

SUMMARY REPORT
"GATEWAY ALGEBRA PROGRAM"¹
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By
Dr. Daryao S. Khatri, Professor of Physics
Dr. Anne O. Hughes, Professor of Education/Sociology, ret.
Professor Brenda Brown, Department of Mathematics
The University of the District of Columbia
Washington, DC 20008

Status of College Remediation in Mathematics

According to a report by the National Center for Education Statistics, 28 percent of freshmen who registered in public higher education institutions were required to take at least one remedial course in Fall 2000 (NCES, 2002-168).² Nationally, the Center for Evaluation and Education Policy³ (CEEP, Vol. 4, No. 5, Spring 2006), reported that these students stay for at least a year in remedial math and reading courses, and the dropout rate of such students is high. Also, according to this article, "African American students were the most likely of those students to have taken remedial coursework at some point in their college career (45.9 percent)... Of the students who took remedial courses in 1999-2000, about three-quarters of African American, white, and Hispanic students took remedial mathematics courses, compared to 58 percent of Asian students." With regard to a national longitudinal study by NCES of high school students from 1982 to 1993, Adelman, who was a visiting fellow at The College Board in 1998, reported that only 12% of students earn a baccalaureate degree who must enroll in a remedial reading course and in three or more other remedial courses (1998).

With regard to costs of remediation, the National Education Summit on Higher Education⁴, in a 2005 report, gave a figure of \$16 billion for both postsecondary institutions' remedial efforts and the costs associated with loss of productivity for businesses. Illustrative of the remedial costs at the state levels in postsecondary institutions in 2000 were \$601 million for Michigan and \$540 million for Alabama (Meisotis and Phipps⁵, 2000). Based on our own analyses of these and other reports, the actual costs of remedial education seem murky since these references have often used different bases (e.g., samples, institutions and course offerings) for computing the costs.

To show the magnitude of the national problem further, we quote Bettinger & Long⁶ (2006), as follows: "Because the average college student attends a nonselective institution to which he or she is almost assured admission, the remedial placement exam taken when first arriving on campus has become the key academic gate-keeper to postsecondary study... The bulk of remediation is provided by non-selective public institutions, the point of entry for 80 percent of four-year students and virtually all two-year students. Four-fifths [80%] of public four-year colleges and 98 percent of community colleges provide remedial courses."

¹ The funding for this research project was provided by the Office of the President and Title III Office of the University of the District of Columbia.

² Most recent data available

At The University of the District of Columbia (UDC), an open admission primarily minority institution, approximately 80-85% of entering freshmen enroll in several remedial courses based on their scores on the *Accuplacer*, the university's placement test. Also, if these students must take both remedial math courses (Basic Math, 005, and Introductory Algebra, 015), and most of them do; it will typically extend their graduation by at least a year since no remedial course carries credit for graduation.

Statement of the Problem

The problem for this research study was to ascertain if a short, intensive eight-week intervention project in basic math and introductory algebra would produce a recognizable improvement in the math performance of entering UDC freshmen students as measured by the *Accuplacer* math placement test and the UDC Math Department's final examinations in the two below-college math courses.

Program Description

Applications for the UDC summer 2007, named the "Gateway Algebra Program", were mailed to approximately 263 students who had been admitted to the university as freshmen students for the Fall Semester 2007. The 263 student population was selected from a list of approximately 1200 students provided by the admissions office. All these students were admitted as freshmen for the Fall Semester 2007. The approach used was systematic random sampling, in which the first case of the 1200 was randomly selected. At this point every student had an equal chance to be selected. After the initial selection was made, every fifth student from the list was sent the letter.

Forty-three students applied for the program either through email or by fax. The numbers here seem low, but this program was competing against the students' need to work fulltime to earn money and/or the belief they didn't need a program of this nature. Of this group, 31 students took the university's placement test, administered by the university's Office of Student Affairs. All of them were interviewed. The 17 students finally selected were the "most academically challenged," meaning that all them would have to enroll in the lowest level remedial math course, Basic Math 005. Obviously, students who performed well on the placement test were not considered.

