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The effect of problem-oriented and rule-oriented computer-based instructional strategies on concept acquisition in microeconomics

Lasnik, Vincent Elliott, Ph.D.
The Ohio State University, 1988
Dedicated with love to the memory of my mother, Toby, and to my father, Nathan, toward the fulfillment of the hope that all things are possible. L'Chiyam! (To Life!)
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CHAPTER I
INTRODUCTION

During the last ten years, the microcomputer has emerged as a widely implemented, rapidly-evolving medium of instruction (Hall, 1982; Kearsley, Hunter, & Seidel, 1983; Walker & Hess, 1984). Extensive evidence suggests that computers can be used to improve: (1) the rate of learning (Kulik, Bangert, & Williams, 1983; Kulik & Bangert-Drowns, 1983; Kulik, Kulik & Cohen, 1980); (2) the degree of learning achievement (Chambers & Bork, 1980; Deignan & Duncan, 1978); (3) the attitudes of students toward computers (Magidson, 1978; White, 1969); and (4) the motivation and interest of students in the learning experience (Seymour, Sullivan, Story, & Mosley, 1987). Moreover, the research, development and application of computer-based instruction has had an increasing impact on the entire phenomenon of education theory and practice, most noticeably in the domains of instructional systems design, concept learning, learning strategies, individual differences toward learning, and the teaching of skills in thinking and problem solving.

**Economic Education**

Also during the same period, curriculum and instruction in pre-college economic education has become widespread throughout the public schools of the United States (Walstad & Watts, 1985). At least half of the state boards of education have mandated economics instruction, and nearly ninety percent of all secondary schools (junior and senior high schools combined) offer at least one economics elective course (Clark & Barron, 1981). These observations are supported by the promulgation of comprehensive instructional materials and regional centers specifically for economic education, and in the continuing nationwide effort to coordinate these programs by the Joint Council on Economic Education (Hansen, Bach, Calderwood, & Saunders, 1977; Morton, Buckles, Miller, Nelson, & Prehn, 1985).

Meanwhile, the search for explanatory models of economic learning has contributed to instructional development across the economic education curriculum (Becker & Walstad, 1987). In particular, the Joint Council on Economic Education has promoted the evaluation and implementation of computer courseware, film series,
and other media to provide students with the economic understanding and problem-solving ability needed to deal with both personal and societal economic issues (Morton et al., 1985; Soper & Walstad, 1983; Walstad, 1979). In contrast to the passive student models of lecture-delivered and workbook-assisted instruction, interactive computer-based instruction has provided considerable potential for enhancing concept acquisition in economics for many groups of learners (Dalgaard, Lewis & Boyer, 1984; Paden, Dalgaard & Barr, 1977; Post, 1985; Soper, 1974).

Purpose of the Study

Importantly, designers of computer-based instruction continue to have inadequate knowledge of critical learner cognitive and affective characteristics and of the effectiveness of various computer-mediated teaching strategies to teach concepts on the secondary level. This inadequacy is particularly evident in the design and implementation of effective computer courseware in precollege economics education. Therefore, research investigating the interaction of courseware strategies and individual differences in precollege economics principles instruction would contribute to the continuing development of the economics curriculum, and may have
additional implications to the teaching of thinking and problem-solving across many other content domains (Heiman & Slomianko, 1987; Nickerson, Perkins, & Smith, 1985).

In estimating the effects of various programs on student economic learning, most evaluation studies have measured only cognitive outcomes while often neglecting to measure affective learning and individual differences (Soper & Walstad, 1983). The absence of affective data is particularly true in the limited research investigating the effectiveness of microcomputer courseware in precollege economics (Dalgaard et al., 1984). No studies could be found which have attempted to design and apply research-based microcomputer instruction in economics while subsequently analyzing the complex interrelationships between achievement in economics and attitude toward economics, level of computer anxiety, and attitude toward learning. As a result, a critical need existed for empirical research into the factors which contribute to the development of excellence in computer-based instruction in precollege economics. Therefore, this study attempted to investigate several important issues involved in the design and implementation of concept learning courseware in precollege economics, including the phenomenon of learning economics from computers across both cognitive and affective domains.
Problem-Oriented and Rule-Oriented Processes

A problem-oriented and a rule-oriented instructional strategy were systematically designed and adapted to computer courseware lessons comparing the teaching of microeconomics concepts to Grade 12 students. Generally, an instructional strategy defines with precision the appropriate, theory-based methods and conditions that are critical to the acquisition of specified learning outcomes (Glaser, 1982).

Problem-oriented strategies are derived from a diversity of cognitive learning theories. Cognitive theories posit that changes in behavior occur as a result of learning, and that individual learners construct meaning as they approach new content domains (Di Vesta & Rieber, 1987; Shuell, 1986; Wittrock, 1974, 1978). Cognitive-designed instructional systems encourage the learner to use heuristics, learning strategies and critical thinking during the process of concept acquisition and problem-solving (diSessa, 1977; Nickerson et al., 1985).

Problem-oriented pedagogy posits that instruction can foster meaningful learning by emphasizing relationship and connectivity between information, concepts and principles within a relevant, intrinsically motivating context (i.e., a problem scenario,
controversial issues, or other situations related to the lives of students). Computer-based learning strategies designed from a cognitive, problem-oriented model may facilitate the individual's ability to explore his or her thinking processes, deal with ambiguity, recognize underlying assumptions, and search for commonalities among data (Clark, 1984; Eysenck, 1984; Perkins, 1986).

In this study, an instructional strategy designed from a cognitive, problem-oriented model emphasized the following elements: (a) initial tasks epitomized superordinate principles in a conceptual model of the content domain, (b) tasks then presented increasingly complex elaborations of the other important domain concepts; (c) the tasks fostered active learner involvement in a problem scenario that placed the student in the artificial role of a company manager and which intrinsically motivated learners to use specific cognitive strategies to resolve problem situations within the scenario, thereby deriving concepts inductively.

Rule-oriented instructional strategies are adapted from behavioral learning theory. Behavioral theories have been extensively applied to instruction and have been the foundation upon which much of conventional computer courseware has been designed. The deductive, step-by-step sequencing of Skinner's instructional
strategy emphasized unambiguous, rote rule-example-recall sequences, followed by immediate reinforcement after a correct response (Merrill & Tennyson, 1977; Scandura, 1964; Skinner & Holland, 1961). These theories have collectively argued that behavior is learned, and that learners associate correct responses to stimuli in their environment as new subject matters and content domains are studied (Amsel, 1960; Groper, 1983; Lumsdaine, 1960; Skinner, 1954, 1958).

In this study, an instructional strategy designed from a behavioral, rule-oriented model emphasized the following elements: (a) the tasks provided practice in the comprehension and application of given rules and concepts within the content domain, (b) the tasks fostered direct concept acquisition by presenting explicit, well-defined rules with multiple examples to illustrate and reinforce previously stated definitions of terms and principles; and (c) concepts and principles were organized in a predefined, hierarchical sequence beginning with basic concepts and ending with the most comprehensive principle (e.g., equilibrium) after each previous concept had been presented and learning evaluated and remediated.
Statement of the Problem

Research into the optimal computer-based instructional strategies to teach concepts and principles within specific knowledge domains is essential if courseware implementing such strategies is to prove useful in addressing long-term instructional needs. Specifically, this study examined how two distinct computer-based strategies could facilitate the acquisition of conceptual knowledge in microeconomics. A series of ten substantive hypotheses were constructed to systematically analyze certain subsets of this broader problem. These hypotheses, while providing a practical and conceptual structure to the investigation, were not themselves the primary focus of this study. Collectively, the principal educational problems investigated in this study were therefore:

1) The effect of rule-oriented and problem-oriented instructional strategies on the acquisition and retention (using immediate and delayed measures, respectively) of basic conceptual knowledge in a computer-based, senior high school level microeconomics principles unit;

2) The differential effect of the two instructional approaches on learning and cognition as measured by the higher-order and lower-order question levels of the achievement instruments;

3) The relationship between attitude toward economics and economic attitude sophistication in a microeconomics principles lesson unit;
4) The less understood factor of computer-related anxiety in relation to precollege learning from computer-based instruction;

5) Exploratory knowledge into the deep versus surface approach toward learning dichotomy, particularly in relation to instruction in an unfamiliar subject matter to students;

6) The factor of student gender as interrelated to the other research issues stated in this section;

7) The interaction of the factors noted above in relation to learning in a computer-based economics principles unit;

Research Hypotheses

A series of directional relationships were specified from certain treatment, gender and affective variables that observed student performance on the cognitive outcome measures. A variety of appropriate empirical procedures were utilized to investigate the following alternative research hypotheses predicted to be observed:

\[ H_1 \] The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects receiving instruction via the problem-oriented treatment strategy.

\[ H_2 \] The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects receiving instruction via the problem-oriented treatment strategy.

\[ H_3 \] The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for male subjects.
$H_4$  The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for male subjects.

$H_5$  The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a more positive attitude toward economics and greater economic attitude sophistication.

$H_6$  The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a more positive attitude toward economics and greater economic attitude sophistication.

$H_7$  The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a lower anxiety toward computers.

$H_8$  The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a lower anxiety toward computers.

$H_9$  The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a deep approach toward learning.

$H_{10}$  The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a deep approach toward learning.
Definition of Terms

The following frequently used terms were defined in this study as follows:

**Computer Courseware**

Computer software designed for the purpose of instruction or training is referred to as courseware. Computer-based instruction includes the application of interactive computer technology in education and training curricula, and includes the various computer courseware types: drill and practice, tutorial, and simulation programs, as well as other computer-based instructional applications utilizing interactive videodisc, hypermedia, and compact-disc technologies (Hall, 1982; 1978).

**Microeconomics Concepts**

Microeconomics is a major subdivision in the field of economics that is concerned with the economic behavior of individual households, markets, and companies. The major components of microeconomic theory are concerned with how the prices and quantities of goods and services are determined by the interaction of the factors of supply, demand and equilibrium (Morton et al. 1985; Samuelson, 1973).

**Problem-Oriented Strategy**

The problem-oriented strategy developed for this study was a synthesis of cognitive learning theories emphasizing inductive problem-solving and guided-discovery instruction (Blake, 1984; Reigeluth, 1983; Wittrock, 1974, 1978). The general instructional sequence followed a consistent series of learning events including (a) an initial overview section beginning the first part of each lesson module, (b) an initial presentation of problem situations, each requiring participation by the learner as an active component of the simulation in a decision-making role, (c) presentation of specific cognitive problem-solving strategies to approach problem situations, (d) subsequent practice from embedded questions requiring analysis and advanced application of earlier principles.
and strategies, and (e) conclusion of the full lesson sequence with a summative review and practice module.

**Rule-Oriented Strategy**

The rule-oriented strategy developed for this study was a synthesis of behavioral learning theories emphasizing deductive, expository, and rule-learning tutorial instruction (Amsel, 1960; Groper, 1983; Merrill & Tennyson, 1977). The general instructional sequence followed a consistent simple-to-complex series of learning events including (a) an initial overview section beginning the first part of each lesson module, (b) an initial presentation of rule names and definitions corresponding to specific concepts, (c) presentation of a recall question delivered after the initial rule presentation and preceding subsequent presentation of examples and non-examples illustrating and discriminating the rules; (d) subsequent practice with the new rules in the form of questions, and (e) conclusion of each lesson module with a mastery evaluation and conclusion of the full lesson sequence with a summative review and practice module.

**Cognitive Domain**

Cognitive, as used here, refers to "activities such as remembering and recalling knowledge, thinking, problem-solving, creating" (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956, p. 2). Questions measuring learning achievement and reflecting levels of the relative complexity of cognitive processing required in a learning task have been categorized according to a cognitive domain taxonomy by Bloom et al. (1956).

**Affective Domain**

Affective, as used here, refers to the subjective aspects of human response "which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection." (Krathwohl, Bloom & Masia, 1964, p. 7). Statements and descriptors measuring the relative level of an individual's "interests, attitudes, appreciations, values, and emotional sets or biases" toward a particular object or topic have been categorized in an affective domain taxonomy by Krathwohl et al. (1964, p. 7).
Higher-Order Questions

Higher-order questions require the cognitive processing skills of analysis, synthesis, and evaluation, as categorized using the cognitive domain taxonomy developed by Bloom et al. (1956). Advanced application-level questions (implicit application as delineated in the Revised Test of Understanding in College Economics, Saunders, 1981) were also included within the higher-order question subscales utilized in this study.

Lower-Order Questions

Lower-order questions require the cognitive processing skills of knowledge, comprehension, and application, as categorized using the cognitive domain taxonomy developed by Bloom et al. (1956). Simple application-level questions (explicit application as delineated in the Revised Test of Understanding in College Economics, Saunders, 1981) were also included within the lower-order question subscales in this study.

Attitude Toward Economics

Attitude toward economics is an affective domain measurement of the general level of a student's interest in the study of economics as a subject area. In this study, attitude toward economics was measured by the Survey on Economic Attitudes (Soper & Walstad, 1987), including a subscale that specifically measured student interest in economics as a subject area (the Attitude Toward Economics scale, or ATE).

Economic Attitude Sophistication

Economic attitude sophistication is an affective domain measurement of the degree to which a student's general understanding of economic issues and behavior is consistent with current economic knowledge. Economic attitude sophistication was measured by the Survey on Economic Attitudes (Soper & Walstad, 1987, 1988), including a subscale that specifically measured the degree of sophistication in the student's general understanding of economic issues (the Economic Attitude Sophistication scale, or EAS).
Computer Anxiety

Computer anxiety was the overall level of a student's positive or negative feelings about computers, including using and thinking about computer technology in general. In this study, computer anxiety was measured by the Computer Anxiety Index (CAIN) developed by Maurer (1983; Simonson, Maurer, Montag-Torardi, & Whitaker, 1987).

Attitude Toward Learning

Attitudes toward learning are measurements in the affective domain of the basic orientation and general level of student involvement in a learning task. In this study, attitude toward learning was measured by the Learning Attitude Survey, including two subscales that measured: (a) a deep approach (the DEEP scale), and (b) a surface approach (the SURF scale) toward learning, respectively. This instrument was developed locally by the investigator based upon the research of Biggs & Rihn (1984).

Deep Approach Toward Learning

A deep approach toward learning refers to a student's attitude toward learning tasks in general. A deep approach implied a personalized engagement and intrinsic enjoyment in learning tasks, interest in integrating new knowledge with prior knowledge, and the search for hypotheses, explanations, and meaningfulness in new material. The degree to which a student possesses a deep approach toward learning was measured by the deep subscale (the DEEP scale) of the Learning Attitude Survey, constructed for this study (Biggs & Rihn, 1984).

Surface Approach Toward Learning

A surface approach toward learning refers to a student's attitude toward learning tasks in general. A surface approach implied an impersonal disengagement and extrinsic motivation toward learning tasks, little interest in integrating new knowledge with prior knowledge, concern about the duration of learning tasks, and the reliance on memorization to learn new material. The degree to which a student possesses a surface approach toward learning was measured by the Surface
subscale (the SURF scale) of the *Learning Attitude Survey* used in this study (Biggs & Rihn, 1984).

**Limitations of the Study**

The population of the study was limited to four accessible high schools selected through the City of Columbus Public School District. The study was confined to 12th grade students distributed in eight classes enrolled in elective, conventional social studies courses at these schools. The specific generalizability of the study was therefore limited to the specific schools and student subpopulation within the classes and grade level stated here.

The Pretest, Posttest I (the immediate measure) and Posttest II (the delayed measure), although including many nationally-normed items from several diverse sources, were not nationally normed instruments. In addition, the Learning Attitude Survey, including the Deep and Surface approach toward learning subscales (the DEEP and SURF scales, respectively), was constructed locally and implemented without nationally-normed reliability data. The restriction of locally normed instruments further limited the generalizability of the findings.
A principle interest of the study was the design of microcomputer courseware in secondary level economics education. The scope of the study was limited to the investigation of specific cognitive and affective outcomes from two microcomputer-based instructional strategies teaching introductory concepts in microeconomics. The treatment conditions of the study were entirely computer-based, and all treatments were conducted within self-contained, high school microcomputer laboratories. The researcher did not train, observe, or otherwise utilize the class teachers in any capacity beyond general classroom management functions. Therefore, questions related to the comparative efficacy of computers versus human teachers and to the long-term economic and pedagogic benefit from computers to education, while important to the evaluation of many important curricular and policy issues, were not included in this study.

Assumptions of the Study

For the purpose of this study, the researcher assumed: (a) that the students participating in this study were within the normal range of ability and achievement and were broadly representative of typical Grade 12 students within the Columbus Public Schools in
terms of personological and demographic characteristics; (b) students were generally familiar with computers, were within the normal range of computer-related anxiety and would be fully capable of performing tasks associated with the simple use of computers required by the courseware treatments; (c) student learning performance was an indirect product of a complex combination of previous cognitive and affective factors, the specific instructional strategies designed and implemented in this study, and the unique instructional features of the computer courseware; and (d) participating students attempted to perform to their best ability on the courseware lessons and cognitive outcome measures, and indicated their choices sincerely in the self-report affective instruments of the study.

Overview of the Study

In Chapter I, both the general background and specific rationale for the study were presented accompanied by a concise statement of the problem and the research hypotheses that were investigated, the definitions of important terms, and the principle limitations and assumptions of the study. Chapter II describes the historical, theoretical, and practical context of the study, and reviews the relevant research
in computer-based instruction, instructional design, concept learning, and economics education. Chapter III elaborates the research design, experimental treatments and conditions, and the data collection and analysis procedures employed in the study. Chapter IV presents the research findings of the study, while Chapter V interprets these research findings and discusses their implications to the appropriate fields of educational theory and practice.

**General Summary**

In conclusion, the relatively nascent field of computer-based instruction has demonstrated tremendous potential for the improvement of instruction in many subjects. Interestingly, at the same time economics education has become an integral part of the entire K-12 curriculum. In an attempt to contribute to the study of these two important, multidisciplinary fields, two diverse instructional strategies representing contrasting views about the processes of instruction and learning were implemented in a computer-based unit teaching basic microeconomics concepts. In addition, systematic research into the design, implementation and evaluation of theory-based courseware strategies in precollege economics may be applicable to other appropriate
instruction and training domains and thus contribute to improving the next generation of computer-based instructional systems.

Several important variables related to individual differences in achievement and attitude were identified since research suggested that lesson design should consider both the affective and cognitive factors that are likely to affect the learning process. An experimental research study was subsequently designed and conducted to evaluate the effects of the economics courseware unit on Grade 12 students, and the relationship that existed between student cognitive and affective learning in the principles unit, including factors of both higher and lower-order thinking skills, gender, attitudes toward economics, computer anxiety, and approach toward learning tasks in general. The dissertation report describes the rationale, methodology, findings and implications of the study outlined here in Chapter I.
CHAPTER II
REVIEW OF LITERATURE

Introduction

The review of literature explores the empirical and theoretical background of this study, focusing on the following topics: (a) the field of computer-based instruction, including instructional simulations and computer anxiety; (b) relevant research on instructional systems design, media-related research, concept learning, and individual differences towards learning; (c) the problematic diversity of definitions attributed to problem-oriented and rule-oriented methodologies, and (d) the field of economic education, including the design and implementation of economics courseware, the issue of gender-related learning differences in economics, and continuing research into learner attitudes towards economics, especially in relation to cognitive achievement in economics. An overview briefly summarizes the literature on each topic.
Computer Based Instruction

Introduction

This section of the review examined the relevant research on computer-based instruction, with particular attention to the conceptual and technical features of high quality computer courseware. The analysis included: (a) a discussion of the relative effectiveness of computer courseware, (b) an analysis of the characteristics of computer-based instructional simulations and the potential of simulation courseware to contribute to concept formation, and (c) a brief examination of the collateral phenomenon of computer anxiety, a factor usually neglected in most computer based instruction research.

The Field of Computer-Based Instruction

While there has been extensive research over the last 20 years on the development and effectiveness of computer-based instruction, only a representative sample of the literature was surveyed here. Riccobono (1984) estimated that 62 percent of teachers in the United States used computers in some instructional role in their school, although primarily in a supplemental drill and practice capacity. A nationwide survey conducted by Chambers and Bork (1980) indicated that 90 percent of the
school districts responding were currently using the computer and that level would increase to 94 percent by 1985. While students in secondary-level courses in mathematics, science, and language arts were the most frequent users of microcomputer programs, Chambers and Bork predicted a consistent increase in the demand for quality courseware in the social sciences. They also noted a substantial shift in usage from rigid, lower-cognitive level drill and practice programs to more sophisticated, interactive tutorial and instructional simulation courseware. This trend is important since many conventional computer programs have emphasized the learning of facts over concepts and principles, suggesting that the potential of computer technology to improve human thinking and learning has been significantly undervalued (Licklider, 1979).

Increasing evidence exists that computers can be used to improve both the efficiency and the effectiveness of instruction in numerous areas (Chambers and Sprecher, 1980; Kulik & Bangert-Drowns, 1983; Magidson, 1978; Niemiec & Walberg, 1987; Thomas, 1979). Kulik, Bangert, & Williams (1983) conducted a meta-analysis of 51 studies examining the effects of computer-based teaching in Grades 6-12. The results demonstrated that students using computer drill and practice, tutorial, and
simulation instruction in a variety of academic subject matter generally performed better than students not using computer-based materials on immediate posttests by a mean of .32 standard deviations across the 51 studies reviewed. The computer also significantly reduced the amount of time necessary for students to complete the learning tasks compared to more conventional teaching. An earlier meta-analysis (Kulik, Kulik, & Cohen, 1980) found similar results for 59 studies on the college level, although the effect sizes were smaller than were the studies using grade school populations. Finally, the broadly positive findings of the Kulik et al. meta-analyses have been corroborated by other researchers (Samson, Niemiec, Weinstein, & Walberg, 1986).

The literature was consistent in finding more modest achievement gains on the secondary and college levels and in observing significantly higher effects sizes from microcomputer-based instruction than from mainframe-based instruction (Niemiec & Walberg, 1987). Hall (1982) summarized the broader implications of the research trends in computer-based instruction by observing that computers reduce learning time 40-50 percent with equal or increased retention in contrast to traditional instruction. Kulik and Bangert-Drowns (1983) cautioned, however, that although the observation of more
efficiency, effectiveness, and improved student attitudes toward computers is robust and well-documented, there is the continued threat of novelty and Hawthorne effects in addition to other uncontrolled factors confounding the findings. Moreover, they reiterated the perceptions of many researchers that using computers as a complete replacement for conventional teaching would seriously weaken the value of computer-based instruction. Therefore, courseware programs should essentially be developed as independent lesson modules to be used by teachers and their students within a broadly flexible instructional setting (Magidson, 1978; Chambers & Sprecher, 1980).

Research into various attributes of the computer environment have involved a diversity of instructional strategies, academic content areas, and individual differences (Niemiec & Walberg, 1987; Thomas, 1979; Wedman & Ragan, 1986). Instructional features of exemplary computer courseware include true learner/program interactivity derived through (a) individual pacing and learner control of branching and program sequence (Tennyson, 1982, 1980), (b) immediate corrective, remedial, and elaborative feedback to learners (Bardwell, 1981; Siegel & Misselt, 1984; Tennyson & Park, 1984; Wager & Wager, 1985), and (c)
continuous monitoring of student performance (Tennyson, 1981, 1982).

Courseware design reflects variability in general program approaches, such as tutorials and simulations, and includes both lower and higher-order questions with appropriate feedback requiring a broad range of cognitive processing in the learner (Hall, 1982, 1983; Merrill, 1987; Park, 1982). In addition, exemplary courseware: (a) maintains a consistent clarity and precision in presentation and screen design (Allessi & Trollip, 1985), (b) includes a moderate level of visual detail and task difficulty (Dwyer, 1978), and (c) carefully employs high-resolution graphics, animation, color, and sound to emphasize critical attributes of the subject being instructed and enhance attention, motivation, and aesthetic value where possible (Hartley & Lovell, 1984; Kearsley et al., 1983; Walker & Hess, 1984).

Research and development integrating cognitive learning theories with emerging instructional design paradigms is needed if the full potential of computer-based instruction is to be realized (Federico, 1983; Mitzel, 1981; Wedman & Ragan, 1986). After two decades of research in the use of advanced technologies in education, the degree to which alternative hypotheses compete to explain the conclusions of these studies is
undetermined, and there are still considerable gaps in the knowledge base on the effects of major cognitive and instructional variables. In summary, while computer-based education has been perceived as a powerful educational innovation with the ability to enhance human potential, it has remained apparent that "the implications of computer technology are only vaguely understood and are not being studied or planned in a comprehensive manner" (Hall, 1982, p. 363). Therefore, this empirical study attempted to systematically investigate several factors which could contribute to an increased understanding of the theory and practice of computer-based instructional systems.

Microcomputer-Based Educational Research. The use of microcomputers in educational research is also supported by the practical advantages of: (a) transportability, replicability and treatment standardization across experimental settings, (b) cost-effectiveness when administering complex treatments to large subject samples, (c) increased precision in specifying instructional strategies and investigating gross (macro level) and subtle (micro level) changes in those strategies, and (d) potentially greater objectivity in the management of experimental procedures generally.
Computer Based Instructional Simulations

Computer-based instructional simulations have emerged as a dynamic application of the computer to instruction and training. Computer simulations can provide highly engaging, interactive learning environments which employ many of the unique and powerful capacities of computer technology (Allessi & Trollip, 1985; Ellinger & Brown, 1979). Moreover, instructional simulation courseware has been implemented to teach concepts in many fields including science, mathematics, geography, medicine, business, and economics (Gentry, 1974; Hall, 1982; Horn & Cleaves, 1980; Joseph, 1970; Wilson & Schug, 1979).

Recently developed computer-based instructional simulations have applied the cognitive view of thinking as a perceptually and conceptually driven phenomenon (Ausubel, 1968; Hollnagel & Woods, 1983; Tennyson, 1982). Computer-based instructional simulations are designed to allow prediction and explanation of causal or correlative phenomena within a content domain (Cunningham, 1984). In the typical simulation experience a simplified model of a theory-based system is observed within the context of a realistic problem situation. A problem scenario serves as an advanced organizer which provides an opportunity for the student to establish a familiar frame of
reference for all subsequent interactions (Ausubel, 1968). Presented a set of clearly defined program rules, user options, and goals, the learner must analyze objects, events, concepts and interrelationships in the simulation scenario and induce successful strategies to achieve objectives.

Simulation as a pedagogical technique facilitates the learner to (a) generate and test hypotheses about the behavior of a system by manipulating certain elements in the system model while keeping others constant, (b) distinguish cause and effect relationships in the system, (c) distinguish between facts and hypotheses and between relevant and irrelevant elements, (d) identify previously unclear interdependencies and associations within the system, and (e) develop adaptive decision-making and higher-order thinking skills (Allessi & Trollip, 1985; Crawford, 1966; Cunningham, 1984; Greenblat, 1975; Thiagarajan & Stolovich, 1978).

**Computer Anxiety**

In studies of the effects of computer-based treatments, the motivational influence of computer novelty or the detrimental effect of situational anxiety from naive subjects with little or no computer keyboard experience can have considerable unnoticed impact on the
conclusions of a study (Clark, 1983; Kulik, Bangert, & Williams, 1983; Tobias, 1973). Confounding can also occur from the interaction of computer instruction and unmeasured personological characteristics of the subjects such as anxiety level, academic aptitude, and learning style (Cambre & Cook, 1985). Recent evidence suggests that there is a continuing motivation on the part of students to use computers in learning tasks (Seymour et al., 1987). However, a small but significant outlying group of individuals has tended to exhibit considerably higher computer anxiety than the norm. Thus it remains valuable to include computer anxiety as a factor to reduce confounding in computer-based instructional research (Maurer, 1983).

While the interactions between anxiety and human learning have been well documented, relatively limited research has specifically investigated the attributes and correlates of computer-associated anxiety (Cambre & Cook, 1985; Sieber, 1977; Tobias, 1979). Studies have often used teacher educators, classroom teachers, or college-level students while measuring collateral issues such as intent to use computers, apprehension in talking about computers, and computer fear. Generally, few significant findings on the dimensions of computer anxiety were revealed (Jordan & Stroup, 1982; Rohner and Simonson
The gender factor, however, has produced consistently strong relationships, with females reporting higher degrees of anxiety toward using the computer (Cambre & Cook, 1985).

The Computer Anxiety Index or CAIN (Maurer, 1983; Simonson, Maurer, Montag-Torardi and Whitaker, 1987) is a standardized, highly-reliable measure of generalized anxiety towards the computer. The CAIN was applied in this study to investigate learner anxiety associated with instructional computer usage. Maurer (1983) defined computer anxiety as:

The fear and apprehension felt by an individual when considering the implications of utilizing computer technology, or when actually using computer technology. The individual is in the state (of computer anxiety) because of the fear of interaction with the computer, even though the computer possesses no immediate or real threat. (p. 2)

Simonson et al. (1987) recently conducted an extensive validation study that extended the earlier work of Maurer (1983). The final CAIN version was constructed using a six-point Likert scale that recorded the level of agreement towards 26 statements related to attitudes towards computer technology (See Appendix F). The CAIN was normed from quantitative data collected from 1943 subjects, including junior high school and college
students, and produced a high internal-consistency reliability estimate \( r = .94 \). Also, means from sample distributions tended to indicate a general acceptance of computers and absence of any specific fear of computer technology. Additional research using the CAIN and similar instruments is necessary if the construct of computer anxiety is to become a valid and useful area in research into computer-human interactions.

**Summary**

The computer has become thoroughly established as an important instructional media throughout the United States. The challenge facing the designers and developers of the next generation of computer-based instructional systems is to engineer and implement effective research-based courseware across the K-12 curriculum, and particularly in the social sciences. Computer-based instructional simulations have emerged as important applications of computer technology to instruction and training. The promulgation of computer-based simulations for teaching higher-order thinking and conceptual knowledge across a variety of disciplines is accelerating. Meanwhile, computer anxiety continues as a potential problem among certain groups, particularly females. Although many researchers have contributed to
the definition, measurement and validation of the computer anxiety construct, investigations of the computer anxiety phenomenon, especially in conjunction with the field of computer-based instruction, have been inconclusive and relatively undeveloped.

**Instructional Systems Design**

**Introduction**

An analysis of selected research on instructional systems design, instructional media, concept formation and acquisition, and individual differences towards learning tasks was conducted across the literature of various disciplines. Relevant studies from the literature on knowledge representation, graphic theory, problem solving and the teaching of thinking were examined. The discussion focuses on the significance of these domains to the design and implementation of effective instructional strategies in microcomputer courseware.

**Instructional Design Theory**

Instruction has been defined as "the deliberate design of conditions for the acquisition of performance based on some theory of learning" (Glaser, 1982, p. 300). Performance here includes the range of knowledge,
comprehension, application, analysis, synthesis, and evaluation as described in the cognitive domain taxonomy of Bloom et al. (1956). Instructional system design theory considers learning as an integrated process composed of three major variables: outcomes, conditions, and methods (Reigeluth, 1983). Outcomes define the learning projected to occur as a result of the methods and conditions of instruction. Conditions refer to the internal intellectual state of the learner, including factors related to individual differences. The methods of instruction are the modifiable and controllable elements of the learning process. Finally, instructional strategies attempt to align the student conditions and the appropriate teaching methods that are critical to the acquisition of specified learning outcomes (Gagne, 1987, 1977; Gagne & Briggs, 1974; Gagne & Glaser, 1987).

