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GRADUATE COLLEGE

THE EFFECT OF COLLEGE ALGEBRA AND HIGH SCHOOL BOOKKEEPING ON ACHIEVEMENT IN THE SECOND COURSE OF ELEMENTARY ACCOUNTING

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

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BY

CHARLES C. STUMBAUGH

Norman, Oklahoma

1975

THE EFFECT OF COLLEGE ALGEBRA AND HIGH SCHOOL BOOKKEEPING ON ACHIEVEMENT IN THE SECOND COURSE OF ELEMENTARY ACCOUNTING

APPROVED BY

DISSERTATION COMMITTEE

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THE EFFECT OF COLLEGE ALGEBRA AND HIGH SCHOOL BOOKKEEPING ON ACHIEVEMENT IN THE SECOND COURSE OF ELEMENTARY ACCOUNTING

CHAPTER I

THE PROBLEM

Introduction

The Industrial Revolution and the expansion and revision of the Internal Revenue Code in 1939 are two of the major factors which caused the previously known field of bookkeeping to blossom into the much more scientific area of study, accounting. The continued growth and the increased complexity of sole proprietorships, partnerships, and corporations have forced drastic expansion of the objectives of accounting professors, accounting students, and the accounting profession. Originally defined as one of record-keeping, the role of accounting must now include the development and the analysis of data, the testing of their validity and relevance, and the interpretation and communication of the resulting information to intended users. The information may be expressed in monetary or other quantitative terms, or in symbolic verbal

forms depending upon whether the intended user is an accountant, a manager, an economist, or another concerned person.[1]

Accounting is one form of quantitative expression that is widely used[2] as scientific developments in the field of business require extensions of information and control systems. Accounting is an analytic mechanism which seeks to expose the essence of quantified data and logically becomes the source of the necessary explanations.[3] These results, estimates, and predictions are couched, in part, in quantitative terms, so that comparisons and evaluations can be facilitated.

The information which accounting provides is essential for effective planning, control, and decision-making by management, as well as for discharging the accountability of organizations to investors, creditors, governmental agencies, tax authorities, welfare institutions, and others. To produce peak results, accounting information must be utilized in a cooperative atmosphere existing among the separate disciplines of the business world. Management of a modern business enterprise, with its complex operations and extended market, is no longer by "rule of thumb." Complex modern management requires ability and experience of high order. Efficiency has resulted from specialization and cooperation. Men produce more things when they

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[1]Robert H. Roy and James H. McNeill, Horizons of a Profession (New York: American Institute of Certified Public Accountants, 1967), p. 20.

[2]Maurice Moonitz, "The Basic Postulate of Accounting," Accounting Research Study No. 1, (American Institute of Certified Public Accountants, 1961).

[3]Thomas H. Williams and Charles H. Griffin, The Mathematical Dimensions of Accountancy (Cincinnati, Ohio: South-Western Publishing Company, 1964), pp. 2, 170.

concentrate their efforts on particular tasks, and they can do so by cooperating with others in a business enterprise.[1] Accounting is a specific requirement of any efficient commercial organization.

When accounting is viewed in its entirety, one sees that it is, in effect, the principal line of communication in the economic system. Therefore, accounting has become a basic source of vital information in almost every facet of governmental and commercial endeavors.

In terms of years, accounting is, indeed, a young profession but a profession that is rapidly becoming a sophisticated field of study. At this point, it would seem that the most serious mistake that members of the accounting profession could make would be to underestimate either their future possibilities or the increased varieties of educational and technical abilities that will be required to take advantage of these possibilities.

Recognition of the importance of communication, cooperation, and the interdependence of business structure--along with increased usage of electronic data processing, statistical methodologies, finite techniques of depreciation, amortization, depletion, capital budgeting, and many more specific calculations--have caused many accounting educators to believe that mathematics should become a required part of the accounting educational programs.[2] To a greater extent than in the past, tomorrow's accountant must be trained in mathematics; and, from his study of mathematics, statistics, and probability, the prospective

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[1]J. M. Yang, "Accounting in a Free Economy," The Accounting Review, XXI (July, 1959), 442-51.

[2]John Stollan, "Accounting and It's Productiveness," The Accounting Review, LX (April, 1970), 53-59.

accountant should become familiar with the mathematical techniques which are applicable to the solution of business problems.[1] The accountant should develop a facility with symbolic notation, he should be able to reduce complex problems to their essential elements, and he should be able to express the relationships among these elements in quantitative terms.[2]

Mathematics is a tool not only of accounting but also of all other phases of business. Demands for quantitative criteria in decision making and operations are placing pressures on the instructional profession that educators cannot afford to ignore. Future aspirants to "top-level" positions in business will, undoubtedly, require considerable mathematical knowledge.

The early stages of educational preparation for businessmen are of utmost importance. A solid foundation in basic required courses of a business curriculum makes subsequent advanced courses more meaningful and intelligible for the student. However, the training of many of these future businessmen begins at the secondary level of schooling. Many secondary schools now offer several courses of business-oriented subjects for either vocational-job training or college preparatory study. Specifically, the two semesters of high school bookkeeping appear to have a direct effect on the level of success attained by students attempting the first course of elementary college accounting.

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[1] Frank S. Capon, "Accounting in an Expanding Environment," Financial Executive, December, 1967, pp. 45-54.

[2] Report of Committee on Education and Experience Requirements for CPA's, (New York: American Institute of Certified Public Accountants, 1969).

Chapter II will present research studies that indicate that students who have had one year of high school bookkeeping achieve more easily and at a higher level in college elementary accounting than students who have not had this prior training.

As prospective business students progress from secondary to post-secondary education, their educational backgrounds become quite diverse. The students interested in a business administration major have not been required to enroll in exactly the same course of study before enrolling in collegiate accounting.

This study is concerned with the second course of elementary accounting and with two specific areas of background preparation, college algebra and high school bookkeeping.

Jordan refers to accounting as the art of recording; classifying; summarizing in a significant manner and in terms of money, transactions and events that are, in part at least, of a financial character; and interpreting the results thereof.[1] In other words, accounting deals with measurement for the purpose of communicating significant data to various interested parties.

Accounting educators, practicing accountants, and other professional accounting organizations have been striving to improve the educational programs in accounting at the collegiate level. One specific requirement of modern educational programs in accounting is that they must be as comprehensive as possible. It is no longer desirable for accounting education to be centered only around accounting courses.

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[1]John R. Jordan, Jr., "Financial Accounting and Communications," The Price Waterhouse Review (Spring, 1969), 12-22.

The demand for broader education emphasizes the need to study the humanities, behavioral sciences, and quantitative methods, in addition to accounting. The American Accounting Association, a professional accounting organization for educators, has stated the purposes of an accounting education to be those that prepare students for careers in accounting and related fields, prepare students to deal effectively with the problems they will face as practicing members of their profession, and prepare them to be responsible citizens of the social and the economic community in which they live.[1]

The American Institute of Certified Public Accountants stated compliance with and belief in the broader scope of accounting preparation when it published "Horizons for a Profession" in 1967.[2] This study dealt with the preparation of the Certified Public Accountant and stated that the beginning CPA should have a common body of knowledge as a vital part of his educational background. Law, mathematics, the humanities, economics, behavioral sciences, statistics, probability, functional fields of business, and studies in accounting[3] were included in the suggested areas of study.

As the concepts of businessmen, practicing accountants, and accounting educators are noted, several points of commonality rise to the surface. Two of these similar beliefs are (1) accounting educational preparation should be broad in its scope, and (2) accounting

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[1]C. A. Moyer, et al., "Report of the Committee on Educational Standards," The Accounting Review, XXXIX (April, 1964), 447.

[2]Roy and McNeill, op. cit., p. 214.

[3]Ibid., p. 11.

information is necessary for all phases of business. Students of business from the separate disciplines should have basic understandings of the common body of knowledge for maximum communication and efficiency.

Elementary accounting principles, I and II, serve as the basis for developing accounting or other education for business. In the second course of accounting principles, particularly, the areas of quantification and communication begin to develop through a presentation of such topics as present value, ratio analysis, turn-overs, fund flow, cost and revenue relationships for management, and financial statement analysis.

Purpose of Study

A basic element in the successful progress through the second course of elementary accounting which has not been submitted to extensive classroom investigation is that of the effect of certain non-required background courses that could enhance the student's opportunity for success in accounting.

The purpose of this study was to test the effects of two basic areas of background preparation on the success of students completing second-semester elementary accounting at four-year colleges and universities in Oklahoma. The first consideration was to indicate whether a difference in the degree of success exists between the students who have completed a course in college algebra prior to enrollment in the second course of elementary accounting and those students who have not completed a course in college algebra prior to enrollment in the second course of elementary accounting. A further consideration of the study was to determine whether a difference in the degree of success exists

among the students who have completed a course in high school bookkeeping and those students who did not have this background prior to their enrollment in the second course of elementary accounting.

A final consideration of the study was to determine whether there is any interaction between college algebra and high school bookkeeping as background preparation for elementary accounting.

Definition of Terms

Before stating the problem and the hypotheses to be tested, the following terms must be defined:

1. Second Course of Elementary Accounting Principles refers to the second three hours of accounting instruction offered at the college and university level of education.

2. College Algebra refers to the course so titled at Central State University (base for the study) and is equivalent to mathematical preparation exceeding two courses of Algebra taken in high school. Also, in this study, it is referred to as minimal mathematical preparation because it is under consideration as a minimal mathematical requirement for all business administration majors at Central State University.

3. High School Bookkeeping refers to the two-semester course commonly offered in senior high school.

4. Universities refer to Oklahoma University, Oklahoma State University, Tulsa University, and Central State University.

5. Colleges refer to Northeastern State College, Southeastern State College, Southwestern State College, and East Central State College.

6. AICPA Orientation Test refers to the intelligence test developed by the American Institute of Certified Public Accountants (AICPA) that is weighted toward the field of business.

7. ACT Composite Score refers to the composite standard score made by the student on the American College Test prepared by the American College Testing Program, Inc.

8. AICPA Achievement Test refers to the AICPA Achievement Test, Level I, Form E-S. This is a 50-minute elementary accounting achievement test developed for the College Accounting Testing

Program of the American Institute of Certified Public Accountants. This test is designed to measure accounting achievement after the completion of the second course of Elementary Accounting Principles. It will function as the Accounting Pretest and the Accounting Posttest in this study.

9. The Statistical Design refers to a 2(Algebra-No Algebra) X 2(Bookkeeping-No Bookkeeping) factorial.

10. The Statistic refers to Analysis of Covariance performed on (Posttest) Final Examination Scores.

11. The Covariates refer to the ACT Scores, AICPA Orientation Test scores, Pretest scores (AICPA Achievement Test, Level I, Form E-S).

12. Independent Variables refer to College Algebra (yes-no), Bookkeeping (yes-no).

13. Dependent Variable refers to the score achieved on the Posttest (AICPA Achievement Test, Level I, Form E-S).

14. Group I is composed of those students who have had College Algebra but have not had high school bookkeeping.

15. Group II is composed of those students who have not had either College Algebra or high school bookkeeping.

16. Group III is composed of those students who have had both College Algebra and high school bookkeeping.

17. Group IV is composed of those students who have not had College Algebra but have had high school bookkeeping.

Statement of Problem

This study was concerned with the following questions:

1. Do the students in the second course of elementary accounting in selected Oklahoma colleges and universities who have completed the course in College Algebra (or equivalent), before enrollment in the second course of elementary accounting, make higher scores on the final achievement examination than do those who did not have this minimum mathematics preparation?

2. Do the students in the second course of elementary accounting in selected Oklahoma colleges and universities who completed a year of high school bookkeeping make higher scores on the final achievement examination than do those students who did not have this background preparation?

3. Does the mean difference of (a) exceed the mean difference of (b)?

   (a) What is the mean difference on the final achievement examination between those students who have obtained a college algebra and high school bookkeeping background when contrasted with those students who have obtained only a college algebra background?

   (b) What is the mean difference on the final achievement examination between those students who have obtained only a high school bookkeeping background when contrasted with those students who have obtained neither a college algebra nor a high school bookkeeping background?

