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A Study to Determine if Predictive Relationships Exist Between First Month Apprentice Mathematic Failures and Unsuccessful Completion of the Three Year Norshipco Apprentice Program

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A STUDY TO DETERMINE IF PREDICTIVE RELATIONSHIPS EXIST
BETWEEN FIRST MONTH APPRENTICE MATHEMATIC FAILURES AND
UNSUCCESSFUL COMPLETION OF THE THREE YEAR
NORSHIPCO APPRENTICE PROGRAM


A Research Paper
Presented to
the Faculty of the School of Education
Old Dominion University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Education

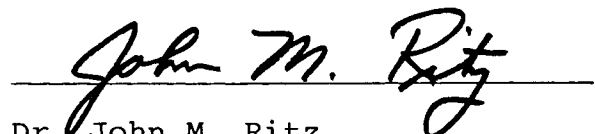
by
Donald Allan Kilmer
January 1980

This research paper was prepared by Donald A. Kilmer under the direction of Dr. John E. Turner in VIAE 636, Problems in Education. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Master of Science in Education.

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Chapter 1

INTRODUCTION

An apprentice program has been in existence at the Norfolk Shipbuilding and Drydock Corporation (Norshipco) since the Voluntary Apprenticeship Act of 1938 became law. Commencing with the annual apprentice hiring in 1973, the Norshipco apprentice program was reduced from four to three years. Within the three year apprentice program, there are four one month periods of related instruction comprising a general technical education curriculum. Of these four one month periods, the first month contains two mathematic courses.

STATEMENT OF THE PROBLEM

The problem of this study was to determine if a correlation exists between first month apprentice mathematic failures and unsuccessful completion of the four months of related instruction in the three year apprentice program.

HYPOTHESES

In order to determine the predictive relationship between the apprentices failing one or both of the two first month mathematic courses and their unsuccessful completion of the four months of related instruction, the following

null hypotheses were tested:

H₀₁. No predictive relationship exists between the unsuccessful completion of the two first month mathematic courses by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

H₀₂. No predictive relationship exists between the unsuccessful completion of the mathematic course Arithmetic Review (AR) by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

H₀₃. No predictive relationship exists between the unsuccessful completion of the mathematic course Calculations and Formulas (CF) by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

SIGNIFICANCE

The significance of this study lies in the fact that there appears to be a correlation between an apprentice who fails one or both first month mathematic courses and an apprentice who does not complete the four months of related instruction in the three year apprentice program. To date, no study has been conducted to determine if a correlation exists between apprentices who fail one or both mathematic courses in the first month of related instruction and those

apprentices who complete the four months of related instruction in the three year apprentice program.

If a correlation exists, Norshipco will have an additional measuring device, supplemented by work performance records, trade instruction reports and other data, which may assist in indicating those apprentices who should be dropped after the first month of related instruction.

LIMITATIONS

Several limitations inherent in conducting this study were:

A. Academic data was obtained from records of apprentices who were:

<u>Hired</u>	<u>Graduated</u>
1973	1976
1974	1977
1975	1978
1976	1979

B. Attrition, for reasons other than failure in first month mathematics courses was, not addressed.

C. No attempt was made to correlate any mathematic marks with the trade of any apprentice.

ASSUMPTIONS

Several assumptions germane to this study were:

1. Teacher grading procedures during 1973 through 1976 were the same.

2. The teaching abilities of the teachers during 1973 through 1976 were equal.

3. The learning abilities of apprentices enrolled during 1973 through 1976 were representative of future populations of apprentices to be enrolled in the Norshipco apprentice program.

PROCEDURES

Data has been presented to show passing or failing grades for both first month mathematic courses. The tabulation shows the number of apprentices who failed one or both mathematic courses at the end of the first month and who were, also, unsuccessful in completing the four months of related instruction in the three year apprentice program.

DEFINITION OF TERMS

Apprentice: a worker who learns, according to a written agreement, a recognized skilled trade requiring two or more years of work experience on the job, through employment supplemented by appropriate related training experience (Roberts, 1971, p. 383).

Apprentice program: a program registered with the Virginia Apprenticeship Council and evidenced by official approval of the Secretary of the Virginia Apprenticeship Council as meeting the apprenticeship standards of the Virginia Apprenticeship Council (Virginia Apprenticeship Council, EEO in Apprenticeship, State Plan, Rev. 1978, p. 1).

