Institutional Analysis, Assessment & Reporting

The Relationship of Grades in First Math Course and Test Scores For Fall 2003 and Fall 2004 First-Time-in-College Students Research Report 2005-07

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To say that Boise State University students have some difficulty with mathematics is an understatement. New freshmen are more likely to need to re-take their first math courses than they are to pass them. In a large number of cases, students won't be retaking math because they will no longer be enrolled at Boise State University. Consider the following data from Fall 2003 and Fall 2004 new freshmen:

Course:	***Number of New Freshmen Enrolled***	***Percent with D, F, or W***	***Percent Enrolled Fall 2005 (Passers vs. Failers)***
MATH 25	801	65.2%	67% vs. 37%
MATH 108	850	68.5%	68% vs. 47%
MATH 143	299	42.5%	77% vs. 51%
MATH 147	281	37.4%	80% vs. 46%
All Math courses	2746	55.3%	72% vs. 43%

Knowing that failure rates were too high, the purpose of this study was to assess the role that *test scores* played in math performance. In addition, the effects of the following were also studied: (1) which *instructor* students had, (2) whether or not instruction was delivered mainly by *computer* (in MATH 25 and MATH 108 only), (3) *academic background* (defined as completing the high school math core and receiving a "regular" diploma or a GED), and (4) *demographics* (gender, ethnicity, and age).

This study was based on 4,080 students who were new to Boise State University in either Fall 2003 or Fall 2004. Of this group, 67% enrolled in a mathematics course prior to Fall 2005. Students most often began in MATH 108 (31% of math enrollment) or MATH 25 (29% of math enrollment).

Summary and Recommendations:

Though performance on a test of mathematics knowledge was an important indicator of grades, the role of the instructor and how the instruction was delivered were often more important. Students who were older, had completed their math core courses in high school, and were female tended to perform better in their selected math course.

Based on these findings, we recommend the following:

- Modify or eliminate computer delivery of math instruction in MATH 25 and 108. (Almost all students (89%) took MATH 25 or 108 by computer.)
- Work to ensure that math instructors have common learning outcomes and similar standards for meeting those outcomes. (Depending on the course, as much as 20% of the variability in course grades was related to instructor.)
- Work with the high schools to ensure that students have completed their math core requirements before attending college. (While 87% were categorized as meeting the high school math core, only 71% had achieved it through completing regular high school courses.)
- Encourage *all* students to submit either ACT or COMPASS scores to help in course placement. (About 90% of the new freshmen in this study had one or more test scores.)
- Review the current cut-scores for course placement.

Findings by Course

The final question of interest was "What is the relationship of test scores, instructor, computer delivery of instruction, academic background, and demographics to grades?" We sought an answer in two ways. First, each set of variables was regressed against math grades and the proportion of variance that was associated with grades was identified. Second, a stepwise regression was undertaken to identify which specific set of variables provided the best prediction of grades (instructor was not included in this analysis). Separate analyses were performed for each course and set of test scores (e.g., ACT, SAT, COMPASS). Analyses were conducted only in those cases where more than 200 students were enrolled and had test scores.

The following illustrates this approach for MATH 25 using ACT and COMPASS scores. Similar analyses are available for MATH 108, 143, and 147.

For students enrolled in MATH 25, 438 had ACT Math scores and 373 had COMPASS Pre-Algebra scores. Using ACT scores, only 4% of the variability in math grades could be accounted for by test performance, though this rose to 17% when adjustments were made that took into account the restricted range of ACT scores of students taking MATH 25 (see Table 1 below). Besides test scores, the biggest percentage of variance was due to the instructor (14%). Whether or not students had instruction delivered via the computer also was important, with 7% of the variance accounted for by mode of delivery. Academic background accounted for 4%, and demographics accounted for 3% of the variability in grades.

Table 1. Math 25 & ACT Math Scores (N=438)

Variable	Proportion of Variance Accounted for in Grades
ACT Math Score	.0413 (.1712 when adjusted for range restriction)
Instructor	.1424
Computer Delivery	.0703
Academic Background	.0396
Demographics	.0291

Ignoring the role of the instructor, the stepwise regression accounted for 18% of the variability in grades (see Table 2). Mode of delivery was most important, with students receiving face-to-face instruction performing significantly better than those using the computer. ACT Math scores were second in importance. In addition, older students and students who had met the high school math core requirements were more likely to have higher grades. Students with a GED and males performed significantly worse in MATH 25.

Table 2. Predicting Grades in Math 25 using ACT Math Scores
$R^2 = 0.1762$

Variable	Parameter Estimate	Standardized Estimate
Intercept	-2.28686	0

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Variable	**Parameter Estimate**	**Standardized Estimate**
Computer Delivery	-0.90652	-0.24828
ACT Math	0.13297	0.20374
Age	0.08735	0.19806
Met HS Math Core	0.5713	0.18962
GED	-0.48069	-0.11006
Male	-0.27077	-0.10618

Students who had COMPASS Pre-Algebra scores had somewhat similar results (see Table 3 below). COMPASS scores again accounted for 4% of the variability in math grades; the percentage rose to 5.5% after accounting for the restricted range of scores in MATH 25[1]. The role of the instructor accounted for 10% of the variability. Computer delivery played a less important role for COMPASS students with 3% of the variability due to delivery method. Academic background accounted for 3% and demographics accounted for 2% of the variability in grades.

Table 3. Math 25 & COMPASS Pre-Algebra (N=373)	
Variable	**Proportion of Variance Accounted for in Grades**
Compass Pre-Algebra	.0426 (.0550 when adjusted for restrictions to range)
Instructor	.0968
Computer Delivery	.0269
Academic Background	.0259
Demographics	.0204

In selecting the best set of variables, COMPASS scores were the most important predictor of grades followed by whether or not students took the course on the computer. Meeting high school math core requirements and being male were also important. Age was not selected in this model. See Table 4 for details. Note that using COMPASS scores instead of ACT scores resulted in a less accurate prediction of grades (R^2=.18 vs. R^2=.10). It is difficult to interpret this finding. The less accurate prediction using COMPASS scores may be due to better course placement when the COMPASS is used or it may be due to a test that is generally less predictive. It is hard to tell without further study.

[1] The change is much smaller for COMPASS Pre-Algebra scores because these scores are only used for two courses (MATH 25 and MATH 108) instead of placement across the entire spectrum of math courses that the ACT is used for.

Table 4. Predicting Grades in Math 25 using COMPASS Pre-algebra Scores
R^2 = 0.1032

Variable	Parameter Estimate	Standardized Estimate
Intercept	0.71653	0
Compass Pre-algebra	0.01433	0.21748
Computer Delivery	-0.57045	-0.15858
Met HS Math Core	0.51752	0.14077
Male	-0.30926	-0.11401