Hypotheses

The hypotheses tested in this study are as follows:

Ho_1 The adjusted means of the final achievement examination of Group I and Group III are higher than the adjusted means of Group II and Group IV when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Ho_2 The adjusted means of the final achievement examination of Group III and Group IV are higher than the adjusted means of Group I and Group II when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Ho_3 The difference between the adjusted means of the final achievement examination of Group III and Group I is higher than the difference between the adjusted means of the final achievement examination of Group IV and Group II when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Assumptions

The assumption was made that the ACT Test composite score and the AICPA Orientation Test, Form E, composite scores were valid and reliable covariates for the purpose of controlling the "extraneous" variable of academic aptitude.

The assumption was made that the AICPA Level I, Form E-S Achievement Test was a valid and reliable testing instrument for measuring achievement in the second course of elementary accounting.

The assumption was made that academic standards and teaching methodologies were similar among all selected Oklahoma colleges and universities.

An assumption was also made that subjects represented in the sample were typical of those students enrolling in the second course of elementary accounting at the selected Oklahoma colleges and universities.

Delimitations

This investigation was limited to eight senior-level institutions in Oklahoma's system of higher education. These colleges and universities were chosen because of their geographic location for assurance of a sample including rural, urban, and metropolitan subjects. The sample was limited to those students who had completed the second course of elementary accounting, who had participated in the taking of the AICPA Orientation Test, Form E, and the AICPA Form E-S Achievement Test, Level I, and who had obtainable ACT standard composite scores. The study was conducted during the fall of 1973 and spring of 1974.

Limitations

The sample consisted of the enrollment of one prime-time course in the second course of accounting from each of the selected schools; therefore, the sample was limited to approximately 265 students who had completed the course and supplied all the necessary information for analysis.

Each school offers the specified course on a three-hour per week--lecture, problem, discussion-basis, with no regularly scheduled laboratory session. This arrangement precludes any laboratory interaction in this study.

Subjects in this study were unaware of taking the AICPA Orientation Test and the AICPA Achievement Test (Pretest and Posttest) until the exact time of testing. No effort was made to determine the psychological effects of this unawareness on the performance of the subjects.

Methodology and Analytical Procedures

The Sample

The sample consisted of college and university classes of second course elementary accounting taught during the fall semester of 1973 and the spring semester of 1974, one prime-time course from each selected school. The study involved students at the University of Oklahoma at Norman, Oklahoma State University at Stillwater, Tulsa University at Tulsa, Central State University at Edmond, Southwestern State College at Weatherford, East Central State College at Ada, Southeastern State College at Durant, and Northeastern State College at Tahlequah. These schools were selected because of their geographic location and their related functions in the four-year program in the higher educational system of Oklahoma.

Because the students participating in this study were unaware that they were involved in an experimental situation and because approximately 265 students completing the course and providing the necessary information randomly elected to enroll in these sections of second-course elementary accounting, a homogeneous grouping of students

with similar backgrounds in the selected class groupings was neither possible nor necessary. Therefore, Groups I-IV were formed by blocking within each section. Assignment of students to the experimental groups was made on the basis of background preparation.

Procedures for Collecting Data

At the close of the summer term, 1973, each administration and professor at the selected institutions were contacted and permission was obtained to conduct the investigation. The actual process of data collection began in the first week of the 1973 fall semester when the AICPA Orientation Test, Form E, was administered to all students attending the second course of elementary accounting classes on the chosen day.

The following class period the AICPA Achievement Test, Form E-S, Level I, was administered to the same students who completed the orientation examination. The specific data collection steps were:

1. Cooperation was obtained from the administration of each of the schools selected for this study.
2. Class schedules were obtained; and from the time brackets the prime-time sections were chosen.
3. Cooperation was secured from the professors instructing the chosen sections and permission was granted to use their classes in this study.
4. Through the use of an information sheet created by the writer, the permission of participating students was obtained to use ACT composite scores contained in their records.
5. The signed information sheets were submitted to the records office of each institution and the ACT composite scores were copied from the students' records.
6. Transcripts, high school and college, were used to determine the academic background of each student. Supplemental data were

supplied when the information sheets were completed by each student.

7. The AICPA Orientation Test, Form E, and the AICPA Achievement Test, Level I, Form E-S were administered within the first two weeks of each semester.

8. The AICPA Achievement Test, Level I, Form E-S, was administered a second time, during the last week of each semester, for Post-test purposes.

Procedures for Data Analysis and Interpretation

The statistical design for this study was a 2(college algebra - no college algebra) X 2(bookkeeping - no bookkeeping) factorial. Analysis of covariance was performed on the final examination (Posttest) scores while ACT scores, AICPA Orientation Test, Form E, scores, and the AICPA Achievement Test, Level I, Form E-S (Pretest) scores were covaried. Analysis of covariance was chosen for use in this study because of its capability of controlling variables which would otherwise have become extraneous. Williams and Popham state:

> Analysis of covariance provides a basis for ruling out pretreatment differences when our interest is in testing post-treatment differences.[1]

> This powerful technique allows the researcher to statistically equate the independent variable groups with respect to one or more variables which are relevant to the dependent variable.[2]

These hypotheses were tested with F-values obtained from the use of analysis of covariance.[3]

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[1]Frederick Williams, Reasoning with Statistics (New York: Holt, Rinehart and Winston, Inc., 1968), pp. 92-94.

[2]W. James Popham, Educational Statistics: Use and Interpretation (New York: Harper & Row, Publishers, 1967), p. 223.

[3]Williams, op. cit., p. 93.

A computer program designed to compute analysis of covariance with multiple covariates, or independent variables, and one dependent variable was utilized to establish differences in the achievement of the students participating in this study.

Organization of Study

This study is composed of five chapters arranged as follows:

Chapter I includes an introduction to the research project, the purpose of the study, definition of terms, statement of the problem, hypotheses to be tested, assumptions, delimitations, limitations, methodology and analytical procedures and the organization in this study.

Chapter II presents a review of the literature which is related to this study.

Chapter III presents the methodology and the analytical procedures employed in this study.

Chapter IV presents the statistical analysis and interpretation of the data collected in this study.

Chapter V presents a summary of this study. Conclusions are drawn and recommendations made from the results of this study.

CHAPTER II

REVIEW OF RELATED LITERATURE

Higher education in the United States has followed a course of constant growth since the estimate of 157,000 students in 1890 to an estimated 597,000 in the postwar year of 1920.[1] The trend of increased enrollment has remained constant in an upward spiral to produce a population in colleges and universities today that totals in the millions.

Coincidental with this tremendous expansion of our higher educational system, an equally phenomenal growth of American business has occurred. Business development and expansion demand trained personnel. Thus, education has become the main source for producing the required personnel to meet the needs of business.

To cope with these challenges, collegiate schools of business have expanded their curricula and developed disciplines of study that allow the prospective entrant into the business world either to specialize in a specific field of study or to generalize his knowledge through an individual approach to several fields of study.

A requirement for all students of business is involvement in the field of accounting. The accounting major specializes by completing

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[1]James H. Bossard and J. Frederick Dewhurst, University Education for Business (New York: Arno Press, 1931), p. 248.

27-33 semester hours of accounting course work, while the remainder of the business majors are required to complete from 6-12 semester hours of accounting course work.

This review of literature will focus on general research and publications dealing with the accounting course work taken by all business majors, with a focus on the field of mathematics as a supplemental area to enhance the opportunities for success in accounting, as well as an aid toward more permanent understanding of the challenge of analyzing and communicating accounting information to other business disciplines.

In addition to a review of opinions concerning the effect of mathematics on successful achievement in accounting, high school bookkeeping will be reviewed for its effect on achievement in the elementary accounting course.

Review of Publications, Opinions, and Studies

As stated by the Committee on Basic Accounting Theory, the objectives of accounting are to provide information for the following purposes:

1. Making decisions concerning the use of limited resources, including the identification of crucial decision areas and determination of objectives.
2. Effectively directing and controlling an organization's human and material resources.
3. Maintaining and reporting on the custodianship of resources.
4. Facilitating social functions and controls.[1]

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[1]American Accounting Association, "A Statement of Basic Accounting Theory," Report of Committee on Basic Accounting Theory, The Accounting Review, XLV (April 1970), 322.

These objectives expand considerably the scope of the accounting function. Accounting must now control, accumulate, communicate, and participate in decision making. These are essential processes that force a greater exchange of ideas and information among the separate parts of a business entity.

As new challenges arise from these additional requirements, new problems of clarity and efficiency also emerge. Some of the accounting problems are more difficult to solve because of the lack of educational background to comprehend their entire scope. Moreover, advances are taking place in management technology and management information that may well have considerable significance to accounting principles in terms of guiding management to make a fairer presentation of the economic progress of a business.[1]

In preparing future businessmen, accounting educators often adhere too closely to the textbook content because problems, cases, and other materials must be covered. However, when instructors do not expand their teaching methods and use supplemental ideas or materials, the students' skills in computer science, higher mathematics, and statistics are not being used advantageously. In such instances, students may not be made aware of the importance of those skills for accounting education. Many educators and practitioners say that these skills are important.[2]

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[1] R. M. Skinner, "Generally Accepted Accounting Principles," The Canadian Chartered Accountant, March, 1968, p. 52.

[2] Dr. Milton Usry, "Accounting Education: A Look To The Future," The Journal of Accountancy, CLVIII (July, 1972), 87.

In a survey, conducted by Whitham,[1] which explored the basic educational preparation (in terms of strengths and weaknesses) of business employees, nearly two-thirds of the respondents rated their present staff assistants as weak in mathematical techniques. However, over two-thirds of the respondents expected mathematics, statistics, and probability to have increased future importance.

The trend in a demand for a broad-base education in the quantitative areas to supplement the capstone specialty courses is definitely continuing upward. In reflecting on changes in the general environment and business education during the 1960's, Horngren[2] viewed business and accounting education as being affected by the increasing pace of economic, technical, social, and political events. He felt that education would have to be recognized as a lifelong process if people are to keep pace with the mounting importance of all sectors of the American economy. Horngren[3] believes that continuing education will have become a growth industry as the near future arrives. Emphasis in mathematical models and behavioral issues are also seen by Horngren as items to challenge the future businessman.[4]

As these prognostications evolve into actual and existing demands of the business community, the intertwining of the commercial disciplines becomes even more essential.

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[1]Robert B. Whitham, "Five Years of University Education Not Required," The Journal of Accountancy, CLXXXV (September, 1974), 94.

[2]Charles T. Horngren, "The Accounting Discipline in 1999," The Accounting Review, XLVI (January, 1971), 1.

[3]Ibid., p. 11.

[4]Ibid., pp. 6-7.

New areas of accounting that include the human resource element are demanding greater quantitative skills. Flamholtz[1] believes that the model, which is an inter-disciplinary approach to developing an individual's worth to a company, draws on economic, social, and psychological determinants. (A person's value is the product of the attributes that he brings to the company--these values can be expressed in quantitative terms through the use of mathematical models.) Also, to meet the needs of management for decisions involving acquisition, development, allocation, and retention of people, a model, mathematical in form, will be implemented to quantify these factors.[2] Other authors such as Rensis Likery, J. Hekimian, and C. Jones state or give strong indication that some sophistication in mathematics knowledge must be attained in order to quantify the variables contained in the models.

It is true that human resource quantification, through the use of mathematical models, is on the parameter of mathematical requirement; nevertheless, it must be considered as a future event. Many other intra-disciplinary areas demand some sophistication of mathematical abilities. Electronic data processing is one comparatively recent development that has displayed remarkable versatility and tremendous usage in the business community. However, the computer depends on human brainpower for its input and analysis of its output. To maximize the versatility of the "metal brain," the businessman

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[1]Eric Flamholtz, "Human Resource Accounting: A Review of Theory and Research," Human Resource Accounting, (California: Dickenson Publishing Co., Inc., 1973).