Arithmetic Review (AR): review of whole numbers, common fractions, decimal fractions, ratio and proportion, percent, variation, squares and square roots. Numerous practical applications. No calculator. Textbook/Workbook. This course is pencil and paper arithmetic. Thirty hours. (Norshipco Apprentice School academic course descriptions, 1977, p. 2).

Calculations and Formulas (CF): powers of 10, scientific notation, evaluating formulas, simple areas and volumes, metric system, use of units and unit conversions. This course is specific preparation for Chemistry and Physics. Calculator. Instructor prepared worksheets. Thirty hours. (Norshipco Apprentice School academic course descriptions, 1977, p. 2).

Norfolk Shipbuilding and Drydock Corporation (Norshipco): a privately owned, profit seeking company in the marine shipbuilding, drydock, conversion and repair industry located in Norfolk, Virginia. (Apprentice Program at Norshipco, 1977, p. 1).

Related instruction: supervised industrial technologically oriented general education courses designed to inculcate in the apprentice the value of productivity. Related instruction is designed to:

1. "Broaden his horizons in the industrial and technological aspects of our culture.
2. Develop his technical competencies for responsible citizenship within society and the free enterprise system. and

3. Determine his potential for management within the shipbuilding, conversion and repair industry."

(Kilmer, 1979, p. 2)

Virginia Apprenticeship Act of 1938: a state law enacted by Virginia General Assembly in 1938 which provides for a system of voluntary apprenticeship, having as its basic objective, the development of a cooperative relationship between employers and employees for the purpose of providing a system through which, skilled craftsmen may be trained. (Virginia, Department of Labor and Industry, Apprentice Training in Virginia issued by the Office of Director, Division of Apprentice Training, Richmond: c. 1973, p. 4).

SUMMARY

This study attempts to establish whether the apprentice who fails one or both first month mathematic courses will be unsuccessful in completing the four months of related instruction in the three year apprentice program. To determine if a correlation exists, academic data for the apprentices hired annually in 1973 through 1976 will be examined.

This should also assist in indicating those apprentices who should be terminated after the first month of related instruction. Further, this study may earmark those apprentices who should be assigned additional studies between the first and second months of related instruction.

Chapter 2

REVIEW OF RELATED LITERATURE

The Norfolk Shipbuilding and Drydock Corporation (Norshipco) has maintained an apprentice program since enactment of the Virginia Apprenticeship Act of 1938. Throughout the three year apprentice program, the application of mathematical skills to practical problems in the industrial technology of the marine industry has been stressed.

The three year apprentice program consists of four one-month academic periods of related instruction comprising a general technical education curriculum. In the first month there are two mathematic courses which could be used as predictors of the failure or success of the apprentice to complete the four months of related instruction in the three year apprentice program.

The problem of this study was to determine if a correlation exists between first month apprentice mathematic failures and successful completion of the four months of related instruction in the three year apprentice program. For purposes of this study, the review of literature provides: (1) historical perspective of the apprenticeship system; (2) state of the art of apprentice training in Virginia; (3) overview of the apprentice program at Norshipco; (4) academic requirements for apprentice training for the shipbuilding

trades; and (5) summary.

HISTORICAL PERSPECTIVE OF THE APPRENTICESHIP SYSTEM

Apprenticeship is the process of learning through planned experiences to become a skilled craft worker. Craft workers have been transferring skills from generation to generation. The importance of maintaining skilled workers in the society was recognized very early in the history of civilization. This is evidenced by the Babylonian Code, compiled about 4,000 years ago, which had provisions to ensure that skilled craft workers would pass on their arts to youth (A Woman's Guide to Apprenticeship, U. S. Dept. of Labor, Office of the Secretary, Women's Bureau, 1978, p. 3).

In Europe, skills were traditionally passed on through a Master-Apprentice System in which an apprentice was indentured to a "Master Craftsman" for a specified number of years. The apprentice received food, clothing, and shelter in return for the work performed while learning the trade or craft. When the period of indenture was over, the apprentice was recognized as a "journeyman" or fully skilled independent worker.

