A COMPARISON OF NON-BUSINESS AND BUSINESS STUDENT TEST SCORES IN BASIC

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Abstract

An experiment is described that analyzes differences in BASIC test scores between a group of 58 non-business and 104 business majors. All students were given four weeks of instruction in BASIC and took a common BASIC examination testing their knowledge of language rules and their ability to read programs.

Analysis of multiple covariance was used to statistically adjust BASIC test scores for performance on a computer concepts examination and age. The results showed no significant difference between the scores of the non-business and business majors on the BASIC examination.

These findings are important since they provide empirical evidence that the ability to understand programming language is independent of students' academic direction. Thus, the benefits of programming experience appear to be realizable for both business and non-business students.

INTRODUCTION

Two types of introductory computer courses are currently being offered at many colleges and universities. One course is directed towards the undergraduate Business Administration major and is usually a degree requirement. This course covers the standard topics such as hardware and software systems, introduction to systems analysis, programming concepts, and computer applications on business.

The second type of course is the so called Computers & Society course aimed at the non-business major. Major topics include hardware and software systems, programming concepts, social implications of the computer, and computer applications in the humanities and social science. At some schools this course can be used to partially satisfy general education requirements in Social Sciences.

An important consideration in developing introductory computer classes for both business and non-business majors is how much programming should be taught. A survey of 306 Business Administration and Computer Science departments (Braswell, 1977) has shown that most of their introductory courses include programming language instruction as a major component, with 58% of the respondents devoting more than 25% of class time to programming languages. There does not appear to be a similar consensus as to the amount of programming that should be included in a course for non-business majors. Consequently, Programming language instruction can vary from none, to a level that is comparable to that of the introductory computing classes for business and computer science majors. Another approach followed in many Computers and Society courses is to teach the use of library packages (e.g. SPSS, BMD, etc.) instead of a particular language.

The rationale for the deemphasis of programming language instruction in introductory computer classes for non-computer related majors is that students will not have the necessary background skills to successfully learn to program. The comment that I most often hear is that these students are "afraid" of the computer and a lot of programming will only serve to "terrify" them.

There are two questions underlying this issue. First, is ability to program necessary to appreciate the increasingly important role that computers are playing in our lives? I feel that the answer to this question is most definitely "yes." An understanding of human-machine communication and structured problem solving (programming) enables students to objectively evaluate the capabilities and limitations of the computer. The second question is whether or not there is a significant difference in the ability to learn programming between business and non-business students. This is an important question since it's answer will influence the organization of the introductory computer course.

This paper describes an experiment that compares the Bus 280 (non-business majors) and Bus 294 (business majors) student scores on an examination testing their proficiency with BASIC. Proficiency was measured by an examination that tested students knowledge of language rules and their ability to determine the output of given BASIC programs.

METHOD

SUBJECTS. The subjects consisted of 104 business majors who completed one of four Bus 294 classes and 58 non-business majors who completed one of four Bus 280 classes. All eight sections were day classes and were taught by the researcher. One section of each course was taught each quarter from Fall, 1978 to Fall, 1979. Table 1 presents data on the number of students by section.

Table 1

Number of Students Included

In The Study By Section

Quarter/Year	Course Bus 280	 Bus 294
Fall/1978	21	25
Winter/1979	9	25
Spring/1979	10	30
Fall/1979	18	24
Total	58	104

Table 2 presents a more detailed description of the students. As shown in this table, 43 of the students completing Bus 280 and 22 of the students completing Bus 294 were not included in the analysis. The decision was made to not include any business majors enrolled in Bus 280 or non-business majors enrolled in Bus 294 in the comparative analysis. This decision was based on the desire to focus exclusively on students enrolled in the introductory course specifically designed for their academic direction. However, students in the two treatment groups whose records indicated that they had not defined a major, were included since they were assumed to have indicated their interest in pursuing either a business or non-business major by virtue of their enrollment in either Bus 280 or Bus 294. This assumption seems valid based on the researcher's personal knowledge of the academic orientation of most of these students.

