PLACEMENT TESTS AS PREDICTORS OF STUDENT ACHIEVEMENT IN MATHEMATICS, CHEMISTRY AND HUMANITIES

Vladimir Briller, Ed.D., Perry Deess, Ph.D. and Martha Zola, Ph.D.
New Jersey Institute of Technology

Abstract

The study developed out of the NJIT administration and faculty concern about effectiveness of remedial courses and freshmen retention. After analyzing data on students who dropped out, it was discovered that their performance was especially low on required math, humanities (HSS) and chemistry courses. One of the hypotheses was that the existing placement tests were not instrumental in placing students at appropriate course level in math, HSS and chemistry.

After being admitted, all freshman students are required to take placement tests in English and mathematics; chemistry placement test is required for some majors. The population in this study included 12,728 students who took math and English placement tests and 7,183 students who took chemistry tests between 1994 and 2000. The researchers analyzed a set of correlations: (a) between English placement test scores, grades on HSS courses and students retention; (b) between math placement test results, Math 103/104 grades and student retention; (c) between math placement test scores, Math 111 grades and student retention, (d) between chemistry placement test results, freshman chemistry grades and student retention, and (e) between student SAT verbal and math scores and placement test scores and grades on freshman math, chemistry and HSS courses. The results provide important information that would serve the purposes of student placement, remedial education, and freshmen retention.

Introduction

The study of placement testing has been conducted as a follow-up to the study of barrier courses, and results indicating low passing rates on some required general university requirement courses. One of the main concerns was that students' low rates were attributed to placement tests which were not instrumental in placing students at appropriate course level.

After being admitted, all freshman students are required to take placement tests in English and Mathematics. In addition, the students who plan to major in Chemistry take a Chemistry placement test. Placement test results, high school grades and SAT scores are used to determine individual course placement.

The Mathematics placement is based on Elementary Algebra, Pre-Calculus, SAT Math score, and High School Rank in Class, when applicable. The English placement is based on scores on three New Jersey College Basic Skills Placement Test and SAT Verbal score. Toledo Chemistry Placement Exam is used to place students in Chemistry classes. Table 1 provides information on current NJIT requirements for placement in Math, English, HSS and Chemistry GUR courses.

Table 1. Current requirements for student placement in Math, Chemistry and HSS courses.

Courses	Minimum score placement requirements in Fall of 2001	Maximum possible score
Math 111/113/138 *Physics 111*	Algebra 25 Pre Calculus 22 SATM 550	30 36 800
Math 104 *Physics 105*	Algebra 23/24 Pre Calculus 20/21 SAT M 500	30 36 800
Math 103 *Physics 105*	Algebra 22 Pre Calculus 18-21 SATM 500	30 36 800
Math 103 *No Physics*	Algebra 20 Pre Calculus 14-17 (7-13 is OK if rank in class is OK) SATM 500	30 36 800
Math 098	Algebra 0-19 Pre Calculus 0-13 SATM <500	30 36 800
Chemistry 121	Toledo Test 35-56	100
Chemistry 125	Toledo Test 57+	100
Honors	Mathematics: SATM 600+ (Good rank in class) Pre Calc 30+ Chemistry: SATM 600+ (Good rank in class) Toledo Test 70+	 800 36 800 100
HSS 101	SATV ≥ 500 NJ Sentence Sense ≥ 26 NJ Reading Comp. ≥ 27 NJ Essay ≥ 7	800 36 36 12
HSS 099-100	SATV < 500 NJ Sentence Sense < 26 NJ Reading Comp. ≤ 27 NJ Essay < 7	800 36 36 12
HSS 099S-100S-ESL	SATV < 400 NJ Sentence Sense < 26 NJ Reading Comp. ≤ 27 NJ Essay ≤ 5 ESL section questions ≤ 4	800 36 36 12 5
Honors	SATV ≥ 610 NJ Sentence Sense ≥ 30 NJ Reading Comp. ≥ 31 NJ Essay ≥ 9	800 36 36 12

Research design

The following research questions laid the foundations of the study:
1. What percentage of freshmen were placed into remediation courses as a result of a placement test?
2. Is there a relationship between SAT scores, content course grades and placement tests?