Today the apprenticeship process is a formal arrangement involving employers, unions, post secondary vocational/technical schools and individuals who want to become skilled in a trade or craft. The modern apprentice program combines on-the-job training, supervised by skilled first class mechanics/journeyworkers, with related instruction. The

apprentice learns the arts and skills of the trade through on-the-job planned experiences at the worksite. The theoretical aspects of work are taught through classroom instruction. These theoretical aspects are contained in courses which include practical applications in mathematics, engineering drawing and graphic technology, communications technology and the physical sciences related to the job.

The length of the apprentice program varies from one to four years depending upon the trade or craft. Initially, apprentice wages are about 50% of the journeyworker rate and, in general, increases are awarded every six months so that toward the latter part of the program the apprentice is performing the work of a journeyworker and receiving about 95% of the journeyworker wage.

With the foregoing in mind and with the inception of the Voluntary Apprenticeship Act of 1938 in Virginia, the premise of hands on training under the guidance of a skilled worker combined with related instruction appears to be a cost effective method of providing skilled craft persons for Virginia's industries.

STATE OF THE ART OF APPRENTICE TRAINING IN VIRGINIA

The Virginia Apprenticeship Act, enacted by the Virginia General Assembly in 1938, provides for a system of voluntary apprenticeship. The Act has for its basic objective the development of cooperative relationships between employers and employees for the purpose of providing a system through which skilled craftpersons may be trained.

The Virginia Apprenticeship Council, appointed by the Governor, is composed of three representatives each from employer and employee organizations respectively. The Council is charged by the Voluntary Apprenticeship Act with the responsibility of establishing and maintaining a system of apprenticeship training.

The Division of Apprentice Training of the Department of Labor and Industry is responsible for administering and carrying out the provisions of the Act under the guidance of the Council. It cooperates with industry, labor, state educational systems, and other state and federal government agencies to assure continued success of apprenticeship training. This Division supports, assists and advises, educators, professional and trade groups, and the state veterans assistance agencies on apprenticeship matters. Personnel of this Division serve on Area Manpower Planning Councils and various vocational education advisory groups and participates with the State and National Apprenticeship System (a program information system designed to collect data on a national basis). Cooperation with the Bureau of Apprenticeship Training, U.S. Department of Labor leads to state and national cooperation and universal recognition of apprenticeship graduates. In 1978, there were

497 new programs and 3,139 new apprentices registered. Apprenticeship completions for the year totaled 1,399. This was the eighth consecutive year that 1,000 or more apprentices completed training in Virginia. The total number

of active apprentices at the end of 1978 was 6,603. (VA Department of Labor and Industry Annual Report 1978, p. 18),

OVERVIEW OF THE APPRENTICE PROGRAM AT NORSHIPCO

The apprentice program of the Norfolk Shipbuilding and Drydock Corporation (Norshipco) was established in 1936 to meet the need to train apprentices in shipbuilding trades and to instruct them in subjects related to their trades. The three year apprentice program is a formal relationship between Norshipco, a privately owned, profit-seeking company, and the apprentice with mutual responsibilities established between them. This relationship is manifested in a signed apprenticeship agreement in which Norshipco agrees to provide the apprentice with thorough instruction and practice in a trade, reasonable assurance of steady employment and to pay for his labor according to a definite schedule of rates. The apprentice agrees to be punctual and regular, proper in his conduct, to be diligent and persevering at all times and to endeavor to become proficient and productive in his craft to the best of his ability.

Annually, an apprentice trade selection board considers all eligible (pre-screened) applicants paying particular attention to physical capacity for rigorous activity, academic records and evaluations of personal interviews conducted by the trade selection board. Employment of successfully screened applicants is a company prerogative based upon available openings and the applicant's qualifications.

In conjunction with the foregoing and to provide profitable production within the marine shipbuilding, drydocking, conversion and repair industry, Norshipco maintains the following trades:

Ship carpenter/Joiner	Shipfitter
Electrician	Boilermaker
Rigger	Pipe maintenance
Machinist (Inside)	Pipefitter
Machinist (Outside)	Insulator
Welder	Painter
Dockmaster	Sheetmetal
Blacksmith	

Once a trade or craft is mutually agreed upon the apprentice undergoes four one month periods of related (academic) instruction and one month of related training (Burning and Welding School) during the three years apprenticeship program. The four one month periods of related instruction consist of a general technical education curriculum. This curriculum encompasses the following academic work specifically related to marine industrial technology.