[2]Eric Flamholtz, "Replacement Cost as a Surogate Measure of Human Resource Value: A Field Study," University of California at Los Angeles, ATS Working Paper No. 74-1, July, 1973.

must be able to comprehend both input and output. Corcoran relates, in a paper prepared for The Accounting Review, that nearly every accountant is confronted today with both applied mathematics and computers.[1] Those accountants not due for retirement in the near future must "know" either math or computers, preferably both, if accounting is to survive as a contributing discipline in modern commerce.[2] It is erroneous, for instance, to assume that a mathematician has a vast knowledge of computers. It is also erroneous to assume that the accountant "knows" computers if he has command of a data processing language such as COBOL. Data processing, per se, is limited. An accountant could not be an information systems expert without knowing both scientific and data processing languages, and without knowing at least a minimal amount of mathematics.[3]

Along the same vein, without a familiarity with mathematics, it would be impossible to understand much of the current literature of most business fields; furthermore, the likelihood of creating new approaches to managerial problems would be seriously curtailed. This would apparently create these two immediate problems for management: (1) understandably organizing the mass of data created by their past decisions, and/or in preparation for future decisions; and (2) interpreting significant meaning from studies of information prepared for them by other disciplines, such as reports of the financial condition

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[1] A. Wayne Corcoran, "Computers vs. Mathematics," The Accounting Review, XLIV (April, 1969), 359.

[2] Ibid.

[3] Ibid., p. 360.

of the enterprise and a summary of revenue and expense generated by the use of enterprise properties as determined by their directions.

In order to meet these challenges, accounting information users, with the aid and knowledge of electronic computers and some basic mathematical models of analysis, could become more able to process large amounts of data[1] with much greater insights to the financial observations.

It is not necessary for the beginning businessman to be either a mathematician, a statistician, or a probabilist. But, opportunities for success in tomorrow's business community will call for substantially more knowledge of mathematics, statistics, and probability.[2] Jordan concurred with this opinion when he stated that some understanding of the new mathematics is essential to the businessman in the age of the computer.[3] Decision making in the nuclear age requires the use of mathematical tools in order to give consideration to economic lot sizes, investment decisions, and so forth.

The preceding paragraphs indicate that accounting professionals and educators have initiated investigations into the areas of supplemental educational preparation. These investigations are concentrated efforts to enhance opportunities for greater achievement in the study

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[1]Robert E. Jensen, Empirical Evidence from the Behavioral Sciences: "Fish Out of Water," The Accounting Review, XLV (July, 1970), 508.

[2]Guy W. Trump and J. T. Ball, "Education and Professional Training," The Journal of Accountancy, LXXXXV (February, 1967), 89.

[3]Raymond B. Jordan, "Cost and Management," The Journal of Accountancy, CVII (March, 1968), 53.

of accounting from elementary principles to the advances course work.

Thompson[1] in a brief paper prepared for the DPE Journal, stated the hypothesis that the shape or continuity of any business aspect can be charted by arranging words and symbols in sets. He believes that business teachers, like mathematicians, can employ precisely arranged rows and columns of information that can be either added or subtracted from similar sets. Thompson also states that the matrix adds a third dimension to the perception of course content and the teaching process bringing instructors a step closer toward grasping the multidemensional nature of teaching.[2] The understanding of the matrix alignment becomes simplified through a basic knowledge of mathematical function.

In 1961 Williams[3] conducted an investigation of the mathematical dimension of accountancy. His conclusions, drawn from surveys, conversations, and personal experience in both the classroom and business, were that mathematical models may be established and stated in symbolic language. The models may be broken down and further refined in the attempt to improve correspondence to the real world and to attain more generality.

These models can be constructed for simple accounting analysis such as break-even point, rate of return, and other elementary facets

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[1]Dr. Willard Thompson, "The Matrix Concept Applied to Business Education," DPE Journal (August, 1967), 18.

[2]Ibid., p. 22.

[3]Thomas Howard Williams, "An Investigation of the Mathematical Dimensions of Accountancy," (unpublished Ph.D. dissertation, University of Illinois at Urbana-Champaign, 1961), 287.

of financial interpretation. This would provide an anticipated infusion of both the content and the methodology of mathematics into the methodology of accounting and seems to be a desirable and intellectual extrapolation of the temporal locus of accountancy. As tools of practice, quantitative techniques are essential to the comprehension of modern developments.[1]

A survey was done in 1954 by price.[2] Questionnaires were composed which concentrated on the objectives of accounting education at the college and university level. From the data of his study, Price concluded that two primary objectives of accounting education at the specified level should be (1) to teach the students how to think and reason more clearly and (2) to reach deeply into the interpretation of financial statements and place emphasis on accounting cooperating (interfusing) with management. Additional inferences were made to some commonality of background preparation. Therefore, the elementary courses of accounting study become extremely important as foundations are established for either advanced study or the interdisciplinary exchange of information.

The second course of elementary accounting becomes even more of a pivotal course of study when one considers the fact that nonaccounting majors rarely enroll in more than one or two courses above this level of accounting study. The investigations seeking to discover courses

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[1] Ibid.

[2] Harry Ralph Price, "Accounting Education at the University Level," (unpublished Ph.D. dissertation, Northwestern University, 1954), p. 173.

for maximum achievement and understanding in this particular segment of accounting study are very limited.

The related research studies reviewed by the writer indicated that the requirement of mathematics in schools of business administration in smaller midwestern colleges and universities is in a state of transition. The traditional approach of the three basic R's is changing in that some schools have dropped mathematics completely from the business administration curriculum, while others have increased their mathematics requirements quite significantly.

Pour[1] in 1962 conducted an investigation at Northern Illinois University in an attempt to discover any significant differences or similarities between two groups of second-semester accounting students. Fifty-six students were divided into two groups at the completion of the second course of elementary accounting. The first group, called successful, was comprised of the 33 students who earned either an A or B grade in the second semester of accounting. The second group, called unsuccessful, was comprised of the 23 students who earned either a D or F grade in the second semester of accounting. No effort was made to analyze the C students as they were termed "middle of the road," and no effort was made to isolate individual characteristics for effect.[2] The study attempted to determine those factors which might

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[1]Frederick Albert Pour, "The Similarities and Differences in the Successful and Unsuccessful Second-Semester Accounting Students at Northern Illinois University," (unpublished Ph.D. dissertation, University of Minnesota, 1962) cited by Dissertation Abstracts, p. 2381.

[2]Ibid.

account for any differences between the successful and the unsuccessful groups.

Significant differences were found between the two groups on the following characteristics: (1) grade earned in first-semester accounting; (2) grade earned in college mathematics; (3) grade earned in business mathematics; (4) cumulative grade-point average in business subjects; (5) several other lesser characteristics.[1] An inference was drawn that intelligence and mathematical background would be the strongest factors in the achievement of the successful group.

In 1954, Slater[2] found in studying accounting practices in teacher-training institutions in Illinois that a combination of teacher demonstration, and supervised laboratories should be used in presenting subject matter to elementary accounting students. He also found that business mathematics and other background courses assisted the demonstration and laboratory techniques in producing the best results from these students.

George[3] (1958) in a similar study of colleges and universities of 12 midwestern states, recommended that, where feasible, both business mathematics and some course in college mathematics should be

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[1] Ibid., p. 2382.

[2] Robert M. Slater, "A Study of the Practices in Teaching First Year Accounting in the Teacher-Training Institutions of Illinois," The National Business Education Quarterly, XX (March, 1954), 5-10.

[3] Stephen L. George, "Practices in the Teaching of Collegiate Elementary Accounting," The National Business Education Quarterly, XXXVI (March, 1958), 6-10.

scheduled for business administration majors, especially the students who leaned toward accounting as a major field of study.

The Accounting Teacher's Guide,[1] published under the auspices of the American Accounting Association in 1959, reports that business mathematics, when employed properly by an effective teacher and taught in sufficient conceptual depth, can be of great aid in providing a learning situation in elementary accounting courses. The guide suggests that the course in business mathematics be taken by the student just preceding or concurrently with the first course in accounting.

In a study by Null[2] (1954), 29 institutions in Oklahoma offering instruction in elementary accounting were investigated. Forty-eight accounting teachers and department chairmen were interviewed to obtain data concerning practices, procedures, and circumstances involved in the instruction of accounting at the college and university level. Null found the typical course of study for business administration majors called for a requirement of a course in business mathematics. In addition, the educators who were interviewed by Null agreed that the most important objective of elementary accounting is to enable students to develop an understanding of the basic concepts and principles of elementary accounting theory. They further agreed that another important

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[1]The American Accounting Association, Accounting Teacher's Guide, (Cincinnati: South-Western Publishing Co., 1959), p. 62.

[2]Elsie La Hassa Null, "Accounting at the Collegiate Level," (unpublished Ed.D. dissertation, University of Oklahoma, 1954), 68.

objective of accounting principles was to assist the students in becoming competent in applying accounting principles and solving business problems.[1]

Bachman and Patten,[2] in a 1967 study made of major universities that were members of the American Association of Collegiate Schools of Business, found a distinct movement in these schools away from the use of business mathematics as an aid for students majoring in business administration. However, a distinct trend was reported in the use of college algebra and one or two courses in calculus as requirements for these same students.

In 1968, Ross[3] reported the results of a study made of introductory and managerial accounting being taught in Louisiana, Arkansas, Oklahoma, Texas, and New Mexico. Ross further confirmed the trend toward the use of higher mathematics as requirements for business administration majors. Among the schools reporting, 45.1 per cent of the instructors indicated that business mathematics is of no significant value in the present teaching of accounting and related subjects. He also reported that 62 per cent of the instructors of these institutions favored some course or courses in pure college mathematics (algebra, calculus).

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[1] Ibid.

[2] Joseph W. Bachman and Ronald J. Patten, "Trends in the Elementary Accounting Course," Collegiate News and Views, XXI (March, 1967), 11-13.

[3] Frank A. Ross, "A Summary of Results From a Survey of Teaching Procedures in Introductory and Managerial Accounting," Collegiate News and Views, XXII (October, 1968), 7-9.

Larson[1] (1968) made a study of laboratory teaching methods mixing business mathematics with laboratory practices in the teaching of the first course in accounting at Montana State College. Three accounting laboratory treatment groups with two laboratory sections in each group were studied. The students were blocked and randomly assigned on the basis of either business mathematics or no business mathematics. The emphasis here was not on the mathematics but on either the enrichment or the neglect of the treatment groups. All students received the same accounting problems and other assignments.

Larson found that students assigned to "Enriched" laboratory treatment obtained significantly higher mean total achievement scores than those students assigned to the "Regular" or the "Neglected" laboratory treatment, regardless of whether or not they had taken the business mathematics course. Also, students who had a background of high school bookkeeping obtained significantly higher mean total achievement scores than those without this background. Of the people who dropped out of the course, 53.8 per cent came from the "Neglected" laboratory treatment group and 86 per cent were males without high school bookkeeping. Thus, the effect of the course in business mathematics was minimal and definitely not significant in the achievement results.

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[1]Harvey A. Larson, "An Evaluation of Teaching Procedures for a Beginning College Course in Principles of Accounting," (unpublished Ed.D. dissertation, Montana State College, 1968) cited by Dissertation Abstracts, p. 200.

In 1969, Butts and Prickett[1] made a similar study designed to compare the relative effectiveness of instruction in a laboratory situation. In this study, the laboratory group received traditional instruction consisting of coordinating lectures, demonstrations, and problems. The control group (non-laboratory) received traditional instruction only. This study revealed that the laboratory group achieved significantly higher levels of learning than the control group. In the first course of accounting principles, backgrounds such as high school bookkeeping and business mathematics were minimal in their effect on achievement because the focus of the investigation centered on the laboratory, non-laboratory treatment. However, the students in the laboratory group having had two or more of the background courses achieved at a higher level, but not significantly higher than those in the laboratory group without the background courses.

The American Institute of Certified Public Accountants (1967), conducted a survey of schools, businesses, and professionals in the field of accounting. From this survey evolved the publication, Horizons for a Profession,[2] in which courses of study were recommended for students interested in the field of accounting or other closely related areas. In each of the four suggested courses of study, college mathematics (modern algebra, calculus, statistics, and probability were listed. These

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[1]Franklin E. Butts and Gary L. Prickett, "The Effect of Audio-Tutorial and Programmed Instruction on Achievement in Accounting Principles," (unpublished Ed.D. dissertation, Northern Colorado University, 1969) cited by Dissertation Abstracts, p. 473.