Media Related Research

This section observed the broader context of media-related research and the difficulty of generalizing the findings of many studies using mediated instructional interventions. Research on media has contributed to the construction of theoretical models of how media attributes interact with human cognitive and affective variables to foster individual learning (Salomon, 1979).
The principle goal of media-related research is the continued improvement in the design and implementation of effective instructional systems, and not to demonstrate the gross superiority of one medium over another medium, or over conventional teaching (Clark, 1986; Salomon & Clark, 1977). In a major review of recent media comparison studies, Clark (1985) failed to find significant learning differences that can be unambiguously attributed to any particular medium of instruction.

Most comparison studies on the influence of different media on learning have been inconclusive and often confounded by many factors, with the result of poor generalizability (Clark, 1986, 1985, 1983; Clark & Salomon, 1977; Levie & Dickie, 1973; Mielke, 1968). Although instructional media systems are often designed to be used in regular or laboratory-based classrooms, little media research has been conducted using content from the conventional K-12 curriculum. The content of many media studies consists of nonsense syllables, digits, letters, simple facts, paired associates, or the use of imaginary characters, sciences, or other contrived subject matters ostensibly used to eliminate the confounding of prior learning with treatment (Dwyer, 1978). As a result, findings from much media research
has had limited practical application in the grade school curriculum. A study that used academic content from the standard school curriculum and conducted both treatment and observation in a conventional school environment would contribute to the generalizability of any media research findings (Salomon & Clark, 1977).

Concept Learning Research

This section of the literature review described research on concept acquisition, particularly in relation to instructional design perspectives in the teaching of abstract concepts and principles from the social sciences.

The systematic design of instruction for concept learning includes: (a) an underlying theory of learning, (b) methods of evaluating student knowledge, (c) instructional strategies that foster the learning of hierarchies of categories and rules corresponding to concepts and principles within the content domain; and (d) the testing and refining of the resulting learned rules on new problems which extend the generalizing power of the new knowledge (Merrill & Tennyson, 1977; Scandura, 1977; Tennyson & Cocchiarella, 1986).

Concepts can be taught effectively by reducing the three common classification errors students make:
overgeneralizations, undergeneralizations, and misconceptions (Tennyson & Park, 1980). To accomplish this goal, the instructional strategy of Merrill and Tennyson (1977) presents instructional sequences comprised of:

1) a definition, consisting of a rule statement that verbally states the critical attributes of the concept;

2) expository instances, consisting of examples and non-examples that present the content information in a statement format;

3) interrogatory instances, consisting of examples and non-examples presented in question format; and

4) attribute elaboration, consisting of expository instances that present analysis while interrogatory instances present corrective feedback.

Using this method in a concept-learning task, the student must perform each subtask (involving the presentation of example/nonexample sequences and appropriate questions) correctly and continue on the next component until mastery. Mastery is achieved when every relevant attribute of the concept is clearly understood (Park, 1982; Tennyson & Cocchiarella, 1986).

While clear rule statements presented with the names of concepts can reduce misconceptions and improve the initial recognition of concept instances, the
presentation of labels, attributes, rules, and concept definitions alone appears insufficient to enhance the formation of deep conceptual knowledge (Anderson & Kulhavy, 1972; Reitman & Bower, 1973). Conceptual knowledge consists of more than storage and retrieval of facts, but is also "an understanding of a concept's operational structure within itself and between associated concepts" (Tennyson & Cocchiarella, 1986, p. 41). This observation suggests that persistent, unifying higher-order rules of behavior and theory often referred to as laws or principles cannot effectively be reduced to classification schemes (Reigeluth, 1983).

Armento (1987) examined the application of behavioral and cognitive theory specifically to the teaching of economics concepts. In addition to confirming the value of teaching many concepts from the perspectives described by Tennyson & Cocchiarella (1986), Armento cautioned that the more abstract and relational the concept is, the more difficult a concept is to teach. Particularly on the secondary and college levels, much economics content includes principles concerned with change relationships between two or more subordinate concepts such as supply and demand. As Armento (1987) stated:
Such concepts are the most demanding to learn and to teach...Relational concepts cannot be learned from definitional information only. Definitions are useful to set the boundaries of the concept, but examples and the various contexts of the concept are needed to enable the student to understand the meanings of these abstract and difficult ideas. (p. 180)

The terms "concept" and "principle" have often been used broadly and interchangeably. Reigeluth (1983) distinguishes between concepts, which are predefined categorizations of phenomena, and principles, which are observed as relationships of change. These changes may simply be correlational, where two or more elements change simultaneously, or they may be causal, where a change in one element causes a corresponding change in another. While a concept consists of "a set of objects, events, or symbols that have certain characteristics in common," principles describe "the relationship between a change in one thing and a change in something else." (p.343).

Elaboration Theory. According to Reigeluth (1983), the distinction between concepts and principles is important since each requires an organizing strategy appropriate to its instructional emphasis (Reigeluth & Curtis, 1987). An application of Elaboration Theory to
the design of an introductory course on microeconomics would require the implementation of a theoretical strategy since microeconomic principles are considered laws that describe with consistency the fundamental behavior of all market economies and are based upon the basic change relationships that exist between the prices and quantities of supply, demand and equilibrium.

In Elaboration Theory, the following components are emphasized: a) early ideas in an instructional sequence epitomize rather than summarize concepts, with a unifying superordinate principle introduced initially as the general model that provides the conscious framework for all subordinate concepts that follow; b) these ideas are taught at an application level of thinking and not at a superficial rote level of association or comprehension (Bloom et al., 1956); c) specific cognitive strategies, analogies and models are both explicitly taught and embedded within the sequence and provide students with flexible tools with which to approach subsequent problems; d) principles are then synthesized through new examples which require increasingly sophisticated analyses and higher-order applications of the learned strategic skills and principles, e) knowledge within a sequence is then summarized before proceeding to a deeper level within the superordinate principle, which is an
elaboration consisting of a more detailed epitome and problem (Reigeluth & Stein, 1983).

An exemplar of this technique adapted for the problem-oriented strategy of this study used the principle of equilibrium within a narrative problem situation delivered through a role-playing simulation emphasizing the integral connection between the concepts of supply and demand. The complete instructional sequence of events present the equilibrium model in context as the lesson epitome. Subsequent levels of the instruction teach cognitive strategies based on the equilibrium model with which to approach understanding new problem situations involving the change relationships between supply, demand and equilibrium (at an application and analysis level of knowledge). New problem examples are presented at an increasingly complex level of sophistication and thus foster a deeper understanding of the change relationships of supply and demand.

Cognitive Strategies. Central to the application of many instructional design theories is the critical role of cognitive strategies in the learning process. Rigney (1978) defined cognitive strategies as "operations and procedures used to acquire, retain, and retrieve different kinds of knowledge and performance." (p. 165).
In a set of lessons using an Elaboration Theory model, cognitive strategies are either embedded in the instruction, taught explicitly, or both (Reigeluth & Stein, 1983). The strategy can be taught as both a skill and a heuristic. Such a heuristic is learned as a technique about how to systematically approach a problem conceptually, although without the solution having been clearly identified. Later, during the presentation of deeper levels in the elaboration sequence, a cognitive strategy activator (a statement requesting a learner to use the strategy) specifically directs learners to apply to new problems the strategy they have been taught (Reigeluth & Curtis, 1987).

Cognitive strategies have been prominent in the development of instructional design and learning theory (Briggs, 1977; Dansereau, 1978; Gagne & Briggs, 1974; Grippin & Peters, 1984; Rigney, 1978). Appropriate cognitive strategies can facilitate the learner in "learning how to learn, how to remember, how to carry out the reflective and analytic thought that leads to more learning." (Gagne, 1977, p. 167). Moreover, learning a model of the underlying reasoning process used to generate solutions to problems within a domain is an important aspect of formalizing knowledge and in fostering skills in concept acquisition (Polya, 1957). A
strategy utilizing such a model can become a conscious "metastrategy" used by learners as a powerful tool in their approach to understanding novel problem situations and concepts within the content domain (Allen & Merrill, 1985; Derry, 1985).

**Graphic Theory.** An explicit orienting task which requires the learner to represent a problem situation graphically can act as a cognitive strategy activator appropriate to many content domains (Derry, 1985; Rigney, 1978). The mnemonic technique of using visual imagery in the form of graphic illustrations has been shown to assist learners in associating coordinate concepts within a logical framework and thus significantly improve concept attainment (Dwyer, 1978). Also, many of the critical heuristic methods for perceiving, representing, analyzing and ultimately solving a problem can be augmented by the drawing of a graph or diagram (Polya, 1957). A well-constructed graph can clearly and unambiguously represent all of the important concept relationships in a set of data or in a problem situation. Moreover, Bertin (1981) emphasized that:

In considering hypotheses and methods, it is necessary to envisage the whole problem. The matrix analysis of a problem is a process which enables us to see the whole, that is, to
construct it graphically, and to "forsee" the possible choices and their repercussions. (p. 17)

Therefore, the use of graphing as both a heuristic method and as a conscious cognitive strategy could enhance the problem solving repertoire of learners and contribute to their ability to: (a) systematically observe, decompose and define the problem in an X-Y matrix system; and (b) process, interpret and verify the hypothesized relationships between the data (Mayer, 1983; Nickerson et al., 1985; Polya, 1957). In particular, the content domain of economics is well-suited for the application of graphic methods in the teaching of fundamental concepts and principles, and economics education has traditionally used graphs in many curriculum materials (Hansen et al., 1977; Morton et al., 1985; Post, 1985; Samuleson, 1973).

**Individual Differences**

Research into individual differences suggests that certain individuals have different orientations towards planning, organizing, conceptualizing, interpreting, and generally approaching learning tasks (Kirby, 1984). These intrinsic orientations interact with external conditions, methods, or treatments during instruction to
produce new learning. Messick (1976) observed that these orientations:

cut across domains. They appear to serve as high-level heuristics that organize lower-level strategies, operations, and propensities—often including abilities in such complex sequential processes as problem solving and learning. (p. 276)

There is evidence that individual differences matched to the appropriate instructional treatments may produce increased student learning performance (Anglin, Anglin, & Schwen, 1982; Cronbach & Snow, 1972; Pask & Scott, 1972). The implication is that instructional designers should systematically integrate individual differences with treatment to optimize learning outcomes. Although many studies have failed to find hypothesized interactions (Cronbach and Snow, 1972; Eastman and Behr, 1977; Tobias, 1987), Reigeluth (1983) maintains that the phenomena of individual differences is promising for designers of individualized instructional systems.

Attitude Toward Learning. In the active learning of new concepts and principles, one potentially important individual difference is the depth of cognitive processing that occurs as a result of various factors including intelligence, the nature of the instruction,
and student interest and motivation to learn the new material (Craik & Lockhart, 1972; Keller, 1983; Shuell, 1980). Scheraga (1986), in discussing an innovative computer-based instructional strategy to teach college economics observed that "many students, unfortunately, do not see the advantages of developing their intuition. They are interested only in learning by rote." (p. 139). Recently, Biggs and Rihn (1984) have supported that two broad orientations towards new learning tasks exist, a deep approach and a surface approach, and that students may be predisposed towards one or the other orientation based on many complex factors. They described these two basic orientations in the following manner:

In a **deep approach towards learning**, the student: a) is interested in the academic task and enjoys carrying it out, b) searches for the inherent meaning of a task, c) personalizes the task, d) integrates aspects or parts into a whole, e) seeks relationships and meaning between new and previous knowledge, and f) tries to form and test hypotheses about the task.

In a **surface approach towards learning**, the student: a) sees the task as a demand to be met, or as a means to reach some other goal; b) avoids personal or other meanings the task may have, c) sees parts of the task as discrete or unrelated to each other or other tasks, d) is worried about how much time the activity is taking, and e) relies on memorization to learn new material. (p. 281)
A deeper approach towards instructional tasks has been associated with improved learning outcomes (Biggs, 1984). Since both the strategies and instruments developed for this study would be complemented by any analysis of related learner differences, a special questionnaire, the Learning Attitude Survey ($r = .45$), was constructed locally to measure a learner's orientation towards learning (See Appendix H). A surface approach was characterized by instrumentalism (performing learning tasks as means to other ends), extrinsic motivation, the surface reproduction or memorization of new material, and student concern over the length of time the learning task would take. A deep approach towards learning was characterized by interest in the material itself, intrinsic motivation, relating new information to previous knowledge, inductive and exploratory reasoning during a learning task, and a personalization of the new knowledge (Biggs & Rihn, 1984). The Deep Approach Toward Learning subscale proved to be highly reliable ($r = .82$), and was used in a broader analysis of attitude-related individual difference factors.

Summary

This section of the review described the relevance of theory and research in the field of instructional
systems design. The broader context of all media-related studies was then discussed. The importance for continuing investigations into optimal strategies for concept learning was discussed, with particular attention to the instructional theories of Merrill, Tennyson, and Reigeluth. The value of fostering the acquisition of adaptive cognitive strategies for approaching new content domains was well supported in the literature, as was the phenomena of individual differences in motivation and learning. Finally, the need to incorporate a learner's attitude toward learning tasks in investigations of optimal instructional strategies was supported by emerging research into individual differences.

**Problem-Oriented and Rule-Oriented Processes**

**Introduction**

Considerable diversity was observed in the research literature which contributed to the design of problem-oriented and rule-oriented instructional strategies. No single comprehensive study, series of studies or literature reviews has established the definitive characteristics of either macro-level instructional strategy examined in this study. Therefore, this section of the literature review attempted to develop a theory-
based framework contrasting problem-oriented and rule-oriented instructional methodologies in relation to their fundamentally different conceptions of human cognition, knowledge organization, concept learning, individual learner differences, instructional sequencing, and the interaction of these factors.

Behavioral Theory and Expository Instruction

Expository concept-learning instruction has often been constructed in unambiguous, explicit rule-example sequences accompanied by immediate corrective feedback (Blake, 1984; Hermann, 1971; Merrill & Tennyson, 1977; Scandura, 1964). Although the connectionist view of thinking as a learned response associated with a specific stimulus predated B. F. Skinner (Thorndike, 1913), the major catalyst in applying behavioral theory to programmed instruction in "learning machines" was the linear, step-by-step frame approach of Skinner (1954, 1958). Self-paced programmed instruction featured immediate reinforcement after a correct response, yet was essentially nonadaptive to individual student learning differences (Amsel, 1960; Lumsdaine, 1960; Skinner & Holland, 1961).
Cognitive Theory and Discovery Instruction

By contrast, problem-oriented techniques have been ambiguously defined by many labels from inductive to discovery. Bruner (1961, p. 22) described discovery learning as "a matter of rearranging or transforming evidence in such a way that one is enabled to go beyond the evidence so reassembled to additional new insights." Ausubel interpreted the problem/rule duality to be comprised of discovery versus reception processes. For Ausubel, "receptive learning" consisted of presenting to the student the entire, completely defined content of what is to be learned in final form. Discovery was a more omnibus category that included problem-solving and inductive reasoning (1963). Collectively, these approaches entail an underlying holistic pedagogy of inquiry, guided discovery, and reflective thinking (Dewey, 1933; Hullfish & Smith, 1961). Moreover, problem-oriented techniques, such as simulations, can use the advanced technical capability of computer technology to apply the cognitive theories of generative learning and individualized, intrinsically motivating instruction (Keller, 1983; Malone, 1981; Wittrock, 1974, 1978).
The Cognitive Movement in Instruction

Cognitive approaches to instruction are concerned with the active, generative construction of meaningful knowledge in the mind of the learner. Serious future research into any aspect of the dynamic instruction and learning process from a cognitive orientation must maintain an awareness that:

The distinctive characteristic of cognitive research is the idea that instruction influences achievement through student thought processes. That is, instruction influences thinking and in turn thinking influences learning and performance. The cognitive approach therefore assumes that instruction is mediated by student thought processes. (Clark, 1984, p. 2)

The literature on cognitive models posits that the fundamental characteristic of the mind as a cognitive system is adaptability: the long-term ability to modify existing internal conceptual schemata to absorb new information (Eysenck, 1984; Glaser, 1977; Wang, 1980; Wittrock, 1978). Learners construct meaning as they approach new content domains and problem-solving tasks through active processes of inquiry, exploration, and hypothesis-generation and testing (Taba, Durkin, Fraenkel, & McNaughton, 1971; Wittrock, 1974). Thinking critically and formulating generalizations and principles through the manipulation and observation of data is a
concept formation activity which places the major responsibility for learning on the student (Taba et al., 1971; White, 1969). Generally, these studies emphasize that thinking involves an active transaction between an individual and the data which he or she is studying. Data becomes meaningful only when an individual performs certain cognitive operations upon such data. Moreover, all students are viewed as potentially capable of thinking at abstract, analytical levels under the appropriate conditions of learning, and instructional strategies can be designed which will improve the higher-order thinking skills of individual learners (diSessa, 1977; Kirby, 1984; Nickerson et al., 1985; Perkins, 1986; Shuell, 1986; Wittrock, 1978, 1974).

Behavioral and Cognitive Instruction Compared

Research to date comparing the effectiveness of indirect, inductive, discovery methods of instruction, and direct, deductive, expository methods of instruction is inconclusive and often contradictory. Cronbach and Keislar (1965) observed that there was no evidence to support the hypothesis that inductive or "discovery-centered" learning was more effective than direct instruction, either for acquiring concepts initially or for long-term retention. In the detailed monograph which
synthesized the proceedings of the national research conference on "Learning By Discovery", Shulman and Keislar (1966) concluded that:

Examination of both the exhaustive reviews of literature and deliberations of the conference lead to an inescapable conclusion: The question as stated is not amenable to research solutions because the implied experimental treatment, the discovery method, is far too ambiguous and imprecise to be used meaningfully in an experimental investigation. (p. 191)

During the last two decades, research into various rule and problem-oriented instructional strategies has been characterized by many weaknesses. Little consensus exists in the literature as to the distinction between problem-oriented and rule-oriented methodologies. There is consistent disagreement concerning the precise meaning of terminology including the arbitrary application of the terms: discovery, inductive, deductive, and expository (Blake, 1984; Hermann & Hincksman, 1978; Shulman & Keislar, 1966). Moreover, treatments in discovery and expository studies have often differed from one another only in minor details, such as the presentation order of examples and rule statements (Blake, 1984; Wittrock, 1963). The design of the treatments has not been based on theory, nor has there been consistent control of either the structure or the substance of the actual
stimulus delivery (Tobias, 1976).

**Programmed Instruction.** Studies which used programmed instruction techniques for control and uniformity of treatment conditions have generally found insignificant results (Hermann, 1971; Tanner, 1969). The majority of experiments in this domain have been inadequately designed and conducted. Many studies have ignored the importance of measuring time-on-task and have claimed superiority for one strategy despite a disproportionate amount of time given to the subjects in the higher achieving treatment group (Gagne & Brown, 1961; Hermann, 1969; Kersh, 1958; Scandura, 1964). Finally, many studies have used content which was not meaningful academically, such as nonsense syllables, imaginary characters or concepts (Breaux, 1975; Tobias, 1976).

**Rule-Learning and Problem Solving.** Egan and Greeno (1973) delineated discovery and rule-learning. Subjects in their study learning by the discovery method received minimal initial instruction, then proceeded to examples requiring theorem generalization and problem-solving. Subjects in the rule-learning treatment received full beginning instruction, including complete definitions of
theorems in binomial probability and subsequent practice to apply the given rules to problems. In this view, discovery involves substantially more problem-solving and generalizing behavior, requiring learners to search for, infer or systematically generate relationships between concepts and principles derived from the problem. Egan and Greeno found that the discovery tasks in their study led to greater integration of new information into existing cognitive schema, and therefore more meaningful learning than through the rule-learning treatment. Expressing concern over the reliability of their testing instruments, Egan and Greeno observed that while the discovery process produced an enhanced structural integration of previously known concepts, the rule-learning tasks led to the addition of new knowledge and skills, and therefore a combined instructional approach using first rule-learning and then discovery learning might be optimal for many individuals.

Gagne (1966) stated that the process of learning by discovery requires a learner to internally generate a cognitive representation of the problem being explored. While concept learning is possible without discovery-induced, individually generated problem analysis, Gagne asserted that discovery leads to better retention and transfer of newly acquired concepts. The
implication is that problem-solving develops the heuristic search skills of discovery in learners since it intrinsically motivates an individual to reduce ambiguity, and improves the depth and adaptability of personally-generated knowledge. This hypothesis may be amenable to empirical verification but remains uninvestigated while advocates of discovery learning often appeal to intuition or other unsubstantiated evidence.

Induction and Deduction as Pedagogical Techniques. Hermann (1969) categorized inductive teaching as being based on the presentation of sufficient examples to enable the learner to determine the rule or principle. Deductive teaching is a method that proceeds from explicit, clearly presented rules and examples to the subsequent application of the rules to new problems or instances. Glaser (1966) observed that:

A learning by discovery sequence involves induction. This is the procedure of giving exemplars of a more general case which permits the student to induce the proposition involved. (p. 15)

Rizzuto (1970) defined the inductive method as the presentation of loosely structured sequences of selected situations, facts, instances or exemplars from which the
learner was to discover the rules and concepts of the task domain. The process of discovery involves hypothesis formation, trial and error, observing, inferring causal relations, and increasingly moving from lower to higher-order cognitive operations. Rizzuto also used a deductive teaching strategy where the concept was presented prior to exposure to examples, and this is comparable to other deductive approaches (Andrews, 1984; Blake, 1984; Breaux, 1975).

In a series of U.S. Navy projects conducted by Tallmadge and Shearer (1971), expository-deductive and inductive-discovery methods teaching naval rules and concepts were crossed in a 2 by 2 multivariate experimental design with two levels: (a) meaningful understanding-learning, and (b) the traditional pedantic rote-learning. The distinction between the two groups that were crossed was idiosyncratic to their study: inductive groups were taught concepts and principles in addition to problem-solving procedures, while the deductive groups were restricted to problem-solving procedures only. No relevant significant results were obtained, and whether the narrowly-defined treatment categories would be adequate to determine meaningful differences in any study is doubtful.
Generating and Verifying Hypotheses. Wittrock (1966) observed that discovery learning is actually a much more complex process than inductive reasoning alone, a view more recently elaborated by Strike (1975). The concept of verification is critical to a complete understanding of the logic of discovery. A cognitive skill involves the capacity to use inferential thinking or follow a heuristic rule and learning how to apply a cognitive strategy is thus itself a cognitive skill. Discovery for Strike consists of two distinct cognitive skills: (a) the analytic process of formulating or generating hypotheses, and (b) the testing, confirming, and generalizing of those hypotheses. The search for patterns and relationships, and the inferential skills of analysis, synthesis, and evaluation, work together to verify the concept in the mind of the student. Both cognitive components are necessary for true discovery learning to occur.

Learner Motivation. The emphasis on enhancing intrinsic motivation and problem-solving skills is prominent in problem-oriented instruction for concept learning (Malone, 1981). Advocates of problem-solving approaches to concept learning contend that: (a) students presented with problem tasks find the experience more
stimulating and relevant than mere rote memorization of statements and explanations, and (b) students learning through problem-solving activities analyze and apply knowledge operationally rather than mechanically, and therefore retain conceptual knowledge longer than other students exposed to lectures, workbooks, and other passive means (Ellis & Glenn, 1977; Miller & Weil, 1986; Nickerson et al., 1985; Scheraga, 1986).

The Egrule Versus Ruleg Controversy. On the other end of the argument is the formal reduction of problem and rule-oriented strategies exclusively to the instructional sequencing of rules and examples, the egrule (example-rule) and ruleg (rule-example) methods, respectively. Gagne (1977) defined rules as classes of relationships among classes of objects or events. More recently, Gallini (1984) distinguished rule learning from rule memorization. In rule learning, the student is at some early point presented with a precise definition of the rule, which is then applied to a variety of examples. In rule memorization, however, verbal rule definition information is remembered without being generalizable to any situations other than those memorized concurrently with the rule. Ruleg instruction posits that the initial presentation of rule statements acts as guidance to help
the learner master the rules and concepts of the task. The rule is given first, followed by examples which illustrate the critical attributes of the rule. The learner is then given practice exercises to apply the rule or concept in specific instances. In the egrule approach, the learner is first presented examples, practice items, and problems which illustrate the elements of the task concepts, principles or rules. The rules are then induced and formulated by the learner who is generally supplied confirmatory feedback. At some stage during the lesson task, the student is then presented the rule statement to verify the hypothesized rule (Hermann, 1971).

In a major review, Hermann (1971) concluded that there were few significant differences among the results of the many studies defining ruleg and egrule strategies. Those studies that did observe significant differences were clearly compromised by poor research methodologies which ignored critical features of the treatments including: (a) the rate, number and order of rule-example sequences, (b) the greater time-on-task often allotted for the discovery group, (c) the apparent lack of correspondence between the features or characteristics ascribed to each method by the experimenter and those actually presented, (d) generally unreliable treatment
controls, and (e) other interaction effects which could result as a combination of two or more of the preceding problems (Krumboltz & Yabroff, 1965; Tanner, 1969).

Summary

The research suggests that under controlled conditions using precise, clearly outlined, uniform methodology, only marginal evidence of the overall superiority of one or the other instructional approach can be found. However, modest claims that discovery learning enhances discovery-type cognitive skills and may be more intrinsically motivating than didactic, expository instruction are well supported (Blake, 1984; Hermann, 1969; Keislar & Shulman, 1966; Malone, 1981; Rizzuto, 1970). Nevertheless, while some degree of agreement is discernable in the literature regarding the more deductive, rule-oriented strategy, substantial confusion has continued to persist as to what constitutes the problem-oriented strategy. The arbitrary and ambiguous distinctions between the terms discovery, inductive and problem-centered have contributed to the marginal, inconclusive findings in much of the research literature. In those cases where statistically significant results were obtained, they are of little practical significance since either the experimental
controls, instrumentation, or treatments were inadequate, invalid, or too narrowly-defined to be useful in the resolution of this continuing debate of pedagogy and technique.

**Economics Education**

**Introduction**

This section of the review discusses relevant research from the field of economic education. The rationale for using microeconomics concepts is presented, followed by an examination of instructional strategies in the teaching of economic reasoning, concepts and principles. Research into the design and effectiveness of economics courseware is described, followed by an examination of instructional simulations in economics. The significance of gender-related learning performance differences on measures of economic knowledge and attitudes is also discussed. Finally, the relationship between student attitude toward economics and student cognitive achievement in economics is examined within the context of the current study.

**The Field of Economic Education**

One of the primary goals of economic education has been to improve and standardize curriculum and
instruction of fundamental economic concepts, principles and reasoning skills. An important goal of economic education is to promote learning activities that assist students to competently analyze and evaluate their environment in relation to the vital public and private economic policy issues present in the complex modern commercial economy (Clark & Barron, 1981; Hansen et al., 1977; Morton et al., 1985; Schug, 1985; Walstad & Watts, 1985).

Unfortunately, despite the recent advances in theoretical and practical knowledge in the field of economic education, economic education research has tended to: (a) unnecessarily duplicate existing studies, (b) overlook major research findings within the general educational research literature, and (c) utilize research techniques more consistent with the discipline of economics than education (Cogan & Dalgaard, 1982). Therefore, future contributions to the literature need to consider improving the design, implementation and dissemination of economic education research.

Microeconomics Concepts

Microeconomics concepts were used in this study since: (a) there is a growing knowledge base in the field of economics education available to instructional
designers of computer-based education; (b) there is relatively little disagreement within the field of economics as to the essential character, definition, and behavior of microeconomics principles in general; and c) since microeconomics is an integral part of the regular school curriculum, computer courseware treatments using microeconomics content would be unobtrusive to the normal academic regimen (Cogan & Dalgaard, 1982; Highsmith, 1986; Schug, 1985; Strober, 1987; Walstad & Soper, 1982).

In addition, the use of microeconomics concepts complemented the advantages of the microcomputer as a research tool since the content domain was clearly defined and could be standardized across treatments, permitting the design of courseware teaching the same basic material while specifically contrasting different instructional strategies (Post, 1985).

**Instructional Strategies in Economics Education**

Recent research in economic education has investigated the role of instructional strategies and related materials in shaping economic understanding. Economic concepts and principles are taught with instructional strategies appropriate to the class of economic problems under analysis. Students have demonstrated that superior performance on measures of
economic achievement taken after academic courses in economic principles was significantly influenced by the use of high-quality instructional materials, even in cases where the teacher had only limited knowledge of the subject (Highsmith, 1986).

Economics educators have also begun to implement many of the theory-based instructional strategies derived from the literature on problem-solving. The applicable techniques emphasize (a) problem representation, (b) visual (graphic) portrayal, (c) role-playing and exploring alternatives in decision-making exercises, and (d) determining relevant from irrelevant, dynamic from static, and cause from effect in problem situations (Armento, 1987).

Also, the development of economics principles courses which emphasize learning concepts in the context of issues is an example of the importance of interest, motivation, and relevance in education (Keller, 1983; Malone, 1981). In these courses, stimulating controversial economic problems are presented from the perspective of critical public policy tradeoffs. Students infer relationships from one situation or problem case, and then predict and generalize to new problem situations and cases. In addition, an emerging consensus from the literature recognizes that students
prefer these active instructional techniques, and that this preference is indicated by both increased achievement and positive attitudes toward economics (Ellis & Glenn, 1977; Highsmith, 1986; Leftwich & Sharp, 1974; Millerd & Robertson, 1987).

Economics Courseware

There is a substantial need for continued research on the effects of computer-based instruction in the secondary social studies curriculum and on the optimal design and implementation of computer courseware in precollege economics in particular. A review of the literature since the comprehensive work of Soper (1974), revealed: (a) there has been comparatively limited research and development of microcomputer courseware in precollege economics, (b) most courseware has been developed for reduced-access, mainframe-based networks like PLATO (Programmed Logic for Automatic Teaching Operations), TIPS (Teaching Information Processing System), and ALS (Advanced Learning System); and (c) most courseware has targeted college level courses in economic principles, with almost no mention of microcomputer programs designed for precollege courses in economics (Dalgaard et al., 1984; Henry & Ramsett, 1978; Kelley,
Despite earlier findings indicating that the potential of computer-based instruction to teach economics concepts had been both undervalued and neglected (Davisson & Bonello, 1976; Siegfried & Fels, 1979; Soper, 1979), there is considerable evidence that the construction of interactive computer environments to teach economics can: (a) concentrate the attention, involvement, and interest of students, with the result that substantially less time is required to achieve academic objectives; (b) individualize the instructional process by keeping students informed of their progress through immediate feedback, achievement summaries, concept review remediation and elaboration; (c) lead to greater achievement on higher order questions that require analysis and evaluation skills, (d) improve attitudes toward economics and (e) improve concept learning through interactive instructional simulations in which students can manipulate the microeconomic and macroeconomic dimensions of simulated market economies in ways not possible without a computer (Dalgaard et al., 1984; Ellis & Glenn, 1977; Henry & Ramsett, 1978; Kulik et al., 1983; Miller & Weil, 1986; Millerd & Robertson,
Instructional Simulations in Economics. Computer-based economic simulations can produce intensive experiential learning during which important economic principles are systematically and directly investigated. Learners analyze and evaluate various economic principles, such as equilibrium price determination, while manipulating key variables and parameters, such as the quantity of a product supplied or demanded at various prices (Post, 1985; Gentry, 1974). Extended periods of time are condensed in computer models to facilitate the observation of patterns and trends in the behavior of dynamic systems such as markets—an advanced learning feature completely beyond the capability of traditional high school economics text and workbook lessons (Gentry, 1974; Joseph, 1970; Lumsden, 1970; Millerd & Robertson, 1987; Scheraga, 1986).