<u>AREA</u>	<u>SUBJECT</u>	<u>TOTAL COURSE HOURS</u>
Mathematics	Arithmetic/Calculations and Formulas/Algebra/ Geometry/Trigonometry	150
Sciences	Physics/Chemistry/ Strength of Materials	130
Engineering Drawing and Graphic Technology	Blueprint Reading/Engi- neering Drawing	140

<u>AREA</u>	<u>SUBJECT</u>	<u>TOTAL COURSE HOURS</u>
Construction, Repair and Conversion	Shipbuilding/Marine Engineering	40
Humanities	Communications Technology/ Economics/First Aid and Safety	100

The remaining thirty-one months of the thirty-six months apprentice program are concerned with on-the-job training, individual trade instruction, and meaningful work experiences at the worksite.

The Norshipco program was approved by the Virginia Apprenticeship Council and the Veterans Administration. The State Department of Education, through the Norfolk Public School's Adult and Vocational Department, assists in maintaining high standards of academic performance in related instruction. This program was designed to inculcate in the apprentice the value of productivity and to:

1. "Broaden his horizons in the industrial and technological aspects of our culture.
2. Develop his technical competencies for responsible citizenship within society and the free enterprise system and
3. Determine his potential for management within the shipbuilding, conversion and repair industry." (Kilmer, 1979, p. 2)

ACADEMIC REQUIREMENTS FOR APPRENTICE TRAINING FOR THE SHIPBUILDING TRADES

Within the Southeastern Virginia, urban-industrial complex, the marine industry is represented by three major shipbuilding, drydock, conversion and repair shipyards.

Ownership of the shipyards is equally divided among the federal government and the commercial and private sectors. Both the government and private shipyards are predominately conversion and repair oriented while the commercial shipyard, the largest of the three, is keyed to new construction. Additionally, both the commercial and private shipyards perform work under contract to various governmental agencies (Department of Defense, Maritime Administration, National Oceanographic and Atmospheric Administration, etc.).

Each of these shipyards maintains an apprentice program within the guidelines provided by the Virginia Apprenticeship Council. All have the same eligibility application standards regarding age, proof of satisfactory secondary school completion or its equivalent, satisfactory physical examination and appropriate recommendations from previous employers.

Regardless of the trade under consideration for a particular applicant, a thorough review and evaluation of overall academic performance and, specifically, mathematics is conducted by the trade selection committees of each shipyard. The practical applicability of mathematical skills in reasoning and logic is of substantive importance throughout all shipbuilding trades. Although successful completion of algebra and/or geometry prior to application is not a prerequisite for acceptance by either of the shipyards, each trade selection committee, knowing the value to both the individual and the program, considers successful

completion of one or both of these courses a major determinant for accepting or not accepting an apprentice applicant.

SUMMARY

The purposes of the review of literature for this study were: (1) to provide an historical perspective of the apprenticeship system; (2) to indicate the state of the art of apprentice training in Virginia; (3) to briefly describe the apprentice program at Norshipco; and (4) to reflect the academic requirements for apprentice training for the shipbuilding trades.

Chapter 3

METHODS AND PROCEDURES

A discussion of the design and procedures used for collection and treatment of the data is contained in this chapter under the following headings: (1) statement of the null hypotheses, (2) population of the study, (3) instrument selection, (4) collection of the data, and (5) treatment of the data. It was the problem of this study to determine if a correlation exists between first month apprentice mathematics failures and unsuccessful completion of the four months of related instruction in the three year apprentice program.

STATEMENT OF THE NULL HYPOTHESES

In order to determine the predictive relationship between apprentice failure in one or both of the two first month mathematic courses and their unsuccessful completion of the four months of related instruction, the following null hypotheses were tested:

H_{01} . No predictive relationship exists between the unsuccessful completion of the two first month mathematic courses by apprentices in the Norshipco four months of related instruction and their subsequent success or failure on the remainder of the four months of related instruction.