[2]American Institute of Certified Public Accountants, Report on the Committee on Education and Experience Requirements of CPA's, March, 1969, pp. 41-59.

recommendations were based on the increased usage of mathematics in the communical languages in the field and on the increased specificity of reporting financial position in decision making in the field of business.

Bryan[1] (1973) conducted a study to determine certain factors that could be used as predictors for student success in Intermediate Accounting I. Accounting Principles I and Accounting Principles II grades, high school grades reported by the ACT Program, ACT scores, and first and second semester freshmen grade point averages were used as intellective factors in developing regression equations. From the analysis, Bryan determined that the best predictors of achievement in Intermediate Accounting I were the grades earned in Accounting Principles I and II. The ACT mathematics score, and the ACT composite score were also strong predictive measures for achievement in Intermediate Accounting I.[2]

In 1963, Whiteman[3] conducted an investigation in an attempt to determine whether or not a background in high school bookkeeping and/or business mathematics is helpful in achieving success in the first course of elementary accounting. The study included the semesters beginning with the fall of 1959 through the fall of 1962. During this period of

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[1]James Alvin Bryan, "A Study of Selected Factors Related to Student Achievement in Intermediate Accounting," (unpublished Ed.D. dissertation, Oklahoma State University, 1973), 76.

[2]Ibid.

[3]Floyd E. Whiteman, "A Study of the Effect of a Background in College Business Mathematics and High School Bookkeeping Upon Success in College Elementary Accounting," (unpublished Master's Thesis, Kansas State Teachers College, Emporia, 1963), pp. 30-40.

time, 1,172 students had received a letter grade in the first course of elementary accounting at Kansas State Teachers College. These students comprised the sample used by Whiteman in the investigation. Whiteman used the letter grade earned in the first course of elementary accounting, the letter grade earned in college business mathematics (if this course had been completed at the time of the study), and the letter grade earned in each completed semester of high school bookkeeping (if the student had obtained one or more courses of the subject). Based on the background of the students, groups were formed. Chi-square tests compared the distribution of college elementary accounting grades of students with one year of high school bookkeeping with those accounting students who had not had high school bookkeeping.[1] The tests were repeated for those students with two years of high school bookkeeping[2] and again for those students with the one semester course in college business mathematics.[3]

From an analysis of the data, Whiteman concluded that it makes very little difference whether or not the course in college business mathematics is taken if achievement in the first course of elementary accounting is the primary factor for enrolling in this course. He also concluded that a background in high school bookkeeping is definitely helpful in achieving success in college elementary accounting. The more courses of high school bookkeeping which a student has completed

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[1] Ibid.

[2] Ibid.

[3] Ibid., pp. 41-59.

tends to be directly related to his degree of success in college elementary accounting.[1]

Tonne,[2] in a brief statement prepared for The Journal of Business Education, tends to support Whiteman and his conclusion concerning business mathematics. He believes that students who can learn and profit from involved business mathematical experience probably do not need it. They would be better off devoting their time to algebraic and other advanced mathematical learnings. Many of the processes can be done far better algebraically and the rationale is usually more obvious.[3]

In a study covering a period of three years, Quinn[4] discovered that students enrolled in elementary accounting courses disclosed a large deficiency in handling arithmetic functions, understanding arithmetic functions, and speed in dealing with numbers.

A majority of the research studies and literature dealing with achievement in the first course of elementary accounting either imply or strongly indicate that a background in high school bookkeeping has a direct, positive effect on the degree of success attained in this particular course of accounting.

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[1] Ibid., p. 63.

[2] Herbert A. Tonne, "The New Mathematics in Business Education," The Journal of Business Education (May, 1971), 317.

[3] Ibid.

[4] Mildred Louise Quinn, "Accounting Class Failures and Arithmetic Deficiencies," Business Education Forum (March, 1974), 30.

Will[1] found, in studying the effect of free operant learning on achievement in the first course of accounting principles, that prior instruction in high school bookkeeping produced a significant difference in achievement, when tested at the .05 level.

Webb[2] reported a significant relationship between high school bookkeeping, as measured by standardized tests, and predicting success in the first course of elementary accounting. He also concluded that intelligence, reading, listening, writing, and quantitative ability in mathematics were factors that could influence the degree of success attained in studying the elementary course of accounting.

In 1968, Smith[3] conducted an investigation to determine whether or not a background in high school bookkeeping would save the first year of accounting student time while enhancing the student's opportunities for achievement. Smith grouped students with a high school bookkeeping background and placed them in a section of elementary accounting that met three hours per week (no scheduled laboratory). The students who did not have the high school bookkeeping background were grouped and placed in a section of elementary accounting which

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[1]Milton Mike Will, "The Effect of Free Operant Learning on Achievement In the Principles of Accounting Course," (unpublished Ph.D. dissertation, The University of North Dakota, 1970) cited by Dissertation Abstracts, p. 6490.

[2]Harold Quentin Webb, "The Prognostic Potential of Selected Factors For Predicting Achievement In the Study of Highschool Bookkeeping and Accounting," (unpublished Ph.D. dissertation, The Ohio State University, 1971) cited by Dissertation Abstracts, p. 3645.

[3]John William Smith, "Articulation of Highschool Bookkeeping and College Elementary Accounting," (unpublished Ed.D. dissertation, University of Oklahoma, 1968) cited by Dissertation Abstracts, p. 1054.

met five hours per week (two hours compulsory laboratory). The investigation covered one semester; and at its conclusion Smith found a significant difference between the achievement of students in college elementary accounting who have and those who have not studied bookkeeping. Furthermore, the student who studied bookkeeping also successfully completed college elementary accounting in substantially less time than that required for those students who had not studied high school bookkeeping.

A survey was completed by Barbour[1] in 1955 in which she attempted to determine whether the study of bookkeeping in high school contributes to achievement in collegiate accounting principles. Questionnaires were used to obtain the opinions of 117 accounting students, 108 bookkeeping teachers, and 98 accounting instructors concerning the value of studying bookkeeping before studying accounting.

From replies to the questionnaire, Barbour concluded that the amount of overlapping in the content of first-year bookkeeping and first-semester accounting is considerable. The overlapping in the content of second-year bookkeeping and second-semester accounting is considerably less than that of the first year. Moreover, the bookkeeping grade cannot be used to predict the second-semester accounting accounting grade although bookkeeping grades are high predictors for first-semester accounting grades.[2]

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[1]Edna Hollar Barbour, "The Effect of the Study of Highschool Bookkeeping Upon Achievement in Elementary College Accounting," (unpublished Ph.D. dissertation, Ohio State University, 1955) cited by Dissertation Abstracts, p. 476.

[2]Ibid., p. 476.

A study conducted by Sink[1] sought to determine the effect of bookkeeping on achievement in three types of first-term accounting courses. The types of accounting courses were determined by the teaching methodology and course content of each section. Only students earning a B grade or higher in high school bookkeeping were included as part of the study. From his data, Sink concluded that bookkeeping students who later study first-term accounting can expect to make use of some of the bookkeeping topics and some of the bookkeeping terminology learned in high school. Yet, students who have not studied bookkeeping are as likely to complete the first-term accounting course as are students who have studied bookkeeping. The degree of achievement was not a primary consideration in the Sink study, but indications were that bookkeeping students making a B or higher would achieve at a higher level than students making C or less, or those students not having the bookkeeping background.

Summary

Chapter II is the product of an extensive search of the available literature dealing with accounting, mathematics, and high school bookkeeping. This review revealed a present and future need for a background in college mathematics in relation to the field of accounting and the other disciplines of the business community. Numerous articles and studies were cited that dealt with the future of the businessman and his scope of educational background, specifically for attaining the maximum achievement in the elementary accounting courses.

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[1]Clay Van Sink, "The Effect of Bookkeeping on Achievement in Three Types of First-Term Accounting Courses," (unpublished Ph.D. dissertation, Ohio State University, 1968) cited by Dissertation Abstracts, p. 437.

Studies reviewed were those that indicated a difference in achievement in the first course of elementary accounting among students with a high school bookkeeping background when compared with the students without this previous instruction.

The crucial point of Chapter II was a review of literature dealing with recommended mathematical requirements as suggested by such professional organizations as the American Institute of Certified Public Accountants and the American Accounting Association. These organizations, along with other professional accountants and accounting educators, recognize a dire need for the expansion of the scope of the basic courses required for all business majors.

Communication appears to be the crux of cooperation among the business disciplines. Experts are calling for some common ground for the exchange of ideas and information. The literature dictates mathematics as one subject through which these goals can be more readily attained.

Little effort has been made to determine the effect of college mathematics on success in the second basic course of elementary accounting. Therefore, a study testing this effect, along with that of high school bookkeeping, seems highly justified if accounting education is to continue to reach for horizons that are broader in scope and deeper in understanding.

Chapter III presents the research methodology and the statistical techniques used to test the hypotheses of the study.

CHAPTER III

METHODOLOGY

The purpose of this study was to test the effects of two basic areas of background preparation on the success of students enrolled in the second course of elementary accounting at selected four-year colleges and universities in Oklahoma. Individual consideration was made for each area of background preparation. A further consideration was to determine whether interaction existed between the two areas of background preparation.

Sample

The sample was taken from the population of students enrolled in the second course of elementary accounting principles of eight selected colleges and universities in Oklahoma. Because of their geographic locations, these institutions of higher education provided a sample composed of subjects from rural, urban, and metropolitan areas. The selected institutions were the University of Oklahoma at Norman, Oklahome State University at Stillwater, Tulsa University at Tulsa, Central State University at Edmond, Southwestern State College at Weatherford, East Central State College at Ada, Southeastern State College at Durant, and Northeastern State College at Tahlequah. One prime-time section (8:30 a.m., 9:30 a.m., 10:30 a.m.) was chosen from each institution

except Central State University, base for the study, where three prime-time sections of second-course elementary accounting were chosen.

The process of data collection began during the first week of the 1973 fall semester when the AICPA Orientation Test, Form E, was administered to all students attending eight selected sections of second-semester elementary accounting. Within the next three class periods, the AICPA Achievement Test, Level I, Form E-S, was administered to 96 per cent of these same students, as the pretest instrument. At the close of the semester, the AICPA Achievement Test, Level I, Form E-S was administered a second time to the students completing the accounting course. This process was repeated to two additional prime-time sections of second-course elementary accounting at Central State University in the Spring Semester of 1974.

A sample of 265 students was formed from the 422 students tested by at least one of the instruments. One hundred fifty-seven students eliminated themselves from the sample by failing to meet the criteria necessary for this study. The criteria met by each of the 265 students forming the sample were:

1. Completion of the AICPA Orientation Test, Form E.
2. Completion of the AICPA Achievement Test, Level I, Form E-S, when employed as the pretest instrument.
3. Completion of the AICPA Achievement Test, Level I, Form E-S, when employed as the posttest instrument.
4. An obtainable ACT standard composite score.

The criteria were the same for each student regardless of the institution where testing took place.

Table 1 indicates the number of second-course elementary accounting sections, the total of the students completing at least one of the testing instruments, and the number of students meeting and failing to meet the requirements necessary for inclusion in the sample.

TABLE 1

NUMBER OF SECTIONS OF SECOND-COURSE ELEMENTARY ACCOUNTING PRINCIPLES, NUMBER OF STUDENTS COMPLETING AT LEAST ONE OF THE TESTING INSTRUMENTS, AND THE NUMBER OF STUDENTS MEETING AND FAILING TO MEET THE CRITERIA REQUIREMENTS

Schools	Sections	Total Students Tested	Number Meeting Criteria	Number Not Meeting Criteria
Oklahoma University	1	22	6	16
Oklahoma State University	1	51	37	14
Tulsa University	1	30	21	9
Central State University	3	166	113	53
Southwestern State College	1	42	30	12
East Central State College	1	34	18	16
Southeastern State College	1	43	26	17
Northeastern State College	1	34	14	20
Totals	10	422	265	157

An analysis of background preparation was then made for the 265 subjects meeting the criteria. This analysis provided facts which revealed the college mathematics, and high school bookkeeping preparation of each subject included in the sample. These facts were then employed to form the four groups indicated in Table 2.