The large proportion of business majors completing Bus 280 is puzzling since they are advised (the first week of class) not to take this course since it cannot be used to satisfy the business core requirement (they must still take Bus 294) and it turns out to be a superfluous course in satisfying the General Education requirements.

PROCEDURE. All students received three weeks of instruction on introductory computing concepts and four weeks of instruction in BASIC. The introductory material included discussion of major hardware and software components, brief history, flowcharting fundamentals, and introduction to programming languages. The coverage of BASIC included the following statements: LET, PRINT, END, READ, DATA, GO TO, IF, INPUT, and FOR-NEXT. In additon, the following system commands were covered: LIST, RUN, NEW, OLD, SAVE, UNSAVE, RENAME, REPLACE, CATALOG, and BYE. All classes were assigned six homework problems ranging in difficulty from simple arithmetic calculation to controlled-loop processing. Students worked in a time-shared environment using a PDP 11/45 minicomputer. Structured walk-throughs, as described in Lemos (1979), were incorporated into the instructional process. While students used different textbooks, the lecture material on computer systems and BASIC was presented from the same set of notes.

All students took two common examinations. One focused on the introductory concepts covered during the first three weeks. This 50 point examination was made up of true/false and multiple choice questions that are typical of the ones that are found in Insturctor's manuals. The second examination, also worth 50 points, focused soly on BASIC. The questions on BASIC were of two types. The first type consisted of 35 true/false questions on correct language usage. Examples of test items include the fllowing:

> In the For-Next command, the counter can be increased by any value.
>
> The GO TO statement is a conditional branch statement.
>
> An INPUT statement requires an associated DATA statemetnt.

Table 2

Student Population By School and Major

Bus 280			Bus 294		
School/Major	No. of Students		School/major	No. of Students	
Fine and Applied Arts		8	Business Admin		86
			General	10	
Child Devel	2		Special Bus	1	
Indust Arts	1		Labor Relations	1	
Music	1		Pre-Legal	5	
Criminal Justice	1		MBA	1	
Physical Educ	3		Unclassified Grad	5	
			Accounting	31	
Letters and Science		22	Bus Info Systems	3	
			Bus Education	2	
Biology	1		Office Admin	1	
English	1		Economics	1	
Chemistry	3		Finance	2	
Biochemistry	2		Real Estate	5	
Geology	1		Management	11	
Political Sci	1		Marketing	4	
Math	4		International Bus	3	
Medical Tech	6				
Sociology	1				
Liberal Studies	2				
Engineering		5			
General	1				
Electrical	3				
Civil	1				
Undecided		23	Undecided		18
Business Admin (not included in the analysis)	(43)		Non-Bus Admin (not included in the analysis)	(22)	
Total		58			104

(correct=true, incorrect=false)

```
999 IF X9=999 THEN 999

75 FOR A=X2 TO T4

35 LET A$=CAL STATE UNIVERSITY
```

The second type of question consisted of five programs (three points each) that students were to read and determine the result output. the following is an example of these types of questions:

What is the first line of output generated by the following program?

```
 5 LET X = 0
 7 LET A = 1
20 LET X=(X+1)*(A+1)
30 LET IF X>15 THEN 50
35 LET A=A+1
40 IF A<10 THEN 20
50 PRINT A, X
60 END
```

a.	3	40
b.	3	45
c.	4	40
d.	4	50
e.	none of these	

All tests were completed during the allotted time period and were machine scored.

RESULTS

STATISTICAL ANALYSIS. Analysis of multiple covariance was used to compare the BASIC examination scores of the Bus 280 and Bus 294 students. Two covariates were used: student test scores on the first examination (computing concepts) and student age (derived from student records). Student test scores were used as a covariate to estimate students' academic skills. Age was chosen as a covariate because it has been shown to be an important variable in the ability of people to learn a skill (WELFORD, 1958).