H₀₂. No predictive relationship exists between the unsuccessful completion of the mathematic course Arithmetic Review (AR) by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

H₀₃. No predictive relationship exists between the unsuccessful completion of the mathematic course Calculations and Formulas (CF) by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

POPULATION OF THE STUDY

The population of this study consisted of two hundred and thirty seven apprentices, predominantly from Southeastern Virginia, who entered into three year apprenticeship agreements with the Norfolk Shipbuilding and Drydock Corporation (Norshipco) during the period 1973 and 1976. A summary of apprentices who entered each year during the period 1973 through 1976 is provided in Table 1.

Table 1. Summary of Apprentices Entered by Year (N = 237)

Year	1973	1974	1975	1976
Number Entered	49	46	60	82

As part of the apprenticeship agreement, the apprentices were enrolled in the company sponsored, state registered, apprentice school.

Each of the apprentices included in the population had met the minimum basic requirements for employment and selection by Norshipco. These basic requirements according to the Apprenticeship Act of 1938, are "Apprentices shall be selected on a basis of objective and specific qualification standards. Examples of such standards are fair aptitude tests, school diplomas, age requirements, occupationally essential physical requirements, fair interviews, school grades and previous work experience." In the "Apprentice Program at Norshipco" (developed and distributed by Norshipco, Norfolk, Virginia, 1977, p. 1), these basic requirements are listed as:

1. Have reached his eighteenth and not his twenty-sixth birthday.
2. He must be a high school graduate and present proof thereof by means of an official transcript of his high school record.
3. He must give permission to the Corporation to ask his former employers for their recommendations regarding the quality of his workmanship and attendance.
4. He must be able to demonstrate a reasonable degree of mechanical aptitude.
5. He must pass a physical examination by the company's physician.

Additionally, consideration is given to physical capacity for rigorous activity and scholastic record (including

attendance, extra curricular activities participation and successful completion of algebra and geometry courses). Finally, selection is made from all eligible applicants by a selection board that objectively evaluates each applicant and selects those best qualified.

INSTRUMENT SELECTION

One instrument was used in this study to collect data: the Norshipco Apprentice School student's report card which was designed to reflect the individual apprentices' raw scores, total points, class standing and number in class for each of the four one month related instruction periods (Appendix A).

COLLECTION OF THE DATA

The population of this study consisted of two hundred and thirty seven applicants who entered into apprenticeship agreement with Norshipco during the period 1973 through 1976. Throughout this period, instructors measured the apprentices' academic performance for each course. Individual apprentice raw scores, total raw score for the month, class standing and number in the class at the end of each of the four one month periods were recorded on the Apprentice School student's report card and certified by the Supervisor of Apprentices. Since student report cards are maintained for a period of seven years, an effective review of 100 percent was accomplished.

TREATMENT OF THE DATA

The data was recorded directly from the apprentice's individual apprentice school report card. These cards contained data to determine passing or failing scores for both first month mathematic courses. A tabulation was completed showing the number of apprentices who, failing one or both mathematic courses at the end of the first month were also, unsuccessful in completing the four months of related instruction in the three year program.

Technically no tests of significance could be calculated because the apprentices included in this study represented a population rather than a sample. Additionally, "no prior research could be found which would support the use of a particular absolute numerical difference in mean scores between environmental groups" (annual hirings) "as being of predictive importance." (Turner, 1974, p. 49) This was also necessary since the four environmental groups (annual hirings) were composed of a different number of apprentices (unequal N's).

Chapter 4

FINDINGS

The problem of this study was to determine if a correlation exists between first month apprentice mathematic failures and unsuccessful completion of the four months of related instruction in the three year apprentice program. This chapter contains the presentation of data and accompanying analyses relative to the following topics: (1) population of the study, (2) analysis of the null hypotheses, and (3) the summary.

POPULATION OF THE STUDY

The population of this study consisted of two hundred and thirty-seven apprentices, predominantly from Southeastern Virginia, who entered into three year apprentice agreements with the Norfolk Shipbuilding and Drydock Corporation (Norshipco) during the period 1973 through 1976. A summary of apprentices who entered each year during the period 1973 through 1976 is provided in Table 1.

Table 1. Summary of Apprentices Entered by Year, 1973 Through 1976 (N = 237)

Year	1973	1974	1975	1976
Number Entered	49	46	60	82

This table shows that, during the period 1973 through 1976, two hundred and thirty-seven apprentices entered the three year apprentice program at Norshipco. Also, this table indicates that, except for 1974 when forty-six apprentices entered that program, the numbers of apprentices who entered each year increased.

