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ABSTRACT

A study was conducted at Pima Community College to determine the relationship between the final grade received by students in an introductory, algebra-based physics course (PHY 121) and their scores on the reading, writing, and mathematics portions of the college's nonmandatory assessment test. Between 1983 and 1988, 639 students obtained a final grade in PHY 121. Of these, 558 took the Nelson-Denny Reading Test (NDRT), 280 took a locally developed writing test, and 431 took a locally developed math test. When correlation coefficients were examined, the test result most highly correlated with successful completion of PHY 121 was the NDRT score, followed by the Pima College Math Test score. Other study findings included the following: (1) on average, students who took the NDRT read at a 13.8 grade level; (2) 84.2% of the students entered PHY 121 without the prerequisite math skills, indicating that either the prerequisite was inappropriate for the course or the math portion of the test was an inaccurate measure of student ability; and (3) 48.8% of the students who took the writing test were placed in a developmental writing course, compared to 17.8% who were placed in Freshman Composition. (AJL)

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A STUDY OF THE RELATIONSHIP BETWEEN STUDENT PLACEMENT TEST SCORES AND FINAL GRADES IN PHYSICS 121 AT PIMA COLLEGE

by

David G. Iadevaia, M.A.T.

Pima Community College

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JC 890 080

A Practicum presented to Nova University in partial fulfillment of the requirements for the degree of Doctor of Education

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ABSTRACT

A non-mandatory assessment test has been available for all students entering Pima Community College (Pima College) during the interval beginning with the Spring 1983 semester and ending with the Spring 1988 semester. Numerous students took different portions of the test, but specifically, the reading portion. Since a student must test at least at the twelfth grade reading level to graduate, this seemed to be the preferred test for those students who elected to be assessed.

A study was conducted on the relationship between the final grade received in the introductory, algebra based, physics course (PHY 121) and the reading, writing and mathematics portions of the assessment test. A Pearson correlation coefficient calculation, was applied to a population of up to 639 students, over the five year interval. It was found that the Nelson-Denny (N-D) Reading Test versus PHY 121 final passing grade had an $r = 0.32539$. The Pima College writing test versus the final passing grade for PHY 121 had an $r = 0.21865$ and for the Pima College mathematics test, $r = 0.22315$. Since slight correlation existed, it was concluded that the reading portion of the assessment test was the best predictor of a passing grade in PHY 121.

Based upon the results of this study, it was recommended that the assessment test components, be examined as to their ability to accurately assess students.

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BACKGROUND AND SIGNIFICANCE

Program planning and curriculum development necessitates an accurate assessment of the student as the student enters the educational system. A fundamental element of the Programs for Higher Education seminar in Curriculum and Program Planning was to properly design a program which was sensitive to the placement of the student. As found in Herrscher, Mizell and Pautler's Curriculum and Program Planning Guide (1986:25):

> 1. Analysis of needs, goals and priorities: The instructional designer must clearly determine and state the needs, goals and priorities central to the curriculum development effort.

Paramount to this effort are the student's needs, goals and priorities. The student must be central in this process.

According to Gagne (1988:20), "an instructional system may be defined as an arrangement of resources and procedure used to promote learning". At the very beginning of an instructional design sequence it is assumed that the learner is assured of reasonable success if the learner has a basic command of prerequisite knowledge. From this assumption, one can design an appropriate curriculum which may be made of a collection of loosely related courses. Others may design a rather rigorous set of courses, which when completed will allow the learner to have gained considerable knowledge of a

certain topic. In either case the learner must begin somewhere. According to Gagne, "initial placement of students in an appropriate level with respect to first assignments in each subject" (1988:310) should be the starting point for a student's educational career. Hence, a study of science curriculum should begin at the assessment stage as well.

For the purpose of this study, the research question examined was: Of all students enrolled in Pima College for the last five years, who have completed PHY 121 and have taken the assessment test, does there exist a relationship between the grade earned in PHY 121 and the assessment test score?

A comparison of the assessment test score and the final grade earned by a student in PHY 121 was made. A correlation computed from this comparison was used to determine the relationship between the assessment test score and the final grade earned in PHY 121.

A rather concerted effort on the part of educators at Pima College has been made to establish the current assessment test. This test was used to suggest to students the proper entry level into the curriculum, as well as predict academic success. But, as found in the literature (for example, Lewis, 1985 and Weber, 1986), the numbers of articles regarding assessment testing with an emphasis on reading, composition and some mathematics

courses, seemed to be consistent with the emphasis of the assessment test at Pima College. No work, to date, had been done on the placement in, and prediction of, students into introductory physics courses.