Not everyone may learn with equal effectiveness through simulations, however. Fraas (1982) used a computer-based instructional system, Starting a Small Business, in an introductory college economics course. The microeconomics concepts taught included supply, demand, and price elasticity. The total computer
time-on-task was approximately five class periods. Using
the Cognitive Style Questionnaire of DeNike and
Strother (1976), Fraas confirmed the original findings of
DeNike (1973) that some students derive more knowledge
and skills from simulation experiences than other
students.

Dolbear, Attiyeh, and Brainard (1968) concluded that
the participation by a learner in a simulation requiring
economic reasoning will reinforce the acquisition of
concepts since

theory will be viewed as a useful tool for
understanding economic events rather than as
mechanical rules for manipulating a set of
abstract relationships all of which appear
unrelated to the real world. (p. 459)

It is significant that while many students are
interested in only learning academic content by rote,
surface approaches, computer-based instructional
simulations are socratic, discovery and inquiry-oriented
which require students to develop their intuitive,
analytic, and independent thinking abilities (Allessi &
Trollip, 1985; Gentry, 1974; Miller & Weil, 1986;
Scheraga, 1986). Research suggests that the problem-
solving tasks of economic simulations are superior to
more conventional methods in: (a) increased economic
knowledge, (b) increased retention of economic concepts and principles, (c) greater transfer of economic knowledge and reasoning, and (d) increased positive attitude toward economics and learning in general (Dolbear et al., 1968; Ellis & Glenn, 1977; Gentry, 1974; Joseph, 1970; Miller & Weil, 1986; Schenk, 1983).

Gender Based Learning Differences

Although the issue of gender-based learning differences has received considerable attention within the economics education literature, the results, particularly concerning precollege populations, have been inconclusive (Highsmith, 1986; Jackstadt & Grootaert, 1980; Siegfried, 1979). Gender appears to be a factor in economic understanding at the secondary level, but the literature is equivocal about the implications to economics instruction. The review by MacDowell, Senn, and Soper (1977) found 13 studies in which gender was an important explanatory variable in determining cognitive performance outcomes in economics, but 10 studies in which male-female differences were insignificant. Their review concluded that in studies which reported significant sex-related differences, males consistently performed higher than females on standardized economics tests such as the Test of Economic Literacy (Soper, 1979).
and the Test of Understanding in College Economics (Highsmith, 1974). Interestingly, this effect has been most noticeable at the college level, and on potentially sex-biased multiple-choice based test instruments (Ferber, Birnbaum, & Green, 1983; Lumsden & Scott, 1987).

MacDowell et al. (1977) conducted an extensive pretest-posttest study of 2000 students in grades 5 through 12 using the Junior High School Test of Economics to determine whether student gender could be unambiguously related to economic knowledge at the pre-college level. At the same time, the extensive research reviews by Dawson (1977) and Ladd (1977) also examined this issue. Together their findings corroborated that although sex was not a determinant in student learning through the elementary and secondary grades, at some point between the high school years and introductory college economics courses, a significant gender-based difference in economic understanding begins to occur. This difference was delineated by Saunders and Welsh (1975) when measuring differential performance on the higher and lower order question subscales of the Test of Understanding in College Economics. They noted that college level males performed slightly better on the higher-order questions requiring advanced application and analysis skills, although the differences were not
statistically significant. Further research into the association between gender and performance on lower and higher-order question subscales is needed to clarify these findings.

There is increasing evidence that in cases where males and females receive comparable instruction in economics at the high school level, no significant learning differences occur whether achievement gain is measured by standardized tests or grades (Jackstadt & Grootaert, 1980; Hahn, 1982; Highsmith, 1974, 1986). Also, the weight of the research suggests that in college-level introductory courses, males were significantly ahead of females in initial understanding of economics, but that following instruction performance appears commensurate (Lumsden & Scott, 1987; Siegfried, 1979).

Siegfried (1979) critically reviewed the literature on gender-related differences in economic knowledge across all grade levels. He distinguished between economic understanding, the sum of an individual's economic knowledge at a particular point in time and generally measured with nationally-normed standardized instruments, and economic learning, the achievement gain in economic knowledge over the duration of an economics instructional unit. While males consistently
outperformed females on measures of understanding, gender differences usually disappeared after both groups received equivalent economics instruction. Siegfried (1979) considered the research on gender-related differences as problematic since many studies (a) had inadequate or limited research methodology, were poorly controlled and conducted, and usually included gender as a tertiary variable of only marginal interest; (b) varied considerably as to their basic designs, accessible populations, sample sizes, units of observation, and levels of statistical and practical significance; and (c) frequently confused the hypotheses while ignoring contradictory results among the data. The inclusion of gender as a primary variable of interest assisted in the observation of gender-related differences in this study.

**Relationship of Attitudes to Cognitive Performance in Economic Education**

In evaluating both the main effects and interactions of different learner variables and instructional programs on economic achievement, many earlier studies have measured only cognitive outcomes while disregarding relevant affective behavior. Nevertheless, learner attitude has become an important factor in psychometric models of the economic education process (Becker &
Substantial evidence exists to support the high degree of association between cognitive and affective domains (Bloom et al., 1956; Krathwohl et al, 1964; Martin & Briggs, 1986). However, the issues of whether (a) cognitive achievement results in altered attitudes toward the subject, or (b) affective predisposition toward a subject affects subsequent cognitive achievement, or (c) that both cognitive and affective conditions affect each other simultaneously and bi-directionally remain controversial and unresolved (Martin & Briggs, 1986). Scholars evaluating the efficacy of economics instruction have not considered these issues settled and have espoused the need for continuing inquiry into the relationship between cognition and affect (Becker & Walstad, 1987; Siegfried & Fels, 1979; Walstad & Soper, 1982).

Research into affective dimensions of learning in economics has delineated two major areas: students' basic attitudes toward economics as a subject area and their degree of attitude sophistication toward various economic
policy issues. Bloom (1976) described subject related affect as the degree to which an individual, presented with the opportunity, would voluntarily pursue learning tasks in a particular subject. This view has generally been adopted by evaluators measuring student attitudes toward economics as a subject matter or field of personal interest (Soper & Walstad, 1983, 1988). The second area, economic attitude sophistication, was defined by Mann and Fusfeld (1970) as the degree to which an individual's opinions about economic policy issues are consistent with the generally accepted current body of knowledge in economics. They observed that the application of that knowledge to a specific problem often leads to similar conclusions or opinions in spite of differing ideologies. Such opinions reflect a high degree of knowledge and a rational analysis of the problem, and can correctly be termed sophisticated. (p. 112)

Mann and Fusfeld designed a 14-item Questionnaire of Economic Attitudes to measure pre and post-course economic sophistication. Using a diverse battery of cognitive evaluation instruments on different student characteristics, they found that college students who performed better during an introductory course also demonstrated significantly higher attitude sophistication. The fact that students receiving higher
course grades, posttest achievement and attitude sophistication scores were also superior in math and reading ability may have obscured the clear association between increased knowledge and attitude sophistication. Despite findings to corroborate the relationship between increased understanding of economics and greater sophistication toward economic issues (Riddle, 1978), Siegfried & Fels (1979) declared that "it has not yet been established that attitude sophistication is a measurable output" (p. 936).

Some studies have attempted to measure the pre and post-course opinions and attitudes of students toward economics, although descriptions of the affective instruments were vague and without data on either reliability or validity (Henry & Ramsett, 1978; Hodgin, 1984). Although findings have tended to support the hypothesis that greater achievement in economics is positively correlated with attitudes toward economics, a critical need existed for robust validation and standardization of affective measures that could be widely applied in economic education research (Becker & Walstad, 1987; Hodgin & Manahan, 1979).

Survey on Economic Attitudes. The nationally-normed Survey on Economic Attitudes (SEA) was systematically
developed to address this need (Soper & Walstad, 1983, 1987, 1988). The instrument (See Appendix G) consists of two indexes: (a) the Attitude Toward Economics (ATE) scale, a general attitudinal measure toward economics as a subject area; and (b) the Economic Attitude Sophistication (EAS) scale, comprised of statements reflecting views on various economic issues and measuring the degree of sophistication in the student's general understanding of economic problems and policy. Together, these two scales provide a highly reliable, valid, and comprehensive measure of the economics-related attitudes of high school students in the United States (Becker & Walstad, 1987).

The 28-item SEA has become an exemplar of the type of instrumentation required to seriously address psychometric problems in the affective domain. The revised version of the major standardized test measuring high school economics achievement, the Test of Economic Literacy, has included the SEA as a valuable component of the evaluation instrument (Soper & Walstad, 1988). The ATE and EAS scales have Cronbach's alpha reliabilities of .87 and .67, respectively. The lower reliability of the EAS scale reflects the more complex nature of attitude sophistication and the difficulty of accurately assessing such a construct in precollege populations (Walstad &
Soper, 1982). Yet both the EAS and ATE scales are comparatively the best such measures constructed to date and have proved increasingly useful in examining the relationship between attitude change and economics instruction (Soper & Walstad, 1988).

The collective findings of implementing the ATE and EAS scales (Highsmith, 1986; Soper & Walstad, 1983, 1987, 1988; Walstad & Soper, 1982) have supported the following observations:

1) Exposure to an effective instructional program in precollege economics (e.g., the DEEP Program) may result in superior economic achievement, more positive attitudes toward economics and greater economic sophistication, although these relative gains may or may not be significant;

2) Improved understanding of economics positively influences ATE and EAS, whereas the effect of ATE and EAS on understanding or achievement in economics is unclear;

3) Improved achievement in economics following effective instruction can also result in a more negative ATE score if the instructional experience, although successful as measured on achievement test results achievement, is perceived negatively by students;

4) The finding of post-instruction increases in ATE, EAS, and cognitive achievement does not necessarily imply either a causal or a correlational relationship between any of these factors;

5) Both ATE and EAS are sensitive to differences in teacher orientation and ability, school intellectual climate, and personological factors that may confound investigations of specific instructional interventions;
6) Gender-related differences on the ATE and EAS have been demonstrated, with males scoring consistently higher on both scales although the differences are not usually significant;

7) The EAS ultimately measures only the tendency of respondents to hold views in agreement with the consensus state of knowledge, and a higher EAS may not reflect the specific outcome of any particular instructional intervention;

8) The relationship between ATE and EAS is not clear, so that a high degree of EAS does not necessarily imply that economics is liked as a subject area (high ATE), and enjoying the study of economics does not imply a sophisticated grasp of economic issues and policies; and

9) The ATE and EAS must be implemented only as indexes of the two dimensions they measure, and pre-post comparisons between scores on individual items are not appropriate.

In conclusion, the Survey on Economic Attitudes has substantial norming data to support its reliable and valid implementation in economic education research. Although many questions remain unresolved, such as the apparently minimal power of instructional interventions in economics to have a significant impact on student interest in economics or sophistication toward economic policy issues, the deliberate inclusion of the affective domain will continue to be important in the emerging empirical and theoretical literature within the economic education community.
Summary

This section of the literature review examined selected research across the field of economic education. The purpose here was to describe the context in which the present study contributed to both the theoretical and practical development of computer-based instruction in pre-college economics. Research supports that computer-based instructional simulations in economics can provide an effective learning experience that facilitates higher order thinking skills, increased retention, and more positive attitudes toward economics than instruction without simulation courseware. Comparatively little research existed in the design of microcomputer courseware for teaching secondary level microeconomics concepts, and there was no evidence that problem-oriented and rule-oriented instructional strategies were simultaneously compared in courseware units at any level of economics education.

Overview of the Literature for the Current Study

Major research findings throughout the fields of computer-based instruction, instructional design, cognitive and behavioral learning theory, and economic education were integrated in this review of literature. There existed a critical need to investigate the effects
of microcomputer courseware for teaching economic concepts on the secondary education level.

The first section of the review discussed the broader context of computer-based instruction, and included an analysis of computer-based instructional simulations, and the potential of simulation courseware to contribute to concept formation. The phenomena of computer anxiety was also addressed, and its relevance to continued research on computer-based instruction was emphasized.

The second section of the review explored the domain of instructional systems design, with particular analysis of applicable instructional design theory and several issues affecting generalizability of media-related research findings. The section presented a synthesis of the growing knowledge base derived from concept learning and problem solving research, and pragmatic adaptations of this knowledge by instructional design theorists. The second section concluded with a discussion of individual differences, and the salience of studying the surface versus deep approach toward learning dichotomy in research using secondary-level target populations.

The third section of the review attempted to systematically describe and elucidate the considerable volume of literature produced broadly comparing the
domains of rule-oriented and problem-oriented instruction. It is clear that although there have been many empirical and theoretical explorations into the two pedagogies, the substance of the findings has remained equivocal and indeterminate. The identifiable commonalities within the various studies were presented in conjunction with emerging paradigms of thinking and learning.

The final section of the review synthesized relevant research in the field of economics education. A wide diversity of research findings and methodologies applicable to conducting experimental research in computer-based instruction in precollege economics were critically examined. In addition, no studies were found that attempted to explore the interrelationships between the factors of (a) instructional treatment, (b) gender, (c) attitudes toward economics, (d) attitudes toward learning, (e) computer anxiety, (f) overall cognitive achievement, and (g) differential performance on both higher and lower order questions in a computer-based microeconomics principles unit. The present study was designed to explore each of these issues in relation to pre-college instruction in economics.
CHAPTER III
METHODOLOGY

Introduction

The methodology chapter describes the empirical conditions and operational procedures of this study, focusing on the following topics: (a) the design of the study, including the primary variables and experimental controls used in the study to address the threats to internal and external validity; (b) a description of the subjects and of the locations selected for the study; (c) a description and analysis of both the cognitive and affective outcome measures employed in the study; (d) a systematic and detailed description of the microcomputer courseware treatments in the study; and (e) a complete discussion of the data collection procedures and the conditions of treatment, testing and date analysis used in the study. An overview briefly summarized the experimental methodology employed in this study and previewed the presentation of the full results in Chapter IV.
Design of the Study

This section of the methodology examines the general design of the experiment conducted in this study. The analysis includes: (a) the observations and instructional treatments of the final data collection period, (b) the dependent and independent variables used in the data analysis, (c) the experimental controls and techniques used to eliminate confounding of the results, and (d) the major threats to internal and external validity in this study. A summary highlights the critical features of the study.

Experimental Design Structure

A true experimental, pretest/posttest repeated measures design was used in this study (Campbell & Stanley, 1963; Cook & Campbell, 1979). An independent variable was manipulated across two groups: each group was randomly assigned to one of two levels of treatment conditions, the problem-oriented and rule-oriented instructional strategies. The unit of analysis was the individual student: (a) each subject was first randomly assigned to one of two groups and then (b) each group was randomly assigned to one of two treatment conditions. The alternative treatment, rule-oriented or
problem-oriented instruction, served as the control condition.

Subjects were first pretested to determine their level of prior knowledge in microeconomics, and selected data on affective measures was also collected during the pretest observation. The experimental instructional intervention was then delivered. Immediately following the treatment a parallel form achievement test was administered to all subjects. In addition, a complete battery of affective measures was also administered in the immediate posttest period. Finally, a parallel form achievement posttest was administered two weeks following the immediate posttest (the delayed posttest). The basic design of this study is shown schematically in Figure 1 using conventional notation (Campbell & Stanley, 1963):

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Figure 1. Structure of the Experimental Design.
Dependent and Independent Variables

This study observed six dependent variables related to cognitive achievement: 1) the overall Posttest I (total immediate posttest) score, 2) the lower-order question subscore for Posttest I, 3) the higher-order question subscore for Posttest I, 4) the overall Posttest II (total delayed posttest) score, 5) the lower-order question subscore for Posttest II, and 6) the higher-order question subscore for Posttest II. Performance outcomes for the overall, higher-order and lower-order question subscales of the Pretest were used as regressor independent variables in analyses of various posttest variables. In addition, scores from the three scales of Posttest I were used as regressor independent variables in analyses of Posttest II outcomes.

Two major independent variables were: 1) the treatment variable, fixed with two levels—a problem-oriented and a rule-oriented instructional strategy, and 2) gender, also fixed with two levels—male and female. The relationship between affective and cognitive variables was viewed as complex, and therefore various combinations of variables were used as both dependent and independent variables in separate analyses.

The following four affective measures were used: (a) the Attitude Toward Economics (ATE) index and (b) the
index, both derived from the Survey on Economic Attitudes (Soper & Walstad, 1983); (c) the Computer Anxiety Index or CAIN (Simonson et al., 1987) and (d) the Deep Approach Towards Learning (DEEP) subscale of the Learning Attitude Survey (LAS) constructed by the experimenter.

The primary empirical interest of the study was in:
(a) the overall main effect differences between each of the treatment and gender levels on Posttests I and II;
(b) the main effect differences between each of the treatment and gender levels on the lower-order and higher-order question subscales of Posttests I and II;
(c) differences between each level of treatment and gender on the ATE, EAS, CAIN and DEEP indexes; (d) any differences accounted for by the interaction of gender, treatment and selected affective variables on the overall, lower-order and higher-order question subscales on Posttests I and II; (e) the specification of best-fit regression models using theory-based combinations of the above variables.

Experimental Controls

The attempt to control error and confounding in experimental studies of cognition, aptitude, and instructional variables by randomization and pretesting is well accepted (Cook and Campbell, 1979; Kennedy and
Bush, 1985; Kerlinger, 1973). Also, learner time-on-task required control to reduce any problematic disparity between the treatment exposure of the two experimental groups. The rationales for implementing these control procedures are discussed in the following sections.

**Randomization.** The control of extraneous sources of variance by randomization strengthens the internal validity of most behavioral science research designs (Campbell & Stanley, 1963). Potentially confounding personological differences related to gender, race, intelligence, and socioeconomic status were controlled in this study through randomization. Gender was also controlled by building the factor into the study design as an independent variable. In addition, the possibly detrimental variations in time of day, mental fatigue, individual class composition and school laboratory environments were randomly distributed between treatment groups, further reducing any confounding of the treatment effects. Subjects were randomly assigned to levels of treatments using the procedures specified later in this chapter.

**Pretesting.** A parallel-form cognitive pretest was administered to experimental subjects in each treatment
group to measure their pre-treatment knowledge of microeconomics concepts. Results of the pretest indicated that prior knowledge of the subject matter domain was evenly distributed among experimental units in each group. Cognitive pretesting all subjects raised the internal validity threat of pretest sensitization and the external validity threat of testing-treatment interaction.

Attitude pretesting was also implemented to gauge the general attitudinal characteristics of the experimental sample. The potential reactivity particularly associated with attitudinal measures was controlled in the following manner. During the experimental randomization process, individual subjects were also randomly assigned to three additional groups independent of other group membership (i.e., gender or treatment assignment). Each of the three groups were randomly administered one of the three affective measures (the SEA, the CAIN, or the LAS), while two-thirds of the full sample was not exposed to either of the other two affective instruments. Generally, data from the affective pretest indicated a broad treatment group equivalence in terms of the attitudes measured.
**Time-on-Task.** Many studies have ignored this control factor with the result that one treatment group received a disproportionate amount of time to complete the tasks. Superior performance attributed to treatment groups using substantially more time than other groups has often confounded time-on-task with the treatment effect. Therefore, (a) since the computer-based lessons of this study could potentially be completed at different rates by different subjects and (b) because there were specific time limitations (50 minute class periods standard in each school) related to the smooth logistical operation of the study, it was necessary to address the impact of this factor on posttest performance. A log was maintained on the amount of time students spent on each lesson module and on the entire instructional unit. Randomization procedures assured that each treatment group had individuals from the range of abilities present in the experimental sample (e.g., levels of achievement, reading skill). Since treatment lessons were uniformly terminated at the end of each 50 minute class period, comparative advantages or disadvantages associated with time-on-task factors were substantially eliminated.
Threats to Internal Validity

Campbell and Stanley (1963) have cautioned that extraneous factors can become rival hypotheses and contribute to the empirical error and confounding of any experimental study. These critical factors are briefly discussed below in relation to this study.

History. The distracting influences of extraneous incidents or specific events that could have affected the intrasession difference between the pretest, posttest and delayed posttest performance were generally controlled by random assignment. In addition, commensurate treatment conditions closely supervised by the experimenter and run concurrently for five class periods on 5 consecutive days were conducted in self-contained computer laboratories. In one high school site, the computer laboratory was an open annex to the school learning resource center but close supervision was again maintained.

More importantly, general historical events were evenly distributed among all subjects due to randomization procedures. One possible exception occurred in the aftermath of the dramatic economic events beginning "Black Monday" October 19, 1987. Characterized as a cataclysmic stock market crash that was "the worst in financial history," (Church, 1987, p. 24), the Dow
Jones industrial average, a prominent economic indicator, had dropped in one day by 508 points or a decrease of 22.6% (representing a financial market loss of over 500 billion dollars) and greater than twice the size of a similar stock market crash in 1929 prior to the Great Depression. The short-term impact of the notorious and highly-publicized 1987 crash was to intensely focus the attention of the radio, television and newspaper media on a plethora of economics-related issues and topics (Church, 1987). The treatments and data collection of the study had meanwhile begun on September 28, 1987 with approximately one-third of the final data collected. However, although the general data collection schedule was staggered, only a single school (24 subjects) had competed the immediate posttest, and no subjects had yet taken the delayed posttest. Subjects from two school sites had not yet participated in the study. Although randomization should have ameliorated any intrasession impact by distributing the effects equally across the two treatment groups, additional paired t-test analyses supported that attitudinal differences between pretest and posttest periods were not significantly different for the ATE, EAS and CAIN measures.
Maturation. Maturation was not a significant problem beyond that of other studies conducted in public high school settings and utilizing one class period each day over five day period. Personological factors such as boredom, anxiety, and hunger did not represent significant problems during the limited duration of the study and were in any case equally distributed between treatment groups by randomization.

Testing. A cognitive pretest was used in this study for both treatment groups, but rival hypotheses attributable to the pretest on immediate posttest performance (or in the case of the delayed posttest of both pretest and immediate posttest experience) on learning performance were controlled by randomization since each group experienced the identical cognitive instrumentation in all cases. A limited proportion of test items (50%) were distributed across the three tests to enhance the reliability of the parallel instruments. At no time were scores or error responses reported to the subjects, and therefore any confounding from subjects associating correct responses to particular items was not supported.
Instrumentation. The cognitive instruments used in this study were constructed predominantly from items derived from nationally-normed achievement tests. Complete item analyses were performed on each parallel form microeconomics test, and the affective measures used in inferential analyses (ATE, EAS, CAIN and DEEP) produced acceptable to excellent reliabilities (See Tables 1, 2 and 4). There were differences in difficulty, reliability and other summary statistics between the tests, but these differences did not appear to significantly affect performance outcomes. Randomization procedures established that both treatment groups experienced the identical cognitive measures, affective posttest battery and conditions of testing, thus eliminating any relevant confounding attributable to instrumentation problems.

Regression. Statistical regression was not a problem since both treatment groups were randomly assigned from the same subject pool, equally distributing any probable regression effects. The frequency distributions for both treatment groups on pretest performance indicated an equivalence of both high and low scorers and thus an equilibrium between the groups.
regarding error inflation or depression in relation to the mean.

Selection. Although subjects for this study were selected from public senior high schools across a large and diverse metropolitan district with unequal distributions of income, socioeconomic status, race and other characteristics, any selection biases were controlled by the following factors: (a) the district was actively enforcing a pupil redistribution policy from court-mandated busing involving all schools and that effectively reduced demographic homogeneity in any particular school population, (b) pretesting was used to control possible prior knowledge bias between the two experimental groups, and corroborated the observation of equivalent groups in terms of economic understanding; and (c) while some selection bias may have occurred at two of the four school sites, there was ultimately a single subject pool from which all subjects were randomly assigned to groups and levels of the treatment. Selection, therefore, was controlled by a robust randomization procedure in this study.

Mortality. The problem of mortality that ordinarily occurs due to lost or missing cases did not exist here
since only 4 subjects were not included in the study due to: (a) missing more than one day of the treatment, (b) and also missing any two of the cognitive achievement tests (the Pretest, Posttest I or II). This potential threat was virtually eliminated since the data collection was well coordinated with the optimal availability of students and both the school curriculum and individual class schedule. The remaining sample size of 155 students was sufficient to eliminate any threat posed by the loss of 4 subjects.

Selection-Maturation Interaction. Again, the problem of selection-maturation effects were controlled by (a) the fact that intact class groups were not the experimental unit since the individuals were randomly assigned to instructional treatments, (b) the use of subjects from a homogeneous sample pool (Grade 12 students in regular social studies courses) whose rate of maturation is generally commensurate, and (c) the relatively short duration of the data collection procedures.

Threats to External Validity

Complementing the work of Campbell and Stanley (1963) on experimental and quasi-experimental design and
methodology, Bracht and Glass (1968) detailed the potential threats to external validity. Two major areas where threats to the generalizability of this study existed were population validity and ecological validity. The issue of population validity applied to what subjects with which characteristics the study could be generalized, while ecological validity applied to which environments or physical settings the study was potentially generalizable.

**Population Validity.** Randomization was a necessary precondition to generalize to all subjects involved in the final sample of the study. Randomization of subject's assignment to groups controlled existing factors (e.g., race, intelligence, socioeconomic status, individual learning differences) which could have reacted with the treatment experience to confound the external validity of the study.

The delimitation of the study sample to a single grade level was intended to reduce various threats to internal validity such as maturation and selection-treatment interactions. The narrow target population focus served to eliminate the differential effects of using subjects selected across a wide range of grades, ages, and correspondingly disparate intellectual
abilities and maturational factors. It is true, however, that the use of students exclusively from Grade 12 tends to limit the generalizability of the results, although this compromise was considered acceptable. Moreover, a heterogenous accessible population of subjects representative of a normal range of socioeconomic and demographic backgrounds (from a major urban public school district) was deliberately chosen for this study to potentially augment the population validity and generalizing power of the findings.

Ecological Validity. Ecological validity concerned the complex interaction of the experimental conditions and treatment. The experimental data collection involved unobtrusive academic content, paper and pencil achievement tests and questionnaires that were commensurate to a common, everyday school experience. Moreover, multiple-treatment interference was not a problem in this study since subjects received only a single level of the treatment.

Experimenter effect did not become a factor since all content and specific on-line instructions were delivered through the microcomputer and all treatments and objective achievement testing procedures were uniformly and consistently administered in this study.
The experimenter introduced the nature of the research project, the cognitive and affective measures, the computer and all appropriate operating skills, and general expectations to the subjects in a conversational lecture format to reduce problems associated with novelty and anxiety. The routine nature of the courseware treatment conditions, especially for students with any computer experience at all, diminished novelty and disruption effects considerably. Also, the reactive effect of the perception of participating in an experiment, or Hawthorn effect, was minimized in this study since the treatments were conducted in conventional microcomputer laboratories in the public high schools selected for the study.

Finally, precise and explicit descriptions of the courseware treatment variable and all data collection procedures were included to assist in replication and generalization issues.

Summary

This section of the methodology described the general research design of the experimental data collection. Dependent and independent variables were noted, especially the difficulty of classifying some factors as exclusively dependent in all analyses. The
experimental controls used to reduce or eliminate the principle extraneous sources of variance were then outlined. In particular, randomization helped to reduce or eliminate many of the threats to internal validity, as well as some threats to the generalizing power of the study. The final discussion presented the major threats to internal and external validity in relation to the experimental controls and other techniques used to reduce experimental error, counter competing hypotheses, and support a conservative generalizability of the research findings.

**Subject and Site Selection**

This section of the methodology examines the procedures used to select the actual sample for the study, including a description of the basic characteristics of the target population and the corresponding locations where the final data collection was conducted. The procedures used to construct the final sample who participated in the study are then described. The official approval of the study protocol is noted in reference to the university regulations monitoring the use of human subjects in experimental research. A brief summary concludes this section.
Selection of Data Collection Sites

The selection of the data collection sites and cooperating teachers and classes was conducted through collaboration with the economics education coordinator of the Columbus Public Schools. Five schools geographically distributed over the school district were originally identified as potential sites for participation in the final data collection phase. The schools were selected on the basis of: (a) their representative diversity as senior high schools in Columbus, (b) the common availability of an adequate computer laboratory, and (c) the special cooperation developed during the last decade between the Columbus Public Schools and computer-based research projects conducted by faculty and staff of the College of Education at The Ohio State University. In addition, a single cooperating teacher was identified at each school who could facilitate the successful implementation of the study protocol in their social studies classes.

Selection of Target Population Subjects

Subjects were public high school students selected from regular social studies courses in the Columbus Public Schools in Franklin County, Ohio. Grade 12 was identified as appropriate for two principle reasons: (a)
Grade 12 was broadly representative of the secondary education level and could accurately be characterized for many students as precollege level instruction, (b) the social studies courses specifically focusing on government and economics-related subject matter were normally offered within the district curriculum at the Grade 12 level.

The subject population from Columbus Public Schools consisted of generally lower-middle socio-economic status students aged 17-18. The original subject pool included approximately 250 Grade 12 students within these five schools. The inability of one school to meet logistical preconditions of the protocol immediately prior to the final data collection necessitated the elimination of that site from the study. Moreover, a problematic and unanticipated shortage of microcomputer systems at two of the remaining schools required a further reduction in the accessible student population within those schools. Therefore, the final sample consisted of four high schools, eight social studies classes and a total of 155 individuals (76 males and 79 females) participating in the study.

Sample size data were calculated with the assistance of a consultant from the Department of Statistics at The Ohio State University and was estimated to be 80 students.
for a conservative estimation where the desired power value was .80, and the alpha level was .05. The actual sample from the study substantially exceeded these minimum requirements for statistical purposes, and supported a more liberal alpha level (.10) for some inferential statistics.

**Final Sample Selection**

Although all subjects selected to participate in this study were randomly assigned to treatment groups, the process by which the accessible population was initially selected was modified for two schools. In the two schools that possessed microcomputer facilities adequate to accommodate all students assigned to the designated social studies courses, all available students enrolled in the course were included in the participating sample. However, two schools with more students than microcomputers available required alternative selection procedures. In the case of these two schools, all students in each of the three social studies classes involved were initially randomly assigned to a participating or a non-participating group. Subsequently, participating subjects were randomly assigned to treatment groups. Both of these assignments
were conducted using the same experimental randomization method.

In the case of one school, an exception to the selection procedure was made to accommodate nine students from two participating classes who could be scheduled into the microcomputer laboratory during a common intervening class period and thus augment the sample size. Although these individuals technically comprised a convenience sample, they were originally scheduled to participate in the study but an unforeseen shortage of microcomputers required the (random) elimination of students from the study. Fortunately, a reasonable compromise on microcomputer and student availability was available, and these nine students were maintained in the study. Their random assignment and total participation in the study did not differ from other subjects in the study in any dimension. Finally, students who were not selected to participate in the study were not part of any experimental condition, and no data were included in the study for these individuals. Students who did not participate during the study were advised that the courseware programs would be made available to their teachers and ostensibly to them from their teachers at a later unspecified date.
Human Subjects Review. The study was confirmed as exempt from formal human subject review under categories 1 and 2 of the Human Subject Program Guidelines established by the Behavioral and Social Sciences Human Subject Review Committee of The Ohio State University on 5 May 1984. The research was conducted in regular public school settings, involved normal educational practices, and used unobtrusive, commonly accepted instructional and achievement test procedures. Data collection and analyses were conducted in such a manner as to insure complete confidentiality, and no data from individual student performance was made available, or included in a permanent personal scholastic record of any participant. All required final clearance and permission was obtained through the appropriate officials in the College of Education of The Ohio State University, the Columbus Board of Education, the Economics Education coordinator of Columbus Public Schools, and each public high school and participating classroom teacher selected for the study. Therefore, the protocol of the study met the regulations for the discreet protection of human subjects.
Summary

The procedures used to select the final sample and data collection sites was delineated in this section. General background characteristics of both the target and accessible populations were described. A controlled modification of the original selection protocol was noted in the case of two schools. In addition, the rationale was presented for protecting the confidentiality of all study participants while excluding the study from the formal human subjects review process.