ANALYSIS OF THE NULL HYPOTHESES

Analysis of the Data Associated with Null Hypothesis H_{01}

Null hypothesis 1 states that no predictive relationships exists between the unsuccessful completion of the two first month mathematic courses by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction. The two first month mathematic courses are Arithmetic Review (AR) and Calculations and Formulas (CF). A summary of apprentice failures in both courses and their subsequent success or failure in the program by year is presented in Table 2.

In 1973, of the sixteen apprentices who failed the two first month mathematic courses, AR and CF, fifteen failed both the mathematic courses and the apprentice program resulting in a failure rate of 98.8 percent. In 1974, the seven apprentices who failed AR and CF, also, failed the apprentice program resulting in a failure rate of 100.0 percent. In 1975, the two apprentices who failed AR and CF,

also, failed the apprentice program resulting in a failure rate of 100.0 percent. In 1976, the thirteen apprentices who failed AR and CF, also, failed the apprentice program resulting in a failure rate of 100.0 percent.

Table 2. Summary of Apprentice Failures in Both AR and CF and Subsequent Success or Failure in the Apprentice Program, 1973 through 1976 (N = 237)

Year	1973	1974	1975	1976
Number entered	49	46	60	82
Number failed Both AR and CF	16	7	2	13
Number failed Both AR and CF and Failed the Program	15	7	2	13
Percent failed both AR and CF and failed the program	93.8	100.0	100.0	100.0

Analysis of the Data Associated with Null Hypothesis H_{02}

Null hypothesis 2 states that no predictive relationship exists between the unsuccessful completion of the mathematic course, Arithmetic Review (AR), by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction. A summary of apprentice failures in AR and their subsequent success or failure in the program by year is presented in Table 3.

Table 3. Summary of Apprentice Failures in AR and their Subsequent Success or Failure in the Apprentice Program, 1973 through 1976 (N = 237)

Year	1973	1974	1975	1976
Number entered	49	46	60	82
Number failed Only AR	23	15	8	26
Number failed AR and Failed the Program	17	13	3	16
Percent failed AR and Failed the Program	73.9	86.7	37.5	61.5

In 1973, of the twenty-three apprentices who failed only one mathematic course, AR, seventeen failed both AR and the apprentice program resulting in a failure rate of 73.9 percent. In 1974, of the fifteen apprentices who failed only one mathematic course, AR, thirteen failed both AR and the apprentice program resulting in a failure rate of 86.7 percent. In 1975, of the eight apprentices who failed only one mathematic course, AR, three failed both AR and the apprentice program resulting in a failure rate of 37.5 percent. In 1976, of the twenty-six apprentices who failed only one mathematic course, AR, sixteen failed both AR and the apprentice program resulting in a failure rate of 61.5 percent.

Analysis of the Data Associated with Null Hypothesis H_{03} .

Null hypothesis 3 states that no predictive relationship exists between the unsuccessful completion of the mathematic course, Calculations and Formulas (CF), by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction. A summary of apprentice failures in CF and their subsequent success or failure in the program by year is presented in Table 4.

Table 4. Summary of Apprentice Failures in CF and Their Subsequent Success or Failure in the Apprentice Program, 1973 through 1976 (N = 237)

Year	1973	1974	1975	1976
Number entered	49	46	60	82
Number failed only CF	16	8	6	21
Number failed CF and Failed the Program	15	7	4	16
Percent Failed CF and Failed the Program	93.8	87.5	66.7	76.2

In 1973, of the sixteen apprentices who failed only one mathematic course, Calculations and Formulas, CF, fifteen failed both CF and the apprentice program resulting in a failure rate of 93.8 percent. In 1974, of the eight appren-

tices who failed only one mathematic course, CF, seven failed both CF and the apprentice program resulting in a failure rate of 87.5 percent. In 1975, of the six apprentices who failed only one mathematic course, CF, four failed both CF and the apprentice program resulting in a failure rate of 66.7 percent. In 1976, of the twenty-one apprentices who failed only one mathematic course, CF, sixteen failed both CF and the apprentice program resulting in a failure rate of 76.2 percent.