The program carried a stipend of \$1,200 for each student as an offset for not being able to work full-time during the summer. Students were also provided money or metro fare cards for travel. In addition, students received awards for regular attendance.

The program ran for four hours per day, five days a week for eight weeks (June 25 – August 17, 2007) from 10:00 AM to 2:00 PM. The last hour was devoted to "homework", and no lunch was provided. The classroom management rules, which were handed out to students and discussed on the first day of class of the program, were strictly enforced throughout the duration of the program.

In addition, throughout the program, students were not permitted to use a calculator during any assignment in class or in completing their homework. The whole purpose of not allowing calculators was to enhance students' mental agility with numbers, accurate estimation of answers, and their own self-confidence in problem solving.

Math Results

The results of the research project are presented under three headings: results in terms of placement, the *Accuplacer* results, and the results of Math Department final examinations for the two below-college level courses. This mix of testing was considered ideal for program rigor and to provide an accurate placement of students.

Results in Terms of Placement

Based on the UDC placement test, the *Accuplacer*, and the Math Department final examinations, the following results are reported. Nine of the 16 students tested out of both remedial courses, thereby saving a full year of remedial math courses that do not even count toward graduation. Five others were able to test out of the basic math course, thereby saving a semester of remedial math. The remaining two students showed increased readiness for the basic math course and were advised to enroll in this course.

Accuplacer Results

	MATH 005: Basic Math		MATH 015: Intro. Algebra	
Statistics	Pre-Assessment (N=17) ¹	Post-Assessment (N=13) ²	Pre-Assessment (N=16)	Post-Assessment (N=16)
Mean	39.2	67.54	38.19	63.06
Standard Deviation (s.d.)	18.96	24.76	17.10	20.57
Two-tailed t-test of the null hypothesis for paired observations	6.21 (3.930) ³ With 12 df Confidence level >.001		7.43 (3.713) ³ With 15 df Confidence level >.001	

¹ Seventeen students initially took the pre-test; one student dropped out of the program after four weeks.

² Only 13 students are shown for the post-test in basic math because the computer system does not show scores above the critical threshold for placement in 005, Basic Math.

³ The numbers in parentheses for the t-test are the critical values for two-tailed paired observations.

On the pre-test for 005, Basic Math, the mean score for the group (N=17) was 39.2, with the passing score being 70. The standard deviation was 19.0 suggesting a non-homogeneous group to start with. On the post-test, the mean increased to 67.5 showing an improvement of 72 percent, showing the entire group had gained. The s.d. was 24.8 suggesting that the instruction profited some of the students more than others. Turning to the results for Math 015, Introductory Algebra, the pre-test mean for the group (N=16) was 38.2 with an s.d. of 17.1. The passing score for Introductory Algebra was 85 on the university's placement test. On the post-test, the mean increased to 63.1, showing a general improvement for the entire group.

The Students t-ratio for paired observations, using a two-tailed test, was applied to the results of both the pre- and post-test results for 005 (Basic Math) and 015 (Introductory Algebra). The t of 6.21 was statistically significant beyond the .001 level for 005, Basic Math

with a critical value 3.930 for a two-tailed test with degrees of freedom (df) = 12. The t of 7.43 was significant again at the 0.001 level with a critical value of 3.713 for the two-tailed test with 15 df for the 015, Introductory Algebra.

Math Department Final Exam Results

For the program, UDC Math Department final examinations for both Basic Math, 005, and Introductory Algebra, 015, were used at various points in the program to measure students' progress for placement purposes. During the program, students took a total of eight in-class tests (at least every Friday), the *Accuplacer* test on August 16, 2007, and two take-home tests. In addition, these students completed independently a total of 28 sets of classroom problems (ranging from 50-75 problems per set) and eight sets of problems that they completed when they went home. The *Accuplacer* cutoff scores were 70 and 85 for Basic Math and Introductory Algebra respectively.