Outcome Measures

This section of the methodology presents evidence for the validity and reliability of the empirical outcome measures used in this study. The discussion includes: (a) the development of the cognitive achievement instruments, (b) complete data supporting their validity and reliability, and (c) brief descriptions of each affective instrument and the attitude scaling techniques used in the analyses. A brief summary of the instrumentation concludes this section.

Cognitive Achievement Instruments

Three separate but parallel cognitive achievement instruments were developed specifically for this study.
Although items on these measures were predominantly derived from previously nationally-normed instrument sources, many new items were added in the local norming of the hybrid parallel forms of the cognitive outcome measures. The following paragraphs discuss the procedures used to construct the three tests (the Pretest and Posttests I and II), and provide evidence to support their validity and reliability as parallel form instruments.

**Instrument Development.** Validated and reliable instruments were pilot tested and revised during a ten month period beginning in August 1986. Difficulty and discrimination values for each test item were calculated and later used to select items for inclusion in the final version of the three parallel achievement tests. An original candidate pool of 90 questions consisted primarily of items derived from three nationally-normed and standardized instruments: (a) the original *Test of Economic Literacy (TEL I)*, Forms A and B, (Soper, 1979); (b) the *Revised Test of Economic Literacy (TEL II)*, Forms A and B (Soper & Walstad, 1986); and (c) the *Revised Test of Understanding in College Economics (TUCE)*, Micro Forms A & B (Saunders, 1981). Other items were adapted from the *Give & Take Test Bank* (Joint Council on Economic
Education, 1984), and from the Studyguide to Accompany Samuelson: Economics (Robinson, 1973). In addition, a pool of questions was created by the experimenter, in particular to supplement the higher-order questions available for the three achievement tests.

All questions were pilot tested and subsequently item analyzed to determine their suitability for inclusion in the final versions of the Pretest, Posttest I (immediate) and Posttest II (delayed). The item pool was arbitrarily divided into three sub-batteries. Each sub-battery consisted of approximately 30 questions and was distributed across the two levels of the higher-order and lower-order cognitive domain taxonomy adapted for this study. A single site was originally selected as the location for pilot testing. The pilot data were collected during the early Autumn 1986 using Grade 12 students from one of the schools later used as an experimental data site. None of the students who participated in the pilot research was available (due to graduation) nor were pilot subjects included in the experimental sample at any time.

Each question derived from either the TEL I or the Revised TEL II was categorized by its corresponding level of cognitive processing as determined through five levels of Bloom's Taxonomy. Only knowledge, comprehension,
application, analysis and evaluation levels were specified by Soper and Walstad (1986) while the synthesis category was omitted from the TEL question level matrix. Questions derived from the Revised TUCE were identified as requiring a level of thinking from one of three categories (recognition & understanding, explicit application, and implicit application).

The two diverse TEL and TUCE question level schemes emphasized the difficulty of precisely categorizing a question into a single type. Many question items could theoretically be classified into more than a single cognitive level, and a logical conflict existed between the two competing schemes. The equivocal issue of question levels classification was resolved by dichotomizing the continuum into two broader and inclusive categories, higher-order and lower-order questions, and carefully sorting each question into the appropriate group. Also, each item on the final test instruments was juried by six Ph.D. candidates in the College of Education of The Ohio State University to corroborate the correct categorization into higher and lower cognitive groups. The results of the jurying strongly support the accurate categorization of the majority of items. In those cases (14 of 102 items) where jurors disputed the designated item classification,
each item was again checked with its original source to assure it was correctly categorized. No items on the final cognitive instruments were found miscategorized by these follow-up procedures.

**Validity and Reliability Data.** Based on the pilot test data, three parallel form cognitive achievement tests (See Appendixes C, D & E) were constructed to measure pre-treatment, post-treatment, and long-term retention knowledge. Each test consisted of 34 multiple-choice questions, with 17 questions each classified as higher-order and lower-order level. An attempt was made to balance each test with representative items for each concept taught in the courseware treatments. Upon completion of the final data collection period, the three instruments were juried to support their validity and analyzed to determine the level of internal-consistency reliability, mean discrimination and difficulty index of each item and each overall test instrument.

Content validity is concerned with the representativeness of the test in accurately measuring indicated content from the subject matter domain under investigation (Kerlinger & Pedhazur, 1973). Although the content validity of the individual items selected from the TEL I, Revised TEL II and Revised TUCE had already
been established, other items had not been validated. Since an evaluation of test content by subject matter expert judges would support the case of content validity, a jury consisting of one full professor of economics and two Ph.D. candidates from the Department of Economics at The Ohio State University evaluated the three achievement tests during Spring 1988. The results of the jurying strongly supported the content validation and precision of both the questions and their corresponding correct answers. A miscoding of one item was identified in the pretest and the statistical program was corrected prior to further data analyses. No other significant problems were found with any items, thus providing expert evidence to validate the economics content of the achievement measures.

Internal-consistency reliability estimates of the achievement test instruments were analyzed statistically through the Kuder-Richardson-20 formula. While Cronbach's coefficient alpha was used to determine the reliability of the affective measures utilizing weighted scales, the KR-20 was appropriate to apply since scoring on all cognitive items were dichotomous (Nunnally, 1978).

Item difficulty measured the relative difficulty of each item determined by the proportion of subjects answering that item incorrectly. A good item had a
moderate difficulty level in a range between .40 and .60, indicating that the item was neither too easy nor too hard for most of the test subjects. The mean item difficulty index for the Pretest, Posttest I and II was .59, .58, and .67, respectively, within the acceptable range for efficient instruments (Ebel, 1972; Nunnaly, 1978).

Item discrimination reflected the degree to which each item discriminated between upper and lower performance groups (the top and bottom 27%, respectively). A good item had a higher item discrimination value, indicating that subjects in the higher performing groups answered the item correctly more often than subjects in the lower performing groups. The mean item discrimination index for Posttest I and II was .37 and .31, respectively, and were "reasonably good" for cognitive achievement tests (Ebel, 1972).

Results from these descriptive measures supported the observation that the three achievement test forms were generally commensurate in reliability, difficulty and discrimination, stability and accuracy. Moreover, the single most critical instrument in the study, Posttest I, had a relatively high KR-20 value (.76), a moderate mean item discrimination value (.37), and a moderate (.58) mean item difficulty value, all within the
range of values indicative of an efficient and reliable instrument (Ebel, 1972; Nunnally, 1978). Although improvements across the various indexes on each of the instruments would augment the overall reliability of each measure, they were generally acceptable for the purposes of the study. The summary statistical data on each test are presented in Tables 1 and 2.

Table 1
Descriptive Data for Cognitive Achievement Instruments

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Pretest n = 137</th>
<th>Post I n = 150</th>
<th>Post II n = 151</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>13.76</td>
<td>14.36</td>
<td>11.27</td>
</tr>
<tr>
<td>Median</td>
<td>14.00</td>
<td>13.00</td>
<td>11.00</td>
</tr>
<tr>
<td>Mode</td>
<td>14.00</td>
<td>11.00</td>
<td>11.00</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>3.77</td>
<td>5.38</td>
<td>4.28</td>
</tr>
<tr>
<td>Standard Error</td>
<td>2.83</td>
<td>2.77</td>
<td>2.68</td>
</tr>
<tr>
<td>Skewness</td>
<td>-0.02</td>
<td>0.91</td>
<td>1.00</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>-0.46</td>
<td>0.66</td>
<td>1.55</td>
</tr>
<tr>
<td>Maximum Possible</td>
<td>34.00</td>
<td>34.00</td>
<td>34.00</td>
</tr>
<tr>
<td>Lowest Score</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
</tr>
<tr>
<td>Highest Score</td>
<td>24.00</td>
<td>32.00</td>
<td>29.00</td>
</tr>
<tr>
<td>Range</td>
<td>21.00</td>
<td>29.00</td>
<td>26.00</td>
</tr>
<tr>
<td>Kuder-Richardson 20</td>
<td>0.50</td>
<td>0.76</td>
<td>0.63</td>
</tr>
<tr>
<td>Item Difficulty</td>
<td>0.59</td>
<td>0.58</td>
<td>0.67</td>
</tr>
<tr>
<td>Item Discrimination</td>
<td>0.28</td>
<td>0.37</td>
<td>0.31</td>
</tr>
</tbody>
</table>
Table 2

Reliability of Cognitive Instruments and Subscales

<table>
<thead>
<tr>
<th>Question Scale</th>
<th>Pretest</th>
<th>Post I</th>
<th>Post II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Order</td>
<td>0.27</td>
<td>0.62</td>
<td>0.44</td>
</tr>
<tr>
<td>Lower Order</td>
<td>0.49</td>
<td>0.63</td>
<td>0.53</td>
</tr>
<tr>
<td>All Questions</td>
<td>0.50</td>
<td>0.76</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Note. Cronbach's Alpha coefficient is equivalent to the Kuder-Richardson 20 coefficient for dichotomous items. Higher-order and lower-order reliability values in this table are Cronbach's Alpha coefficients.

Readability Level of Instruments. Readability analyses were conducted on each final cognitive instrument using the Fog Index (Gunning, 1952), a widely applied conventional measure of the reading level of text (Klare, 1974). Three random observations and readability scores were made across both higher-order and lower-order questions in each cognitive instrument. The results of these analyses are presented in Table X, and generally confirm that the reading grade level for all tests was between Grades 8 and 9. The range of readability was between Grades 8 and 13, with several questions on the higher-order subscales possessing difficulty beyond the
13th Grade level, although these exceptions did not appear to significantly effect the overall readability of the test instruments.

Table 3

Fog Index Reading Grade Level of Cognitive Instruments

<table>
<thead>
<tr>
<th>Question Scale</th>
<th>Pretest</th>
<th>Post I</th>
<th>Post II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher Order</td>
<td>8.81</td>
<td>9.05</td>
<td>8.75</td>
</tr>
<tr>
<td>Lower Order</td>
<td>8.37</td>
<td>8.05</td>
<td>8.72</td>
</tr>
<tr>
<td>All Questions</td>
<td>8.59</td>
<td>8.55</td>
<td>8.73</td>
</tr>
</tbody>
</table>

Affective Instruments

Three affective instruments, each measuring a different attitude area, were included in the data collection of this study. The following pages examine the nature of attitude scaling and scoring relevant to the use of these measures and present brief descriptions of each instrument: the Survey on Economic Attitudes, the Computer Anxiety Index, and the Learning Attitude Survey, respectively.
Attitude Scale Measurement Techniques. Attitude has been defined by Thurstone (1946) as the degree of positive or negative affect that can be associated with some psychological object. The psychological objects of interest in this study are: (a) the subject of economics as an area of study, (b) computer technology in general, and (c) the approach to and performance of learning tasks in general. While various techniques have been developed for the purpose of empirically estimating the degree of an individual's favorableness or unfavorableness toward positive and negative statements about such objects (Edwards, 1959), the summated ratings Likert-type scale has become a highly-reliable, easily employed and widely accepted method in psychometric studies involving attitudes (Ebel, 1972; Likert, 1932).

A standard 6-point Likert-type response framework was used in this study. The descriptive scale included responses of (a) very strongly disagree, (b) strongly disagree, (c) disagree, (d) agree, (e) strongly agree, and (f) very strongly agree. The neutral response point (undecided or uncertain) conventionally included in many studies involving attitudes was eliminated to create a forced-choice measure of respondent attitudes. The rationale for removing the neutral point was: (a) attitude theory broadly suggests that individuals do in
fact possess predispositions to behave toward an object or perceive an object positively or negatively to some degree and that if required to make a choice, individuals will exhibit this predisposition; (b) the neutral point does not improve the sensitivity of the scale to any changes in attitude, (c) the results of the local pilot testing of the SEA and CAIN indicated that given the neutral point option in the scale between 50 to 60 percent of all responses were made in the undecided category, constituting an unnecessary loss of potentially valuable data; and (d) the CAIN, which was nationally-normed using a 6-point scale without a neutral point was substantially more reliable than the two indexes of the SEA which was nationally-normed using a 5-point scale with a neutral point. For these collective reasons the 6-point scale was adopted for all affective measures to ostensibly enhance the sensitivity and thus the reliability of the self-report observations.

**Application of Certainty Estimates.** While a single response framework (the 6-point Likert scale format) was used for all affective measures, two distinct schemes of coding and scoring the data were implemented. The same original data and general Likert methodology of summated ratings was used for both scoring techniques. During
data analysis, the scales were later recoded for each scheme in the following manner. The first coding scheme used a straight six-point continuum based on the premise of equal appearing intervals (Edwards, 1959). The scoring interval assigned between each point on the continuum was precisely 1, and the corresponding values were as follows: (a) very strongly disagree = 0, (b) strongly disagree = 1, (c) disagree = 2, (d) agree = 3, (e) strongly agree = 4, and (f) very strongly agree = 5. Negative items were recoded using the converse scheme where very strongly disagree = 5, strongly disagree = 4, etc.

The second coding scheme used an adaptation of the certainty method developed by Warren, Klonglan, & Sabri (1969). These researchers found that affective instruments using coding schemes transformed on the basis of the certainty method produced increased precision in measurement. During the data analyses for the current study, reliability coefficients were generated for the affective instruments using both coding schemes (i.e., the straight equal-interval and adapted certainty methods). Certainty coded reliability estimates for two indexes were marginally higher (EAS and SURF) and for one index marginally lower (ATE) than the estimates derived from straight equal-interval values (See Table 4).
Table 4
Reliability Data for Affective Instruments

<table>
<thead>
<tr>
<th>Affective Index</th>
<th>CAIN</th>
<th>ATE</th>
<th>DEEP</th>
<th>EAS</th>
<th>SURF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight Code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha</td>
<td>0.95</td>
<td>0.84</td>
<td>0.82</td>
<td>0.67</td>
<td>0.27</td>
</tr>
<tr>
<td>Mean</td>
<td>3.11</td>
<td>2.36</td>
<td>2.93</td>
<td>2.87</td>
<td>2.25</td>
</tr>
<tr>
<td>Certainty Code</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alpha</td>
<td>0.95</td>
<td>0.83</td>
<td>0.82</td>
<td>0.68</td>
<td>0.28</td>
</tr>
<tr>
<td>Mean</td>
<td>9.74</td>
<td>7.49</td>
<td>9.13</td>
<td>9.01</td>
<td>7.28</td>
</tr>
</tbody>
</table>

The certainty method does not assume equal intervals between the response points on any scale measuring attitudes. Larger interval increments are assigned toward the end points on the continuum. The rationale for this coding scheme is based on the increasing degree of certainty that a statement is perceived by an individual as more favorable or more unfavorable the closer a score occurs toward either endpoint.

The certainty coding scheme in this study used a sixteen-point continuum based on the method of
probability-based intervals (Warren et al., 1969). The
distribution of the scoring values across the 16-point
continuum is based on a probability estimate of certainty
where a choice of very strongly disagree (a score of 0)
indicates a level of agreement or favorableness
represented by .00, while a choice of very strongly agree
(a score of 16) indicates total agreement or
favorableness represented by 1.00. The interval between
agree and disagree is therefore the narrowest (2 points),
the interval between agree and strongly agree is wider (3
points), and the interval between strongly agree and very
strongly agree is the widest (4 points).

The data originally recorded using the 6-point
Likert response format was then recoded in the following
manner. The scoring interval assigned between each point
on the 16-point continuum was adjusted to a corresponding
probability value estimating the relative degree of
certainty as follows: (a) very strongly disagree = 0, (b)
strongly disagree = 4, (c) disagree = 7, (d) agree = 9,
(e) strongly agree = 12, and (f) very strongly agree =
16. Negative items were recoded using the converse
scheme where very strongly disagree = 16, strongly
disagree = 12, etc. All statistics involving the ATE,
EAS, CAIN and DEEP indexes were recalculated twice, the
first time using the conventional equal-interval scale and the second time using the adapted Certainty method.

**Survey on Economic Attitudes.** As described earlier in Chapter II, the nationally-normed *Survey on Economic Attitudes* (SEA) was developed to provide a valid and reliable measure of affective behavior related to economics (Soper & Walstad, 1988, 1986). The Revised Test of Economic Literacy has included the SEA indexes since both questionnaires have demonstrated their potential value in measuring the relationship between attitude change and economics instruction (Soper & Walstad, 1988, 1986; Walstad & Soper, 1988). The SEA is not a single instrument, but rather consists of two major indexes: (a) the **Attitude Toward Economics** or ATE ($r = .87$) index measuring basic attitudes toward economics as a subject area, and (b) the **Economic Attitude Sophistication** index or EAS ($r = .67$) index measuring attitudes reflecting the degree of sophistication in understanding of economic problems and policy (See Appendix G). Each of these indexes observes different aspects of the affective domain related to economics and are therefore interpreted as separate instruments in all data analyses (Becker & Walstad, 1987).
Computer Anxiety Index. The Computer Anxiety Index (CAIN, Maurer, 1983) was used in this study to investigate learner anxiety associated with instructional computer usage (See Appendix F). The CAIN is a single inclusive index that measures the level of agreement toward 26 statements related to attitudes toward computer technology. The CAIN was normed from quantitative data collected from 1943 subjects and produced a high internal-consistency reliability estimate ($r = .94$). Although high means from norming sample distributions tended to indicate a general acceptance of computers and absence of any specific fear of computer technology in precollege subjects (Simonson et al., 1987), computer anxiety was still considered important to measure as both a contribution to growing knowledge of the phenomenon and as a control of potential confounding in computer-based instructional research.

Learning Attitude Survey. The Learning Attitude Survey (LAS) was used in this study to investigate the general learner attitude associated with the approach toward new learning tasks (See Appendix H). Based principally on the critical work of Biggs and Rihn (1984), the Learning Attitude Survey is not a singular instrument, but rather consists of two major indexes: (a)
the Deep Approach Toward Learning or DEEP index ($r = .82$) measuring the degree to which student attitudes toward learning tasks reflected a deep approach toward learning, and (b) the Surface Approach Toward Learning or SURF index ($r = .27$) measuring the degree to which student attitudes toward learning tasks reflected a surface approach toward learning. The DEEP and SURF scales was locally normed from quantitative data collected from 155 subjects and were also juried by six doctoral candidates in the College of Education, The Ohio State University. Results of the jurying strongly confirmed the correct categorization of 15 of the 16 items. Moreover, since the reliability estimate of the SURF index was very low while the DEEP index produced a relatively high reliability estimate, only the DEEP items were used in this study to measure the attitude toward learning construct.

**Experimental Treatments**

This section of the methodology provides comprehensive descriptions of each instructional treatment strategy contrasted and compared in this study, particularly in relation to the content, structure, and operational characteristics of the rule-oriented and the problem-oriented courseware treatments. A brief summary
highlights the critical features of the courseware treatment instructional design.

Courseware Lesson Content and Development

Two distinct microcomputer courseware treatments were designed and developed for this study: a problem-oriented and a rule-oriented lesson set. Each lesson set consisted of five computer programs on 5 1/4 inch floppy diskette media (a total of 10 diskette programs). Together, the design, production, modification, testing, jurying, and final revision process required 13 months to complete. The ten courseware programs included (a) two programs that were substantially modified and adapted from existing instructional software, and (b) eight original programs that were designed and authored by the experimenter. Each program lesson was intended to be completed by individual students within a regular 50 minute class period and to be used effectively by students with little or no prior computer experience. Also, prior knowledge of the economic subject matter was not required for successful completion of the courseware lessons.

The treatments were constructed to maximize the experimental variance between them. Both instructional strategies were attenuated to emphasize the basic
pedagogical differences between a rule-oriented and problem-oriented approach toward the teaching of selected microeconomics concepts. These differences are delineated later in this section (See Appendix B for a detailed description of each courseware lesson program).

The concepts taught included scarcity, markets, prices and quantities, supply, demand, and equilibrium. Emphasis was placed on learning the basic interactions and market outcomes resulting from changes in the determinants of supply and demand. The microeconomics content included a full range of supply and demand concepts from an independent increase in demand with supply held constant to simultaneous increases and decreases in both supply and demand. The result of these changes on equilibrium price and quantity was either an increase, a decrease, or an unpredictable status contingent upon the degree of the simultaneous changes. This latter condition, indeterminacy, generally occurs with simultaneous changes in supply and demand and was perhaps the most complex concept for the typical student to learn. A complete list of these concepts are included in Appendix B.

Courseware Field Testing Procedures. The microcomputer lessons developed for the study were field
tested in April 1987 in a Columbus high school computer laboratory using sixty-three Grade 12 students similar to those of the experimental target population. Four program modules underwent an initial formative evaluation and revision based upon the constructive feedback and suggestions of the student participants. Three rule-oriented programs and one problem-oriented program were reviewed and tested. Based upon these detailed evaluations, the six programs created after the field tests were systematically designed to the revised specifications and improvements. In addition, two experts in microeconomics education and two experts in the design and development of microcomputer courseware were consulted as a quality control on the final versions of all ten courseware programs.

The field testing procedures were intended to identify errors in the logic, language, display, sequence and general operation of the program modules. The comments and criticisms by both naive student users and adult experts in the teaching of economics and instructional design assisted in the detection and correction of problems pertaining to: (a) the scope, accuracy and clarity of the microeconomics content, (b) the grammar, spelling, and level of reading difficulty in textual passages; (c) the inaccuracies in any visual
displays utilizing complex graphics, (d) the inconsistencies in questioning, branching, remediation, or feedback sequences; (e) the degree of representativeness and congruence between the microeconomics concepts actually taught, and the concepts actually measured; (f) the estimation of the average length of time-on-task necessary to complete each module at an appropriate pace, and (g) other immediately undefined problems, such as individual perceptions of screen design formats, degree of computer novelty and frustration, and levels of motivation and interest students would normally encounter during the lessons.

Readability Level of Courseware Text. Readability analyses were conducted on each treatment lesson using the Fog Index (Gunning, 1952; Klare, 1974). A single random observation and readability score was made in each of the 10 courseware programs, and the mean calculated for each lesson set. The results of these analyses indicated a mean reading grade level of 6.9 for the rule-oriented treatment and 8.4 for the problem-oriented treatment. The range of readability across both treatments was between Grades 6 and 10. Although the mean reading grade level was higher for the problem-oriented courseware by approximately 1.5 grade years,
both mean values were within the normal range of variability in Grade 12 populations. Therefore, neither this difference nor the mean readability levels appeared to significantly effect the overall readability, and by implication comprehensibility, of either treatment.

Rule-Oriented Lesson Set

In the rule-oriented lesson set (See Appendix B), the general instructional sequence used a combined drill and tutorial-based approach, proceeding through the presentation of concepts and questions delivered within the context of explicit expository and inquisitory instruction (Allen, 1986; Merrill, 1983; Merrill & Tennyson, 1977). The strategy consisted of (a) a series of information presentations, (b) rule-recall questions, and (c) rule-example/non-example-instance instructional sequences teaching knowledge of the major principles and concepts in microeconomic theory. Brief review and overview sections began each lesson module to maintain the continuity between lessons. Supply and demand were introduced as the fundamental components of the market system, while equilibrium was presented as the superordinate concept between supply and demand. Subsequent expository and inquisitory sequences required application of the previous content and an increasingly
complex set of well-defined economic rules that were both explicitly taught and exemplified throughout the lessons.

A rule as viewed here is a knowledge representation of some event or object (e.g., economic supply) consisting of a name and corresponding definition classifying the behavior or structure of the event or object (Merrill & Tennyson, 1977). Hence the term rule-oriented refers to the technique of (a) employing superordinate and subordinate concept names and definitions presented initially with critical and variable attributes (expository generalities), (b) presenting and contrasting examples and non-examples (expository instances), (c) frequent questioning on the rules and concepts names and definitions (inquisitory generalities, including direct recall questions); and (d) questioning newly encountered examples (inquisitory instances) to augment student understanding concepts within a logical and unambiguous rule hierarchy.

**Lesson Set Structure and Sequence.** The rule-oriented lesson set designed in this study was structured using a parallel rule-recall-example-practice, review and mastery quiz format. Each rule-recall-example-practice set was modularized for uniformity and consistency of presentation. The complete instructional sequence of
events is related to the presentation of a single microeconomic concept. Subsequent levels of the instruction teach the selected hierarchy of concepts from scarcity to simultaneous changes in supply and demand with the resulting changes in equilibrium price and quantity. New examples and nonexamples are presented as an increasingly complex class of rules and logical relationships (IF supply increases AND demand remains unchanged, THEN equilibrium price will decrease). Learning the rule definitions thus promotes a deeper understanding of the change relationships of supply, demand, and equilibrium.

The rule-oriented lesson set consisted of the five program diskettes noted earlier. Disks 1, 2, and 4 had a parallel lesson structure. Disk 1 began with an introduction to the lesson set and a series of concept definitions (an advanced organizer) that was similar to the introductory modules of the problem-oriented lesson set. This introductory section consisted of basic microeconomic knowledge that helped to familiarize the students with common terms and ideas of the subject matter domain.

Following the introduction, the initial concept sequence began. The general instructional sequence followed a consistent series: (a) first, an advanced
organizing preview and review segment prepared the learner for the current lesson, (b) the subsequent presentation of a rule name and definition (expository generality; the initial presentation of the definition included the critical and variable attributes of the concept), (c) a recall question on the preceding rule name and definition (inquisitory generality), (d) a set of paired examples and non-examples in tabular form and brief descriptions of an economic situation which served to illustrate and discriminate the rule clearly (expository instance), (e) a question on the preceding material using an example not encountered previously, and (f) a summarizing restatement of the newly acquired concept name and definition. This basic sequence was reiterated throughout each lesson disk 1, 2, and 4. All questions included informing the learner of results and supplying the correct answer if the learner was unsuccessful after the second attempt. A summative review, including the presentation of rule tables listing each previously learned concept and followed by a mastery series of 8-10 questions concluded each lesson.

In Lesson Disk 5, all concepts taught throughout the full lesson set were systematically reviewed. Following the review, a mastery quiz consisting of 20 questions (across the range of Bloom's Taxonomy) was presented.
Knowledge of results and corrective feedback was given in each instance. An incorrect response resulted in a remediation sequence reviewing the prior definition and examples. A correct response resulted in a positive reinforcement (a "Good Job" statement) and an immediate continuation of the question sequence. Knowledge-of-results corrective feedback was delivered at each problem analysis section. A final review with complete rule tables concluded the program and lesson set.

Disk 3 was a special hybrid version modified from an existing software package, Marketplace (Nelson, 1985). The first half of the program was a tutorial on the fundamental relationship between supply and demand, with the emphasis on the movement of curves corresponding to changes in the determinants of supply and demand. The tutorial was augmented by the consistent use of animated hi-resolution graphics to demonstrate the movement of supply and demand curves, and to illustrate corresponding changes in equilibrium price and quantity. This portion of the Marketplace program exemplified many features of a rule-oriented strategy. The microeconomics content was revised exclusively for the study, and full copyright citation was included at all times.
Problem-Oriented Lesson Set

In the problem-oriented lesson set, the general instructional sequence employed a role-playing simulation of an imaginary business, proceeding through the presentation of concepts and questions embedded within the context of problem scenarios and events. The lesson set consisted of a series of situations emphasizing application and analysis level knowledge of the major principles and change relationships in microeconomic theory. Brief review and overview sections began each lesson module to maintain the continuity between lessons. Equilibrium, the superordinate concept, was presented initially and consistently as a unifying construct between supply and demand. Subsequent problem situations required application of the student's growing knowledge and a specific cognitive strategy: the "Graphic Method." The Graphic Method was both explicitly taught and repeatedly embedded throughout the lessons to guide students in hypothesis generation and testing concerning changing behavior within the simulated market system. Hence the term problem-oriented refers to the technique of employing problem situations as the core to understanding concepts operationally, and in using a context-specific problem-solving strategy, the Graphic
Method, to resolve the problem by predicting the outcome based upon market changes in supply and demand.

The Problem Scenario. The student is placed in the role of the owner and chief executive officer of a new business. At the same time the computer tutor component of the program plays the role of a professional consulting firm (Microbiz Associates) for young companies similar to the one the student is now operating. The idea is broadly to establish a friendly working relationship between the "consulting firm" tutor and the student "manager" in the course of operating the new business successfully.

The student is requested to invent both a product and a company name. The student enters these names into the program and they are subsequently presented within each problem situation, feedback elaboration and remediation segments of that particular courseware program.

Various motivational frames appear throughout the lesson to encourage the student manager to become interested in the profit-making capabilities of his or her own business enterprise. The explicit suggestion is made that profit will be enhanced by correct decision-making during the business operation cycle. Four lesson
diskettes (Lessons 1, 2, 4 and 5) create a simulated business fiscal year, each lesson representing a corporate quarter (3 months) of that year.

The new company begins in full production of the chosen good or service. The new student manager is periodically presented with simulated electronic mail business reports sent from the Microbiz firm. The content of each report is a simulated problem situation, each describing a set of particular events requiring the immediate attention of the business manager. These on-line reports include text, supply and demand schedules, and graphs of supply and demand curves. The manager is then required to predict the effect of the economic changes in the determinants of supply and demand on the new equilibrium price and quantity of his or her product.

Concepts and principles are learned at an application level throughout the lesson set. At the conclusion of each program, a synthesizing review is presented over the concepts emphasized during the recent "business quarter". The final lesson program (Lesson Disk 5) includes a series of complex problem situations requiring the application of all previous conceptual knowledge. At the conclusion of the lesson set, a summative evaluation of student performance in terms of "profit points" is presented.
The Graphic Method Cognitive Strategy. The Graphic Method is an adaptation of a simple and widely-used market analysis technique found in introductory economics courses. This technique is taught in conjunction with a step-by-step problem-solving strategy to approach new problems. The strategy is presented as a decision-making tool by the Microbiz firm and consists of: (a) a general approach to recognizing the critical elements of each new situation and (b) the specific method that would lead to a complete graphic matrix analysis of the problem.

The manager is coached to observe several things in each situation: 1) take the problem apart by recognizing what events are changing in the situation, and which events are static; 2) identify the reasons for the dynamic and static events (the determinants of supply and demand), then 3) translate the changes in supply and demand into a graph to predict the resulting outcome. The successful application of the strategy by the student produces a successful prediction and ostensibly increases the long-term profit efficiency of the simulated company.

The Graphic Method requires the student to:

1) Draw a small "X" graph with the prices and quantities (i.e., vertical and horizontal axes, respectively) identified, and the supply and demand curves intersecting in the center at a clear equilibrium point;
2) Then, draw in the new curves resulting from the observed changes in the determinants;

3) Find the new equilibrium price and quantity by following the new equilibrium point to the respective axes.

Analysis of a given microeconomic problem situation using the systematic graphic method tool serves two purposes: (a) to assist the student manager in predicting the market behavior of his or her product in a simplified, low-risk, simulated "real-world" economy; and (b) to foster learning selected microeconomics concepts in a highly engaging and interactive instructional unit, thereby fostering appreciation of economics as a system of competing interests that can be comprehended and interpreted using a set of functional economic concepts and reasoning skills. The attempt is to connect the problem examples and their economic resolutions experientially in context to aid in long-term memory, and to provide a concrete analytic tool to frame and visualize the change relationships that the underlying microeconomic principles represent.