SUMMARY

For the purpose of this study, three null hypotheses were established to determine the predictive relationship between the unsuccessful completion of one or both first month mathematic courses and the successful completion of the four months of related instruction.

Data, collected for null hypotheses H_{01} , indicated that of the two hundred and thirty-seven apprentices who entered the apprentice program during the period 1973 through 1976, thirty-eight failed both first month mathematic courses, Arithmetic Review (AR) and Calculations and Formulas (CF). Of the thirty-eight apprentices who failed the two first month mathematic courses, thirty-seven subsequently failed to complete the apprentice program, resulting in a failure rate of 97.4 percent.

The data, collected for null hypotheses H_{02} , indicated that seventy-two of the two hundred and thirty-seven

apprentices who entered the apprentice program during the period 1973 through 1976, failed the Arithmetic Review (AR) course. Of these seventy-two apprentices, forty-nine subsequently failed to complete the apprentice program resulting in a failure rate of 68.1 percent.

For null hypothesis H_{03} , it was found that fifty-one of the two hundred and thirty-seven apprentices who entered the apprentice program during the period 1973 through 1976 failed the Calculations and Formulas (CF) course. Of these fifty-one apprentices, forty-two subsequently failed to complete the apprentice program resulting in a failure rate of 82.4 percent.

Chapter 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This Chapter is initiated with a summary of the study including the background of the problem, statement of the problem, procedures used in collection and treatment of the data and the findings. Secondly, the conclusions are presented based upon the findings. Finally, recommendations for using the results of this study are stated.

SUMMARY OF THE STUDY

Background of the Problem

The Norfolk Shipbuilding and Drydock Corporation (Norshipco) has maintained an apprentice program since the enactment of the Voluntary Apprenticeship Act of 1938. Within the three year apprentice program, there are four one month periods of related instruction comprising a general technical education curriculum. The first month of the four months of related instruction contains two mathematic courses, Arithmetic Review (AR) and Calculations and Formulas (CF).

Statement of the Problem

The problem of this study was to determine if a correlation exists between first month apprentice mathematics failures and unsuccessful completion of the four months of related instruction in the three year apprentice program.

Procedures used in Collection
and Treatment of the Data

Instrumentation. The instrument used to collect the data was the Norshipco Apprentice School student report card which is a record of individual course scores for each of the four one month related instruction periods. The Supervisor of Apprentices provided individual report card certification for each of the two hundred and thirty-seven applicants who entered the Norshipco apprentice program during the period 1973 through 1976. This resulted in an effective rate of 100.0 percent.

These cards contained data to determine passing or failing scores for one or both first month mathematic courses, AR and CF. A tabulation was completed, showing the number of apprentices who, failing one or both mathematic courses at the end of the first month were, also, unsuccessful in completing the four months of related instruction in the three year program.

Null Hypothesis. In order to determine if a predictive relationship exists between the apprentice failing one or both of the first month mathematic courses and their unsuccessful completion of the four months of related instruction, three related null hypotheses were formulated and stated as follows:

H₀₁. No predictive relationship exists between the unsuccessful completion of both first month mathematic courses by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder

of the four months of related instruction.

H₀₂. No predictive relationship exists between the unsuccessful completion of the mathematic course, Arithmetic Review (AR), by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

H₀₃. No predictive relationship exists between the unsuccessful completion of the mathematic course, Calculations and Formulas (CF), by apprentices in the Norshipco four months of related instruction and their subsequent success or failure in the remainder of the four months of related instruction.

Technically no tests of significance could be calculated because the subjects (apprentices) of this study represented a population rather than a sample.

Findings of the Study

Findings of the study are reported as they related to the three null hypotheses.

1. H₀₁ was rejected. Thirty-seven of the thirty-eight apprentices who failed both first month mathematic courses during the period 1973 through 1976, also, failed the apprentice program resulting in a failure rate of 97.4 percent.

2. H₀₂ was rejected. Forty-nine of the seventy-two apprentices who failed one mathematic course, Arithmetic Review (AR), during the period 1973 through 1976, also, failed the apprentice program resulting in a failure rate of 68.1 percent. However, although, on an annual basis, the

percent varied from 37.5 to 86.7, the overall failure rate of 68.1 percent was considered sufficiently high for use as a probable predictor.