A covariate is a factor representing a source of variation which influences the experiment but cannot be experimentally controlled (through random assignment of subjects to treatments). Covariance analysis then statistically controls for the effect of one or more covariates on the dependent variate being studied. This reduces experimental error and obtains an unbiased estimate of treatment effects. Covariate analysis is appropriate for experiments involving intact groups (classrooms) since it statistically addresses the lack of preexperimental sampling equivalence in situations where randomization is latent (Elashoff, 1969; Kirk, 1968). However, Elashoff (1969) emphasizes the importance of satisfying the following assumptions about the data when covariance analysis is used:

1. Covariates must be statistically independent of the treatment. This is insured by measuring the covariates prior to the administration of the treatment (instruction in BASIC).
2. The covariates and the criterion variable must exhibit a linear relationship. This was checked by analyzing sets of scatter plots for each treatment group. Also, the slopes must be statistically different from zero.
3. Covariates must not exhibit treatment-slope interaction. This means that covariates must not have statistically unequal slopes.

Since both covariates were tested and satisfied these assumptions, the dependent variate (BASIC test scores) was adjusted for multiple potential sources of biases.

MAJOR FINDINGS. Table 3 presents the analysis of multiple covariance results for BASIC test scores of the two groups.

The two groups were found to be very similar in terms of their pretest (Test 1) scores and age. Also, both of these covariates exhibited slopes significantly different from zero (zero slope hypothesis rejected with F=37.2), and statistically similar slopes (hypothesis accepted with F=.02). Bus 280 students achieved a higher adjusted BASIC test score mean (38.34) than the Bus 294 students (37.52). However, this difference was not found to be significantly different (F=.57) at any probability level.

DISCUSSION.

This study presents empirical evidence that there is no significant difference in programming language learning capability between business and non-business majors. This finding suggests that from an academic point of view, a focus on programming is entirely appropriate in the introductory computer course designed for non-business majors. This is very encouraging since it has been the researcher's experience (based on informal comments and written evaluations) that students find programming to be the most interesting part of the course. Thus, the assertion that the general university student will not do well if programming is stressed, does not appear to have an empirical basis.

An important consideration in this study is the possibility that experimental mortality (loss of subjects from the treatment groups) may have introduced systematic biases into the experiment. In other words it may be possible that authorized and unauthorized withdrawals by students may have resulted in non-representative treatment groups. Therefore, the following attrition rates were calculated for the Bus 280 and Bus 294 groups, respectively: .123 and .118. A test for significance of difference between two proportions shows a non-significance z-value of .12.

While a similarity in cognitive measures appears to exist between these two groups, empirical research is needed to investigate differences in attitudinal outcomes of students enrolled in both types ofcourses when programming is stressed. A study by Lemos (1978) shows that business majors tend to exhibit positive attitudes towards programming. An attitudinal study of non-business majors needs to be undertaken. I would hypothesize that non-business student attitudes would also be significantly positive. If both cognitive and attitudinal measures indicate the effectiveness of focusing on programming in the introductory computer course for all students, then current proposals for non-programming introductory computer courses appear to be difficult to justify.

Table 3

Analysis of Multiple Covariance

For BASIC Examination Scores

Source	D.F.	SS	MS	F
Equality of Adjusted Cell Means	1	24.92	24.92	.57
Zero Slope	2	3243.85	1621.93	37.20*
Error	158	6888.29	43.60	
Equality of Slopes	2	1.47	.73	.02
Error	156	6886.82	44.15	

*p <.01

	Control Variables				Criterion Variables			
	Age		Pretest		Unadjusted BASIC Test Scores		Adjusted BASIC Test Scores	
Group	Mean	SD	Mean	SD	Mean	SD	Mean	Std Error
Bus 280 (n=58)	23.03	6.57	39.16	5.93	38.48	7.72	38.34	.87
Bus 294 (n=104)	23.99	5.47	39.10	6.08	37.44	8.09	37.52	.65

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