**Lesson Set Structure and Sequence.** The general instructional sequence consists of a series of problem situations, each illustrating a set of increasingly complex interrelationships between concepts in the
content domain. Each problem situation requires analysis and advanced application of various principles and strategies. A core feature of each sequence is the use of the principle of equilibrium within a descriptive or narrative problem situation emphasizing the integral connection between the concepts of supply and demand: the epitome. Subsequent levels of the instruction teach the Graphic Method cognitive strategy based on the equilibrium principal. Increasingly complex new problem examples are presented to clarify the equilibrium epitome and to assist in a deeper understanding of the change relationships of supply and demand.

The problem-oriented lesson set consisted of five program diskettes. Disks 1, 2, 4 and 5 had a parallel lesson structure. Disk 1 began with an introduction to the lesson set and a series of concept definitions which served as an advanced organizer similar to the introductory modules of the rule-oriented lesson set. This introductory section consisted of basic knowledge that helped to familiarize the students with common terms and ideas of the microeconomics content domain.

Following the introduction, the initial problem scenario began. The instruction followed a general structure adapted in part from Reigeluth's Elaboration Theory. The mental model of the market system proposed
in the lesson epitome was that of a balance with equilibrium at the center. The problem-oriented concept definitions emphasized that the principle of equilibrium was the core idea in understanding the market system. The problem scenario proceeded to elaborate each of the selected microeconomic concepts in the context of additional problem situations requiring the student manager to make successful predictions of the changing market condition in relation to the student's simulated product and company. Each new problem lead to a problem analysis section where three alternative hypotheses were presented to explain the change relationship just observed. The task of the student was to successfully choose the correct hypothesis explaining the situation. When appropriate, the program offered tutorial advisement in the form of suggestions, hints and simulated "electronic mail" reports. In addition, the Graphic Method was explicitly taught in the first lesson.

In Lesson Disks 2, 4 and 5 the identical format was followed using increasingly complex elaborations of the central concepts of supply and demand. A cognitive strategy activator (Reigeluth, 1983) suggested that the student manager apply the Graphic Method to each new problem situation. An incorrect hypothesis resulted in a remediation sequence with tutorial advisement as
described in the preceding paragraph. A correct hypothesis resulted in a brief summary of the situation and the resulting economic outcome using the Graphic Method. Knowledge-of-results and corrective feedback was delivered at each problem analysis section. A summary and review section completed each lesson disk.

Disk 3 was a special hybrid version combining two existing software packages: Shifty (Post, 1985, 1983) and Marketplace (Nelson, 1985). The student first reviews a concise operational introduction to the Shifty instructional simulation that explains the functions and procedures that need to be grasped by the student to use the simulation more effectively. The student then performs the Shifty simulation and when the student terminates the Shifty simulation session, the second half of the lesson presents a random sequence of 13 microeconomic problems adapted from the Marketplace program. This particular sequence of problems acts as a debriefing phase of the instructional simulation in which the student applies the Graphic Method directly to newly encountered word problems.

Shifty was originally developed for college-level introductory courses in microeconomic theory. The computer simulation itself consists of a single screen with three graphs and two variable selection menus. The
graphs represent demand, supply, and the interaction of demand and supply represented by the equilibrium values of the two change relations. In the lower left of the screen is a menu where the learner selects (a) a determinant of either supply or demand, and (b) an increase or a decrease in that determinant. The student subsequently applies the Graphic Method strategy using the computer keys to manipulate the demand and supply curves corresponding to the determinant and direction selected. Finally, the learner must accurately predict the resulting outcome in the combination of the two curves corresponding to the observed changes in prices and quantities of supply and demand. A complete set of correct decisions is rewarded by a number of points for that particular simulation round. The simulation continues with the learner selecting a new set of determinants and levels to explore another problem situation. Points are accumulated until the learner terminates the simulation.

Summary

Two distinct instructional treatments were developed using the identical set of microeconomic concepts. The microeconomics content included the full range of fundamental change relationships between supply and
demand. The specific content of each diskette was judged by experts in the field of economics, modified according to their recommendations, and generally validated for the authenticity and accuracy of the lesson content. The basic structure and sequence of each treatment strategy was designed on a rule-oriented or problem-oriented approach to instruction and learning. Computer-based treatments were designed using the Apple Superpilot authoring language and included a series of drill and tutorial programs and instructional simulations. Ten diskettes were produced, including eight original software programs specifically created for this study. The duration of the courseware treatments was five class periods, utilizing one computer diskette per day. Programs were designed to be easy to comprehend and use without additional instruction. During the study, students generally enjoyed the computer lessons and tended to complete the programs before the end of each class period, and there appeared to be no outstanding student problems with either the operation of the programs or the economics content per se.

Experimental Data Collection

This section of the methodology examines the procedures used in conducting the observations and
instructional treatments of the final data collection period. The systematic description of the conditions of treatment and testing includes: (a) the method used in randomization and assignment, (b) the scheduling of treatment and testing across the four data collection sites, (c) the verbal instructions given subjects before testing and each computer-based lesson treatment, (d) how the microcomputer laboratories were used and subjects correctly assigned to lesson treatments each day, (e) the conditions of classroom testing, and (f) a description of which specific outcome measures were used during the pretest and posttest phases of the study. A brief summary highlights the data collection procedures implemented in this study.

Conditions of Treatment and Testing

All observations and courseware treatments were conducted within the classrooms and other facilities of the four high schools participating in this study. All of the cognitive and affective measures used were administered in the regular assigned classrooms of each student and during normally assigned class periods. Several students who were temporarily absent during one of the scheduled data collection periods were administered the appropriate measure on the day
immediately following the originally scheduled date, provided they attended class and were available to participate. The total number of students who were absent and subsequently administered rescheduled measures did not exceed 10.

Randomization and Assignment Method. A robust procedure to randomly assign subjects to treatment groups was designed and implemented as follows:

1) the names of all participating students were put into a series of lists corresponding to each school and class,

2) each list was then alphabetized for administrative purposes,

3) a special computer program designed by the experimenter (See Appendix A) was then seeded with the number of students in each list, and three complete sequences of all numbers in the set of students was randomly generated;

4) one of the three sequences was randomly selected, and a number was then assigned to each subject beginning with the first number in that sequence and until each name on the class list had received a number; and

5) subjects on each list were then randomly assigned to treatment groups (in one class odd numbered subjects were assigned to one treatment, while in another class even numbered subjects were assigned to the same treatment).

At no time did the experimenter make any distinction between which group, even or odd, was assigned to which
treatment, the problem or rule oriented strategy. In the two schools with more students than computers, separate lists were made for each class, and students were randomly assigned to one of two groups, participant or non-participant. Subsequently, the participating subjects were randomly assigned to a treatment group using the identical procedure described in this section.

**Scheduling.** The logistical arrangements to conduct the study in four high schools during the autumn school term required the coordination of multiple class schedules, intervening school events, and computer system availability. Ten full class periods were required in each completed data collection sequence, including the following activities specified on each day, respectively:

| Table 5                                                                 |
| Description of Sequential Experimental Activities                        |

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>General Orientation</td>
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<tr>
<td></td>
<td>Affective Pretests</td>
</tr>
<tr>
<td>2</td>
<td>Cognitive Pretest</td>
</tr>
<tr>
<td>3</td>
<td>Treatment Lesson One</td>
</tr>
<tr>
<td>4</td>
<td>Treatment Lesson Two</td>
</tr>
</tbody>
</table>
Table 5 (Continued)

<table>
<thead>
<tr>
<th>Day</th>
<th>Activity</th>
</tr>
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<tbody>
<tr>
<td>5</td>
<td>Treatment Lesson Three</td>
</tr>
<tr>
<td>6</td>
<td>Treatment Lesson Four</td>
</tr>
<tr>
<td>7</td>
<td>Treatment Lesson Five</td>
</tr>
<tr>
<td>8</td>
<td>Cognitive Posttest I (Immediate)</td>
</tr>
<tr>
<td>9</td>
<td>Affective Posttests</td>
</tr>
<tr>
<td>10</td>
<td>Cognitive Posttest II (Delayed)</td>
</tr>
</tbody>
</table>

A final data collection schedule (See Appendix I) integrated the sequence of experimental events in all four schools and was successfully implemented without any significant disruption or variation from the original project schedule.

**Experimenter Instructions.** No formal specific verbal instructions were given subjects during the final data collection period. In the general orientation session (Day 1), the project was introduced as a series of computer lessons on the subject of microeconomics, including the mention of the concepts supply, demand and
equilibrium. Students were informed that prior knowledge of economics was not necessary for their successful participation in the project lessons and performance measures. No discussions, examples, or definitions of any kind related to the subject matter were presented at any time. Interested students who asked questions related to the subject matter were informed that any related topics would be addressed during the coming courseware lessons and after the series by their classroom teachers.

During the general orientation session, the initial affective data were collected. Each questionnaire included a brief explanation of the 6-point Likert scale and a single example illustrating the scale and proper method of marking the machine-scanable score sheets. Students were instructed that whether an individual received a yellow, green or white attitude questionnaire was irrelevant since it was necessary to randomly assign one third of the students to each color questionnaire for administrative purposes. Students were also cautioned to coordinate the correct number of the item with the correct response space on the score sheets.

No special instructions were required for the cognitive achievement measures since these instruments were designed in the format of conventional 4-option
multiple choice examinations frequently experienced by senior high school students. Students were encouraged to work hard, to guess answers if necessary, but to attempt every question. Students were permitted to use the entire class period for each cognitive measure, although most students completed the achievement tests within a 35 minute period. Talking was not permitted at any time, and classroom management was strictly enforced. No problems were observed during the cognitive measure data collection.

The courseware treatments were designed to be immediately comprehensible and easy to operate. Results during the treatment pilot testing revealed that the microcomputer lessons were self-explanatory and required no additional training or instruction prior to delivery. For those few students unfamiliar with the Apple IIe microcomputer keyboard and who asked questions related specifically to program operation, the experimenter individually assisted the student to locate the appropriate keys. On occasion a student would ask a content-related question during the course of the computer lesson. These students were informed without exception that questions related to the content of the programs could not be answered at that time, but would need to be addressed at some other time. In the
beginning of Treatment Lesson Two students were instructed that some of them would complete lessons requiring the use of the vertical and horizontal arrow keys, and therefore the location of these keys was noted. Near the conclusion of each laboratory period, students were informed of 1 to 2 minutes remaining and requested to complete the question or text page they were on as soon as possible. No other instructions were given in the computer laboratories at any time.

Microcomputer Courseware Delivery. All courseware lessons were delivered on Apple IIe microcomputers. All computers contained at least 64 kilobytes of memory necessary for the courseware lessons to operate. There was some variation in other components of the Apple IIe systems including the use of both monochrome and color monitors. At the beginning of the first lesson, the experimenter introduced the basic operational features of the microcomputer that were necessary for successful completion of the courseware lessons. Students appeared both generally comfortable and experienced in the use of Apple microcomputers, although some students did require additional assistance in locating the escape, backspace and return keys, and in monitor adjustment. At the beginning of each computer lesson, students were
permitted to adjust the visual brightness, contrast, and color controls of the monitor at their computer station. Although many elements of the courseware lessons were designed with the appropriate use of color text and graphics to optimize the effectiveness of color monitor delivery, color was not considered an essential feature to the courseware. No attempt was made to control for the presence or absence of color, and no distinction was made between color and monochrome systems when assigning courseware treatments. It is interesting that for approximately one third of the subjects, the use of color cuing served to distract their attention from task performance, and they corrected for this problem by selecting the monochrome option on their computer monitors throughout their lessons.

Students were assigned to computer stations corresponding to their respective treatment group. A daily log was kept on student attendance. Each student would report to the computer laboratory as scheduled. The check-in procedure first required the recording of student attendance. The student would then be assigned to a computer station designated by the experimenter and coded by a colored index card clearly displayed on the top of each monitor. The experimenter would place the colored cards on each monitor prior to the beginning of
each courseware lesson. No distinction was made to use a specific color in association with a given treatment and the colored cards were used only as an administrative convenience for rapid and precise assignment of students to treatments.

Except for the initial lesson, students were permitted to begin immediately after each class session officially began. The duration of each class session was 50 minutes. Students were previously instructed to arrive as early as possible to each session. Many students were assigned to the appropriate computer station during the interim time between periods, minimizing time needed for attendance and assignment and maximizing the time-on-task for each student. To facilitate laboratory preparations for the incoming class students, students were reminded within the last 1-2 minutes of each period that they should complete the immediate question or text page. Approximately 45 minutes of each session was on the average utilized for courseware lesson task.

**Test Materials and Setting.** All paper and pencil testing procedures was conducted in regular school classrooms relatively free from distractions to assure external conditions that assisted in optimal student
performance. Full class periods were reserved for this purpose, although none of the tests (the Pretest, Posttest I and Posttest II) required a full class period to complete. Students used soft lead pencils to mark standardized machine-scanned test forms. Only one response could be marked and recorded per item. Each item on the test forms included 10 maximum responses, with a bubble for each response. Each bubble was simultaneously labeled with a designated number and letter in sequence (0 to 9 and A to I, respectively). However, the cognitive measures included only four possible choices (A, B, C, D) and the affective measures included only six possible choices (0, 1, 2, 3, 4 and 5) relevant to scoring any single item.

The participants were explicitly informed that the results of any individual, class or school test scores related to this study would not (a) be made public, (b) contribute to any official class grade, or (c) be made a part of any permanent academic record. All printed test booklets were collected along with the answer forms, and all individual, class and school results remained strictly confidential. Cooperating teachers and administrative personnel were not informed at any time of the performance outcomes of individual students in any class or school.
Three complete sets of student score sheets were coded, collected, and analyzed. A separate score sheet was used for each battery of pretest measures, posttest measures, and the delayed posttest measure. Each sheet was coded by the experimenter with a series of numbers that could discreetly indicate treatment group membership, gender, school site, regular assigned class period, a three-digit personal identification number unique to a particular student, and the appropriate pre, post or delayed-post designation. Using this coding scheme facilitated sorting during the final data analyses.

All instruments were printed using a laser printer and photocopied to assure test booklets of high resolution and clarity. Each cognitive instrument was printed on white paper in every case, while complete sets of the affective instruments (SEA, LAS and CAIN) were printed in a single battery on white paper specifically for use following Posttest I. Separate copies of these affective instruments were printed on paper color coded for use preceding the Pretest as follows: the LAS on green paper, the CAIN on yellow paper, and the SEA on white paper. In addition to the randomization and assignment method applied to each subject regarding treatments, another randomization sequence using the same
methodology was conducted regarding the affective measures for pretesting. Subjects were randomly assigned to one of three groups. Each group was then pretested with one of the three affective measures, so that data could be collected using one third of the sample for each affective measure while considerably reducing the potential threat due to pretest-treatment interaction. No distinction was made between individuals or treatment groups in the random assignment of pretest affective measures.

**Pretesting Measures.** The pretesting data were collected during the initial two days of the study at each school site. The affective measures (LAS, SEA and CAIN) were each randomly assigned to one-third of the subject sample as delineated in the preceding section and were administered on Day 1. The cognitive pretest (See Appendix C) was administered on Day 2 and concluded the pretest measures. The score sheet for each subject optimally contained information on 34 cognitive questions and from 16 to 28 affective statements, depending on which affective measure the student received.

**Immediate Posttest Measures.** The immediate posttest data were collected during the two days immediately
following the conclusion of the courseware treatments (Days 8 and 9). The cognitive Posttest I (See Appendix D) was administered on Day 8. The complete battery of all affective measures was administered on Day 9, the day following the collection of Posttest I and concluded the immediate posttest measures (a total of 34 cognitive questions and 70 affective statement items).

**Delayed Posttest Measure.** The delayed posttest data was collected on Day 10 in the data collection sequence, two full weeks (14 days) from the first date of the immediate posttest measures. The one-week interval commonly used between immediate and delayed posttest measures in many studies was considered inadequate to measure significant retention effects. These retention effects were hypothesized to appear to a greater degree the longer the delay after the initial treatments, although for the purposes of convenience two weeks was considered an appropriate interval for a realistic assessment of retention. Importantly, the Posttest II measure consisted only of the delayed cognitive achievement posttest (34 cognitive questions), and did not include any affective measures.
Summary

This section of the methodology described in detail all relevant procedures of the data collection task. In addition, the following topics were examined: (a) the randomization method employed, (b) the scheduling system used to coordinate the data collection in each of the four site schools, (c) the experimenter instructions used, (d) the content, structure, and physical conditions of the computer-based treatment courseware delivery. The section concluded with brief descriptions of the measures administered in the corresponding pretesting and posttesting periods.

Data Analyses

Upon the completion of data collection, various data analyses applying descriptive and inferential statistical techniques were conducted. Brief descriptions of the data analyses, including the rationale for selection of some techniques, are presented in this section.

All data were recorded initially on three sets of machine-scanned score sheets. The three sets contained the complete data corresponding to the pretest, immediate and delayed posttest measures, respectively. The contents of these score sheets were then recorded on
magnetic tape at the Office of Evaluation of The Ohio State University. The three raw data files contained on the tape were then copied onto active disk storage in the Ohio State IBM 3081D mainframe system. The data were then edited to remove erroneous spacing and characters that were identified as artifacts of the scanning, recording or data transfer procedures. All further data analyses were conducted using these systematically corrected data files.

Analyses conducted via the IBM mainframe system were programmed by the experimenter using the SPSSx Statistical Package, Version 2.2 (SPSS Inc., 1988). Analyses of the affective measures were recalculated using two coding schemes, the straight 6-point Likert-type scale and the 16-point Certainty Likert-type scale.

**Descriptive Statistical Techniques**

Complete item analyses of the three cognitive achievement instruments were obtained using the statistical program developed by the Office of Evaluation at The Ohio State University. The principle descriptive statistics included (a) frequency distributions including histograms on all variables, (b) scatterplots of all variables used in the regression analyses, (c) measures of central tendency (mean, median, mode) on all
variables, (d) measures of variability (standard deviation, range), and (e) Cronbach's Alpha reliability coefficients specifically for all affective measures (Cronbach, 1951). In addition to reporting the structure and pattern of the underlying sample distributions on each variable in the study, the descriptive statistics corroborated that the critical assumptions of normalcy and homogeneity of variance were not violated.

Inferential Statistical Techniques

A variety of statistical procedures were used to test the research hypotheses of this study. Generally, the less conservative alpha level of .10 was adopted since (a) the study is exploratory and achieving significance at the .10 alpha level would be indicative of a relevant result, and (b) given the adequate size of the study sample, the power level of the inferential tests was increased by the use of the larger .10 alpha level. These inferential tests included: (a) a preliminary series of dependent t-tests and univariate analyses of variance, (b) a set of non-parametric measures of association, specifically Chi Square analyses; and (c) sets of both simple and multiple linear regression models. Cramer's V and Phi coefficients were calculated to determine the significance of the observed
Chi Square statistic and to permit conclusions based upon the relative independence of the variables investigated. In addition, single and multiple linear hierarchical regression models were specified based upon the predicted relationships determined from the literature review. The complete results and direct conclusions from each of the relevant inferential statistical analyses are presented in Chapter IV.

Summary

This section of the methodology described the experimental data analysis procedures selected and applied in this study. The procedures required to prepare and code the data and statistical analyses were briefly noted. Descriptive statistics were described followed by the inferential tests used to address the research hypotheses of the study. The findings of most of these analyses are systematically presented in Chapter IV.

Overview of Chapter III

This chapter described in detail the methodology used to investigate the research hypotheses presented in Chapter I. The design of the study was first outlined, including the experimental design and dependent and
independent variables of interest. The primary independent variable was the treatment, consisting of two levels: a rule-oriented and a problem-oriented instructional strategy. Also, gender served as a major attribute variable. The primary dependent variables were immediate and delayed cognitive achievement posttests which included both higher-order and lower-order question subscales. The experimental controls used to reduce confounding were then discussed, particularly randomization. The major threats to the internal and external validity of the study were systematically examined, and evidence was presented to support that various experimental controls reduced extraneous sources of variance related to the threats.

The procedures for selecting the subjects and data collection sites, and the composition of the final sample of the study were then described. The study involved no obtrusive or unusual treatments or measures, maintained strict confidentiality and was exempt from the formal human subject review process.

The selection, construction and validation procedures of the cognitive and affective instruments were described. The use of two different scaling techniques for the affective instrument data was
explained. Relevant results from the jurying and reliability analyses were also presented.

The rule-oriented and problem-oriented courseware treatments designed for the study were then described. The pilot research was discussed in relation to the formative evaluation and revision of the final treatment programs. The lesson content and structure of each treatment lesson set was presented, including an exemplar contrasting the two instructional strategies operationally.

The procedures used in the final data collection were then discussed. The conditions of treatment and testing were described, followed by the various procedures related to the randomization and assignment method used, scheduling, experimenter instructions, the microcomputer courseware delivery, and the test materials and setting. The various combinations of cognitive and affective instruments used in the pretesting period and in the immediate and delayed posttesting periods were also presented.

The last section of the methodology chapter outlined the descriptive and inferential statistical applications used to examine the research hypotheses of this study. Subsequently, the results and conclusions of the statistical analyses are presented in Chapter IV.
CHAPTER IV
FINDINGS

Introduction
The findings chapter systematically reports the relevant results and conclusions derived from the descriptive and inferential data analyses of this study. The following topics are presented: (a) a brief synopsis of the purpose of the study and the procedures used to address the problem of interest, (b) a restatement of the primary research hypotheses, (c) the descriptive data pertinent to the study, (d) the inferential analyses of major hypotheses and the results and conclusions of these analyses, and (e) the results and conclusions pertinent to secondary issues or relationships not originally hypothesized but of substantial research interest. A summary of the results and conclusions, including a preview of Chapter V, completes the findings chapter.

Overview of the Study
This study attempted to design and implement research-based microcomputer instruction in precollege...

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economics and investigate selected issues related to
cognitive achievement in economics, attitude toward
economics, economic attitude sophistication, level of
computer anxiety, and attitude toward learning. The
study used a true experimental pretest/posttest repeated
measures design (Campbell & Stanley, 1963). A final
sample of 155 senior high school students from four urban
public high schools were randomly assigned to two
treatment groups. These two treatment groups were
pretested and subsequently received concept-learning
computer courseware in microeconomics over a period of
five days—a rule-oriented and a problem-oriented
instructional strategy, respectively.

Following the instructional treatment, an immediate
and delayed parallel form cognitive posttest was
administered, including a battery of affective
instruments measuring attitude toward economics (ATE),
economic attitude sophistication (EAS), computer anxiety
(CAIN), and deep approach toward learning (DEEP).

Treatment and gender were the two principal
independent variables in the study. The two principal
cognitive dependent variables, Posttest I (immediate) and
Posttest II (delayed 14 days) included six outcome
measures: (a) two overall Posttest I and Posttest II
scores, and (b) two higher-order and two lower-order
question subscale scores of Posttest I and Posttest II (Bloom et al., 1956). A series of inferential data analyses were performed on these variables including the paired t-test, chi square, and univariate and factorial analysis of variance were used to investigate the principal hypotheses. Further exploratory analyses employing hierarchical multiple linear regression studied secondary combinations and interactions of the independent variables based upon the results of preliminary descriptive and inferential analyses and from unexamined implications from the research literature.

Research Hypotheses

The ten major research hypotheses investigated were:

\( H_1 \) The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects receiving instruction via the problem-oriented treatment strategy.

\( H_2 \) The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects receiving instruction via the problem-oriented treatment strategy.

\( H_3 \) The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for male subjects.
H₄ The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for male subjects.

H₅ The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a more positive attitude toward economics and greater economic attitude sophistication.

H₆ The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a more positive attitude toward economics and greater economic attitude sophistication.

H₇ The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a lower anxiety toward computers.

H₈ The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a lower anxiety toward computers.

H₉ The overall performance (total score) on the immediate and delayed cognitive posttests will be superior for the subjects reporting a deep approach toward learning.

H₁₀ The performance on the higher-order and lower-order question subscales of both the immediate and delayed cognitive posttests will be superior for the subjects reporting a deep approach toward learning.
Descriptive Analyses of Data

The following section presents appropriate descriptive information on the affective and cognitive instruments, respectively.

Affective Instruments

All affective data were calculated using conventional procedures for Likert scale summated ratings. Score values from each subject reporting scores were added for all items on a particular scale, and a mean value obtained for each individual. These mean values were then summed for treatment and gender and compared. Scores above the mean for that affective variable were categorized as "higher" and represented a more positive or favorable attitude toward the object. Scores below the mean were categorized as "lower" and represented less favorable attitudes toward the object (See Tables 6 and 7).

A higher score on the CAIN indicates a more positive attitude towards computer technology and subsequently lower computer anxiety. A higher score on the ATE index indicates a more positive attitude towards economics as a subject area and a higher score on the EAS index indicates greater attitude sophistication towards economic issues and policies. Finally, a higher score on
the DEEP index indicates a deeper approach towards learning. The SURF scale attempted to measure the surface approach toward learning dimension but was determined by Chronbach's coefficient alpha to be highly unreliable as an indicator of learning attitudes ($r = .27$) and was not used further in any data analyses.

The overall summary data on all affective instruments are presented in Table 6 (straight coding: 0, 4, 7, 9, 12 and 16 on positively-scored items) and Table 7 (certainty coding: 0, 1, 2, 3, 4 and 5 on positively-scored items). All descriptive and inferential statistics in this study were recalculated using both six-point Likert coding schemes and thus provided a comparison of the effectiveness between the two schemes. The certainty estimate scaling demonstrated a greater precision as an attitude scaling technique, although none of the statistical results was significantly different by the use of either coding scheme. Therefore, outcomes from statistical applications using the affective measures are reported only once using data obtained from the certainty estimate coding scheme, unless otherwise noted.
Table 6
Summary Data on Affective Instruments (Posttest--Straight Six-Point Scale)

<table>
<thead>
<tr>
<th>Index</th>
<th>Mean</th>
<th>SD</th>
<th>Lowest</th>
<th>Highest</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>3.11</td>
<td>0.88</td>
<td>0.46</td>
<td>4.96</td>
<td>141</td>
</tr>
<tr>
<td>ATE</td>
<td>2.36</td>
<td>0.65</td>
<td>0.00</td>
<td>3.93</td>
<td>143</td>
</tr>
<tr>
<td>EAS</td>
<td>2.87</td>
<td>0.55</td>
<td>0.93</td>
<td>4.64</td>
<td>142</td>
</tr>
<tr>
<td>DEEP</td>
<td>2.91</td>
<td>0.70</td>
<td>0.63</td>
<td>4.75</td>
<td>140</td>
</tr>
<tr>
<td>SURF</td>
<td>2.25</td>
<td>0.45</td>
<td>0.88</td>
<td>3.63</td>
<td>140</td>
</tr>
</tbody>
</table>

Note. Scale technical midpoint = 2.5. Range = 6. Scale minimum = 0, maximum = 5.

Table 7
Summary Data on Affective Instruments (Posttest--Certainty Estimates)

<table>
<thead>
<tr>
<th>Index</th>
<th>Mean</th>
<th>SD</th>
<th>Lowest</th>
<th>Highest</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>9.74</td>
<td>2.88</td>
<td>1.46</td>
<td>15.85</td>
<td>141</td>
</tr>
<tr>
<td>ATE</td>
<td>7.49</td>
<td>1.91</td>
<td>0.00</td>
<td>12.07</td>
<td>143</td>
</tr>
<tr>
<td>EAS</td>
<td>9.01</td>
<td>1.68</td>
<td>3.14</td>
<td>14.86</td>
<td>142</td>
</tr>
<tr>
<td>DEEP</td>
<td>9.13</td>
<td>2.08</td>
<td>2.25</td>
<td>15.00</td>
<td>140</td>
</tr>
<tr>
<td>SURF</td>
<td>7.28</td>
<td>1.40</td>
<td>3.25</td>
<td>11.50</td>
<td>140</td>
</tr>
</tbody>
</table>

Note. Scale technical midpoint = 8.0. Range = 17. Scale minimum = 0, maximum = 16.

The summary data indicated that the study sample displayed a relatively moderate (a) favorable attitude toward computer technology, (b) unfavorable attitude
toward economics as a subject matter, (c) positive economic attitude sophistication, and (d) a deep approach towards learning. These observations were based on the relation between the summary mean on each index and the technical midpoint, the scale value ostensibly representing neutrality toward the object being measured. Interestingly, the attitude of the subjects towards economics as a subject matter was the only mean value negative to the technical midpoint on both straight and certainty coded scales, and tends to confirm the slightly unfavorable attitude of students in the sample towards economics generally.

Although the failure to pretest all subjects across all affective measures may have decreased the explanatory power of certain potential inferential analyses (e.g., two-stage, least squares multivariate regression analyses), the paired t-test comparison data in Tables 8 and 9 show that nonsignificant differences between the pre and post sample means were observed in three out of four affective measures (the ATE, EAS and CAIN indexes, respectively). This finding supported the use of these affective measures as independent variables in various analyses of variance and subsequent hierarchical regression models.
Regarding the DEEP index, there was a decrease of 0.22 points and 0.74 points in straight and certainty estimate coded pairs, respectively. While this difference was statistically significant, one possible explanation involves the nature of the DEEP index statements. These statements (Appendix H) specifically concern student attitudes towards new learning tasks. A relatively small decrease (less than one-quarter of a point in the six-point scale and less than three-quarters of a point in a 16-point scale) over the course of an intensive week-long academic task could be anticipated on the basis of marginal maturational effects of the treatment experience. Similar effects were observed on the ATE measure where attitude towards economics became slightly less positive a decrease of .09 and .26 in the straight and certainty codes, respectively. Thus it is unclear whether treatment-related maturation effects or other factors were responsible for these observed changes. However, since no other tangible evidence of maturational problems was found, the DEEP index was not eliminated from use as an independent variable in subsequent analyses although the explanatory power of the DEEP variable was questionable.

Summary posttest descriptive data on CAIN, ATE, EAS, and DEEP indexes comparing levels of treatment and gender
are reported in Appendix K, Tables 41 and 42, respectively.

Table 8

**Paired t-Test Comparison of Pretest and Posttest**

**Affective Means: Straight Likert Coding**

<table>
<thead>
<tr>
<th>Index</th>
<th>n</th>
<th>Pre</th>
<th>Post</th>
<th>Change</th>
<th>T</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>39</td>
<td>2.45</td>
<td>2.36</td>
<td>-.09</td>
<td>1.06</td>
<td>.295</td>
</tr>
<tr>
<td>EAS</td>
<td>39</td>
<td>2.90</td>
<td>2.91</td>
<td>+.01</td>
<td>0.25</td>
<td>.807</td>
</tr>
<tr>
<td>CAIN</td>
<td>40</td>
<td>3.45</td>
<td>3.29</td>
<td>-.16</td>
<td>1.71</td>
<td>.095</td>
</tr>
<tr>
<td>DEEP</td>
<td>42</td>
<td>3.21</td>
<td>2.99</td>
<td>-.22</td>
<td>2.49</td>
<td>.017</td>
</tr>
</tbody>
</table>

**Note.** Scale technical midpoint = 2.5. Range = 6. Scale minimum = 0, maximum = 5.

Table 9

**Paired t-Test Comparison of Pretest and Posttest**

**Affective Means: Certainty Estimate Coding**

<table>
<thead>
<tr>
<th>Index</th>
<th>n</th>
<th>Pre</th>
<th>Post</th>
<th>Change</th>
<th>T</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>39</td>
<td>7.80</td>
<td>7.54</td>
<td>-.26</td>
<td>1.10</td>
<td>.276</td>
</tr>
<tr>
<td>EAS</td>
<td>39</td>
<td>9.07</td>
<td>9.12</td>
<td>+.05</td>
<td>0.24</td>
<td>.814</td>
</tr>
<tr>
<td>CAIN</td>
<td>40</td>
<td>10.73</td>
<td>10.30</td>
<td>-.43</td>
<td>1.45</td>
<td>.156</td>
</tr>
<tr>
<td>DEEP</td>
<td>42</td>
<td>10.04</td>
<td>9.30</td>
<td>-.74</td>
<td>2.68</td>
<td>.011</td>
</tr>
</tbody>
</table>

**Note.** Scale technical midpoint = 8.0. Range = 17. Scale minimum = 0, maximum = 16.
Correlational Data for Affective Instruments. As shown in Table 10, the intercorrelations between the four principal affective indexes were moderate positive. Two results are notable: (a) The relationship between scores on the ATE and EAS indexes is moderate ($r = .21; p = .005$); and (b) the strongest correlation was observed between the ATE and DEEP indexes ($r = .39$).

