a great program, with very good examples. I just wish I had a computer at home.

- I really liked that the class was self-paced and accessible from any computer, but I felt that the program didn't give clear explanations.

Survey: "On a scale of 1 to 5 (1 is low, 5 is high), how would you rate the teacher's helpfulness to you?"

Responses: Mean = 4.7

Survey: "Do you believe you would have learned the material as well without a teacher?"

Responses: 81% said "No"

Survey: "Did you like not having a textbook?"

Responses: 80% said "Yes". Most common reason given: Less to carry around.

16% said "No". Most common reason given: Need a book for reference.

Survey: "Were the assessments a help or a hindrance to your learning? Why?"

Responses: 69% said "Help"

Student Comments:

- Help, I was constantly reviewing previous material.
- A help because I found out that I really didn't know the stuff I thought I knew.
- Help, they taught me to take notes over what I previously did.

Survey: "What was the best aspect of the course?"

Most common responses: Working at your own pace (26%); working on it anytime, anywhere (10%).

Survey: "What was the worst aspect of the course?"

Most common responses: Losing objectives on assessments (26%); nothing (25%)

Survey: "Describe any changes you have noticed in your comfort level with math that have occurred this semester."

Responses: 65% positive changes (more comfortable, more confident, better understanding), 1% negative changes (less comfortable, aggravated), 15% no change.

Data from pre- and post-surveys (measuring student attitudes) is summarized below:

Survey: Currently, I believe my math skills are (a) excellent. (b) good. (c) adequate. (d) fair. (e) poor.

Responses: Mean 2.2 (pre) up to 3.2 (post) {excellent = 5, ..., poor = 1}

Significant increase of 1.0 (0.05 level, $p = 1.5 \times 10^{-17}$)

Survey: My ability to learn math is (a) excellent. (b) good. (c) adequate. (d) fair. (e) poor.

Responses: Mean 2.9 (pre) up to 3.6 (post) {excellent = 5, ..., poor = 1}

Significant increase of 0.7 (0.05 level, $p = 1.5 \times 10^{-11}$)