3. Is there a relationship between student placement test scores and Math, English, HSS and Chemistry performance and overall academic performance (cumulative GPA)?
4. What are the effects of remedial intervention on student performance?
5. Is there a relationship between student placement test scores and student retention and graduation rates?

Population

The population of the study included all students who took placement tests from Fall-1994 to Fall 2000. (See Table 2.)

Table 2. The distribution of the population by the type of placement test.

	Test name	Number of students who took the test in 1994-2000
1	Math Computation	2,053
2	Algebra	10,630
3	Precalculus	10,975
4	Chemistry	7,183
5	English/HSS (Reading comprehension, Sentence sense, Essay)	12,725
	Total	43,560

Procedure

First, the database was created and statistical analyses were conducted using SAS software. The database included data on 1994-2000 placement test scores and consisted of 25 variables. Statistical analyses provided the following information:
- Average scores on placement tests by year;
- Percentage of students taking placement exams and placed into remedial courses;
- Correlations between math and verbal SAT scores and placement tests;
- Correlations between placement test scores and students' grades in respective courses:
   - Math Placement and Math 103/104, 111, 113 and 138
   - Chemistry Placement and Chemistry 121 and 125
   - English Placement and HSS 099/100, and 101.
- Correlations between placement scores and student retention and graduation;
- Correlations between the students' placement test scores and cumulative GPA;
- Comparative performance on regular GUR Math, Chemistry, and HSS courses of the at-risk students who were placed in remedial classes and those who were not. At-risk students were defined as the students who scored less than 500 on SAT Math tests.

Results

The results of the placement tests in 1994-2000 are summarized in Table 3.

Table 3. Average Placement Scores By Year

	Score	1994	1995	1996	1997	1998	1999	2000	Average
Computation (n=2,053)	Raw	25	24	23	22	24	24	25	24
	Percentage	83%	79%	78%	75%	81%	80%	83%	80%
	n	1020	686	189	77	49	23	9	
Algebra (n=10,630)	Raw	22	22	22	23	23	24	24	23
	Percentage	75%	74%	75%	75%	77%	79%	78%	76%
	n	1057	1312	1404	1549	1762	1726	1820	
Precalculus (n=10,976)	Raw	17	17	17	17	18	18	18	17
	Percentage	47%	46%	46%	47%	49%	50%	50%	48%
	n	1160	1416	1496	1592	1770	1728	1814	
Chemistry (n=7,183)	Raw	47	47	49	47	48	48	47	47
	Percentage	47%	47%	49%	47%	48%	48%	47%	47%
	n	979	1097	1060	1052	1015	987	993	
Reading (n=12,725)	Raw	27	27	28	28	28	29	29	28
	Percentage	66%	68%	70%	70%	70%	72%	73%	70%
	n	1433	1644	1724	1825	2014	1979	2106	
Sentence Sense (n=12,725)	Raw	27	27	27	27	27	27	28	27
	Percentage	76%	77%	77%	77%	77%	78%	80%	77%
	n	1433	1644	1724	1825	2014	1979	2106	
Essay (n=12,725)	Raw	7	7	7	7	7	7	7	7
	Percentage	72%	69%	68%	68%	68%	68%	67%	69%
	n	1433	1644	1724	1825	2014	1979	2106	

As seen from the Table 3, students had very consistent average placement scores throughout seven years of testing; however Computation, Algebra and Sentence Sense placement tests have a high percentage of right answers and that provides insufficient information for placement. Table 4 analyses frequency distribution of different placement tests from 1994 to 2000.

Table 4. Percentage of freshmen who took placement tests and were placed into remedial courses in 1994-2000.