Table 10

<table>
<thead>
<tr>
<th>Variable</th>
<th>Affective Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ATE</td>
</tr>
<tr>
<td>ATE</td>
<td>1.00</td>
</tr>
<tr>
<td>EAS</td>
<td>1.00</td>
</tr>
<tr>
<td>DEEP</td>
<td>1.00</td>
</tr>
<tr>
<td>CAIN</td>
<td></td>
</tr>
</tbody>
</table>

Cognitive Instruments

The results of the cognitive achievement instruments are shown in Table 11. Summary data are presented for each test on the overall score and the higher-order and lower-order question subscales, respectively.
Table 11

Summary Data on Cognitive Instruments (All Scales)

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Range</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>13.76</td>
<td>3.78</td>
<td>4</td>
<td>24</td>
<td>21</td>
<td>137</td>
</tr>
<tr>
<td>Higher</td>
<td>6.02</td>
<td>2.19</td>
<td>1</td>
<td>12</td>
<td>12</td>
<td>137</td>
</tr>
<tr>
<td>Lower</td>
<td>7.74</td>
<td>2.63</td>
<td>2</td>
<td>13</td>
<td>12</td>
<td>137</td>
</tr>
<tr>
<td>Posttest I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>14.36</td>
<td>5.40</td>
<td>4</td>
<td>32</td>
<td>29</td>
<td>150</td>
</tr>
<tr>
<td>Higher</td>
<td>6.52</td>
<td>3.02</td>
<td>1</td>
<td>16</td>
<td>16</td>
<td>150</td>
</tr>
<tr>
<td>Lower</td>
<td>7.84</td>
<td>3.00</td>
<td>1</td>
<td>17</td>
<td>17</td>
<td>150</td>
</tr>
<tr>
<td>Posttest II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>11.27</td>
<td>4.30</td>
<td>4</td>
<td>29</td>
<td>26</td>
<td>151</td>
</tr>
<tr>
<td>Higher</td>
<td>5.10</td>
<td>2.35</td>
<td>1</td>
<td>15</td>
<td>15</td>
<td>151</td>
</tr>
<tr>
<td>Lower</td>
<td>6.17</td>
<td>2.79</td>
<td>1</td>
<td>14</td>
<td>15</td>
<td>151</td>
</tr>
</tbody>
</table>

The data indicated that performance appears to have broadly improved from Pretest to Posttest I treatment.
observations, as indicated both by the mean values and maximum scores achieved on the overall, higher and lower scales. Subjects generally performed better on the lower-order questions and the point difference between mean achievement on higher and lower subscales was 1.72, 1.32 and 1.07 for the Pretest, Posttest I and Posttest II, respectively. The results for Posttest II, however, showed the lowest performance for all scales. As noted by the summary item analyses in Table 1 (Chapter III), Posttest II was apparently a more difficult test than either the Pretest or Posttest I, and the greater difficulty may in part account for the substantially poorer scores.

Summary posttest descriptive data on CAIN, ATE, EAS, and DEEP indexes comparing levels of treatment and gender are reported in Appendix K, Tables 43 and 44, respectively.

**Higher-Order and Lower-Order Subscales.** In observing the relationship between the overall, higher-order and lower-order subscales of the each instrument, a significant association was noted between low and high performance on most of those subscales. Low performance was defined to include all values below the mean and high performance included the mean and all values above.
Subjects scoring in the low group of one subscale tended to score in the low group of the other subscale. The strength of this relationship was moderate for Posttest I (Chi Square = 23.6; \( p < .001 \); Phi = .39), but suggested that there is some significant degree of association between performance on the two subscales of Posttest I (See Table 12). A similar pattern was also observed in an analysis of high and low performance on the overall Posttest I and II (See Table 13). In this case, higher performance on Posttest I was associated moderately with high performance in Posttest II (Chi Square = 20.8; Phi = .37; \( p < .001 \)).

Table 12
Relationship Between Higher-Order and Lower-Order Posttest I Scores

<table>
<thead>
<tr>
<th>Lower-Order Subscale Performance</th>
<th>Higher-Order Subscale Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>( n )</td>
<td>( % )</td>
</tr>
<tr>
<td>Low</td>
<td>61</td>
</tr>
<tr>
<td>High</td>
<td>32</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
</tr>
</tbody>
</table>

Note. Chi Square = 23.6 (Phi = .39; \( p < .001 \))
Table 13

Relationship Between Overall Posttest I and Posttest II Scores

<table>
<thead>
<tr>
<th>Posttest II Overall Performance</th>
<th>Low</th>
<th></th>
<th>High</th>
<th></th>
<th>All Cases</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Posttest I Overall Performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>70</td>
<td>74.5</td>
<td>23</td>
<td>37.7</td>
<td>93</td>
<td>60.0</td>
</tr>
<tr>
<td>High</td>
<td>24</td>
<td>25.5</td>
<td>38</td>
<td>62.3</td>
<td>62</td>
<td>40.0</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>100.0</td>
<td>61</td>
<td>100.0</td>
<td>155</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note. Chi Square = 20.8 (Phi = .37; p < .001)

Correlational Data on Cognitive Instruments. Strong positive correlations were observed on the Pretest scales, although the relationship between higher-order and lower-order subscales is more tenuous (r = .20; See Table 14). As shown in Tables 15 and 16, the intercorrelations between the three scales of Posttest I and II ranged from moderate to very high (all correlations were statistically significant), further evidence of the reliability of the test instruments and the corresponding subscales. In addition, the correlations between the scales of Posttest I and II are
also moderate positive and statistically significant, supporting the consecutive use of these instruments as outcomes measures in this study (See Table 17).

Table 14

Correlation of Overall, Higher-Order and Lower-order Scales of Pretest

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Higher Order</th>
<th>Lower Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1.00</td>
<td>0.77*</td>
<td>0.78*</td>
</tr>
<tr>
<td>Higher Order</td>
<td>1.00</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>Lower Order</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. *(indicates correlations significant at p < .001)

Table 15

Correlation of Overall, Higher-Order and Lower-order Scales of Posttest I

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Higher Order</th>
<th>Lower Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1.00</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>Higher Order</td>
<td>1.00</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>Lower Order</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. All correlations significant at p < .001.
Table 16
Correlation of Overall, Higher-Order and Lower-order Scales of Posttest II

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Higher Order</th>
<th>Lower Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>1.00</td>
<td>0.80</td>
<td>0.87</td>
</tr>
<tr>
<td>Higher Order</td>
<td></td>
<td>1.00</td>
<td>0.40</td>
</tr>
<tr>
<td>Lower Order</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note. All correlations significant at p < .001.

Table 17
Correlation of Overall, Higher-Order and Lower-order Scales of Posttest I and II

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall</th>
<th>Higher Order</th>
<th>Lower Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest I Scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>0.52</td>
<td>0.44</td>
<td>0.42</td>
</tr>
<tr>
<td>Higher Order</td>
<td>0.47</td>
<td>0.43</td>
<td>0.36</td>
</tr>
<tr>
<td>Lower Order</td>
<td>0.46</td>
<td>0.37</td>
<td>0.40</td>
</tr>
</tbody>
</table>

Note. All correlations significant at p < .01.
Variable Dichotomization and Missing Values. In addition to gross summary data, frequency histogram data established that the underlying distributions of all cognitive and affective measures were approximately normal. Since the index means were proximate to both median values and the scale midpoint, an additional series of variables was created by dichotomizing outcomes into lower and higher categories. Category membership was determined by arbitrarily dividing the scales at the mean of the sample distribution. Multiple comparisons and analyses of variance were then possible between low scorers (all values including and below the mean) and high scorers (all values above the mean) on each measure and between both continuous and dichotomized versions of each cognitive and affective variable.

Similarly, missing data on individual items or groups of items from individual subjects did not eliminate that subject from a particular analysis. Mean values were substituted uniformly in each case where data were missing, a conservative and conventional procedure that tends to lower correlations between variables but augments the robustness of many statistically significant results provided the number of mean substitutions is small (Tabachnick & Fidell, 1983). Continuous data were applied where most appropriate (e.g., multiple regression
analyses), and dichotomized data applied to categorical analyses (e.g., ANOVA and Chi Square) where interaction effects could be directly observed.

The correlational data presented in Table 18 supports the strong positive interrelationship between the continuous and dichotomized versions of each affective index. The correlations for the ATE, EAS, DEEP and CAIN indexes are all statistically significant at the $p < .001$ level, and this result tends to support the application of the dichotomized indexes where appropriate in categorical analyses.

Table 18

<table>
<thead>
<tr>
<th>Variable</th>
<th>ATE</th>
<th>EAS</th>
<th>DEEP</th>
<th>CAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATE</td>
<td>.71</td>
<td>.20</td>
<td>.30</td>
<td>.20</td>
</tr>
<tr>
<td>EAS</td>
<td>.14</td>
<td>.73</td>
<td>.16</td>
<td>.28</td>
</tr>
<tr>
<td>DEEP</td>
<td>.23</td>
<td>.17</td>
<td>.71</td>
<td>.08</td>
</tr>
<tr>
<td>CAIN</td>
<td>.10</td>
<td>.29</td>
<td>.20</td>
<td>.78</td>
</tr>
</tbody>
</table>
Support of Statistical Assumptions. First, as noted in the preceding section, histogram data on the sampling distributions for each affective and cognitive variable indicated that the assumption of normality was not significantly violated. Although there was evidence of some moderate skewness in most variables, the distributions were generally normal. Second, a systematic examination of bivariate and residuals scatterplots was performed to verify the assumptions of linearity and homoscedasticity of variances required for various multivariate statistical analyses. In all cases of major dependent variables plotted against independent variables, strong linear relationships and homogeneity of variances were indicated. Residuals histogram data showed the distribution of residuals to be normal and confirmed the initial evidence of normality, linearity and homoscedasticity for all principal variables. Some violation of these assumptions was observed for the higher question subscale of the pretest, and so extensive multivariate analyses with this variable was avoided.

Results and Conclusions of Major Hypotheses

The principal results and conclusions of major hypotheses are presented in the following section. Each hypothesis is presented in sequence with reference to the
appropriate statistical results. A brief conclusion is also presented describing the meaning of the statistical outcome in relation to the acceptance or failure to reject the specific hypothesis being scrutinized. Summary sections are provided at the end of each hypothesis result presentation. More complex interactions or analyses involving the variables investigated in this section are reported in the section on other collateral findings.

**Hypothesis One**

Hypothesis One of the study stated that student concept acquisition in microeconomics as measured by overall performance on Posttest I (immediate) and Posttest II (delayed) cognitive posttests would be superior for the subjects receiving instruction via the problem-oriented treatment strategy. The null form of the hypothesis, that there would be no significant difference in either the Posttest I and Posttest II performance of subjects receiving either problem-oriented and rule-oriented treatments was tested using univariate analysis of variance. The non-significant results of this procedure are presented in Appendix L, Tables 45 and 46.
Although subjects in the problem-oriented treatment group tended to outscore their counterparts in the rule-oriented group, this difference was not statistically significant for either Posttest I or II. Therefore, the null hypothesis was not rejected. The first substantive research hypothesis could not be supported in this case since no significant superiority for the problem-oriented treatment was observed.

**Hypothesis Two**

Alternative Hypothesis Two stated that student concept acquisition in microeconomics as measured by higher-order and lower order question subscale performance on the Posttest I and Posttest II cognitive posttests would be superior for the subjects receiving instruction via the problem-oriented treatment strategy. The null form of the hypothesis was tested using univariate analysis of variance. The non-significant results of this procedure are presented in Appendix L, Tables 47, 48 and 49.

Subjects in the problem-oriented treatment group outscored subjects in the rule-oriented group on the lower-order subscale of both tests and on the higher-order subscale of Posttest I. The difference between groups was statistically significant in only one case,
that of the lower-order subscale of Posttest I \[F (1, 148) = 4.07, p = .045\]. The lower-order subscale difference for Posttest II was non-significant and higher-order subscale differences were not statistically significant for either Posttest I or II. Therefore, three components of the null hypothesis were not rejected. The second substantive research hypothesis was supported in this case only for the lower-order questions of Posttest I (See Table 19), and no additional evidence was observed to indicate significant superiority for the problem-oriented treatment group.

Table 19

Summary Data and Analysis of Variance: Lower-Order Posttest I Scores by Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>RULE</th>
<th>PROBLEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>77.00</td>
<td>73.00</td>
</tr>
<tr>
<td>Mean</td>
<td>7.36</td>
<td>8.34</td>
</tr>
<tr>
<td>SD</td>
<td>3.08</td>
<td>2.84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>35.90</td>
<td>35.90</td>
<td>4.07*</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1304.26</td>
<td>8.81</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1340.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p = .045)
Hypotheses One and Two: Summary. Although subjects in the problem-oriented treatment group outscored the rule-oriented group, this difference was not statistically significant for the overall performance (total score) on either Posttest I or II and therefore alternative Hypothesis One was not accepted. In relation to Hypothesis Two, subjects in the problem-oriented treatment group outscored subjects in the rule-oriented group on the lower-order subscale of both tests and on the higher-order subscale of Posttest I. This difference, however, was statistically significant only in the case of the lower-order subscale of Posttest I. No additional evidence was observed to indicate significant superiority for the problem-oriented treatment group and alternative thus Hypothesis Two was accepted for the Posttest I lower-order subscale but not for the three other cognitive subscales tested.

Hypothesis Three

Alternative Hypothesis Three stated that student concept acquisition in microeconomics as measured by overall cognitive performance on Posttest I and Posttest II would be superior for male subjects. The null form of the hypothesis was tested using univariate analysis of variance. Although male subjects tended to outscore
female students, this difference was not statistically significant for either Posttest I or II and therefore the third alternative hypothesis was not accepted. The non-significant results of this procedure are presented in Appendix L, Tables 50 and 51.

Hypothesis Four

Alternative Hypothesis Four stated that student concept acquisition in microeconomics as measured by higher-order and lower-order question subscale performance on Posttest I and Posttest II would be superior for male subjects. The null form of the hypothesis was tested using univariate analysis of variance. Again, although male subjects outscored female students, this difference was not statistically significant for the higher and lower-order subscales of either Posttest I or II and therefore Hypothesis Four was not accepted. The non-significant results of this procedure are presented in Appendix L, Tables 52, 53, 54 and 55.

Hypothesis Three and Four: Summary. Male subjects outscored female subjects on all cognitive measures, including (a) the overall performance on Posttests I and II, and (b) both the higher-order and lower-order
question subscales on Posttests I and II. None of these differences was significant, however. No additional evidence was observed to indicate superior achievement for male subjects and therefore Hypothesis Three and Four were not accepted.

Hypothesis Five

Alternative Hypothesis Five stated that student concept acquisition in microeconomics as measured by overall cognitive performance on Posttest I and Posttest II would be superior for the subjects reporting a more positive attitude towards economics and greater economic attitude sophistication. As described in Chapter III, subject attitudes were measured using the nationally-normed Survey on Economic Attitudes (Soper & Walstad, 1987) comprised of the Attitude Toward Economics (ATE) index and the Economic Attitude Sophistication index, respectively. Univariate analysis of variance was used initially to test the null form of the hypothesis for both variable separately and the non-significant results are presented in Appendix L, Tables 56, 57, 58 and 59. None of the ATE or EAS differences was statistically significant for either Posttest I or II and therefore the fifth alternative hypothesis was not accepted.
**Interactions of ATE and EAS.** A secondary analysis was conducted to observe interaction effects between the ATE and EAS measures since an important interrelationship was anticipated to exist between student attitude toward economics and the degree of student sophistication towards economic issues (Soper & Walstad, 1988, 1987). Performance on the ATE and EAS measures was dichotomized into higher and lower groups using the procedures noted earlier in this chapter. Factorial analyses of variance were used to investigate the possible interactions on the overall scores of Posttest I and II. The results of these analyses are presented in Tables 20 and 21.

**Table 20**  
Summary Data and Factorial Analysis of Variance: ATE and EAS on Overall Posttest I Scores

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>Low</th>
<th>High</th>
<th>ATE Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE Score</td>
<td>14.88</td>
<td>13.61</td>
<td>14.25</td>
</tr>
<tr>
<td>Low</td>
<td>12.95</td>
<td>15.95</td>
<td>14.45</td>
</tr>
<tr>
<td>High</td>
<td>13.92</td>
<td>14.78</td>
<td>14.35 (Grand)</td>
</tr>
</tbody>
</table>
As can be observed in Table 20, a significant disordinal interaction occurred between ATE and EAS on the overall Posttest I score \( [F (1, 146) = 5.85; p = .017^*] \). The table of means shows that some relationship exists between High ATE and High EAS, and this is seen graphically in Figure 2. Subjects in the High ATE/High EAS group outscored all other subjects and this superior performance was most dramatic between High ATE/High EAS and (a) High ATE/Low EAS (3.00 points), and (b) Low ATE/High EAS (2.34 points). A three point difference here on Posttest I is also very significant from a practical perspective. Interestingly, the group with the poorest overall Posttest I performance had a more positive attitude toward economics yet Low EAS. This latter observation would corroborate that economic
attitude sophistication is influenced by the degree a respondent has knowledge of economics and of how market economies operate and function. The Posttest II results, however, conflict with this assumption to some degree since the poorest performance was seen in the Low ATE/High EAS group (Table 21).

Table 21

Summary Data and Factorial Analysis of Variance:
ATE and EAS on Overall Posttest II Scores

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE Score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>11.27</td>
<td>10.25</td>
</tr>
<tr>
<td>High</td>
<td>11.14</td>
<td>12.25</td>
</tr>
<tr>
<td>EAS Means</td>
<td>11.21</td>
<td>11.25</td>
</tr>
</tbody>
</table>

ANOVA: Overall Posttest II Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>22.57</td>
<td>1.19</td>
<td>.276</td>
</tr>
<tr>
<td>EAS</td>
<td>1</td>
<td>0.66</td>
<td>0.04</td>
<td>.852</td>
</tr>
<tr>
<td>ATE x EAS</td>
<td>1</td>
<td>40.81</td>
<td>2.16</td>
<td>.144</td>
</tr>
<tr>
<td>Residual</td>
<td>143</td>
<td>18.90</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hypothesis Five: Summary. These results tend to support the fifth alternative hypothesis insofar as subjects reporting greater economic attitude sophistication combined with a more positive attitude toward economics as a subject were significantly superior in terms of overall performance on Posttest I. No statistically significant interaction could be observed in Posttest II, however, although (a) the interaction of ATE and EAS approached significance \( F(1,143) = 2.16; p = \)
and (b) the table of means indicated performance in a similar pattern with High ATE/High EAS outscoring all groups. The overall Posttest II group mean difference was greatest between the High ATE/High EAS subjects and the Low ATE/High EAS subjects (2.00 points). Thus, while Hypothesis Five cannot be accepted regarding ATE and EAS main effects, the finding of significantly superior performance particularly for High ATE/High EAS subjects on the overall Posttest I score sustains the hypothesis in that specific case.

**Hypothesis Six**

Alternative Hypothesis Six stated that student concept acquisition in microeconomics as measured by performance on the higher-order and lower-order question subscales of Posttest I and Posttest II would be superior for the subjects reporting a more positive attitude towards economics and greater economic attitude sophistication. Univariate analysis of variance was used initially to test the null form of the hypothesis for each affective variable separately. No significant main effects were observed in the ANOVA results for Hypothesis Six and these extraneous data were not included in this report.
Interestingly, however, three statistically significant interactions were observed related to Hypothesis Six and these results are presented in Tables 22, 23, and 24.

Table 22
Summary Data and Factorial Analysis of Variance: ATE and EAS on Higher-Order Posttest I Scores

<table>
<thead>
<tr>
<th>Table of Means</th>
<th>EAS Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>ATE Score</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>6.56</td>
</tr>
<tr>
<td>High</td>
<td>5.79</td>
</tr>
<tr>
<td>EAS Means</td>
<td>6.18</td>
</tr>
</tbody>
</table>

(Grand)

<table>
<thead>
<tr>
<th>ANOVA: Higher-Order Posttest I Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
</tr>
<tr>
<td>ATE</td>
</tr>
<tr>
<td>EAS</td>
</tr>
<tr>
<td>ATE x EAS</td>
</tr>
<tr>
<td>Residual</td>
</tr>
</tbody>
</table>

* (p < .05)
A significant disordinal interaction between ATE and EAS was observed \( F (1,146) = 5.34; p = .022 \). The ANOVA results displayed in Table 22 show that subjects in the High ATE/High EAS group outscored all subjects on the higher-order subscale of Posttest I. The greatest difference in mean performance was observed between the High ATE/High EAS group and the High ATE/Low EAS (1.80 points), somewhat smaller yet similar to the results of interaction analyses for Hypothesis Five. The disordinal interaction reported in Table 22 is shown graphically in Figure 3.

![Figure 3. The Interaction of ATE and EAS on Higher-Order Posttest I Score](image)
Table 23

Summary Data and Factorial Analysis of Variance: ATE and EAS on Lower-Order Posttest I Scores

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>Low</th>
<th>High</th>
<th>ATE Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE Score</td>
<td>8.32</td>
<td>7.50</td>
<td>7.91</td>
</tr>
<tr>
<td>Low</td>
<td>7.16</td>
<td>8.34</td>
<td>7.75</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EAS Means</td>
<td>7.74</td>
<td>7.92</td>
<td>7.83</td>
</tr>
</tbody>
</table>

ANOVA: Lower-Order Posttest I Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>3.06</td>
<td>0.34</td>
<td>0.559</td>
</tr>
<tr>
<td>EAS</td>
<td>1</td>
<td>2.82</td>
<td>0.32</td>
<td>0.574</td>
</tr>
<tr>
<td>ATE x EAS</td>
<td>1</td>
<td>36.34</td>
<td>4.09</td>
<td>0.045*</td>
</tr>
<tr>
<td>Residual</td>
<td>146</td>
<td>8.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p < .05)

Again, a significant disordinal interaction between ATE and EAS was observed in relation to mean performance on the lower-order subscale of Posttest I [F (1,146) = 4.09; p = .045]. The ANOVA results displayed in Table 23 show that subjects in the High ATE/High EAS group outscored all subjects, the greatest difference in
mean performance being observed between the High ATE/High EAS group and the High ATE/Low EAS (1.20 points). While smaller, these differences were similar to the results for the Posttest I higher-order subscale and for the overall score of Posttest I noted before in the presentation of the results for Hypothesis Five. The same mean difference (1.20 points) also occurred between the High ATE/Low EAS group and the Low ATE/Low EAS group. Interestingly, subjects reporting both lesser economic attitude sophistication and a less positive attitude toward economics in general again outscored their Low ATE/High EAS counterparts. The disordinal interaction reported in Table 23 is shown in Figure 4.

![Figure 4. The Interaction of ATE and EAS on Lower-Order Posttest I Score](image-url)
The results of the factorial ANOVA for ATE and EAS on the higher-order subscale of Posttest II were not significant. However, Table 24 shows that a significant disordinal interaction between ATE and EAS was observed on the lower-order subscale of Posttest II \[F (1,143) = 5.13; p = .025\].

Table 24
Summary Data and Factorial Analysis of Variance:
ATE and EAS on Lower-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Table of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EAS Score</strong></td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>ATE Score</td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

EAS Means | 6.00 | 6.24 | 6.12 (Grand)

ANOVA: Lower-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>9.03</td>
<td>1.17</td>
<td>0.280</td>
</tr>
<tr>
<td>EAS</td>
<td>1</td>
<td>4.02</td>
<td>0.52</td>
<td>0.471</td>
</tr>
<tr>
<td>ATE x EAS</td>
<td>1</td>
<td>39.46</td>
<td>5.13</td>
<td>0.025*</td>
</tr>
<tr>
<td>Residual</td>
<td>143</td>
<td>7.69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p < .05)
The ANOVA results in Table 24 further indicate that subjects in the High ATE/High EAS group outscored all subjects on the lower-order subscale of Posttest II, with the greatest difference in mean performance observed between the High ATE/High EAS group and the Low ATE/High EAS (1.70 points). The disordinal interaction reported in Table 24 is shown in Figure 5.

![Figure 5. The Interaction of ATE and EAS on Lower-Order Posttest II Score](image-url)
Hypotheses Five and Six: Summary. None of the ATE or EAS main effect differences were statistically significant for any cognitive measure including (a) the overall performance on Posttest I and II, and (b) both the higher-order and lower-order question subscales on Posttest I and II. Therefore, the fifth alternative hypotheses pertaining to main effect differences related to ATE or EAS was not accepted.

A significant disordinal interaction between ATE and EAS occurred on the overall Posttest I score \( [F (1, 146) = 5.85; \ p = .017) \). Subjects in the High ATE/High EAS group outscored all other subjects, and this difference was most dramatic between High ATE/High EAS and: (a) the High ATE/Low EAS group (3.00 points), and (b) the Low ATE/High EAS group (2.34 points). Given the performance frequency distributions and instrument item analysis data, both differences are considered very significant from a practical perspective.

Three statistically significant interactions were observed related to Hypothesis Six. First, a disordinal interaction between ATE and EAS on the higher-order subscale of Posttest I occurred in which subjects in the High ATE/High EAS group outscored all other groups \( [F (1,146) = 5.34; \ p = .022] \). A second similar disordinal interaction between ATE and EAS was shown in relation to
mean performance on the lower-order subscale of Posttest I \(F (1,146) = 4.09; p = .045\). Again, subjects in the High ATE/High EAS group outscored all other groups. A third similar disordinal interaction between ATE and EAS was observed in relation to mean performance on the lower-order subscale of Posttest II \(F (1,143) = 5.13; p = .025\). The interaction results in each of these cases were consistent: subjects in the High ATE/High EAS group outscored all subjects, with the greatest difference in mean performance observed between the High ATE/High EAS group and the Low ATE/High EAS group.

**Hypotheses Seven**

Alternative Hypotheses Seven stated that student concept acquisition in microeconomics as measured by overall cognitive performance on Posttest I and Posttest II would be superior for the subjects reporting lower computer anxiety and conversely a more positive attitude towards computer technology. As described in Chapter III, subject attitudes were measured using the highly reliable \(r = .95\), construct validated and nationally-normed Computer Anxiety Index or CAIN (Simonson et al., 1987).

Univariate analysis of variance was initially used to test the null form of the hypothesis using the
dichotomized CAIN scores and the non-significant results are presented in Appendix L, Tables 60 and 61.

While no statistically significant differences could be demonstrated for the main effects of the computer anxiety variable, the trend for superior performance by subjects in the lower anxiety group was observed in the overall performance means of both Posttest I and II. In the case of Posttest I, the difference was 1.32 points; for Posttest II the difference was 1.18 points. However, the seventh alternative hypothesis could not be accepted.

Hypothesis Eight

Alternative Hypothesis Eight stated that student concept acquisition in microeconomics as measured by cognitive performance on the higher-order and lower-order question subscales of Posttest I and Posttest II would be superior for the subjects reporting lower computer anxiety and conversely a more positive attitude towards computer technology. Subject attitudes were also measured using the Computer Anxiety Index (CAIN).

Univariate analysis of variance was used to test the null form of the hypothesis that stated there would be no significant difference in either the higher-order or lower-order subscale performance means for Posttest I or
Posttest II between subjects reporting a more positive attitude toward computers (lower computer anxiety) and subjects reporting a less positive attitude toward computers (higher computer anxiety). This hypothesis was tested using the dichotomized CAIN scores. Only two of the four analyses were statistically significant, and the results of these two ANOVAs are presented in Tables 25 and 26.

### Table 25

**Summary Data and Analysis of Variance: Higher-Order Posttest I Scores by Computer Anxiety**

<table>
<thead>
<tr>
<th>Computer Anxiety</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>60.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Mean</td>
<td>7.18</td>
<td>6.08</td>
</tr>
<tr>
<td>SD</td>
<td>3.06</td>
<td>2.92</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>1</td>
<td>44.00</td>
<td>44.00</td>
<td>4.97*</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1311.44</td>
<td>8.86</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1355.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p = .027)
Table 26

Summary Data and Analysis of Variance: Lower-Order Posttest II Scores by Computer Anxiety

<table>
<thead>
<tr>
<th>Computer Anxiety</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>57.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Mean</td>
<td>6.68</td>
<td>5.80</td>
</tr>
<tr>
<td>SD</td>
<td>2.76</td>
<td>2.80</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>1</td>
<td>27.28</td>
<td>27.28</td>
<td>3.52*</td>
</tr>
<tr>
<td>Error</td>
<td>145</td>
<td>1124.72</td>
<td>7.76</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>1152.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p = .063)

As shown in Table 25, the superior performance by subjects in the lower anxiety group (1.10 points) was significant on the higher-order subscale of Posttest I [F (1, 148) = 4.97; p = .027]. As shown in Table 26, the superior performance of lower anxiety subjects (0.88 points) was significant on the lower-order subscale performance means [F (1, 146) = 3.52; p = .063]. Hypothesis Eight was thus accepted for these two particular cases.

Hypotheses Seven and Eight: Summary. No statistically significant differences were observed for
the computer anxiety variable on the overall Posttest I and II score, and the seventh alternative hypothesis was not accepted. However, evidence was presented indicating a consistent trend for superior performance by subjects in the lower anxiety group on the overall performance means of both Posttest I and II. In the case of Posttest I, the difference was 1.32 points; for Posttest II the difference was 1.18 points.

Regarding Hypothesis Eight, a similar trend for superior performance by subjects in the lower computer anxiety group was statistically significant in two cases: 1) on the higher-order subscale of Posttest I \([F (1, 148) = 4.97; p = .027]\), and 2) on the lower-order subscale of Posttest II \([F (1, 146) = 3.52; p = .063]\). Thus Hypothesis Eight could only be accepted for these two particular cases.

**Hypotheses Nine**

Alternative Hypothesis Nine stated that student concept acquisition in microeconomics as measured by overall cognitive performance on Posttest I and Posttest II would be superior for the subjects reporting a "deep approach" towards learning tasks in general. The nature of this deep approach was described in detail earlier in Chapters I and II of this report. Subject attitudes were
measured using the locally-constructed Deep Approach Toward Learning (DEEP) index ($r = .82$) based upon the landmark work of Biggs and Rihn (1984).

Univariate analysis of variance was initially used to test the null form of the hypothesis using the dichotomized DEEP scores. No statistically significant differences on the overall score of Posttests I and II could be demonstrated for the main effects of the deep approach towards learning variable, and the ninth alternative hypothesis was not accepted. The non-significant results for Posttest I and II are presented in Appendix L, Tables 62 and 63, respectively.