The selection of PHY 121, as the selected specific course, was predicated on the fact that undergraduate physics courses have been looked upon as an insurmountable barrier to many students. Those students who would like to pursue study in areas, such as medicine, may fail to enter that career track because of a poor score in the introductory physics course (Lowe, 1981). A study was found that was based on ACT and high school rank-in-class. It was used to determine the ability to predict general performance in chemistry (Reiner, 1971).

All student records at Pima College are stored on computer tape and can be retrieved on a need-to-know basis. Permission to extract those files germane to this study was obtained. A private communication from the Vice President of Academic Affairs indicated that this study had not been done and would be welcomed (see Appendix A). The Vice President for Academic Affairs had to approve the procedures that were followed (Gorsuch, 1988).

The following procedures were followed in reviewing the data:

1. The records of all students who had registered at Pima during the last five years were examined.
2. Those students who had taken the assessment test and had completed PHY 121 were placed in a file.
3. Using the SPSS (Statistical Package for the Social Sciences), the Pearson correlation technique, was applied to measure the correlation on the data.
4. The results were examined for any relation between the assessment test score and the student's final grade in PHY 121.

This study represents the first time, at Pima College, that the assessment test had been examined as a possible predictor of success in a specific science course.

PROCEDURES

Definition of the Population

The population consisted of 639 students. Each student was enrolled in and completed PHY 121 at Pima College during the interval beginning with the Spring 1983 semester and ending with the Spring 1988 semester. Of those students who completed PHY 121, during that time, only those who took the assessment test were selected for this study. The sample population, therefore, contained only assessment test takers who were passing, completers, of PHY 121.

Table 1

Population by Sex

Sex	Absolute Freq.	Adjusted Freq. (%)
Male	414	64.8
Female	225	35.2

The ethnic and racial make-up of the population is presented in Table 2.

Table 2

Ethnic and Racial Composition of the Population

Group	Absolute Freq.	Adjusted Freq. (%)
Indian	8	1.3
Black	13	2.7
Oriental	29	4.5
Spanish	77	12.1
Other	508	79.5

Collection of Data

Following discussions with the staff of the Pima College computer department, a programmer was assigned to collect the data for this study. The records of all students who had completed PHY 121 were examined. Those students who completed PHY 121 and had taken the assessment test during the five year interval previously described, were stored in a software file consisting of the following test scores:

1. Nelson-Denny Reading Composite Score
2. Pima College Writing Test Raw Score
3. Pima College Math Test Raw Score
4. PHY 121 Final Grade Converted Score

Statistical Procedures

In this study it was desirable to examine the relationship between two variables, that is, the entire assessment test package including the Nelson-Denny test, the Pima College Math and Writing tests with the final grade in PHY 121. It was expected that based on correlations calculated by Brown, Bennett and Hanna (1981:7), "between self-reported grade point averages and Nelson-Denny test scores" that a positive r would be found. This was indeed the case.

Robert Coonce (1988), programmer of the SPSS utility on the Pima College computer system, suggested reading the file of 639 students into the SPSS program and calculate a Pearson correlation coefficient of each assessment test score against the PHY 121 final grade. The Nelson-Denny Reading Score, the Pima College Writing and Math scores were all in numeric form. Coonce converted the final PHY 121 letter grades into a numeric form, compatible with the SPSS program. The following assigned values for each letter grade were used:

A = 5

B = 4

C = 3

D = 2

F = 1

The selection of the Pearson correlation coefficient seemed to be the appropriate statistical technique as described by Hardyck (1969:207):

> The Pearson correlation coefficient is best considered to be a ratio which indicates the degree to which variation in one variable is associated with variation in another variable.

The data results, including the Pearson coefficient as well as other statistical parameters, were produced as computer printout. The various tables included as part of this study were then generated from this printout.

Assumptions

The assumptions listed below were considered important. If these assumptions were not made then undetermined effects could have occurred on the application of the results from this study.

1. It was assumed that regardless of when a student took the assessment test, the results of the test were indeed a true indication of the student's ability.

2. It was assumed that the assessment test was free of ethnic, sexual and race biases.

3. It was assumed that the final grade earned in PHY 121 was objectively arrived at, without regard for the student's ethnic background, race or sex.

The last two assumptions were consistent with policies in effect at Pima College. As described in the Pima Community College Catalog 1988/89 (1988:1),

> Pima Community College has a policy of non discrimination on the basis of race, color, national origin, religion, sex, age . . . This policy applies to all programs, services, and facilities, and includes, but is not limited to applications, admissions, access to programs, classes . . .

The first assumption had limitations which had been set independently of the data collection process, for example, how much time elapsed between the time the assessment test was taken and when PHY 121 was taken.

Limitations

The limitation of the Pearson Correlation in the SPSS package, according to Einstein and Nocks (1987:151) are:

1. You cannot request more than 40 different sets of correlations or matrices with a single Pearson Corr.
2. You cannot have more than 250 individual elements with a single Pearson Corr command.
3. no . . . more than 500 variable names.
4. . . . can not exceed core storage of your computer.