TABLE 2

NUMBER OF STUDENTS IN THE SAMPLE FROM EACH INSTITUTION, NUMBER OF STUDENTS IN GROUPS I-IV

Schools	Number of Students	Group I	II	III	IV
Oklahoma University	6	3	1	1	1
Oklahoma State University	37	9	10	9	9
Tulsa University	21	7	6	5	3
Central State University	113	43	32	13	25
Southwestern State College	30	8	6	9	7
East Central State College	18	2	8	2	6
Southeastern State College	26	5	13	1	7
Northeastern State College	14	4	5	3	2
Totals	265	81	81	43	60

Group I is composed of those students who had completed a course in college algebra (or equivalent) but did not have a background in high school bookkeeping.

Group II is composed of those students who had completed neither a course in college algebra (or equivalent) nor a course in high school bookkeeping.

Group III is composed of those students who had completed both a course in college algebra (or equivalent) and one year of high school bookkeeping.

Group IV is composed of those students who had not completed a course in college algebra (or equivalent) but had completed one year of high school bookkeeping.

One requirement of this study was that the course in college algebra (or equivalent) must have been completed before enrollment in the second course of elementary accounting.

Geographic location of the high schools attended by the subjects composing the sample was not a primary consideration in this study. However, an investigation was made to determine the percentage of the sample who had been graduated from rural, urban, and metropolitan area high schools. These results are presented in the following table.

TABLE 3

NUMBER OF PEOPLE COMPRISING TOWN AND CITY POPULATIONS, NUMBER OF SUBJECTS, PERCENTAGE OF SAMPLE GRADUATING FROM HIGH SCHOOLS IN THESE POPULATION RANGES

Town and City Population Ranges	Number of Subjects	Percentage of Sample
500-5,000	21	.079
5,001-15,000	43	.162
15,001-40,000	47	.177
40,001-80,000	63	.238
80,001-200,000	81	.306
200,001 and larger	10	.038
Totals	265	1.000

The purpose of Table 3 was to reveal any dominant group of subjects whose influence might tend to bias the study. A summary of the percentages in Table 3 indicate 24.1 per cent of the sample obtained high school background in predominantly rural locations, 41.5 per cent of the sample obtained high school background in predominantly urban locations and 34.4 per cent of the sample obtained high school background in predominantly metropolitan locations. This dispersion of the subjects' high schools eliminated locational dominance and thus precluded bias which could have become a confounding variable in this study.

The group of 157 students who did not complete the second course of elementary accounting was also analyzed for background information. An attempt was made to reveal trends in course withdrawals for students with similar preparatory backgrounds. To accomplish this goal, a chi-square was calculated for the students failing to complete the specified accounting course.

Research Design

Two independent variables were included in this study, college algebra and high school bookkeeping. Each independent variable had two levels (yes-no). These areas of preparation were established before the subjects' enrollment in the second course of elementary accounting and were used to separate the students into Groups I through IV, as shown in Table 2.

Because the independent variables had already occurred, an ex post facto research design was used to compare Groups I through IV. Kerlinger defines ex post facto research as:

> . . . . that research in which the independent variable or variables have already occurred and in which the researcher starts with the observation of a dependent variable or variables. He then studies the independent variables in retrospect for their possible relations to, and effects on, the dependent variable or variables.[1]

The scores achieved by the four groups of students on the AICPA Achievement Test, Level I, Form E-S, when administered as the posttest, were defined as the dependent variable.

Kerlinger contends that the most important educational research problems do not lend themselves to experimentation, although they do

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[1]Fred N. Kerlinger, Foundations of Behavioral Research (New York: Holt, Rinehart, and Winston, Inc., 1964), p. 360.

lend themselves to controlled inquiry of the ex post facto kind.[1] He also states that ex post facto research has these three major weaknesses: (1) the inability to manipulate independent variables, (2) the lack of power to randomize, and (3) the risk of improper interpretation.[2] However, Kerlinger believes that the contributions of ex post facto research vastly outweigh its weaknesses when carefully constructed hypotheses and proper statistical tools are employed in the research project.[3] "First sight" results should not be interpreted as final; and one should always treat the results and interpretations of the data of ex post facto investigations with great care.[4]

Due to the diversity of school locations and the prearranged schedules at each institution, it was administratively impossible for the accounting instructors to cater completely to the wishes of the writer regarding the manipulation of students for experimental purposes. Therefore, it was necessary to deal with "intact" student groups in this study. Popham indicates that many situations in educational research require the use of intact student groups.[5] He further indicates that analysis of covariance can be employed as the statistical tool to equate those groups with respect to possible confounding relevant variables.

> . . . . This technique allows the researcher to statistically equate the independent variable groups with respect to one or more variables which are relevant to the dependent variable.[6]

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[1] Ibid., p. 373.

[2] Ibid., p. 371.

[3] Ibid., p. 372.

[4] Ibid., p. 373.

[5] W. James Popham, Educational Statistics: Use and Interpretation (New York: Harper & Row, Publishers, 1967), p. 221.

[6] Ibid., p. 223.

The basic objective of this study was to test the effects of college algebra and high school bookkeeping on the success of students completing the second course of elementary accounting. A secondary objective for the study was to test for interaction which could exist between the two independent variables. As previously defined, the independent variables were college algebra and high school bookkeeping. The dependent variable was the score attained on the second administration of the AICPA Achievement Examination, Level I, Form E-S. The covariates (control variables) were the scores attained on the first administration of the AICPA Achievement Examination, Level I, Form E-S, the ACT composite scores, and the composite scores attained on the AICPA Orientation Examination, Form E. From a review of previous research studies related to achievement, these control factors were shown to be effective covariates.

Evaluative Instrument

An investigation of standardized testing materials developed to measure student knowledge of the first two courses in elementary accounting revealed two sources, the American Institute of Certified Public Accountants and the Educational Testing Service.

The American Institute of Certified Public Accountants publishes an examination designed to measure elementary accounting knowledge at the completion of the second course of elementary accounting. The instrument requires a 50-minute testing period and has an established national norm.

The Educational Testing Service has the College-Level Examination Program, frequently referred to as CLEP tests. CLEP also has an

examination designed to measure elementary accounting knowledge, but this test requires more time than the normal 50-minute class period.

Each of the institutions participating in this study had an allotted examination schedule set for 50-minute class periods. For this reason, the AICPA Achievement Examination, Level I, Form E-S, was determined to be acceptable. William Bock, of the AICPA Testing Project Office was subsequently contacted and permission was secured for the use of the AICPA Achievement Examination as the evaluative instrument. The usage agreement was subject to the provision that no part of the examination would be reproduced in this study. The tests were then ordered.

Upon receipt of the achievement tests, an analysis was made of the test content. The AICPA Achievement Examination, Level I, Form E-S, is an examination specifically designed to measure student knowledge of accounting principles when administered at the completion of the second course in accounting principles. The examination contains 45 multiple-choice questions and is structured for a 50-minute time limit. The test is divided into four parts. Part I is composed of 22 questions emphasizing vocabulary and financial accounting concepts. Part II is composed of nine questions emphasizing elementary cost accounting and system concepts. Part III contains six questions pertaining to cost-volume-profit relationship. Part IV consists of eight questions emphasizing account classification.

From the spring of 1969 through 1970, the American Institute of Certified Public Accountants selected several colleges and universities throughout the United States and requested their cooperation in the

AICPA Testing Program. The Achievement Examination was administered to 10,306 students completing the second course of elementary accounting at these particular institutions. From the results of the examinations, the Institute developed percentile rank norms for Level I of the Achievement Examination.

The AICPA gives no published validity or reliability data for Level I of the Achievement Examination. The Institute does, however, make available an item analysis for the examination revealing a discrimination index and difficulty level for each question. This data is based on 450 students tested in January, 1966, and is reproduced as Appendix A.

The scoring and reporting services, provided by the AICPA Testing Project Office, are composed of a list of each student examined, his raw score, and corresponding percentile ranking.

Williams[1] defines validity as the degree to which the researcher measures what he claims to measure. Three general types of validity used in gathering validity information are content, construct, and criterion validity. The writer was concerned with content validity as it is the type normally associated with achievement tests. Downie and Heath refer to content validity as:

> . . . . a nonstatistical type of validity that is usually associated with achievement tests. When a test is so constructed that it adequately covers both the content and the objectives of a course or part of a course of learning, it is said to have content validity.[2]

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[1]Williams, op. cit., p. 22.

[2]N. M. Downie and R. W. Heath, Basic Statistical Methods (New York: Harper and Row, Publishers, 1965), p. 223.

In order to determine content validity for the AICPA Achievement Examination, Level I, Form E-S, seven college and university accounting instructors from the participating institutions were requested to evaluate the examination for content. On the basis of affirmative reactions, the achievement examination was determined to have content validity for measuring concepts presented in the first two courses of elementary accounting.

The reliability of a testing instrument is another important statistic which must be considered. Reliability is defined as the degree of consistency with which a test measures whatever it does measure, or the degree to which all compensating errors are absent.[1] Therefore, the reliability of the testing instrument becomes very important. The AICPA produces no reliability estimates for the achievement examination; therefore, the writer deemed it necessary to establish an estimate of reliability for the examination as employed in this study. An investigation of statistical materials revealed the following statement by Downie and Heath:

> In general, reliability coefficients of well-made standardized tests tend to be high, .90 or above. There is no hard and fast rule that says that any reliability has to be of a certain size before any test instrument can be useful. Today we look upon reliability as a relative thing, and there are certain areas and certain techniques where reliability coefficients fall well below this .90, and the techniques are still used and found to be very useful.[2]

The AICPA Achievement Examination, Level I, Form D-S, was used as the testing instrument to measure elementary accounting knowledge

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[1]James E. Wert, Charles O. Neidt, J. Stanley Ahmann, Statistical Methods in Educational and Psychological Research (New York: Appleton-Century-Crofts, Inc., Publishers, 1954), p. 329.

[2]Downie and Heath, op. cit., p. 220.

retained by students entering into the study of Intermediate Accounting I, by Krull[1] in 1971. In the investigation, Krull reported a Hoyt reliability coefficient of .80 and a standard error of measurement of 2.85 based on all items of the AICPA Achievement Examination.[2]

A study similar to that made by Krull was completed by Beavers[3] in 1974. The AICPA Achievement Examination, Level I, Form E-S, a revision of Form D-S, was employed as part of the investigation. Using the Kuder-Richardson Formula 21, Beavers reported a reliability coefficient of .82 and a standard error of measurement of 3.04 for all items of the achievement examination.[4] Thus, Krull and Beavers established that the achievement examination was certainly reliable for their investigatory purposes.

Since there were no published reliability coefficients for the achievement test, other than the coefficients established by the two preceding studies, it was necessary to estimate a reliability coefficient for the achievement test as employed in this study. Thorndike and Hagen[5] state that an examination which has a known mean and standard deviation may provide a reliability coefficient by using the Kuder-Richardson Formula 21. The mean for the 265 students taking this examination was

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[1]George William Krull, Jr., "A Study of Two-Year College Transfer Students' Elementary Accounting Achievement," (unpublished Ph.D. dissertation, Michigan State University, 1971), p. 100.

[2]Ibid.

[3]Lorren Hays Beavers, "A Study of the Elementary Accounting Achievement of Junior College Transfer Students in Selected Institutions of Higher Education in Oklahoma," (unpublished Ed.D. dissertation, University of Oklahoma, 1974), p. 61.

[4]Ibid., p. 62.

[5]Robert L. Thorndike and Elizabeth Hagen, Measurement and Evaluation in Psychology and Education (New York: John Wiley & Sons, Inc., 1961), p. 181.

14.56 and the standard deviation was 7.40. Using the established mean and standard deviation, the following Kuder-Richardson Formula 21 was employed to estimate the reliability coefficient:

$$r_{11} = \frac{n}{n-1}\left[1 - \frac{M_t\,\frac{(1-M_t)}{n}}{s_t^2}\right]$$

where r_{11} is the estimate of reliability

n is the number of items on the test

s_t is the standard deviation of the test

M_t is the mean score of the student group.[1]

The reliability coefficient for the test was calculated to be .836 which compares favorably with the coefficients previously reported for Form D-S and Form E-S of the achievement examination.