**Hypothesis Ten**

Alternative Hypothesis Ten stated that student concept acquisition in microeconomics as measured by cognitive performance on the higher-order and lower-order question subscales of Posttest I and Posttest II would be superior for the subjects reporting a deep approach toward learning as measured using the Deep Approach Toward Learning index (DEEP).

Univariate analysis of variance was used to test the null form of the hypothesis using the dichotomized DEEP scores. Only one of the four analyses were statistically
significant and the results of this ANOVA is presented in Table 27 following.

Table 27

Summary Data and Analysis of Variance: Lower-Order Posttest I Scores by Deep Approach Toward Learning

<table>
<thead>
<tr>
<th>DEEP Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>87.00</td>
<td>63.00</td>
</tr>
<tr>
<td>Mean</td>
<td>8.24</td>
<td>7.29</td>
</tr>
<tr>
<td>SD</td>
<td>2.89</td>
<td>3.09</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEEP</td>
<td>1</td>
<td>33.37</td>
<td>33.37</td>
<td>3.78*</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1306.79</td>
<td>8.83</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1340.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*(p = .054)

The preceding ANOVA results indicate a trend of superior achievement for subjects in the Low DEEP group over the subjects in the High DEEP group by 0.95 points \( [F (1, 148) = 3.78; p = .054] \). This curious result clearly contradicted the anticipated advantage of a deep approach toward learning, and the tenth alternative hypothesis was not accepted. A parallel albeit non-significant trend of superior performance by the Low DEEP subjects was also seen for the overall scores of Posttest I and II (See Appendix L, Tables 62 and 63).
Hypotheses Nine and Ten: Summary. No statistically significant differences could be demonstrated for the main effects of the deep approach toward learning variable and Hypothesis Nine was not accepted. Interestingly, a surprising (non-significant) trend of superior performance by subjects in the Low DEEP group was observed in the overall performance means of both Posttest I and II (1.25 and 0.34 points, respectively). In relation to Hypothesis Ten, a significant main effect \( F (1, 148) = 3.78; p = .054 \) was reported in the case of the lower-order subscale of Posttest I. Similar to the trend observed in the analysis of Hypothesis Nine, subjects in the Low DEEP group scored higher than their counterparts in the High DEEP group (0.95 points). Outside of this single statistically significant result, however, none of the other elements of Hypothesis Ten were accepted.

Results and Conclusions of Other Collateral Findings

The principal results and conclusions of the study were presented in the preceding section. Given the open-ended nature of the exploratory research involved in this study, a diversity of collateral hypotheses were also investigated. In this section, more complex interactions and selected multivariate analyses involving the
cognitive and affective variables investigated earlier in this chapter are reported. In addition, a series of theory-based linear models was scrutinized for the potential predictive capability of certain independent variables to explain variance in cognitive achievement. Presentation of the appropriate results and conclusions for these secondary findings are reported in this section.

Unhypothesized Two-Way Interactions

After a systematic and extensive investigation of possible interrelationships between the variables of treatment, gender, and affect, four significant bivariate interactions were observed: (a) the ordinal interaction of treatment and EAS on the lower-order question subscale of Posttest I, (b) the disordinal interaction of treatment and EAS on the lower-order question subscale of Posttest II, (c) the disordinal interaction of treatment and computer anxiety on the lower-order question subscale of Posttest II, and (d) the disordinal interaction of ATE and DEEP on the higher-order question subscale of Posttest II. In addition, two interesting yet non-significant bivariate interactions are also included here. Each of the findings is presented in order.
Table 28

Summary Data and Factorial Analysis of Variance:
Treatment and EAS on Lower-Order Posttest I Scores

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>Rule-Oriented</th>
<th>Problem-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>6.98</td>
<td>8.68</td>
</tr>
<tr>
<td>High</td>
<td>7.97</td>
<td>8.00</td>
</tr>
</tbody>
</table>

Treatment Means
7.48              8.34              7.91
(Grand)

ANOVA: Lower-Order Posttest I Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>34.34</td>
<td>3.92</td>
<td>.050*</td>
</tr>
<tr>
<td>EAS</td>
<td>1</td>
<td>0.91</td>
<td>0.10</td>
<td>.748</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>25.30</td>
<td>2.89</td>
<td>.091</td>
</tr>
<tr>
<td>Residual</td>
<td>146</td>
<td>8.75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p = .05)

Interaction of Treatment and Economic Attitude Sophistication. As can be seen in Table 28, an ordinal interaction existed between level of treatment and EAS score for the lower-order subscale means of Posttest I \[F (1, 146) = 2.89; p = .091\]. An ordinal relationship was maintained with problem-oriented performance superior to
the rule-oriented treatment group performance for both Low EAS and High EAS conditions. Subjects from both treatments were closest in performance when both groups were in the Low EAS category (0.10 points). However, the importance of the treatment variable in this particular situation is demonstrated by the main effect result \[ F (1, 146) = 3.92; p = .050 \]. The largest difference was observed between problem-oriented and rule-oriented subjects on the High EAS level (1.70 points), indicating a possible benefit of greater economic attitude sophistication to one treatment condition while a possible detriment to the other. This relationship is shown graphically in Figure 6.

![Figure 6. The Interaction of Treatment and EAS on Lower-Order Posttest I Score](image-url)
Table 29

Summary Data and Factorial Analysis of Variance: Treatment and EAS on Lower-Order Posttest II Scores

Table of Means

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>Treatment</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rule-Oriented</td>
<td>Problem-Oriented</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>5.21</td>
<td>7.00</td>
<td>6.11</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>6.79</td>
<td>6.00</td>
<td>6.45</td>
<td></td>
</tr>
</tbody>
</table>

| Treatment Means | 6.00 | 6.50 | 6.27   |
| (Grand)         |      |      | **      |

ANOVA: Lower-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>16.02</td>
<td>2.14</td>
<td>.146</td>
</tr>
<tr>
<td>EAS</td>
<td>1</td>
<td>2.59</td>
<td>0.35</td>
<td>.558</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>58.82</td>
<td>7.84</td>
<td>.006**</td>
</tr>
<tr>
<td>Residual</td>
<td>143</td>
<td>7.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**(p < .01)

Any conclusion in the interaction of treatment and EAS was controverted in the only other significant interaction involving these two factors, the case of the lower-order question subscale of the Posttest II. As seen in Table 29, the results for the lower-order subscale of Posttest II are the reverse of the previous
finding for Posttest I. Moreover, while the treatment variable was not itself significant (treatment was significant in the Posttest I case), the disordinal interaction between treatment and EAS was much more pronounced \[F (1,143) = 7.84; p = .006\]. This relationship is shown graphically in Figure 7. The greatest difference between means was between problem-oriented and rule-oriented groups in the Low EAS category (1.80 points). The outcomes are closest between problem-oriented Low EAS subjects and rule-oriented High EAS subjects (0.20 points). The situation in Posttest II is clearly the converse of the Posttest I result and the implications and possible explanations for this interesting finding are discussed in Chapter V.

![Figure 7. The Interaction of Treatment and EAS on Lower-Order Posttest II Score](image-url)
Table 30

Summary Data and Factorial Analysis of Variance:
Treatment and CAIN on Lower-Order Posttest II Scores

Table of Means

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rule-Oriented</th>
<th>Problem-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Anxiety</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Low</td>
<td>7.08</td>
<td>5.16</td>
</tr>
<tr>
<td>High</td>
<td>6.38</td>
<td>6.60</td>
</tr>
<tr>
<td></td>
<td>6.73</td>
<td>5.88</td>
</tr>
</tbody>
</table>

Computer Anxiety Means

| Treatment Means            | 6.12          | 6.49             |
| (Grand)                    | 6.31          |

ANOVA: Lower-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>13.48</td>
<td>1.80</td>
<td>.182</td>
</tr>
<tr>
<td>CAIN</td>
<td>1</td>
<td>22.76</td>
<td>3.04</td>
<td>.084</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>39.58</td>
<td>5.28</td>
<td>.023*</td>
</tr>
<tr>
<td>Residual</td>
<td>143</td>
<td>7.69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* (p < .05)

Interaction of Treatment and Computer Anxiety Level.
As can be seen in Table 30, a disordinal interaction was found between level of treatment and CAIN score for the lower-order question subscale of Posttest II \([F (1, 143) = 5.28; p = .023]\). While subscale performance remained
relatively consistent across problem-oriented subjects in either High and Low Anxiety categories, rule-oriented treatment group performance changed noticeably across the low to high dichotomy. Although Low Anxiety subjects in the rule-oriented treatment outscored all groups, the High Anxiety group scored 1.90 points less, in fact showing the largest difference between any two groups. Problem-oriented subjects in the high anxiety group achieved superior performance over the high anxiety rule-oriented subjects by 1.40 points. Also, the importance of the computer anxiety variable is demonstrated by the main effect result \[ F (1, 143) = 3.04; p = .084 \]. This relationship is shown graphically in Figure 8.

Figure 8. The Interaction of Treatment and Computer Anxiety on Lower-Order Posttest II Score
Attitude Toward Economics and Deep Approach Toward Learning. A significant two-way interaction was observed between ATE and DEEP for the higher-order subscale means of Posttest II [F (1, 143) = 3.10; p = .080]. As shown in Table 31, a disordinal interaction was found between attitude toward economics and deep approach toward learning. While High DEEP subjects outscored all groups, the High DEEP/High ATE subjects scored lower than Low ATE/High DEEP (0.70 points) and High ATE/Low Deep (0.50 points). Although these mean differences may not appear substantial, the fact that the largest difference between
these groups (1.00 points) occurred between the High DEEP and Low DEEP subjects in the Low ATE category is of some interest. The interaction of ATE and DEEP for the higher-order subscale of Posttest II is displayed in Figure 9.

Table 31
Summary Data and Factorial Analysis of Variance:
DEEP and ATE on Higher-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Table of Means</th>
<th>DEEP Score</th>
<th>Low</th>
<th>High</th>
<th>ATE Means</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE Score</td>
<td>Low</td>
<td>4.71</td>
<td>5.53</td>
<td>5.12</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>5.65</td>
<td>5.02</td>
<td>5.36</td>
</tr>
<tr>
<td>DEEP Means</td>
<td>5.18</td>
<td>5.28</td>
<td>5.24 (Grand)</td>
<td></td>
</tr>
</tbody>
</table>

ANOVA: Higher-Order Posttest II Scores

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ms</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>2.31</td>
<td>0.42</td>
<td>.520</td>
</tr>
<tr>
<td>DEEP</td>
<td>1</td>
<td>0.34</td>
<td>0.06</td>
<td>.804</td>
</tr>
<tr>
<td>Interaction</td>
<td>1</td>
<td>17.15</td>
<td>3.10</td>
<td>.080</td>
</tr>
<tr>
<td>Residual</td>
<td>143</td>
<td>7.69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Interaction of Treatment and Gender. Interestingly, male subjects in the problem-oriented group outscored the other gender x treatment groups on the overall score of Posttest I by at least 2.00 points (Table 32), although this disordinal interaction was not statistically significant.

Table 32
Summary Data of Gender and Treatment on Overall Posttest I Scores

<table>
<thead>
<tr>
<th>Table of Means</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatment</strong></td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Treatment Means</td>
</tr>
</tbody>
</table>

Note. [F (1,146) = 1.73; p = .186; n = 150]

Interaction of Computer Anxiety and Gender. A noteworthy but statistically insignificant difference was observed in relation to the ordinal interaction of gender and computer anxiety variables. Male/Low Anxiety
subjects outscored the other gender x computer anxiety groups by a minimum of 2.00 points, and Female/High Anxiety subjects by 2.93 points. This result is shown in Table 33.

Table 33
Summary Data of Gender and Computer Anxiety on Overall Posttest I Scores

<table>
<thead>
<tr>
<th>Computer Anxiety</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14.12</td>
<td>16.40</td>
</tr>
<tr>
<td>Female</td>
<td>13.47</td>
<td>14.26</td>
</tr>
<tr>
<td><strong>Anxiety Means</strong></td>
<td>13.80</td>
<td>15.33</td>
</tr>
<tr>
<td><strong>(Grand)</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (n = 150)

Relevant Three-Way Interactions

The relevant three-way interactions observed in the various analyses of variance are reported in this section. Each subsection reports the results and conclusions of three combined factors and includes
significant findings related to Posttests I and II and the appropriate overall, higher-order or lower-order question subscale.

**Interaction of Treatment, ATE and EAS.** A significant three-way interaction was observed between treatment, ATE and EAS on the higher-order subscale of Posttest II \( F (1, 139) = 3.65; p = .058 \). Highest scorers were in the problem-oriented treatment group in the High ATE/Low EAS category, while lowest scorers were in the problem-oriented, Low ATE/Low EAS category (Means = 6.00 and 4.37, respectively). This particular mean difference (1.63 points) suggests that High ATE is more important than EAS as a factor in cognitive performance. However, the smallest observed mean difference was between problem-oriented subjects with Low ATE/High EAS and problem-oriented subjects with High ATE/High EAS (Means = 5.07 and 5.10, respectively). Therefore, although High ATE is influential, especially in combination with Low EAS, where EAS is high for both groups, ATE was not as salient on the higher-order questions of Posttest II. No other three-way interactions of treatment x ATE x EAS were significant.
Interaction of Gender, ATE and EAS. Initial t-Test results indicated that males reported a statistically greater ATE than females \([t (1,141) = 1.94; p = .054; \text{ See Table 34}]\). No other significant gender-related differences in the mean performance on the EAS, CAIN or DEEP indexes were observed.

Table 34

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>ATE Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>71.00</td>
<td>7.80</td>
<td>1.79</td>
</tr>
<tr>
<td>Female</td>
<td>72.00</td>
<td>7.18</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Note. \( (t\text{-Test value} = t (1,141) = 1.94; p = .054) \).

In relevant three-way interactions of gender, ATE and EAS, highest scorers on the overall Posttest I mean performance dependent variable were male subjects in the High ATE/High EAS category \( (\text{Mean} = 16.95) \) while lowest scorers were female subjects in the High ATE/Low EAS group \( (\text{Mean} = 12.95) \). Although this 4-point difference was very significant from a practical view, the gender x ATE x EAS interaction was not statistically significant on the overall Posttest I, but this 3-way interaction did
attain significance on the lower-order subscale of Posttest I. The ATE x EAS interaction was itself significant, however \[ F (1, 142) = 6.09; \ p = .015 \]. Males and females performed at the same level when both were in the High ATE/Low EAS category (Means = 12.96 and 12.95, respectively). One conclusion from these results is to corroborate the earlier observation of the synergistic effect of High ATE and High EAS attitudes in the economics cognitive achievement measured in this study, and to note that this effect appears most dramatic in the male subjects.

A significant interaction was observed between gender, ATE and EAS on the lower-order subscale of Posttest I [\( F (1, 142) = 3.08; \ p = .082 \)]. Interestingly, highest scorers among all subjects were males reporting Low ATE and Low EAS (Mean = 9.06), while lowest scorers were males reporting High ATE and Low EAS (Mean = 6.91). This is the converse of the expected relationship and performance outcomes.

The interaction of gender x ATE x EAS approached significance on the overall Posttest II score [\( F (1, 139) = 2.39; \ p = .124 \)]. Highest scorers were females in the High ATE/High EAS group (Mean = 12.56), while lowest scorers were females in the Low ATE/High EAS group (Mean = 9.62), a substantial 2.91 point difference. This
result supports the role of High ATE in superior retention performance, and also the positive synergistic effect of ATE and EAS seen consistently for High ATE and High EAS individuals.

Although not statistically significant, the interaction of gender, ATE and EAS on the lower-order subscale of Posttest II also corroborated the importance of ATE in relation to cognitive performance outcomes \( F(1, 139) = 1.97; p = .163 \). The widest difference was between female subjects in the High ATE/High EAS group and females in the Low ATE/High EAS group (Means = 7.31 and 4.69, respectively). This mean difference (2.62 points) also supports the possible synergistic effect of ATE and EAS. No other three-way interactions of gender x ATE x EAS approached significance.

**Interaction of Treatment, DEEP and Computer Anxiety.**
A significant interaction occurred between treatment, computer anxiety and DEEP on the overall Posttest II score \( F(1, 139) = 3.19; p = .076 \). Highest scorers were subjects in the rule-oriented treatment group with Low DEEP/Low Anxiety (Mean = 14.00), while lowest scorers were rule-oriented subjects with Low DEEP/High Anxiety (Mean = 10.15), a mean difference of 3.85 points. Treatment groups were closest when rule-oriented subjects
were Low DEEP/Low Anxiety and when problem-oriented subjects were Low DEEP/Low Anxiety (Means = 11.14 and 11.25, respectively). This finding again supports the importance of the CAIN measure, and the consistent superior performance of subjects with lower computer anxiety.

A significant interaction occurred between treatment, computer anxiety and DEEP on the lower-order subscale of Posttest II \[F (1, 139) = 3.22; p = .076\]. Highest scorers were subjects in the rule-oriented treatment group with Low DEEP/Low Anxiety (Mean = 8.27), while lowest scorers were rule-oriented subjects with Low DEEP/High Anxiety (Mean = 5.15), a mean difference of 3.12 points. Computer anxiety again appears relevant as a factor in several respects: (a) the smallest mean difference (0.03 points) was between subjects in the rule-oriented treatment with High DEEP/High Anxiety and Low DEEP/High Anxiety (Means = 5.18 and 5.15, respectively); (b) in all mean comparisons within the High Anxiety group, subjects in the problem-oriented treatment group outscored rule-oriented subjects, and this superiority was clearest when both treatment groups were also Low DEEP (Means = 7.04 and 5.15, respectively). Thus, this finding corroborates the importance of the CAIN measure and the consistently superior performance
of subjects with lower computer anxiety. The computer anxiety factor, however, appears to have been less salient for subjects in the problem-oriented treatment since their highest group performance was with Low DEEP and High Anxiety. No other three-way interactions of treatment x DEEP x computer anxiety were significant.

Interaction of Gender, DEEP and Computer Anxiety. A significant three-way interaction was observed between gender, computer anxiety and DEEP on the Posttest I higher-order subscale \( F(1, 146) = 3.84; p = .052 \). Highest scorers in this case were males in the High DEEP/Low Anxiety group, while lowest scorers were males in the High DEEP/High Anxiety group (Means = 8.20 and 5.27, respectively). The difference in this case (2.93 points) corroborates other findings of the value of the CAIN measure and also supports continued interest in the learning attitudes reported in the DEEP questionnaire. A further important difference highlighting the CAIN data was seen between females in the Low DEEP category reporting High Anxiety (Mean = 5.54) and those reporting Low Anxiety Mean = 7.28), a difference of 1.74 points. Finally, males and females scored closest when both reported Low DEEP/Low Anxiety (Means = 7.40 and 7.28,
respectively). No other three-way interactions of gender x DEEP x computer anxiety were significant.

**Interaction of Gender, ATE and Computer Anxiety.** A significant three-way interaction was observed between gender, computer anxiety and ATE on the Posttest I lower-order subscale \[F (1, 142) = 4.14; p = .044\]. Highest scorers in this case were males in the High ATE/Low Anxiety group, while lowest scorers were males in the High ATE/High Anxiety group (Means = 9.13 and 7.14, respectively). This result again demonstrates the salience of the CAIN measures in studies involving computer-based instruction in economics. Males and females scored closest when male subjects were Low ATE/Low Anxiety and female subjects were Low ATE/High Anxiety (Means = 7.60 and 7.59, respectively). No other significant three-way interactions of gender x ATE x computer anxiety were significant.

**Linear Regression Predictive Models**

The attempt to establish predictive models of behavior in experimental research is well-supported (Cohen & Cohen, 1983; Kerlinger & Pedhazur, 1973; Stevens, 1986). After examining the univariate and
factorial analysis of variance data from this study, various correlations and interrelationships suggested that an extensive series of multiple regression analyses be conducted to determine the amount of variance that could be accounted for by a theory-based combination of factors used to predict individual performance on Posttest I, Posttest II, and the higher-order and lower-order subscales of each. The results and conclusions of these regression analyses (performed using the mainframe SPSSx REGRESSION procedure) are reported in this section.

**Regression of Major Variables.** Systematic examination of histogram and scatterplot data supported the assumptions of normality, linearity, and homoscedasticity of residuals (variance). In relation to the latter assumption, there was some scatterplot evidence of minor deviation in the case of several dichotomized affective variables where the error of prediction increased slightly for subjects in the High category. This artifact, seen in the case of the CAIN index, may have been influenced by the disproportionate number of subjects in the High (n = 90) and Low (n = 60) computer anxiety categories. Since these were isolated cases and (a) the residuals dispersion did not appear large and (b) the sample sizes were conservatively large,
no special data transformations were made. The presence of any marginal heteroscedasticity posed no barrier to the application of regression procedures in this study.

A series of hierarchical regressions were calculated with the same dependent variables to check for problems associated with multicollinearity. Correlation matrices were also observed for evidence of abnormally high correlations between various independent variables. Based on a variety of information available, variables were selectively deleted from some model specifications to reduce the confounding of multicollinearity.

In only one case were any of the primary independent variables found to significantly contribute to the prediction of a dependent variable. As shown in Table 35, the hierarchical regression of the lower-order subscale of Posttest I on treatment, gender, DEEP and CAIN is reported including the correlations between the independent variables and the lower-order subscale (DV), the unstandardized regression coefficients (B), multiple R (R), coefficient of determination (R^2), the F statistic and the probability value (p).
Table 35

Regression of Lower-Order Posttest I Scores (DV) on Treatment, Gender, DEEP and CAIN

<table>
<thead>
<tr>
<th>Variable</th>
<th>TREAT</th>
<th>GENDER</th>
<th>DEEP</th>
<th>CAIN</th>
<th>(DV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREAT</td>
<td>1.00</td>
<td>0.02</td>
<td>0.06</td>
<td>0.09</td>
<td>0.17</td>
</tr>
<tr>
<td>GENDER</td>
<td>1.00</td>
<td>0.02</td>
<td>0.10</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>DEEP</td>
<td>1.00</td>
<td>0.12</td>
<td>0.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAIN</td>
<td></td>
<td>1.00</td>
<td>-0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DV)</td>
<td></td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>R</th>
<th>R²</th>
<th>R² New</th>
<th>B</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREAT</td>
<td>.16</td>
<td>.03</td>
<td>.03</td>
<td>1.01</td>
<td>4.07</td>
<td>.045</td>
</tr>
<tr>
<td>GENDER</td>
<td>.17</td>
<td>.03</td>
<td>.00</td>
<td>-.26</td>
<td>2.22</td>
<td>.112</td>
</tr>
<tr>
<td>DEEP</td>
<td>.23</td>
<td>.05</td>
<td>.02</td>
<td>-.66</td>
<td>2.72</td>
<td>.046</td>
</tr>
<tr>
<td>CAIN</td>
<td>.23</td>
<td>.05</td>
<td>.00</td>
<td>-.10</td>
<td>2.06</td>
<td>.089</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>8.97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After step 1 in this regression, the treatment variable (TREAT) is a significant predictor of Posttest I lower-order score performance (p = .045), although the $R^2$ is a marginal .03 value. This result also confirms the previous finding related to research Hypothesis Two and the importance of the treatment variable main effect in the Posttest I lower-order subscale performance. After step 2, gender did not add to the prediction of the DV (it is included here to contrast with the Posttest I higher-order subscale regression following). However,
after step 3 the addition of the DEEP variable produced a significant increment in $R^2$, although again this value is marginal (.02). Thus, while treatment was confirmed as the best predictor of Posttest I lower-order performance, the addition of the DEEP score ostensibly assists in the improvement of the amount of variance accounted for in this situation.

Unfortunately, statistically significant predictors on other regressions of the independent variables were not found. However, the treatment variable (TREAT) followed closely by the ATE variable, were consistently the best predictor variables considering all other factors. In the case of the Posttest I higher-order subscale performance (See Table 36), however, EAS demonstrated a slight superiority in predictive power over ATE ($R^2$ New of .03 to .01, respectively). EAS also produced the largest regression coefficient (.81) and intercorrelation with the DV (.16). Interestingly, the gender variable appears more important to prediction of the higher-order score (as contrasted to treatment on the lower-order score) of Posttest I, although the contribution of gender to the amount of variance explained is not statistically significant in either case.
Table 36

Regression of Higher-Order Posttest I Scores (DV) on Treatment, Gender, EAS and ATE

<table>
<thead>
<tr>
<th>Variable</th>
<th>TREAT</th>
<th>GENDER</th>
<th>EAS</th>
<th>ATE</th>
<th>(DV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREAT</td>
<td>1.00</td>
<td>0.02</td>
<td>0.05</td>
<td>0.08</td>
<td>0.01</td>
</tr>
<tr>
<td>GENDER</td>
<td>1.00</td>
<td>0.02</td>
<td>-0.16</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>EAS</td>
<td>1.00</td>
<td>0.21</td>
<td>0.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATE</td>
<td>1.00</td>
<td>0.13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(DV)</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>R</th>
<th>R^2</th>
<th>R^2 New</th>
<th>B</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREAT</td>
<td>.01</td>
<td>.00</td>
<td>.00</td>
<td>-.02</td>
<td>0.03</td>
<td>.870</td>
</tr>
<tr>
<td>GENDER</td>
<td>.12</td>
<td>.01</td>
<td>.01</td>
<td>-.61</td>
<td>1.08</td>
<td>.342</td>
</tr>
<tr>
<td>EAS</td>
<td>.20</td>
<td>.04</td>
<td>.03</td>
<td>0.81</td>
<td>2.08</td>
<td>.106</td>
</tr>
<tr>
<td>ATE</td>
<td>.21</td>
<td>.05</td>
<td>.01</td>
<td>0.40</td>
<td>1.81</td>
<td>.130</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>4.22</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specification of Cognitive Variables. Pretest scores are commonly the best predictors of posttest performance on reliable cognitive achievement instruments, but the predictive capacity is usually so great that multicolinearity occurs with any subsequent variables entered into a regression model. To confirm the predictive value of the measures developed and implemented in this study, a series of univariate regressions were performed using overall and subscale
Pretest scores as predictors for Posttest I performance, and including Posttest I overall and subscale scores as predictors for Posttest II performance. As anticipated, all of these results produced highly significant $R^2$, $F$ and $p$ values. These results are reported for the overall scores of Posttest I and II (Tables 37, 38, and 39).

Table 37
Regression of Overall Posttest I Score (DV) on Pretest Cognitive Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>OVERALL</th>
<th>HIGHER</th>
<th>LOWER</th>
<th>(DV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Scale</td>
<td>1.00</td>
<td>0.77</td>
<td>0.78</td>
<td>0.49</td>
</tr>
<tr>
<td>OVERALL</td>
<td>1.00</td>
<td>0.20</td>
<td>0.57</td>
<td></td>
</tr>
</tbody>
</table>
| HIGHER | 1.00 | 0.19 | |}

Regression Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R$</th>
<th>$R^2$</th>
<th>$B$</th>
<th>$F$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td>.52</td>
<td>.27</td>
<td>0.77</td>
<td>55.66</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>3.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGHER</td>
<td>.46</td>
<td>.21</td>
<td>0.38</td>
<td>40.73</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOWER</td>
<td>.47</td>
<td>.22</td>
<td>0.39</td>
<td>43.10</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>2.49</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
While the Pretest lower-order scale showed the highest correlation with the overall Posttest I score (.57), the regression of the overall Pretest produced the largest $R^2$ value (.27). Although either the higher-order or lower-order subscore could be used to improve prediction of the DV, the overall Pretest score contributes 0.77 points to the regression model outcome, twice as much as either subscore (0.38 and 0.39, respectively).

Correlational data presented in Tables 38 and 39 supports the item analysis evidence of the superior reliability of the Posttest I instrument. Despite this fact and (a) the higher correlation (.52) between the overall Posttest I score and the dependent variable (the overall Posttest II score in Table 39), and (b) the greater variance accounted for by the overall Posttest I variable ($R^2 = .27$), only 0.44 points are added to the overall Posttest II score. Therefore, while all Posttest I scales are equally significant predictors ($p = .000$), the issue of which is practically superior is not clear.
Table 38

Regression of Overall Posttest II Score (DV) on Pretest Variables

Correlation Tables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest Variables</th>
<th>Overall</th>
<th>Higher</th>
<th>Lower</th>
<th>(DV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1.00</td>
<td>0.77</td>
<td>0.78</td>
<td>0.46</td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>1.00</td>
<td>0.20</td>
<td>0.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>1.00</td>
<td></td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Regression Summary

<table>
<thead>
<tr>
<th>Variable</th>
<th>R</th>
<th>$R^2$</th>
<th>B</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>.48</td>
<td>.23</td>
<td>0.57</td>
<td>45.24</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>3.43</td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>.25</td>
<td>.06</td>
<td>0.51</td>
<td>9.86</td>
<td>.002</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>8.22</td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>.25</td>
<td>.06</td>
<td>0.33</td>
<td>9.86</td>
<td>.002</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td></td>
<td>4.19</td>
<td></td>
</tr>
</tbody>
</table>

Table 39

Regression of Overall Posttest II Score (DV) on Posttest I Variables

Correlation Tables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Posttest I Variables</th>
<th>Overall</th>
<th>Higher</th>
<th>Lower</th>
<th>(DV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest I Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>1.00</td>
<td>0.90</td>
<td>0.90</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>Higher</td>
<td>1.00</td>
<td>0.61</td>
<td>0.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower</td>
<td>1.00</td>
<td></td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 39 (Continued)

<table>
<thead>
<tr>
<th>Variable</th>
<th>R</th>
<th>R²</th>
<th>B</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posttest I Scale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OVERALL</td>
<td>.52</td>
<td>.27</td>
<td>.41</td>
<td>55.23</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>5.37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIGHER</td>
<td>.47</td>
<td>.22</td>
<td>.66</td>
<td>42.17</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>6.94</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOWER</td>
<td>.46</td>
<td>.21</td>
<td>.66</td>
<td>41.03</td>
<td>.000</td>
</tr>
<tr>
<td>Constant</td>
<td></td>
<td></td>
<td>6.09</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Summary of Regression Results. An extensive series of multiple regression analyses were performed to determine if specified combinations of independent variables, derived from the original hypotheses and the logical implications of t-Test and ANOVA results, could contribute to a more precise explanation of observed experimental variance. Apart from the inclusion of the treatment variable, the DEEP score and to some degree the CAIN score on the lower-order subscale of Posttest I, no statistically significant regression findings involving the primary independent variables were observed. The application of Pretest and Posttest I variables as regressors was successful on all scales, confirming that (a) the use of pretest scores in the case
of an immediate posttest, and (b) both pretest and immediate posttest scores in the case of a delayed posttest—are powerful factors in explaining the variance of their respective dependent variables. Little evidence was observed to assist in the development of comprehensive psychometric models of behavior regarding the treatment, gender and affective factors investigated in this study.

Final Summary of Results and Conclusions

The results and conclusions of this study are enumerated here:

1) Subjects in the problem-oriented treatment group consistently outscored their rule-oriented counterparts on most cognitive outcome measures including the overall score and lower-order subscale score of Posttest I and II, and the higher-order score of Posttest I. This superior cognitive achievement was statistically significant (p = .045) as a main effect only in the lower-order subscale of Posttest I, however.

2) Mean scores of Male subjects were greater than female subjects on all cognitive measures, including the overall score and both higher and lower-order subscale score on Posttest I and II. Importantly, none of these differences was significant.