None of these limitations were exceeded. All operations performed were well below these limitations.

Definition of Terms

Assessment test: a collection of tests used at Pima College to measure a student's ability in the areas of reading, writing and mathematics. The results of this test is used as a recommended placement for the student.

Completer: a student who finished PHY 121 including the student who failed the course.

Final Grade: is defined as a passing grade, no lower than a D.

Pima College Writing and Math Test: the in-house designed portion of the assessment test.

Level of significance (p): for this study, any value of p greater than 0.001 would reduce confidence in the r value.

RESULTS

Incoming students were not required to take the assessment test and the data reflects this fact. While 639 students completed PHY 121, not all of them took all parts of the assessment test. Hence, the sample size will vary from the 639 student total population. Described in Table 3 are the inferential statistics complied from the three major assessment test components, including the Pearson Correlation Coefficient, r , and the significance level, p.

Table 3

Assessment Test Component Raw Score Versus Final Passing Grade in PHY 121

Test	Sample Size	% of Cases	r	p
N-D Score	558	87	0.32539	0.000
Writing Score	280	44	0.21865	0.000
Math Score	431	67	0.22315	0.000

Table 4

Nelson-Denny Grade Level Equivalent
Descriptive Statistics

Sample Size	558				
Mean	13.8	Mode	16.9	Median	14.0
Range	20.6	Max.	16.9	Min.	4.0
Skew	-1.7	Variance	8.1	St. Div.	2.9
St. Err.	0.121				

Table 4 contains the grade equivalent descriptive statistics. In Table 5, below, the math course placement recommendations are found.

Table 5

Math I Assessment Test Recommended Placement

Math Course	Absolute Freq.	Adjusted Freq. (%)
MTH 060A	3	0.7
MTH 060	65	15.1
MTH 070	363	84.2

Table 6

Math I-II Assessment Test Recommended Placement

Math Course	Absolute Freq.	Adjusted Freq. (%)
MTH 070	174	51.6
MTH 130	151	44.8
MTH 150	12	3.6

Table 7

Writing Assessment Test Recommended Placement

Writing Course	Absolute Freq.	Adjusted Freq. (%)
WRT 070	45	10.7
WRT 100	206	48.8
WRT 101	75	17.8
CLEP	96	22.7

All information contained in the tables were generated from the corputer printouts supplied by the Pima College computer department. All statistical information was calculated using the SPSS program.

The data used in this study were archival in nature. Neither the students nor the professors had any influence on this data as far as having any previous knowledge that such a study would be conducted. The so-called Hawthorne effects were practically nonexistent (Issac and Micheal, 1981:86).

DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

Each student registering at Pima College during the interval from which the data used in this study was collected was asked to take the assessment test. This request did not have to be followed. As indicated by the data, most students who enrolled in PHY 121 had taken some part of the assessment test. In reference to Table 3, it was seen that 87 percent of the total sample population selected to take the reading test. Furthermore, 67 percent selected the mathematics test and only 44 percent selected the writing test. When the correlation coefficients were examined, the highest value was $r = 0.32529$. This value was found between the Nelson-Denny Reading score and the completion of PHY 121 with a passing grade. The next highest correlation, with an $r = 0.22315$, was between the Pima College Math score and the completion of PHY 121 with a passing grade. The correlation coefficient was smallest between the Pima College Writing score with an $r = 0.21865$. A possible conclusion was that the Nelson-Denny Reading score was the best predictor of a student's completion of PHY 121 with a passing grade.

Examination of the data complied in Table 4 indicated that the population of students who took the Nelson-Denny had a reading level grade equivalent to 13.8. The kurtosis of the curve indicated a sudden increase to the mean then an abrupt fall in numbers of students with grades much

above the mean. The resultant curve is more cone shaped than bell shaped. The negative skew indicated a tendency toward higher scores by this population. This may have indicated the possibility that the students who took PHY 121 were self-selective, that is, those students selected PHY 121 because they felt they had the skills needed to pass the course.

The Math I Assessment Test Placement Recommendation, contained in Table 5 was studied. It was found that 84.2 percent of the sample population taking PHY 121 had been placed at the MTH 070 (a math course below the prerequisite for the PHY 121 class). It seemed that 84.2 percent of the students were entering PHY 121 with a lack of the prerequisite math in place. There was an indication of a problem with the math portion of the assessment test. A smaller number of students did elect to take the second half of the math placement test and 44.5 percent, as found in Table 6 were placed in MTH 130 (the math level equivalent to the prerequisite math level stated for PHY 121). It seemed that either the math prerequisite was not appropriate for the PHY 121 or that the math portion of the assessment test was not an accurate measure of a student's ability. The math portion of the assessment test was not used as a suitable indicator of a student's final grade in PHY 121 because of this problem.