Another statistic, referred to as the standard error of measurement, may be utilized to estimate the reliability of a test. Downie and Heath relate that the standard error of measurement:

> . . . . unlike the reliability coefficient is not affected by the range of scores of the sample tested. It tends to be about the same for samples with different variances. This standard error of measurement is the standard deviation of a sample of scores of an individual about his true score.[2]

The formula for calculating the standard error of measurement is:

$$s_e = s\sqrt{1-r_{tt}}$$

where s_e is the standard error of measurement

s is the standard deviation of the examination

r_{tt} is the reliability of the examination.[3]

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[1] Ibid.

[2] Downie and Heath, op. cit., p. 221.

[3] Ibid.

Using the standard deviation of 7.40 and the reliability coefficient of .836 the standard error of measurement for this examination is calculated to be 2.99.

Downie and Heath also indicate that the standard error of measurement is a standard deviation and should be interpreted as such. Therefore, it is possible to state that the chances are two out of three that a student's obtained score on the AICPA Achievement Examination, Level I, Form E-S, was not more than 2.99 units from his true score. The smaller the standard error of measurement, the more reliable the examination and the more confidence can be placed in any score obtained by using the examination.[1]

Data Collection Procedures

During the summer of 1973, administrative personnel of the selected institutions were contacted and permission was secured for testing students in the selected sections of elementary accounting principles courses. Class schedules were reviewed and prime-time sections were chosen. Cooperation was then obtained from each instructor of the chosen sections.

Previous communication with the Testing Projects Office of the AICPA had confirmed the usage of the AICPA Orientation Test and the AICPA Achievement Examination, Level I, Form E-S, in the investigation. These items were received in August, and along with the student questionnaires, distributed to each institution before the start of the fall semester. During the first week of class, the AICPA Orientation Test was administered to the students. Following this, the AICPA

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[1]Ibid., p. 222.

Achievement Examination was then given. Both tests were completed no later than the second class meeting of the second week of the fall semester, thus limiting the amount of course content which could be taught before the administration of the examination.

The first week of class also marked the time that the students were requested to complete the questionnaires. The purposes of the questionnaires were to obtain the subjects' permission for using ACT composite scores in the study, to identify the location of the high schools attended by the subjects, and to specify each student's identification. A copy of the student questionnaire and permission form have been reproduced as Appendix B.

The AICPA Testing Projects Office provided instruction manuals for each instructor administering the tests. The instruction manuals specified procedure and time allotment for each section of the tests. Instructors were requested to follow the testing instructions carefully in order to produce uniformity in the administration of the examination.

The completed test answer sheets and the student questionnaires were collected from the institutions during the third week of the fall semester. The answer sheets were then mailed to the Testing Projects Office for scoring and ranking. Student questionnaires were reviewed for pertinent information and the permission forms were submitted to each institution. The student records were then analyzed.

During the final week of the fall semester, the AICPA Achievement Examination, Level I, Form E-S, was readministered to those students

completing the selected sections of second-course elementary accounting. All examinations and answer sheets were then collected from the institutions and mailed to the Testing Projects Office for scoring and ranking.

After all necessary data for the sample were obtained, the students were grouped on the basis of their background preparation. IBM cards were then punched with all applicable data for each subject. The coding of the data and the order in which the data was punched on the cards are presented in Appendix C. Appendix D represents the entire list of data used for the sample.

Procedures for Testing Hypotheses

As previously stated, the 265 students comprising the sample were separated into four groups. Group classification was based on the college algebra and high school bookkeeping background attained by the students before enrollment in the second course of elementary accounting. Groups I through IV were then employed to form a 2 X 2 factorial design.

The 2 X 2 factorial design was used to test the hypotheses. The score attained on the AICPA Achievement Examination, Level I, Form E-S, when administered as the posttest, was the dependent variable in each hypothesis.

The factorial experiment permits an investigator to evaluate the combined effects of two or more treatments in a single experiment. This is accomplished by combining block designs so that one level from each of two or more treatments is presented simultaneously.[1] The 2 X 2

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[1]Roger E. Kirk, Experimental Design: Procedures for the Behavioral Sciences (Belmont, California: Brooks/Cole Publishing Company, 1968), p. 18.

factorial design provides this study with a test of hypotheses about effects of a background of college algebra, effects of a background of high school bookkeeping, and a test for interaction.

Table 4 presents the 2 X 2 factorial design employed in this study. The cells in the model indicate the number of subjects in the sample with various backgrounds in terms of college algebra and high school bookkeeping.

TABLE 4

2 X 2 FACTORIAL MODEL SHOWING NUMBER OF STUDENTS WITH AICPA ACHIEVEMENT TEST SCORES (POSTTEST)

		Algebra Status	
		yes	no
High School Bookkeeping Status	yes	Group III n=43	Group IV n=60
	no	Group I n=81	Group II n=81

Three hypotheses were pertinent to the investigation:

Ho_1 The adjusted means of the final achievement examination of Group I and Group III are higher than the adjusted means of Group II and Group IV when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Ho_2 The adjusted means of the final achievement examination of Group III and Group IV are higher than the adjusted means of

Group I and Group II when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Ho_3 The difference between the adjusted means of the final achievement examination of Group III and Group I is higher than the difference between the adjusted means of the final achievement examination of Group IV and Group II when the influence of the ACT Test composite score, AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Biomedical Computer Programs (BMDX64)[1] and (BMD05V)[2] were employed to perform the statistical functions of analysis of covariance. BMD05V and BMDX64 are computer programs designed to calculate multiple classification analysis of covariance when the design cells are of unequal size.

The use of multiple classification analysis of covariance with a 2 X 2 factorial design produces three F ratios. The first F ratio tests for differences in achievement between students who have had the college algebra mathematical preparation and those students who have not had this background. The second F ratio tests for differences in achievement between students who have had high school bookkeeping and those students who have not had this background preparation. Since college algebra and high school bookkeeping were defined as the two independent variables, the first two F ratios are termed "main effect" ratios. In other words, the first two F ratios test for the individual effect of each independent variable. The third F ratio tests for interaction which may take place between the two main effects.

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[1]W. J. Dixon, Ed., Biomedical Computer Programs, No. 3 (Berkeley: University of California Press, 1970), p. 34.

[2]Ibid., p. 543.

Summary

Chapter III has presented the composition of the sample for this study, the data collection procedures, and the method employed to group the subjects. The research design was presented along with justification for utilizing the AICPA Achievement Examination as the instrument to measure student achievement. Content validity and reliability coefficient estimates were established for the evaluation instrument.

A description of the statistical techniques for testing the hypotheses was presented. The biomedical computer programs employed to calculate the F ratios which were used to accept or reject the hypotheses were described.

Chapter IV will present the statistical analyses used to test the hypotheses established for this study.

CHAPTER IV

STATISTICAL ANALYSIS AND INTERPRETATION

The basic purpose of this study was to test the effects of two basic areas of background preparation on the success of students completing the second course in elementary accounting principles. The first consideration was to indicate whether a difference in the degree of success exists between the students who have completed a course in college algebra prior to enrollment in the second course of elementary accounting and those students who have not completed a course in college algebra prior to enrollment in the second course of elementary accounting. A further consideration was to determine if a difference in the degree of success exists among those students who have completed a course in high school bookkeeping and those students who did not have this background prior to enrollment in the second course of elementary accounting. A final consideration of the study was to determine whether there is interaction between college algebra and high school bookkeeping as background preparation for elementary accounting.

Description of Data

The success of those students completing the second course of accounting principles was measured through the administration of an achievement examination with established national norms. The achievement

examination was specifically designed to measure knowledge of accounting principles retained by students at the completion of the second course of Principles of Accounting. AICPA Achievement Examination, Level I, Form E-S was the test of achievement employed in this study. The test was administered to eight selected sections of second-course accounting principles at the close of the fall semester of 1973, and to two selected sections at the close of the spring semester of 1974. There were eight schools participating in this study.

Four hundred twenty-two students enrolled in the selected sections of the second course of elementary accounting. From this population, 265 students completing the course provided all information necessary to be included in the sample. Of the total enrollment, 157 students did not complete the accounting course. Reasons for withdrawal were not relevant to this study. However, a chi-square was computed in an attempt to project tendencies, in terms of background preparation, for the students who did withdraw from the course. The factorial model for the chi-square test is presented as Table 5.

A chi-square of .88 was obtained, from the data in Table 5, which is not significant at the .05 level. Therefore, no background tendencies could be predicted for students withdrawing from the course.

In order to make a comparison between college algebra and high school bookkeeping backgrounds, students in the sample were separated into four groups. Group classification was based on the college algebra and high school bookkeeping attained before enrollment in the second course of accounting principles.

TABLE 5

2 X 2 FACTORIAL MODEL FOR STUDENTS WITHDRAWING (CHI-SQUARE)

		Algebra Status: yes	Algebra Status: no	
High School Bookkeeping Status	yes	Group III n=22	Group IV n=37	59
	no	Group I n=44	Group II n=54	98
		66	91	157

$p < .05 = 3.841$

Group I is composed of those students who had obtained a background only in college algebra.

Group II is composed of those students who had neither a college algebra nor a high school bookkeeping background.

Group III is composed of those students who had both a college algebra and a high school bookkeeping background.

Group IV is composed of those students who had obtained only a background in high school bookkeeping.

Following the administration of the final achievement test, the means and standard deviations for each group were calculated from the raw data and included as part of Table 6.

TABLE 6

MEANS AND STANDARD DEVIATIONS OF THE THREE CONTROL VARIABLES AND THE DEPENDENT VARIABLE

Group	n		Control Variables: Orientation Test	Control Variables: ACT Score	Control Variables: AICPA Pretest	Dependent Variable: AICPA Posttest
I	81	mean	46.75	20.42	11.00	16.02
		S.D.	16.97	4.82	5.78	7.14
II	81	mean	43.43	18.75	9.74	11.84
		S.D.	16.76	4.39	5.37	6.96
III	43	mean	44.21	20.67	9.05	16.86
		S.D.	11.36	4.13	5.24	7.03
IV	60	mean	43.10	19.70	10.40	14.60
		S.D.	13.70	4.22	4.77	7.68
Total	265	mean	44.49	19.77	10.16	14.56
		S.D.	15.48	4.19	5.40	7.40

Geographic location of the participating schools and the administrative impossibility of each instructor catering completely to the wishes of the writer necessitated the use of intact groups for the study. Intact groups are normally unequal with regard to intelligence; therefore, three control variables were used as covariates to equate student performance. The control variables were: (1) the AICPA Orientation Examination, Form E; (2) the ACT composite score; and (3) the AICPA Achievement Examination, Level I, Form E-S (administered as a pretest). These data were obtained at the beginning of each semester included in the study. The means and standard deviations for the control variables are shown in Table 6.

The mean scores indicated in Table 6 are synonymous with the arithmetic average scores attained by each group on the four tests included in the study. One standard deviation, above and below the mean, would normally include approximately 68 per cent of the subjects' scores on each test.

The importance of an effective covariate cannot be overlooked. Therefore, Pearson r's were calculated among the three covariates and the dependent variable. The intercorrelation coefficients for these four variables are shown in Table 7.

TABLE 7

INTERCORRELATION BETWEEN THE THREE COVARIATES AND THE DEPENDENT VARIABLE FOR THE COMBINED SAMPLE

	Orientation Test	ACT Composite Score	AICPA Achievement Pretest
ACT Composite Score	.65		
AICPA Achievement Pretest	.38	.33	
AICPA Achievement Posttest	.54	.63	.35

$p < .05$

The correlation between the AICPA Achievement Posttest and (1) the ACT Test is .63, a moderately high correlation; (2) the AICPA Orientation Test is .54, a moderately high correlation; and (3) the AICPA Achievement Pretest is .35, a moderately low correlation. The AICPA Orientation Test and the ACT Test produce a correlation of .65,

also moderately high. The Achievement Pretest correlated with the Orientation Test at .38, and the ACT Test at .33, are both moderately low.

However, all six correlation coefficients are significant at a probability level less than .01. The correlation coefficients can be interpreted as follows:

1. The moderately high positive correlations indicate that:
   a. those students who did well on the Orientation Test also had higher ACT composite scores and Achievement Posttest scores;
   b. the students who did well on the ACT Test also had higher Achievement Posttest scores.

