1950

The Effectiveness of Experienced and Inexperienced Teachers as Shown by Student Achievement

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The large number of students who enrolled in the colleges of the United States after World War II brought many unusual problems to college administrators. The influx of students was so great that the teaching personnel had to be rapidly increased. Many inexperienced teachers had to be employed. It is probable that temporary staff members included many whose training and other traits would have barred them from teaching except during such an emergency. This condition provided an excellent opportunity for testing many hypotheses that could not have been tested under prevailing college conditions in normal times. One of the important issues at that time was the effectiveness of experienced and inexperienced teachers on the future academic achievements of their students. The purpose of this paper is to indicate the effectiveness of experienced and inexperienced teachers as shown by student achievement in calculus.

Academic predictions and analysis of factors affecting academic achievement have been the concern of many educators. Krathwohl [1] applied the predictions to groups of individuals when he conducted an investigation to see if it were possible to predict, before an instructor meets his classes, whether such classes would turn out to be good, medium or poor. He used classes from five courses at the Illinois Institute of Technology: review algebra, college algebra, analytic geometry, calculus I and integral calculus. The Iowa Mathematics Aptitude Test was used, and average class grades were compared with average test scores. He found that ". . . high grades are accompanied by high mathematics aptitude scores."

Another of Krathwohl's findings was that when graduate assistants and part-time instructors were included with full-time faculty members the correlation coefficient between college algebra and mathematics aptitude scores dropped from 0.61 to 0.54. He suggested that the lower correlation might be due to the inexperience of the graduate assistants and part-time instructors in teaching and grading but that it was more likely due to lack of understanding of what these teachers were expected to accomplish.

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1 Krathwohl, William C. Predictions of Average Class Achievement by Means of Aptitude Tests. The Journal of Engineering Education, 37: 234-242, November, 1946.

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Speight,[2] in a sampling of opinion of 123 college teachers, found that a young teacher in a department needed the guidance of the experts in his field.

. . . the young college teacher should be shown how to choose text books, how to make assignments, and how to make out marks; the neophyte should be helped to recognize differences of need, ability, background, and interest in his students, and conduct classroom discussions; . . .

The general opinion of the 123 teachers was that someone in the department in which they are teaching should take over where the professor of education left off because the professor of education cannot be specifically prepared in all fields.

Brewer[3] at Queens College studied 204 students in a physical science survey course which was taught by four instructors. One objective was to see if differences of instructors had been a factor in student achievement. He found the difference to be small with a greater difference occurring in changes of opinion of the students rather than in achievement.

The study here reported was based upon 552 male students who enrolled in college algebra at the Iowa State College for the fall quarter 1946 and finished their first quarter of calculus by the end of the spring quarter, 1948.

The criterion chosen for calculus achievement was the course mark assigned at the end of the first quarter. The controls were: college algebra achievement test score (test was given at the end of one quarter of algebra); the final mark in college algebra (letters were assigned quality points from 0 to 4 inclusive); and the all-college quality point average.

The technique of analysis of covariance was used. The analysis of covariance enables us to dispense with the matching procedures so often used and to secure even greater precision by the use of statistical controls.

The general nature of the method of covariance can best be made clear by use of a simple concrete illustration. Suppose that we are conducting an experiment comparing the effect of two algebra teachers on their students' educational outcomes in calculus. Suppose that we assume the mark given by the instructor is a true measure of the student's initial ability to manipulate algebra and that the mark given by the instructor in calculus is the criterion of

2 Speight, Harold E. B. Who Shall Train the College Teacher? The Journal of Higher Education, 14: 91-96, February, 1943.

3 Brewer, Waldo Lyle. Factors Affecting Student Achievement and Change in a Physical Science Survey Course. Teachers College, Columbia University, Contributions to Education, 863, 1943.

final achievement of the student's ability to manipulate algebra. The hypothesis that we wish to test is that there are no real differences in teachers, and that any differences in final mean marks of the two groups, after allowances have been made for chance differences in initial mean marks, are due entirely to chance difference in random sampling. We have not specified the manner in which the allowances for initial differences will be made in order to obtain the same precision as could have been attained had the groups been actually matched on the basis of algebra marks.

The allowances for initial differences are made in terms of the regression equation using the calculus marks as a criterion and algebra marks as controls. According to our hypothesis this regression is the same for both groups. If x represents the deviation of any student from the mean of the X's of both groups, an estimate of the deviation (y) can be found by multiplying x by the regression coefficient. By adding or subtracting this to the actual final mark we have an "adjusted" criterion mark which is independent of the student's initial ability. Suppose that we find the mean of the adjusted marks for each of our groups separately, the relative magnitude of these adjusted means would be interpreted as if the groups had originally been matched. The analysis of variance can be applied to these adjusted marks to test the hypothesis that the differences in adjusted teacher group means are due entirely to chance.

The foregoing is not a specific procedure, merely an explanation that the analysis of covariance enables us to:

(a) Estimate the regression of calculus marks using algebra marks,

(b) Use this regression coefficient to adjust the calculus marks so as to allow for individual differences in the algebra marks,

(c) Test the significance of the differences remaining in the adjusted teacher group means.

Fourteen of the 37 teachers who taught algebra during the fall quarter of 1946 were inexperienced. An inexperienced teacher in algebra was defined as any teacher having fewer than two years teaching experience. All teachers with two years or more experience were defined as experienced algebra teachers.

One-third of the teachers who taught calculus to the 1946 fall group were inexperienced in teaching calculus. An inexperienced teacher in calculus was defined as any teacher of calculus who had had fewer than five years teaching experience and had taught calculus less than one year.

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In order to ascertain if the experience of the instructor was a factor in their students' college calculus achievement, the 552 calculus students were divided into the following four groups according to the experience of their algebra and calculus teachers: 83 had inexperienced teachers in both algebra and calculus, 118 had inexperienced teachers in algebra but experienced teachers in calculus, 147 had experienced teachers in algebra but not in calculus and 204 had experienced teachers in both. When the four groups were analyzed by means of covariance analysis, the differences between the groups were significant.

The difference between the predicted mean marks and actual mean marks made in calculus is shown in the following tabulation:

Teachers	Actual mean mark minus predicted mean mark in calculus
Experienced in both algebra and calculus	+0.14
Experienced in algebra, inexperienced in calculus	+0.03
Inexperienced in both algebra and calculus	—0.08
Inexperienced in algebra, experienced in calculus	—0.15

Since the two groups which had inexperienced teachers in algebra dropped below their predicted calculus marks and the two groups which had experienced teachers in algebra make marks above the predicted value, it seems reasonable to assume that the experience of the algebra teacher is a factor related to the academic achievement of students in calculus.

In summary the 552 students were divided into four groups according to the experience of their teachers. The technique of covariance was used to analyse the significance of the differences between the four groups. Since the two groups that had experienced teachers in algebra did significantly better in calculus than the two groups that had inexperienced teachers in algebra, it is reasonable to conclude that the scholastic achievement of a student in calculus is affected by the experience of his algebra teacher.