Analysis of Student Success in Math 100 and 120

CRC Research Office

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Background

The CRC Research Office sought to identify factors associated with success in Math 100 and 120, Elementary and Intermediate Algebra, respectively. Enrollment is consistently high in these "gatekeeper" courses – and both are important for progression and completion. It is therefore prudent to identify differences in student performance and potential explanatory mechanisms for success in Math 100 and 120.

Methodology

Official grade and demographic variables (age, ethnicity, and gender) were gathered for students who took Math 120 or Math 100 for the first time from Spring 2014 to Spring 2015. Students were also classified into one of five *placement groups* depending on how they satisfied prerequisites for enrollment:

1) The *Prerequisite* group was composed of students that passed a prerequisite course (Math 30 for Math 100, Math 102/100 for Math 120) with a 'C' or better.
2) The *Tested* group was composed of students that tested into the course as a result of a placement test.
3) The *Exempt* group was composed of students who were exempt from assessment due to possession of an AA degree or higher.
4) The *Tested Lower* group was composed of students that tested lower than the course requirement and had not passed the prerequisite course (the *Tested Lower* group). These students may have entered the course due to a prerequisite challenge and/or through completion of a course at another college.
5) The *Ambiguously Placed* group had no placement or assessment data.

Official grade was recoded into grade points for analysis purposes. Note that a 'W' was coded as 0 grade points even though it would not typically be considered in GPA calculations. Demographic variables and placement groups were then used to predict grade points earned in Math 100 or 120 separately. Data were analyzed with multilevel models in order to reduce the likelihood of false statistical conclusions.

Overview of Findings

Math 100	Math 120
• Placement group was not associated with the average number of grade points earned per student. • Students who are African American earned less grade points than Hispanic/Latino students, and students who are White/API earn more grade points than Hispanic/Latino students. • Females earned more grade points than males. • Age was associated with average number of grade points earned per student, such that younger ages predicted lower grade points.	• Placement group was associated with the average number of grade points earned per student. The prerequisite group earned less grade points than the tested group. • Students who are African American earned less grade points than Hispanic/Latino students, and students who are White/API earn more grade points than Hispanic/Latino students. • Females and males performed equally. • Age was associated with average number of grade points earned per student, such that younger ages predicted lower grade points.

Implications of Findings and Future Directions

Within Math 120, differences in grade points were associated with placement group. In particular, the tested group performed better than the prerequisite group. This finding suggests that there may be slight differences in preparedness between these two groups. Moreover, the findings from this study add to already strong evidence of an achievement gap for students who are African American or Hispanic/Latino.

Future investigations might demonstrate that performance in a prerequisite course predicts performance in Math 100 or 120. For example, a student who received an "A" in a perquisite course may be more prepared than a student that received a "C". Additionally, the present study was unable to determine the effect of supplemental instruction on student preparedness. Evaluation plans are currently being developed to assess the effectiveness of the Supplemental Instruction Program.

Limitations

Although this investigation identifies differences in performance for different demographic groups, it does not explain why differences between these groups exist. Relatedly, these findings are correlational and should not be taken as causal evidence. Finally, within the Math 120 analysis, it is important to note that prerequisite group had a significantly smaller standard deviation than the assessment test group. This circumstance makes false-positive statistical conclusions more likely.

Analysis

From Spring 2014 to Spring 2015, 1901 students took Math 100 for the first time, and 2011 students took Math 120 for the first time. The majority of students qualified for Math 100 through assessment testing. On the other hand, the vast majority of students taking Math 120 for the first time qualified by taking and passing the prerequisite course (Math 100 or Math 102). Note that Native American students were excluded from the analysis due to small sample sizes.

	Math 100		Math 120	
Student Demographic	**N**	**%**	**N**	**%**
African American	289	15.2%	219	10.9%
Asian/Pacific Islander	417	21.9%	629	31.3%
Hispanic/Latino	625	32.9%	557	27.7%
Other/Mixed/Unknown	152	8.0%	145	7.2%
White	418	22.0%	461	22.9%
Female	1077	56.7%	1112	55.3%
Male	797	41.9%	873	43.4%
Unknown	27	1.4%	26	1.3%
Prerequisite	637	33.5%	1138	56.6%
Tested	931	49.0%	513	25.5%
Exempt	78	4.1%	92	4.6%

Tested Lower		51	2.7%	51	2.5%
Ambiguously Placed		204	10.7%	217	10.8%
Age					
	Mean	24.4		23.6	
	SD	9.22		7.8	

Technical Specifications and Description, Math 100. A hierarchical linear model (mixed-effect/multilevel model) was used to predict grade points earned in Math 100. These data would have violated the assumption of *independence* for a standard regression model. Namely, students within classes are more similar to each other (e.g., same teacher, classroom environment, etc.) than they are to students in other classes. A model that does not take into account this *intra-class correlation* will underestimate error variance and lead to potentially false conclusions. A hierarchical linear model takes the intra-class correlation into account when estimating variances. Additionally, variables can be entered as predictors of individual student behavior (e.g., an individual student's success; *level 1 predictors*) or as predictors of overall class behavior (e.g., a classes' average success; *level 2 predictors*). In the model used for this study, ethnicity, gender, age and placement group were all entered as level 1 predictors. The intra-class correlation for this model was modest, $r = .16$. Within this model, placement group was not associated with earned grade points. On the other hand, females (*Mean Grade Points* = 1.42) earned significantly more grade points than males (*Mean Grade Points* = 1.21), $t(1845) = -3.43$, $p < .001$. Age was also significantly associated with earned grade points, $t(1845) = 3.16$, $p < .01$. Finally, students who are Hispanic/Latino (*Mean Grade Points* = 1.23) earned more grade points than students who are African American (*Mean Grade Points* = 0.98), $t(1845) = 3.42$, $p < .001$, and students who are White (*Mean Grade Points* = 1.50) or Asian Pacific Islander (*Mean Grade Points* = 1.61) earned more grade points than Hispanic/Latino students, $t(1845) = 2.38$, $p < .05$, $t(1845) = 4.07$, $p < .001$, respectively.

***Technical Specifications and Description, Math 120*.** A hierarchical linear model (mixed-effect/multilevel model) was used to predict grade points earned in Math 120. The intra-class correlation for this model was also modest, $r = .33$. Unlike Math 100, students who satisfied the prerequisite for Math 120 by assessment test (*Mean Grade Points* = 1.58) earned significantly more grade points than those that completed a prerequisite course (*Mean Grade Points* = 1.45), $t(1954) = 3.64$, $p < .001$. However, it is important to note that prerequisite group had a significantly smaller standard deviation than the assessment test group. This circumstance makes false-positive statistical conclusions more likely. Moreover, older students earned more grade points than younger students, $t(1954) = 2.03$, $p < .05$, but unlike Math 100, gender was not associated with grade points earned. Finally, students who are Hispanic/Latino (*Mean Grade Points* = 1.33) earned more grade points than students who are African American (*Mean Grade Points* = 1.20), $t(1954) = 1.97$, $p < .05$, and students who are White (*Mean Grade Points* = 1.62) or Asian Pacific Islander (*Mean Grade Points* = 1.67) earned more grade points than Hispanic/Latino students, $t(1954) = 4.11$, $p < .001$ $t(1954) = 4.15$, $p < .001$, respectively.