3. H_{03} was rejected. Forty-two of the fifty-one apprentices who failed one mathematic course, Calculations and Formulas (CF), during the period 1973 through 1976, also, failed the apprentice program resulting in a failure rate of 82.4 percent. Again, as with H_{02} , the relationship varied. However, in this case, the numerical limits over which H_{03} varied were narrower and of higher numerical value than that for H_{02} . Therefore, in comparison, the overall failure rate of 82.4 percent for H_{03} was considered to be of higher value as a probable predictor.

CONCLUSIONS

Conclusions drawn from the reported findings are presented in this section as they related to the three null hypotheses and to the Norfolk Shipbuilding and Drydock Corporation (Norshipco) and its apprentice program.

Conclusion Related to Null Hypotheses H_{01}

It can be concluded that there is a practical predictive relationship of nearly 100.0 (97.4) percent between unsuccessful completion of both first month mathematic courses and subsequent failure in the apprentice program. Therefore, an apprentice who fails both first month mathematics courses, Arithmetic Review (AR) and Calculations and Formulas (CF), has only a 2.6 percent possibility of being successful with the remainder of the program.

Conclusion Related to Null Hypotheses H_{02}

It can be concluded that there is a practical predictive relationship (68.1%) between an apprentice's failure of AR and ultimate inability to complete successfully the remainder of the apprentice program. Also, when considered on an annual or per course basis, it can be concluded that the relationship, although marginal, does provide some degree of reliability (37.5% - 86.7%) as a predictor relative to an apprentice's success or failure for the remainder of his apprentice program.

Conclusion Related to Null Hypothesis H_{03}

It can be concluded that there is a practical predictive relationship (82.4%) between an apprentice's failure of CF and ultimate inability to complete successfully the remainder of the apprentice program. Also, when considered on an annual or per course basis, it can be concluded that the relationship is fairly consistent (66.7% - 93.8%) and does provide reliable predictiveness relative to an apprentice's success or failure for the remainder of his apprentice program.

Conclusions Related to the Norshipco Apprentice Program

1. As a result of the foregoing, it can be concluded that there is a practical predictive relationship between an apprentice who fails both first month mathematic courses and his ultimate failure or success in the remaining four months of related instruction in the three year program.

2. Additionally, it can be concluded that there is a practical predictive relationship between an apprentice who fails AR and his ultimate failure or success in the remaining four months of related instruction in the three year program.

3. Further, it can be concluded that there is a practical predictive relationship between an apprentice who fails CF and his ultimate failure or success in the remaining four months of related instruction in the three year program.

4. Finally, it can be concluded that of the three predictive relationships, failure in both first month mathematic courses (H_{01}) has the greatest validity (97.7%) in predicting an apprentice's subsequent success or failure in the remainder of the three month academic program.

RECOMMENDATIONS OF THE STUDY

Recommendations based on the findings and conclusions of this study are presented in this section as they relate to the Norshipco apprentice program. These are:

1. Those apprentices who fail both mathematic courses, Arithmetic Review (AR) and Calculations and Formulas (CF), in the first month of the four months of related instruction should be dropped from the apprentice program.

2. Those apprentices who fail either of the two first month mathematics courses, AR or CF, and whose overall academic average is passing should be placed on academic probation and assigned additional supervised mathematics.

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APPENDIX

NORFOLK SHIPBUILDING & DRYDOCK CORPORATION
Apprentice School
Student's Report Card

Class of _____

SUBJECT	First Month	Second Month	Third Month	Fourth Month
Arithmetic Review				
Calculations & Formulas				
First Aid & Safety				
Basic Blueprint Reading				
Shipbuilding				
Communications I				
Algebra				
Physics I				
Communications II				
Chemistry I				
Drafting I				
Geometry				
Physics II				
Basic Economics				
Drafting II				
Marine Engineering				
Trigonometry				
Strength of Materials				
Physics III				
Drafting III				
Communications III				
TOTAL POINTS				
ADACEMIC	ABOVE AVG.	_____	_____	_____
PROGRESS	AVG.	_____	_____	_____
	BELOW AVG.	_____	_____	_____
CLASS STANDING				
NUMBER IN CLASS				