The passing score in Math Department final examinations is 70%, equivalent to the letter grade of C. If a student's scores on the *Accuplacer* fell within one standard deviation from the cutoff score, then the higher score of that particular student in Math Department's final examinations also was factored in for placement purposes. In other words, if a student's score fell within a standard deviation of the cutoff score of 70 for Basic Math and this student had done well on the Math Department final examination for the course, then the student would be placed in 015 Introductory Algebra.

The raw test averages for the final examination¹ were converted to a 100-point scale in order to equate them to the *Accuplacer* results. The equated averages in Basic Math, 005, were 76.6 on July 27, 2007, and 87.6 on August 10, 2007. The equated test average for the final examination² in 015 Introductory Algebra on a 100-point scale was 80.3.

A comprehensive examination of 70 questions was administered on 8/14/07; it covered all of the material that had been taught during the past eight weeks. The converted average of students' scores for this examination on a 100-point scale was 76.

Additional Results

While the research project was specifically focused on closing the gaps in math, we theorized that improvements might also occur in the other two areas also tested: 014, Reading and 015, English Fundamentals, as a function of improved study habits and having to read different types of math problems. The post-testing showed a general improvement for the group in 015, English Fundamentals, with the mean being 68.8 and a post-test mean of 76.3, and t-ratio of 2.15 which just exceeds 2.145 for a two-tailed test, and 1.761 for a one-tailed test at the 0.05 level of significance with 15 df. The English course essentially deals with sentence construction; the math word problems were often in one or two sentences and had to be very carefully studied. For reading, the pre- and post-test means essentially remained the same.

In addition to these results, there were several others that are worth mentioning. First, the students really had become "college ready" in their self-confidence in their ability to do college-level work, increased attention span, and improved study habits and organization.

¹ About 15% of the questions were modified to accommodate the needs of the program.

² About 10% of the questions were modified to accommodate the needs of the program.

These characteristics of college readiness have been reported to us by other students and by college professors in three other courses in math and science. Finally, five of the 16 students have subsequently declared their majors in either chemistry or physics.

Selected Findings of the Student Evaluation of the Program

A few highlights of the students' evaluation of the program are reported here. Three fourths of the students saw the opportunity and knew they needed it. Approximately, the same number also reported the stipends as having some importance in their enrolling in the program. In the opinion of the instructional team, the stipend provided a "hook," and encouraged them to try an unknown situation. Eighty percent of the students reported that they worked "quite hard" in the program. Their individual notebooks testify to this hard work, with over 300 pages of completed and checked work by each student over the eight-week period, which amounted to approximately 50 pages of work per week.

All of the students (100%) reported the program was "excellent." And, one student added, "I feel like the luckiest person in the world." In addition, the student basically agreed that establishing classroom rules at the very beginning was really useful.

Conclusions

- ◆ Based on the UDC Mathematics Department's model of math remediation, approximately half of the entering Freshmen targeted for the two remedial math courses, that do not count towards graduation, can be prepared for Freshman level college math courses if provided an opportunity for an intensive summer "gateway" program, thereby saving a year of remedial math work.
- ◆ An additional third can reduce the number of remedial math courses required from two courses to one, thereby saving a semester's worth of remedial math work.
- ◆ The remaining students can benefit from the intensive program by improving their general preparation in math.
- ◆ An unexpected outcome of the intensive program was the students' growing realization of their being successful in their math learning. In turn, their academic success was reflected in a boost in their self-confidence about succeeding in college.
- ◆ Supplementing these findings, we also found that when these students entered the summer program, the level of math preparation for many of them seems to have been around the seventh grade level as indicated by the placement test. Further observation, however, revealed that the students had seen, been exposed to, or been taught some of these topics in their high schools, but the necessary practice, applicability to other academic disciplines, and mastery of these concepts was lacking to a great extent.
- ◆ Finally, we estimate that the potential for reducing the costs of remedial education in non-selective institutions of higher education through programs, such as the one being reported here, has real promise.