2. The moderately low correlation between the Achievement Pretest and the other two covariates and the dependent variable can be accounted for by the apparently low level of accounting knowledge at the time of the Achievement Pretest. Thus, a great deal of error was present in each person's pretest AICPA score. An analysis of variance for the Achievement Pretest substantiated the preceding statement when an F of 1.30, which is not significant at the .05 level, was obtained. This suggests that the four groups commenced the second course of accounting with nearly equivalent accounting backgrounds.

In other words, two covariates (AICPA Orientation Test and ACT composite scores) would have produced results equally as significant as those results obtained by using three covariates.

The statistical technique, analysis of covariance, was used to make comparisons of the four student groups. Analysis of covariance permits scores made by groups to be adjusted for relevant factors believed to have influencing effects on performance. Adjustments are made, through the use of covariates (control variables), to equate groups in terms of the stated objectives. The means and adjusted means of Groups I through IV are revealed in the following table:

TABLE 8

MEANS, ADJUSTED MEANS, AND STANDARD ERROR FOR POSTTEST

Group	Mean	Adjusted Mean	Standard Error
I	16.02	15.23	.01
II	11.84	12.74	.62
III	16.86	16.41	.85
IV	14.60	14.78	.71

Table 8 clearly reveals the adjusting effect of the covariates. Groups I and III have adjusted means which are lower than the means calculated from only the raw data, while Groups II and IV have adjusted means which are higher than their raw score means.

The decision to use analysis of covariance appeared to be sound because of the substantial correlation between the covariates and the dependent variable. Specifically, Meyers[1] states that

> . . . . the analysis of covariance is more precise than the treatment x blocks design when the true correlation between x and y is greater than .60.[2]

Hypotheses Tested

A biomedical computer program, designed for multi-classification analysis of covariance and unequal cell size, when used to calculate the

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[1]Jerome L. Myers, Fundamentals of Experimental Design (Boston: Allyn and Bacon Publishers, 1966), pp. 323-24.

[2]Ibid.

F ratios associated with the 2 X 2 factorial design established for this study. The results from computation of the analysis of covariance are presented in Table 9.

TABLE 9

ANALYSIS OF COVARIANCE SIGNIFICANCE TESTS

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Algebra (A)	1	256.72	256.72	8.52*
Bookkeeping (B)	1	156.37	156.37	5.19*
A X B	1	11.06	11.06	.37
Error	258	7776.78	30.14	

*$p < .05$

Table 9 reveals the degrees of freedom, sums of squares, mean square, and the F ratios calculated for each source of variation. The table indicates that the F ratio for the interaction (A X B) was not significant. The F ratios for the (A) and (B) variables were significant beyond the .05 level. These three F ratios were used to test the hypotheses.

The first hypothesis was structured to compare achievement on the accounting posttest of college algebra-no college algebra groups. To test for differences, the hypothesis was stated as follows:

Ho_1 The adjusted means of the final achievement examination of Group I and Group III are higher than the adjusted means of Group II and Group IV when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Table 9 shows the F ratio for the (A) main effect. The F indicates a significant difference between the adjusted mean (15.82) for the college algebra group and the adjusted mean (13.76) for the no college algebra group ($F = 8.52$, $p = .003$). Therefore, the hypothesis was accepted.

Table 8 provides supportive evidence for the preceding statement. The adjusted means for the college algebra groups (Group I and Group III) exceed the adjusted means for the no college algebra groups (Group II and Group IV). Since the difference between the adjusted means is statistically significant, it is evident that the college algebra groups performed significantly higher on the accounting achievement test than did the no college algebra groups.

The second hypothesis was designed to compare achievement on the accounting posttest of high school bookkeeping-no high school bookkeeping groups. To test for these differences, the hypothesis was stated as follows:

Ho_2 The adjusted means of the final achievement examination of Group III and Group IV are higher than the adjusted means of Group I and Group II when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Table 9 shows the F ratio for the (B) main effect. The significant F ratio indicates a significant difference between the adjusted means (15.595) for the high school bookkeeping group and the adjusted means (13.985) for the no high school bookkeeping group ($F = 5.19$, $p < .02$). Thus, the second hypothesis was also accepted.

Table 8 again provides supportive evidence for the preceding statement. The adjusted means for the high school bookkeeping groups (Group III and Group IV) are higher than the adjusted means for the no high school bookkeeping groups (Group I and Group II). Since the difference between the adjusted means is statistically significant, it is evident that the high school bookkeeping groups performed significantly higher on the accounting achievement test than did the no high school bookkeeping groups.

The final hypothesis was designed to test for interaction between main effects (A) and (B). Interaction considers the potential relationship between the dependent variable and the combined effects of the two independent variables. To produce this test, the hypothesis was stated as follows:

H_{o3} The difference between the adjusted means of the final achievement examination of Group III and Group I is higher than the difference between the adjusted means of the final achievement examination of Group IV and Group II when the influence of the ACT Test composite score, AICPA Orientation Test, Form E, and the AICPA Achievement Test, Form E-S, Level I (Pretest), are held constant and when tested at the .05 level of significance.

Table 9 shows the F ratio for the combined main effects (A X B). The F ratio indicates that interaction was not present; the level required for significance was not attained ($F = 0.37$, $p > .54$). Hypothesis three was rejected.

When a significant interaction does exist, college algebra cannot be spoken of unless comments are also made which concern high school bookkeeping. The same is true when attempting to speak only of high school bookkeeping. In other words, a significant interaction would mean that a confounding effect would be produced by one independent

variable upon another independent variable. Since the F ratio for interaction was not statistically significant, the independent variables may be commented on separately.

The lack of a statistically significant interaction may be shown by plotting the adjusted means of Group I through IV in graphic form.

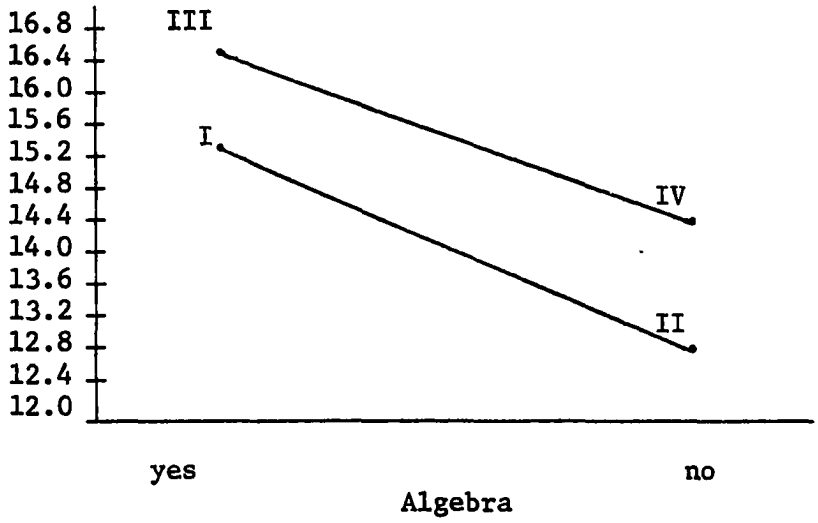

Fig. 1--Adjusted means of college algebra and high school bookkeeping groups.

An analysis of Figure 1 indicates that the college algebra groups attained a higher mean achievement level on the final achievement test than the high school bookkeeping groups. To determine the significance of this difference, the F ratio for interaction (A X B) must be reviewed. An F ratio of 0.37 calculated at the .05 level of significance falls far below the 3.88 value required for significance at the .05 level with 1 and 258 degrees of freedom. Thus, the graph of Fig. 1 and the F ratio for interaction concur.

Summary

Chapter IV has presented the statistical analyses, the testing of the hypotheses, and the interpretations of the data pertaining to the research study. In the second course of elementary accounting, students with a college algebra background indicated a higher level of achievement than students without that background. Students having high school bookkeeping backgrounds performed at a higher level of achievement than those students without high school bookkeeping backgrounds. However, there was no interaction between the college algebra and the high school bookkeeping backgrounds.

Chapter V presents a summary of the research study, conclusions drawn from the interpretation of the results of the data, and recommendations for further study.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of Chapter V is to present a summary of the research project, to present the conclusions drawn from the data, and to present recommendations for further research in related areas. Since the study was limited to eight institutions of higher education in Oklahoma, no attempts are made to generalize beyond this scope.

Summary of Study

This study was concerned with the effect of college algebra and high school bookkeeping on achievement in the second course of elementary accounting. The first consideration was to indicate whether a difference in the degree of success exists between the students who have completed a course in college algebra prior to enrollment in the second course of elementary accounting and those students who have not completed this background preparation prior to their enrollment in the second course of elementary accounting. A further consideration was to determine whether a difference in the level of success exists among the students who have completed a course in high school bookkeeping and those students who did not have this background prior to their enrollment in the second course of elementary accounting. A final consideration of the study was to

determine whether there is interaction between college algebra and high school bookkeeping backgrounds.

After the cooperation of eight colleges and universities was secured, 10 sections of second-course elementary accounting, offered at prime-times, were selected as the population. From this population, 265 subjects completed the accounting course and supplied all the data necessary for inclusion in the sample. One hundred fifty-seven subjects did not complete the accounting course.

The levels of achievement, attained by the students included in the sample, were measured by the AICPA Achievement Test, Level I, Form E-S, administered at the close of each semester. These students were equated in terms of intelligence through the use of three covariates. Two of the covariates were the AICPA Orientation Test, Form E, and the AICPA Achievement Test, Level I, Form E-S. Both tests were administered during the first few class periods of the semester. The third covariate was the ACT composite score which was obtained in an investigation of the students' records.

The college algebra and high school bookkeeping backgrounds of the subjects were obtained from student records and a questionnaire. These two areas of background preparation were designated as independent variables. The score attained in the second administration of the AICPA Achievement Test was the dependent variable.

Analysis of covariance was the statistical technique employed to produce the F ratios used to test the three hypotheses of this study. Analysis of covariance is a statistical technique which allows a comparison to be made of the adjusted means of students selected from intact classroom groups.

The first hypothesis stated that those students with college algebra backgrounds achieved at a higher level than those students who did not have a college algebra background. The second hypothesis stated that those students with high school bookkeeping backgrounds achieved at a higher level than those students who did not have a high school bookkeeping background. The third hypothesis stated that interaction existed between the independent variables.

From the results of testing the three hypotheses, conclusions were drawn relative to comparisons of students with various combinations of college algebra and high school bookkeeping background preparation.

An additional analysis was made of the students who did not complete the sections of the second course of elementary accounting selected for this research project.

Conclusions

The conclusions drawn from this study were based upon answers found through the statistical analyses of the data accumulated for the study. The following conclusions were drawn from the results:

1. The analysis of the students who withdrew from the second course of elementary accounting yielded no differential trends.

2. The students, as a group, who obtained a background in college algebra before entering the second course of elementary accounting produced higher levels of achievement than those students who had not obtained this background preparation. Therefore, it was concluded that prior completion of a course in college algebra tends to accompany success in accounting principles.

3. The students, as a group, who obtained a background in high school bookkeeping achieved at a higher level in the second course of elementary accounting than those students who had not attained this background preparation. Therefore, it was concluded that prior completion of a course in high school bookkeeping tends to accompany success in the second course of elementary accounting.

4. The students, as a group, who obtained backgrounds in both college algebra and high school bookkeeping attained the highest level of success in the second course of accounting principles.

5. The students, as a group, who have obtained only a college algebra background achieve at a higher level in the second course of accounting principles than those students, as a group, who have obtained only a high school bookkeeping background.

6. Students, as a group, with neither a college algebra nor a high school bookkeeping background achieve at a level which is lower than those students, as a group, with at least one of the background areas.

7. The correlation coefficients of the AICPA Orientation Test, Form E, and the ACT scores with the AICPA Achievement Test, Level I, Form E-S, indicate that these two variables are effective predictors for success in the second course of elementary accounting.

The preceding conclusions were drawn from statistical analyses applied to data gathered from students enrolled in selected sections of the second course of elementary accounting in eight Oklahoma colleges and universities. No attempt was made to extend comments outside the higher educational system of Oklahoma.