The writing portion of the assessment test, upon closer scrutiny revealed that a correlation of r = 0.21865 existed. Examination of the data from which Table 7 was complied indicated that 48.8 percent of the sample population was placed at WRT 100.(which is a developmental writing course). Only 17.8 percent were placed at WRT 101 (freshman composition). A problem seemed to exist with the writing portion of the assessment test. There is no writing requirement for PHY 121. It appeared curious that students completing PHY 121 had need of better writing skills. The writing scores were found to be unsuitable as an indicator of a student's completion of PHY 121, with a passing grade, because of this problem.

The implication was plain. The possibility existed that the manner in which PHY 121 was taught during the time interval specified, precluded any need of certain basic skills in mathematics or writing. This seemed unlikely because not all students passed PHY 121. Considering that the assessment test might not, with the exception of the Nelson-Denny reading test, reflect the student's true assessed skills, it was concluded that only the reading portion of the assessment test was able to be used as a predictor of a student's completion of PHY 121 with a passing grade.

The interpretation of the coefficient value, r , is described by Hardyck (1969:217):

> One useful interpretation of r is to consider the amount of total variance in Y which is accounted for by a knowledge of X. This can be determined by squaring r.

From the data, only 10.6 percent (this is r squared) of the variance in the reading scores and completion of PHY 121 with a passing grade were associated. Continuing with the interpretation of r, according to Hardyck (1969:217):

> . . . r can range between + 1.0 and -1.0. A correlation coefficient is not expressed in the units of measurement from which it is obtained, as are the mean and standard deviation. Therefore, we must exercise some caution in deciding the meaning of a correlation coefficient.

A 10.6% association is very low. Furthermore, with reference to Hardyck (1969:218):

> Only the researcher's judgement can be used to decide if the statistically significant results have any practical meaning. One other way to interpret r is in terms of the use for which it is intended.

Hence, based on the original question asked - of all students enrolled in Pima College for the past five years, who have completed PHY 121 with a passing grade, have those students placed high on the assessment test - there does exist a relation between the assessment test score and completion of PHY 121 with a passing grade, albeit at "a definite, but small relationship" (Barton, 1984:53).

It is recommended that all entering students at Pima College be required to take the assessment test. A careful

monitoring should begin of the assessment placement recommendations and the actual progress of the student so placed. Even the low level of correlation indicates that the assessment test, if properly used, can be an indicator of student success in PHY 121 and for this reason, the current assessment policy and test might be ready for revision.

It was also recommended that the Pima College writing and mathematics portion of the assessment test be examined as to the ability of these tests to actually predict a student's success at the time the assessment test is taken.

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APPENDIX A

LETTER FROM VICE PRESIDENT FOR ACADEMIC AFFAIRS

Inter-OfficeMemorandum
PimaCommunityCollege

TO: D. G. Iadevaia

FROM: Carol A. Gorsuch, Interim Executive Vice President for Academic and Student Affairs

DATE: October 5, 1988

SUBJECT: Access to Student Records

First, congratulations on being accepted into the doctoral program in Higher Education with Nova University. Science curriculum is an excellent choice that should provide you opportunities for quality research and potential articles for publication. As you are most aware, community college faculty, in general, have not designed and conducted research on their many outstanding projects.

Since your various research topics may cut across areas of administrative responsibility, I am suggesting that you and I formalize a process for requesting access to student records for each separate topic.

Your current topic regarding the College assessment test(s)' ability to predict a student's success in the basic physics course is a good start. The Computer-Assisted Assessment/ Placement Program in Basic Skills is under the direction of the Vice President for Student Affairs. In the past, Ms. Diana Coonce assisted Dr. Louise Bronson on a mini-grant to determine predictors of student success in PSY 100 courses. Dr. Bronson also enlisted the advice and approval of the Psychology CSAC to conduct this project. You will need to inform the Physics CSAC of your study as well.

Traditionally, the single most important test to determine academic success is the reading test. You may wish to consider analyzing both the math and reading tests. If writing out experiments or reports is required in introductory College-level physics courses, then all three assessment instruments should be analyzed. Also, a significant number of foreign students enroll in Engineering as a transfer program; therefore, English proficiency through the ESL test in tandem with the reading test should be considered. Obviously, narrowing your research topic on assessment as a predictor of success will be a formidable task.

Finally, access to student records will require obtaining approval from the following individuals depending upon the specific focus of each of your research topics:

Fred Montes, Interim Vice President of Student Affairs
Joe Cosentino, College Registrar
Russ Collmer, Director, Institutional Research

Please provide my office with the results of your practicums with copies to the administrative area that officially approved your request. Thank you for the offer to suggest additional studies for your practicum.

CAG:ej

cc. F. Montes
J. Cosentino
R. Collmer
D. Coonce

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