Year	Students who took English tests	Students who were placed in English/HSS remedial class	Students who took Math tests	Students who were placed in Mathematics remedial class	Students who took Chemistry test	Students who were placed in Chemistry remedial class
1994	128	9 (7.0%)	746	307 (40.35%)	225	87 (38.67%)
1995	160	7 (4.3%)	887	404 (45.55%)	237	108 (45.57%)
1996	308	5 (1.6%)	765	396 (50.45%)	251	94 (37.45%)
1997	443	132 (26.7%)	668	350 (52.40%)	226	86 (38.05%)
1998	571	307 (60.1%)	667	323 (48.42%)	155	44 (28.39%)
1999	503	149 (37.0%)	683	317 (47.10%)	182	44 (24.18%)
2000	534	249 (49.5%)	743	386 (52.23%)	206	78 (37.86%)

The number of students who are placed in remedial English, Math, and Chemistry classes varies over time. The important question is how effective remedial education is; that is, how students perform on regular courses after they had been taught in remedial ones.

The test of correlations between placement tests and student retention and graduation rates has not revealed any correlation. The test of correlations between placement tests and SAT scores, and grades on selected courses, has produced mixed results. (See Table 5.)

Table 5. Correlations between placement test scores, SAT scores (SAT Math for Mathematics and Chemistry courses and SAT Verbal for HSS and English courses), and Math 111, Math 103, HSS 101 and English 095 grades. (Pearson correlation coefficients and probabilities)

Course	Placement Test	Correlation Coefficients and Probability		
		SAT-Placement	Grade-Placement	SAT-Grade
Math111 (n=2,125)	Precalculus	.537 (p<.0001)	.292 (p<.0001)	.233 (p<.0001)
	Algebra	.094 (p<.0001)	.067 (p<.002)	
Math 103/104 (n=2,328)	Precalculus	.243 (p<.0001)	.242 (p<.0001)	.093 (p<.0001)
	Algebra	.346 (p<.0001)	.325 (p<.0001)	
HSS 101 (n=1706)	Reading	.739 (p<.0001)	.102 (p<.0001)	.130 (p<.0001)
	Sentence	.649 (p<.0001)	.178 (p<.0001)	
	Essay	.332 (p<.0001)	.110 (p<.0001)	
Eng095 (n=80)	Reading	.720 (p<.0001)	.347 (p=.0015)	.160 (p=.3322)
	Sentence	.465 (p=.0019)	.186 (p=.1010)	
	Essay	.198 (p=.2149)	-.029 (p=.8060)	
Chemistry 121 (n=645)	Chemistry	.245 (p<.0001)	.141 (p=.0003)	.130 (p=.0020)
Chemistry 125 (n=1214)	Chemistry	.327 (p<.0001)	.325 (p<.0001)	.271 (p<.0001)

Summary of the findings

The correlations among variables in the study are currently being analyzed and interpreted in cooperation with the faculty, and the work to describe the effect of the placement tests is underway. Student SAT Math and Verbal scores were not found to be good predictors of student achievement by themselves; however in conjunction with placement tests they can serve as accurate predictors of success on GUR courses. In many cases placement tests can serve as valid predictors of students' success on general requirement courses. To have maximum effect those tests should be able to provide clear variances among students; nevertheless due to the fact that Computation, Algebra and Sentence Sense placement tests have high percentage of right answers they provide insufficient information for placement. Chemistry and Precalculus placement test proved successful for providing information for placement into remedial or GUR courses. Reading test gives sufficient information for placing students into ESL classes, and Essay can serve as a moderate predictor of students' success on HSS courses.

VLADIMIR BRILLER: Vladimir Briller is a Director of the Outcomes Assessment at NJIT. He received his degree from Columbia University in 1995. He worked as an Associate Project Director at Education Development Center International Department in New York and as a Research Project Director at Vera Institute of Justice in New York evaluating various programs in the US and Europe. He has been teaching at undergraduate and graduate levels.

PERRY DEESS, Ph.D.: Perry Deess is the Director of Institutional Research at NJIT. He is a former Fulbright Scholar and has published in areas ranging from institutional change to the culture of higher education. He has also taught the sociology of education, research methods, and survey analysis.

MARTHA ZOLA, Ph.D. : Dr. Zola is the Executive Director of Institutional Research and Planning at the New Jersey Institute of Technology. She has performed research and published on course evaluations as well as in other areas relative to instructional effectiveness and survey research.   She has taught statistics, research design, and educational research courses.