This study has shown that differences in achievement do exist between students having various combinations of college algebra and high school bookkeeping backgrounds. From the results of this study, only general comments can be made concerning the causes of these differences.

Recommendations

The results of this study have raised several unanswered questions for educators who plan curricula and who assist students in planning their course of study. Therefore, it is recommended that research studies be designed to answer the following questions:

1. Do various factors of learning stimulation such as teacher preparation, teacher personality, and teacher interest in students and the accounting profession have statistically significant effects on achievement in the second course of elementary accounting?

2. Does the knowledge attained in college mathematics courses influence success in collegiate accounting courses?

3. Do various academic interests, life styles, and chronological age differences affect achievement in the second course of elementary accounting?

These questions and others which will surface in the future are of utmost importance to students and educators. If education is to improve curricula and academic guidance, specific factors, in addition to background preparation, which influence achievement in accounting principles must be established. Continuing research is the logical and necessary solution to these pertinent queries.

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APPENDICES

APPENDIX A

ITEM ANALYSIS FOR AICPA TEST

ITEM ANALYSIS[1]

Achievement Test, Level I, Form E-S

Item	Difficulty*	Discrimination Index**	Item	Difficulty*	Discrimination Index**
Pt. I			Pt. II		
1.	91	51	23.	89	41
2.	88	43	24.	77	39
3.	73	53	25.	73	46
4.	73	50	26.	60	39
5.	72	43	27.	52	25
6.	72	35	28.	46	41
7.	70	24	29.	40	40
8.	64	32	30.	37	40
9.	59	32	31.	29	35
10.	55	43			
11.	49	41	Pt. III		
12.	48	40	32.	77	68
13.	47	29	33.	80	52
14.	46	37	34.	34	54
15.	45	21	35.	86	56
16.	42	42	36.	83	65
17.	40	37	37.	71	51
18.	37	50			
19.	36	42	Pt. IV		
20.	34	26	38.	42	41
21.	31	40	39.	18	27
			40.	47	42
			41.	78	39
			42.	93	36
			43.	34	28
			44.	30	37
			45.	58	39

*Decimal points omitted

**Correlation between item and total scores ("Flanagan r"); decimal points omitted.

Note: Item analysis is based on a group of 450 students tested in January, 1966, by the following nine colleges: University of Arizona, C.C.N.Y., Hofstra, University of Minnesota, University of North Carolina, Oklahoma State University, University of Rochester, San Jose State, University of Texas.

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[1]The Item Analysis was reproduced for this study by permission from the Testing Project Office of the American Institute of Certified Public Accountants.

APPENDIX B

STUDENT QUESTIONNAIRE

RESEARCH QUESTIONNAIRE

The purpose of this Questionnaire is to gather data for Research being done in the State of Oklahoma for a doctoral study. If you will allow the data from the questionnaire to be used in this Research--AND--if you will grant permission for your records in the Office of Admissions and Records of your school to be used, please sign your name on the permission form below. (Please be certain that no name or identification numbers will be published in the Research. They are for identification purposes only.) Your cooperation will be greatly appreciated in providing the data requested as completely as possible.

NAME (Last, First, M.I. or Maiden) _____ SOCIAL SECURITY NUMBER _____

MAJOR _____ MINOR _____ STUDENT I.D. NUMBER (other than Soc.Sec.) _____

1. HIGH SCHOOL GRADUATED FROM? _____

2. HAVE YOU TAKEN THE AMERICAN COLLEGE TEST (ACT) FOR COURSE ADMISSIONS? _____
   A. IF YES, FOR ADMISSION TO WHAT SCHOOL? _____
   B. IF NO, HAVE YOU TAKEN ANOTHER COLLEGE ADMISSIONS TEST? IF SO, PLEASE INDICATE THE TEST TAKEN AND THE APPROXIMATE DATE.
   _____

3. HAVE YOU EVER ATTENDED ANOTHER COLLEGE OR UNIVERSITY? _____
   IF YES, WHAT SCHOOL OR SCHOOLS? _____
   _____

4. IN HIGH SCHOOL, DID YOU COMPLETE A COURSE IN HIGH SCHOOL BOOKKEEPING? _____

5. IN COLLEGE (UNIVERSITY) DID YOU COMPLETE A COURSE IN COLLEGE ALGEBRA OR AN EQUIVALENT COURSE BEFORE YOUR ENROLLMENT IN THE SECOND COURSE OF ACCOUNTING PRINCIPLES? _____

TO: OFFICE OF ADMISSIONS AND RECORDS

Permission is hereby granted to the Researcher to examine my permanent records in your office for the purpose of gathering data for educational Research only. It is understood that no names or identification numbers will be printed in the Research study.

Date _____ Signed _____
(Student's signature)

School (currently enrolled) _____

APPENDIX C

CARD CODING SYSTEM

CODE SHEET

STUDENT DATA

Code on Data Sheet
Order of Punches on Cards

Card Column

1-5	Group Identification Number 1 Group I 2 Group II 3 Group III 4 Group IV
6-10	Score on AICPA Orientation Test, Form E.
11-15	Score on ACT (Composite Score).
16-20	Score on first administration of AICPA Achievement Examination, Level I, Form E-S.
21-25	Score on second administration of AICPA Achievement Examination, Level I, Form E-S.

APPENDIX D

STUDENT DATA

GROUP I
(n=81)

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
1	37	19	09	08
2	53	27	19	17
3	28	14	06	13
4	40	16	05	13
5	60	22	14	11
6	41	21	04	16
7	48	23	11	13
8	65	21	18	15
9	56	25	01	20
10	55	23	18	21
11	51	27	14	20
12	62	21	11	16
13	90	29	25	31
14	67	25	23	28
15	52	23	15	25
16	32	21	06	19
17	42	19	05	23
18	11	16	04	01
19	49	16	17	13
20	63	27	06	30
21	50	27	18	21
22	27	17	10	17
23	66	24	00	19
24	56	25	07	30
25	38	21	08	31
26	29	17	13	09
27	48	17	16	06
28	59	23	00	20
29	56	20	18	09
30	44	13	11	19
31	62	24	15	23
32	32	15	08	13
33	52	21	14	09
34	73	25	20	24
35	55	27	20	23
36	46	16	10	16
37	61	23	15	13
38	24	15	21	15
39	68	17	12	10
40	60	27	10	15

GROUP I--Continued

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
41	49	21	08	20
42	56	27	21	28
43	55	23	14	20
44	33	20	13	21
45	31	21	04	08
46	43	15	05	18
47	55	13	13	00
48	38	17	04	14
49	69	27	18	25
50	26	14	10	06
51	06	21	21	25
52	58	24	13	19
53	57	25	11	18
54	28	13	03	05
55	30	17	05	11
56	48	19	11	13
57	25	19	01	10
58	60	21	13	15
59	56	21	16	19
60	40	21	18	19
61	75	27	18	33
62	68	30	10	15
63	03	08	02	02
64	41	17	06	16
65	55	17	10	13
66	69	19	10	15
67	51	25	13	18
68	39	07	14	09
69	29	16	03	13
70	44	19	15	15
71	34	17	09	09
72	54	23	10	24
73	51	21	11	19
74	21	18	13	10
75	57	29	07	19
76	38	21	06	15
77	40	26	08	08
78	36	18	06	12
79	37	20	09	10
80	35	13	06	08
81	39	15	06	06

GROUP II
(n=81)

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
1	72	18	14	19
2	36	14	03	05
3	64	24	21	23
4	22	17	07	01
5	54	16	13	11
6	74	30	09	21
7	42	24	06	20
8	59	23	17	19
9	52	19	04	13
10	75	27	14	21
11	15	16	20	10
12	59	21	09	11
13	29	14	02	05
14	38	19	14	14
15	10	19	03	09
16	20	14	05	06
17	17	14	11	09
18	33	21	13	16
19	18	13	03	00
20	34	16	04	09
21	65	29	00	26
22	65	25	05	27
23	64	29	19	28
24	16	13	05	00
25	58	17	14	06
26	27	18	11	00
27	50	19	08	17
28	00	12	06	01
29	45	17	09	03
30	29	18	14	06
31	37	13	05	03
32	45	17	02	13
33	42	16	12	06
34	43	17	00	15
35	36	17	07	09
36	45	14	06	03
37	34	16	08	04
38	46	24	14	06
39	42	17	17	10
40	48	19	18	01

GROUP II--Continued

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
41	48	17	08	04
42	42	19	15	04
43	44	15	06	10
44	31	18	08	18
45	55	25	14	23
46	61	19	18	19
47	30	14	06	05
48	65	25	21	21
49	39	16	04	10
50	26	18	01	11
51	36	21	13	16
52	55	23	14	21
53	43	21	10	15
54	30	20	03	14
55	59	17	12	16
56	01	13	09	03
57	48	17	09	08
58	63	19	05	14
59	30	15	11	10
60	73	21	12	09
61	53	21	10	15
62	45	19	14	18
63	61	25	11	16
64	40	16	11	11
65	71	28	19	21
66	31	16	05	10
67	34	17	00	13
68	38	12	11	13
69	55	23	15	24
70	46	12	08	09
71	40	18	10	10
72	63	23	18	16
73	69	29	11	24
74	29	16	06	11
75	24	16	04	03
76	57	19	16	11
77	39	21	10	11
78	32	14	15	12
79	47	14	04	09
80	50	20	16	12
81	55	21	04	13

GROUP III
(n=43)

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
1	31	19	04	09
2	60	19	10	19
3	33	19	12	13
4	43	19	17	16
5	37	21	11	15
6	42	23	10	18
7	59	27	22	28
8	50	21	13	15
9	63	23	05	13
10	50	25	13	28
11	55	27	15	25
12	39	24	09	02
13	66	30	11	31
14	15	13	04	07
15	46	21	08	28
16	57	25	06	22
17	29	16	04	18
18	44	21	01	23
19	39	21	05	25
20	46	23	10	21
21	48	21	10	13
22	32	13	05	04
23	45	19	09	10
24	41	19	19	15
25	47	21	04	24
26	49	19	15	18
27	28	17	10	15
28	32	17	04	17
29	43	16	06	10
30	51	25	19	26
31	64	26	11	14
32	42	21	05	13
33	49	21	13	10
34	39	18	11	25
35	34	13	06	17
36	55	23	03	22
37	31	14	00	06
38	36	17	16	14
39	40	22	09	13
40	54	27	14	21
41	59	25	01	16
42	54	23	08	20
43	24	15	01	06

GROUP IV
(n=60)

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
1	31	19	09	09
2	36	19	16	11
3	51	15	14	13
4	65	21	18	23
5	53	19	10	16
6	61	25	12	26
7	55	22	21	26
8	35	19	11	18
9	43	19	11	15
10	27	17	08	18
11	49	23	15	21
12	51	24	06	16
13	41	21	05	18
14	36	20	09	00
15	55	27	17	19
16	27	21	13	22
17	52	21	10	19
18	46	23	13	08
19	43	21	06	08
20	40	28	00	21
21	38	22	08	19
22	62	14	13	26
23	43	18	11	17
24	48	19	04	08
25	58	21	06	09
26	43	19	11	09
27	51	17	11	09
28	62	21	14	04
29	68	19	05	19
30	53	24	13	13
31	32	21	07	09
32	53	24	06	12
33	31	19	10	10
34	28	14	09	11
35	06	08	00	00
36	62	27	07	28
37	47	22	21	35
38	47	15	16	21
39	24	17	04	26
40	51	19	11	13

GROUP IV--Continued

Student Number	AICPA Orient. Score	ACT Composite Score	AICPA Achievement First Score	AICPA Achievement Second Score
41	50	24	18	11
42	57	23	15	21
43	28	17	09	11
44	46	19	14	15
45	35	15	04	13
46	59	16	13	26
47	24	16	06	00
48	64	23	13	15
49	31	27	06	11
50	14	16	05	08
51	28	14	05	06
52	60	26	13	15
53	47	20	09	11
54	29	20	06	11
55	20	13	11	11
56	46	19	20	13
57	55	26	09	31
58	06	08	10	00
59	36	16	18	08
60	47	20	09	14