3) None of the ATE or EAS main effect differences was statistically significant for any cognitive measure including the overall score and both higher and lower-order subscale score on Posttest I and II.
4) A significant disordinal interaction was observed between ATE and EAS on the overall Posttest I score ($p = .017$). Subjects in the High ATE/High EAS group outscored all other subjects, and this mean difference was greatest between High ATE/High EAS and: (a) the High ATE/Low EAS group (3.00 points) and (b) the Low ATE/High EAS group (2.34 points). Both differences are considered important from a practical perspective.

5) A disordinal interaction between ATE and EAS on the higher-order subscale of Posttest I was observed in which subjects in the High ATE/High EAS group outscored all other groups ($p = .022$). A similar disordinal interaction between ATE and EAS was also observed in relation to mean performance on the lower-order subscale of Posttest I ($p = .045$). Again, subjects in the High ATE/High EAS group outscored all other groups. Greatest difference in mean performance was between the High ATE/High EAS group and the High ATE/Low EAS group (1.20 points), similar to the results for the Posttest I overall and higher-order scores.

6) A disordinal interaction between ATE and EAS was shown in relation to mean performance on the lower-order subscale of Posttest II ($p = .025$). The result in this case was consistent with the other significant interactions noted above in summary paragraphs 4 and 5: subjects in the High ATE/High EAS group outscored all subjects on the lower-order subscale of Posttest II, with the greatest difference in mean performance observed between the High ATE/High EAS group and the Low ATE/High EAS group (1.70 points).

7) No statistically significant differences could be demonstrated for the overall score main effects of the computer anxiety variable (CAIN), although evidence was presented indicating a trend toward superior performance by subjects in the lower anxiety group on the overall performance means of both Posttest I and II. In the case of Posttest I, the difference was 1.32 points; for Posttest II the corresponding difference was 1.18 points.
8) Significant main effects differences were reported for the computer anxiety variable (CAIN) on the higher-order subscale of Posttest I and the lower-order subscale of Posttest II, respectively. The trend for superior performance (1.10 points) by subjects in the Low Anxiety group was observed on the higher-order subscale performance means of Posttest I ($p = .027$). For Posttest II, the difference between High and Low anxiety subjects was significant only for the lower-order subscale means ($p = .063$).

9) No statistically significant differences could be demonstrated for the overall score main effects of the deep approach towards learning variable (DEEP). However, a surprising trend of superior test performance by subjects in the Low DEEP group over subjects in the High DEEP approach group was observed in the overall performance means of both Posttest I and II (1.25 and 0.34 points, respectively).

10) A significant main effect for the deep approach toward learning variable was reported only in the case of the lower-order subscale of Posttest I. Similar to the trend observed in summary paragraph 9, subjects in the Low DEEP group scored higher than their counterparts in the High DEEP group by 0.95 points ($p = .054$).

11) The ordinal interaction of treatment and EAS on the lower-order subscale of Posttest I indicated that (a) the superior performance of subjects in the problem-oriented group in both Low and High EAS conditions and (b) the positive relationship between High EAS and problem-oriented mean performance. The treatment variable (TREAT) here indicated a main effect result ($p = .050$). The largest difference was observed between problem-oriented and rule-oriented subjects on the High EAS level (1.70 points), indicating a potentially beneficial relationship between learners with High EAS and problem-oriented instruction in economics.

12) Results for the disordinal interaction of treatment and EAS on the lower-order subscale of Posttest II are the reverse of the previous finding for Posttest
I (See summary paragraph 11 above and also Figures 6 and 7). While the treatment variable was not itself significant (treatment was significant in the Posttest I case), the disordinal interaction between treatment and EAS was much more pronounced (p = .006). The greatest difference between means (1.80 points) was between problem-oriented (7.00 points) and rule-oriented (5.50 points) groups in the Low EAS category. This situation was reversed in the High EAS category with subjects in the rule-oriented group outscoring subjects in the problem-oriented group by 0.80 points.

13) A disordinal interaction was found between level of treatment and CAIN score for the lower-order subscale of Posttest II (p = .023). While subscale mean performance remained relatively consistent across problem-oriented subjects in either High and Low computer anxiety categories, rule-oriented treatment group performance changed noticeably across the Low to High Anxiety dichotomy. Although Low Anxiety subjects in the rule-oriented treatment outscored all groups, their Higher Anxiety rule-oriented counterparts scored considerably lower (1.90 points lower mean score), showing the largest difference between any two groups. Problem-oriented subjects in the High Anxiety group achieved superior performance over the High Anxiety rule-oriented subjects by 1.40 points. The importance of the computer anxiety variable is demonstrated by the main effect result (p = .084).

14) A disordinal interaction of ATE and DEEP on the higher-order subscale of Posttest II was reported (p = .080). While High DEEP subjects outscored all groups, the High DEEP/High ATE subjects scored lower than Low ATE/High DEEP (0.70 points) and High ATE/Low Deep (0.50 points). The largest difference between groups (1.00 point) occurred between the High DEEP and Low DEEP subjects in the Low ATE category.

15) A significant three-way interaction was observed between treatment, ATE and EAS on the higher-order subscale of Posttest II (p = .058). Highest scorers were in the problem-oriented treatment in the High ATE/Low EAS category, while lowest scorers were in
the problem-oriented treatment in the Low ATE/Low EAS category (Means = 6.00 and 4.37, respectively). This particular mean difference (1.63 points) suggests that High ATE is more important than EAS as a factor in cognitive performance. However, the smallest observed mean difference was between problem-oriented treatment subjects with Low ATE/High EAS and problem-oriented treatment subjects with High ATE/High EAS (a 0.03 point difference). Therefore, although High ATE is influential, especially in combination with Low EAS, where EAS is high for both groups, ATE was not as salient on the higher-order questions of Posttest II.

16) Highest scorers on the overall Posttest I mean were male subjects in the High ATE/High EAS category (Mean = 16.95) while lowest scorers were female subjects in the High ATE/Low EAS group (Mean = 12.95). Although this 4-point difference was very significant from a practical view, the gender x ATE x EAS interaction was not statistically significant on the overall Posttest I. The ATE x EAS interaction was itself significant, however (p = .015). Males and females performed at the same level when both were in the High ATE/Low EAS category. This finding is further evidence of the relationship between higher ATE and High EAS attitudes in economics cognitive achievement and that the effect was more pronounced in the male subjects.

17) A significant interaction was observed between gender, ATE and EAS on the lower-order subscale of Posttest I (p = .082). Highest scorers (Mean = 9.06) were males reporting Low ATE/Low EAS, while lowest scorers (Mean = 6.91) were males reporting High ATE/Low EAS. This is the converse of the expected relationship and performance outcomes.

18) The three-way interaction of gender x ATE x EAS approached significance on the overall Posttest II score (p = .124). Highest scorers were females in the High ATE/High EAS group (Mean = 12.56), while lowest scorers were females in the Low ATE/High EAS group (Mean = 9.62), a 2.91 point difference. This result supports the role of High ATE in superior retention performance, and also the positive
synergistic effect of ATE and EAS seen consistently for High ATE and High EAS individuals.

19) Although not statistically significant, the interaction of gender, ATE and EAS on the lower-order subscale of Posttest II also corroborated the importance of ATE in relation to cognitive performance outcomes ($p = .163$). The widest difference was between female subjects in the High ATE/High EAS group and females in the Low ATE/High EAS group (Means = 7.31 and 4.69, respectively). This 2.62 point mean difference also supports the possible synergistic relationship of ATE and EAS.

20) A significant interaction was reported between treatment, computer anxiety and DEEP on the overall Posttest II score ($p = .076$). Highest scorers were subjects in the rule-oriented treatment group with Low DEEP/Low Anxiety (Mean = 14.00), while lowest scorers were rule-oriented treatment subjects with Low DEEP/High Anxiety (Mean = 10.15), a mean difference of 3.85 points. Treatment groups were closest when rule-oriented treatment subjects were Low DEEP/Low Anxiety and when problem-oriented treatment subjects were Low DEEP/Low Anxiety (Means = 11.14 and 11.25, respectively). This finding supports the importance of the CAIN measure, and the consistent superior cognitive performance in this computer-based study of subjects with lower computer anxiety.

21) A significant interaction was also reported between treatment, computer anxiety and DEEP on the lower-order subscale of Posttest II ($p = .076$). Highest scorers were subjects in the rule-oriented treatment with Low DEEP/Low Anxiety (Mean = 8.27), while lowest scorers were rule-oriented treatment subjects with Low DEEP/High Anxiety (Mean = 5.15), a mean difference of 3.12 points. In all mean comparisons within the High Anxiety group, the problem-oriented treatment group outscored the rule-oriented treatment subjects, and this superiority was clearest when both treatment groups were in the Low DEEP category (Means = 7.04 and 5.15, respectively). The finding again supports the importance of the CAIN measure and the consistently superior performance of subjects with lower computer anxiety.
The computer anxiety factor, however, appears to have been less salient for subjects in the problem-oriented treatment.

22) A significant three-way interaction was observed between gender, computer anxiety and DEEP on the Posttest I higher-order subscale (p = .052). Highest scorers in this case were males in the High DEEP/Low Anxiety group, while lowest scorers were males in the High DEEP/High Anxiety group (Means = 8.20 and 5.27, respectively). The difference here of 2.93 points corroborates other findings of the value of the CAIN measure. A second important difference was seen between females in the Low DEEP category reporting High Anxiety (Mean = 5.54) and those reporting Low Anxiety Mean = 7.28), a 1.74 mean difference.

23) A significant three-way interaction was observed between gender, computer anxiety and ATE on the Posttest I lower-order subscale (p = .044). Highest scorers in this case were males in the High ATE/Low Anxiety group, while lowest scorers were males in the High ATE/High Anxiety group (Means = 9.13 and 7.14, respectively). This result again demonstrates the salience of the CAIN measures in studies involving computer-based instruction in economics.

24) A series of hierarchical multiple regression analyses were performed. Apart from the inclusion of the treatment variable (p = .045), the DEEP score (p = .046) and to some degree the CAIN score (p = .089) on the lower-order subscale of Posttest I, no other statistically significant regression findings involving the primary independent variables were observed. The application of Pretest and Posttest I variables as regressors was successful on all scales (p = .000 in each case), confirming that (a) the use of pretest scores in the case of an immediate posttest (DV), and (b) both pretest and immediate posttest scores in the case of a delayed posttest (DV) are reliable in explaining the variance of their respective dependent variables.
General Summary

Ten general hypotheses and numerous secondary hypotheses and relationships were investigated in this study. This chapter presented empirical evidence to support or controvert the hypotheses and to augment the explanatory information reported in the data analyses. The subsequent results and conclusions from these analyses were presented beginning with the major hypotheses and continuing with selected observations of secondary associations and interactions.

In summary, several trends can be identified from these results: (a) The main effect of treatment was seen in the marginal superiority the problem-oriented subjects on the lower-order subscale of Posttest I, (b) gender main effects were not found, (c) ATE is clearly positively related to cognitive performance, with superior achievement related to more positive ATE; (d) ATE and EAS are positively related, but only moderately so; (e) ATE and EAS appear strongly related to superior cognitive performance only when both are "high": higher performers have High ATE/High EAS combinations in most cases, while lower performers report Low ATE/High EAS; (f) concerning the interaction of CAIN and DEEP, another trend appears: higher performers report Low DEEP/Low Anxiety, while lower performers report High DEEP and High
Anxiety; (g) CAIN score is inversely related to cognitive achievement: the lower the computer anxiety reported, the higher the cognitive performance (on most measures).

While other interesting and statistically significant results were observed, these trends appear to be the most salient. The discussion in Chapter V will explore the results and conclusions in greater detail and is previewed in the following section.

Preview of Chapter V (Discussion)

In Chapter V, the completed results and conclusions of the study are assessed in relation to the implications and recommendations for theory and practice in the fields of computer-based instruction, instructional design, economics education and related areas. The discussion stresses the importance of the observations from the data analyses to current and future applications of microcomputer courseware in precollege economics, and projects to broader implementations of various instructional strategies for concept teaching in other domains of the social studies curriculum. The relationship of this study to the research literature is then explored and final recommendations for future research are discussed.
CHAPTER V
DISCUSSION

Introduction

In this chapter, the completed results and conclusions of the study are assessed in relation to the implications and recommendations for theory and practice in the fields of computer-based instruction, instructional design, economics education and related areas. The major research issues are reiterated to provide a focus for the discussion of the empirical research findings. Correspondingly, the discussion stresses the importance of the observations from the data analysis to current and future applications of microcomputer courseware in precollege economics and projects to broader implementations of various instructional strategies for concept teaching in other domains of the social studies curriculum. Finally, the relationship of this study to the context of the relevant research literature is elaborated and recommendations for future research are delineated.
Rationale and Overview of the Study

The rationale for this study was based on the emergence of two important phenomena in educational theory and practice: (a) the systematic design, development and widespread implementation of computer-based instructional courseware in public school and commercial training curricula, and (b) the parallel development of the field of economic education and continuing research into the relationship between the affective and cognitive factors related to improving economic education across the academic curriculum. In particular, critical gaps in the literature existed in the design and evaluation of precollege computer-based instructional strategies in microeconomics and the investigation of the relationship between achievement in microeconomics concepts and attitude towards economics, economic attitude sophistication, level of computer anxiety, and attitude towards learning.

An experimental pretest/posttest study design was conceived to empirically explore a complex array of questions and issues related to computer-based instruction in microeconomics. In analyzing the relative efficacy of two alternative instructional strategies (a rule-oriented and a problem-oriented strategy), 155 senior high school students from four Columbus, Ohio
secondary schools participated in the final data collection phase of this study. These two strategies were broadly derived from the competing pedagogical orientations of the respective behavioral and cognitive schools of psychology and learning theory. Two computer-based lesson units, each designed to reflect operational versions of the rule or problem instructional strategy were designed to teach selected microeconomics concepts over an intensive five-day period in microcomputer laboratories located at each of the four site schools. In addition to the treatment variable, gender was also investigated as a factor in both attitudes and learning.

Parallel form cognitive achievement instruments were each systematically developed with moderate to good reliability, strong content validity, and two subscales representing higher-order and lower-order levels of cognitive processing (Bloom et al., 1956). Three existing affective indexes were obtained that measured attitude towards economics (ATE) as a subject, the degree of economic attitude sophistication (EAS) in a general understanding of the market system, and attitude toward computer technology (CAIN) indicating relative level of computer anxiety. A fourth index (DEEP) was developed locally to measure the relative depth of a student's
general approach towards new learning tasks and subject matters.

The effect of the rule-oriented and problem-oriented computer-based instructional strategies on teaching microeconomics concepts was investigated using a variety of statistical analytic techniques including the paired t-Test, univariate and factorial analysis of variance, Chi Square, and multiple linear regression. Cognitive achievement was measured with a multiple-choice pretest, and immediate posttest (Posttest I), and a delayed posttest delivered after a two-week interval for retention effects (Posttest II).

The four affective measures (ATE, EAS, CAIN and DEEP) were randomly administered in the pretest phase while all four were included in a questionnaire battery given in the posttest phase. The data on these affective measures were scored using two different coding schemes (a straight 6-point Likert scale and a 16-point certainty estimate scale), although only data derived from the certainty coding scheme was eventually included in the definitive analyses.

Restatement of Major Research Issues

The study examined numerous questions related to the teaching and acquisition of conceptual knowledge in
microeconomics via problem-oriented and rule-oriented computer-based instructional strategies on the secondary education level. The ten alternative research hypotheses, while providing a logical structure to the investigation, were not themselves the conceptual focus of the study.

The principal educational problems addressed in the study included the following areas of inquiry:

1) The effect of rule-oriented and problem-oriented strategies on the acquisition and retention of basic conceptual knowledge in microeconomics;

2) The differential effect of the two instructional approaches on learning and cognition as measured by the higher-order and lower-order question levels of the achievement instruments;

3) The relationship between attitude toward economics and economic attitude sophistication in a microeconomics principles lesson unit;

4) The less understood factor of computer-related anxiety in relation to precollege learning from computer-based instruction;

5) Exploratory knowledge into the deep versus surface approach towards learning dichotomy, particularly in relation to instruction in a subject matter unfamiliar to students;

6) The factor of student gender as interrelated to the other research issues stated in this section;

7) The interaction of the factors noted above in relation to learning in a computer-based economics principles unit;
Summary of Observations

The results and conclusions based on the critical analyses presented in Chapter IV are reported and summarized in this section beginning with a summary table of significant ANOVA results (Table 40).

Table 40

Summary of Significant ANOVA Results

<table>
<thead>
<tr>
<th>Result Description</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower-Order Posttest I Score by TREATMENT</td>
<td>4.07</td>
<td>.045</td>
</tr>
<tr>
<td>by DEEP</td>
<td>3.78</td>
<td>.054</td>
</tr>
<tr>
<td>Higher-Order Posttest I Score by CAIN</td>
<td>4.97</td>
<td>.027</td>
</tr>
<tr>
<td>Lower-Order Posttest II Score by CAIN</td>
<td>3.52</td>
<td>.063</td>
</tr>
<tr>
<td><strong>Two-Way Interactions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Posttest I Score by ATE x EAS</td>
<td>5.85</td>
<td>.017</td>
</tr>
<tr>
<td>Higher-Order Posttest I Score by ATE x EAS</td>
<td>5.34</td>
<td>.022</td>
</tr>
<tr>
<td>Lower-Order Posttest I Score by ATE x EAS</td>
<td>4.09</td>
<td>.045</td>
</tr>
<tr>
<td>by EAS x Treatment</td>
<td>2.89</td>
<td>.091</td>
</tr>
<tr>
<td>Lower-Order Posttest II Score by ATE x EAS</td>
<td>5.13</td>
<td>.025</td>
</tr>
<tr>
<td>by EAS x Treatment</td>
<td>7.84</td>
<td>.006</td>
</tr>
<tr>
<td>by CAIN x Treatment</td>
<td>5.28</td>
<td>.023</td>
</tr>
</tbody>
</table>
Table 40 (Continued)

<table>
<thead>
<tr>
<th>Result Description</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two-Way Interactions (Continued)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher-Order Posttest II Score by ATE x DEEP</td>
<td>3.10</td>
<td>.080</td>
</tr>
<tr>
<td><strong>Three-Way Interactions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher-Order Posttest I Score by ATE x EAS x Treatment</td>
<td>3.65</td>
<td>.058</td>
</tr>
<tr>
<td>by DEEP x CAIN x Gender</td>
<td>3.84</td>
<td>.052</td>
</tr>
<tr>
<td>Lower-Order Posttest I Score by ATE x EAS x Gender</td>
<td>3.08</td>
<td>.082</td>
</tr>
<tr>
<td>by ATE x CAIN x Gender</td>
<td>4.14</td>
<td>.044</td>
</tr>
<tr>
<td>Overall Posttest II Score: by DEEP x CAIN x Treatment</td>
<td>3.19</td>
<td>.076</td>
</tr>
<tr>
<td>Lower-Order Posttest II Score: by DEEP x CAIN x Treatment</td>
<td>3.22</td>
<td>.076</td>
</tr>
</tbody>
</table>

**Result Summary.** In summary, several trends can be identified from the results. First, the main effect of treatment was statistically significant in only one case that indicated the marginal superiority of the problem-oriented subjects on the lower-order subscale of Posttest I. Gender main effects on the cognitive performance measures were not found, although several gender-related trends were observed including the consistently superior
performance of males on all cognitive variables and a significantly higher ATE reported among the male subjects.

Concerning the measurement of economic attitudes, ATE was positively related to cognitive performance, with superior achievement related to higher ATE. The results generally confirm the findings of Soper & Walstad (1987, 1988) that a moderately positive association exists between the constructs of attitude toward economics and economic attitude sophistication. Moreover, the combination of ATE and EAS appear strongly related to superior cognitive performance only when both are "High". Higher performers have High ATE/High EAS combinations in most cases, while lower performers tend to report Low ATE/High EAS or High ATE/Low EAS.

Concerning the interaction of CAIN and DEEP, another trend appears for: higher performers report Low DEEP/Low Anxiety, while lower performers report High DEEP and High Anxiety and CAIN score is inversely related to cognitive achievement: the lower the computer anxiety reported, the higher/better the cognitive performance (on most measures).
Discussion of Treatment Effects

Main effect differences were significant for the treatment in a single case: the hypothesized superiority of the problem-oriented strategy on cognitive achievement for the lower-order subscale of Posttest I. While the mean difference between the two treatment groups was only 0.98 points, this result was substantial given the overall distribution of scores on the subscale (SD = 2.95, relative effect size = .33). Apparently the problem-oriented strategy was more effective than the rule-oriented strategy in the teaching of the more basic, knowledge type questions characteristic of multiple-choice examinations traditionally used in large social studies classes of urban public schools. Ostensibly, an outcome measure constructed solely from a pool of these lower-order questions might have produced even more dramatic performance differences. In any case, this result is interesting since these knowledge type questions appear tailored to the defined emphasis of the rule-oriented instructional strategy.

Clearly, one inadequacy with the methodology implemented in this study is the inability to discern the precise instructional component of the problem-oriented strategy responsible for this learning difference: (a) the role-playing dialogue of the simulation format, (b)
the motivational features of the realistic context and content of the microeconomics concepts taught, (c) the heuristic power of the specific cognitive strategy taught (the Graphic Method), or (d) all or some combination of these components in conjunction with unobserved personological characteristics such as intelligence, reading ability, attention and motivation.

Undoubtedly, future research will need to modify and improve procedures, and perhaps begin to ask more precise questions that accurately isolate the causality issues that this study, like many others, has left ambiguous. However, some results of this study merit further discussion even given the limited scope of their findings. For example, if the Graphic Method cognitive strategy was the essential pedagogical feature of the problem-oriented strategy, superior performance would probably have been seen to some degree on the higher-order questions.

The Graphic Method was generally presented as an analytic problem-solving technique for the microeconomic problems and situations involving the understanding and application of multiple concepts such as supply and demand that normally occur simultaneously. Since such a potent economic reasoning tool could be effectively applied to basic questions of microeconomic behavior and
market analysis, the Graphic Method as adapted in this study was expected to be useful to students in the resolution of the more complex word and graphic problems prominent in the higher-order question pool. In the absence of any evidence to support the efficacy of the problem-oriented strategy on the higher-order subscales, two possible explanations suggest that: 1) there was insufficient practice by students using the Graphic Method to solve more advanced microeconomic problems or 2) each instructional strategy was equally effective in teaching higher-order thinking skills in the content domain.

A possible explanation for the absence of other cognitive main effect differences on either the higher-order or overall scales from either treatment was the greater item difficulty and higher grade readability level of the higher-order questions. Although normal range frequency distributions were observed on all variables, summary descriptive data on the cognitive instruments tended to show that question difficulty operated in some manner to blunt the performance comparison across all groups. Lower-order scale means on Posttest I and Posttest II were larger than the corresponding higher-order means by 1.30 and 1.10 points, respectively. Overall scale means for Posttest I and II
were 14.36 and 11.27, a mean possible performance ratio out of 34 test items of .42 and .33 respectively. Logically, the best performance ratio was observed for the lower-order subscale of Posttest I (.46), while the ratios for the lower-order scale of Posttest II (.36), the higher-order scale of Posttest I (.38) and Posttest II (.36) were noticeably smaller.

In addition, although few main effect differences were found in the results, there were numerous interesting and significant interactions observed. But of these significant interactions, two involved an overall posttest score, five involved a higher-order subscale and eleven a lower-order subscale. Thus, an apparent instrumentation problem served to diminish possible observations that may have supported the achievement benefit of either the problem-oriented or rule-oriented strategy. The converse, that neither instructional strategy was significantly superior received support by this lack of substantial differences between the treatment groups. Undoubtedly, future research of this nature will need to develop, test and revise more sensitive and reliable measures of achievement performance for particular subsets of the precollege economics curriculum.
Other factors in addition to instrumentation could have contributed to the failure of additional treatment-related main effect differences. The relatively brief duration of the treatment (five 50-minute class periods) may have been insufficient for either instructional strategy to produce significant performance differences. At the same time, dramatic yet unobserved maturational effects associated with an intensive, individualized computer-based lesson may have decreased student attention and motivation. Also, the differentiation between the instructional strategies as perceived and experienced by the subjects may have been insufficient to produce measurable learning differences between treatment groups. There may have been some unobserved residual influence of simultaneous cross-treatment interference due to the proximity of both treatment strategies in the same laboratory environment. Finally, multiple combinations of these factors are equally plausible to have occurred.

The Problematic Interpretation of Three-Way Interaction Results

Three-way interactions, while potentially interesting, are often very difficult to interpret without the confounding of alternative and equally
plausible explanations. The six statistically significant three-way interactions observed in this study are no exception to this problem. Treatment and gender were each involved with three of these interactions.

A significant interaction was observed between treatment, ATE and EAS on the Posttest II higher-order score. Differences between ATE/EAS groups were most revealing in the problem-oriented subjects, and suggested that High ATE was more salient in this study than EAS in economics concept attainment from direct instruction. This is particularly evident when ATE is High and EAS is Low, although the effect is diminished when EAS is High for all ATE groups.

Two similar three-way interactions were observed between treatment, DEEP and CAIN on the overall and lower-order scores of Posttest II, respectively. Highest and lowest scorers were both in the rule-oriented treatment, where a substantial mean difference of 3.85 points was seen between Low DEEP/Low Anxiety and Low DEEP/High Anxiety subjects. Little difference was seen between rule-oriented and problem-oriented subjects, especially when both groups were Low DEEP/Low Anxiety. Thus, this result supports the consistently observed superior cognitive performance of subjects with lower anxiety toward computers.
Gender Interactions. A significant three-way interaction was also observed between gender, DEEP and CAIN on the Higher-Order Posttest I score. High DEEP/Low Anxiety males outperformed all other subjects, particularly males in the High DEEP/High Anxiety group (a 2.93 points difference). At the same time, females in the Low DEEP category reporting Low Anxiety outperformed High Anxiety females by 1.74 points. Male and female performance was closest in the Low Anxiety category, confirming expected outcomes. Together these results emphasize the value of the CAIN index and the computer anxiety variable, and the reduction of performance differences from computer courseware when reported computer anxiety levels are relatively low.

A second three-way interaction involving gender and computer anxiety was significant with the ATE variable. Again, while no major cross-gender differences were identified, highest scorers were High ATE/Low Anxiety males (9.13 points) and lowest scorers were High ATE/High Anxiety males (7.14 points). This interaction reiterates the possible importance of lower computer anxiety and more positive ATE to superior performance from an intensive courseware treatment.

The single largest gender-related performance difference observed in this study was seen in the non-
significant three-way interaction of gender, ATE and EAS on the overall Posttest I score. Males in the High ATE/High EAS group (Mean = 16.95) outperformed females in the High ATE/Low EAS group (Mean = 12.95) by four full points, and the ATE x EAS interaction two-way interaction was highly significant (p = .015). Therefore, both High ATE and High EAS appear to have some synergistic or mutually-reinforcing type of interrelationship in this study, and the absence of a corresponding High EAS to complement High ATE had a notable impact on the microeconomics learning of females in this study.

Initial t-test results indicated that males had a significantly more positive attitude toward economics as a subject than females. As a whole, these results make a solid case for additional research into the multiple interaction of the gender factor with other treatment and psychometric variables if a more definitive understanding of the gender issue in relation to computer-based precollege instruction in microeconomics is to be achieved.

Utility of Regression Results. While the Pretest lower-order scale showed the highest correlation with the overall Posttest I score, the regression of the overall Pretest produced the largest $R^2$ value (.27) and
contributed 0.77 points to the regression model outcome twice as much as either question level subscore. At the same time, the application of Pretest and Posttest I variables as regressors tends to confirm that (a) the use of pretest scores in the case of an immediate posttest, (b) the treatment variable was a significant predictor of Posttest I lower-order score performance ($p = .045$), although the amount of variance actually explained is a marginal value ($R^2 = .03$); and (c) both pretest and immediate posttest scores in the case of a delayed posttest can significantly improve prediction in their respective dependent variables. Unfortunately, the data did not support the construction of comprehensive psychometric models of behavior regarding the treatment, gender and affective factors investigated in this study.

**Discussion of Affective Variables**

All affective measures were administered to the study subjects during a two-day period following the administration of the Posttest I. Scores on the CAIN correlated moderately ($+.27$) with both the ATE and EAS scores, an expected result supporting the premise that higher reported state anxiety (in this case associated with computer technology) is related in some manner to
(a) a less positive attitude towards the content matter taught via the perceived object of threat and (b) less sophistication or understanding about the particular subject matter of the lesson. If this view is tenable, then at least in some cases ATE may have been negatively influenced by a combination of the subject matter, the instructional task, and computer anxiety as measured by the CAIN index.

Use of the Six-Point Scale in Future Attitudinal Research

The use of the six-point scale without an intervening neutral or undecided point is indirectly supported by basic tenets of attitude measurement theory (Edwards, 1957) since

One of the major assumptions involved in the construction of attitude scales is that there will be differences in the belief and disbelief systems of those with favorable attitudes toward some object and those with unfavorable attitudes. (pp. 10-11)

The underlying assumption in the development of forced-choice self-report inventories is that individuals possess attitudes, values and belief systems even though they may not be consciously aware of their affective, cognitive and behavioral orientations towards various objects in the experiential universe. Thus, forced-
choices assist in revealing the predisposition to behave characteristic of attitude formation. Data that tend to cluster around the neutral point of odd-numbered scales (e.g., 5-point) may reveal more about the weakness of the questionnaire statements than about student attitudes. Thus the use of neutral or undecided choice options obfuscates measurement of the underlying predisposition and contributes little to a clarification of individual and group values toward a particular object, even one about which the individual or group has only marginal knowledge or understanding.

Attitudes Toward Learning. The study of a generalized approach towards learning attitude was exploratory in the context of this study. Apparent main effect differences were observed for the DEEP index on the lower-order subscale of Posttest I, indicating that students reporting a less deep approach towards learning significantly outperformed their High DEEP counterparts (a mean difference of .95 points). A similar difference was noted in the overall Posttest I score (1.25 points), approaching significance at \( p = .162 \). The results favoring Low DEEP were opposite from the predicted one, but may suggest that a more surface approach towards new learning tasks benefits students in the acquisition of
certain low-level knowledge and concepts in microeconomics.

The Deep Versus Surface Dilemma. However, the appropriateness of surface approaches for certain tasks that are easier to learn by drill, rote memorization, or other pattern-reinforced behavior could be problematic to individuals who display a more deep approach towards learning. The convenient practice of 'teaching to the test' ingrained in many public school situations as a pragmatic necessity is not a new phenomenon. Surface-learning tasks, rigidly standardized courses, conventional achievement tests and grade school academic curricula might directly or indirectly foster a surface approach towards learning in their students, thereby negatively conditioning student attitudes towards certain strategies and behaviors more conducive to deeper, higher-order thinking skills and more self-reliant strategic learning abilities. There are current political pressures for teachers and schools to be more 'accountable', to raise standardized college entrance test scores of their students, and to generally evaluate learning performance using rote-level, mastery summative measures such as competency testing. If it is true, however, that the collective competency phenomenon is
encouraging the surface learning approach for the precollege population, future cognitive and affective problems currently unforseen may emerge.

Relationship Between DEEP and ATE. A significant disordinal interaction observed between DEEP and ATE on the higher-order subscale of Posttest II score may not be useful in explaining the influence of the DEEP variable on cognitive performance. In this interaction, the highest performers were in the Low ATE/Low DEEP group, while the poorest scores were accumulated in the Low ATE/High DEEP group (mean difference = 1.00 point). Why subjects with a relatively negative attitude toward economics as a subject matter and a more surface approach toward learning would outperform all other subjects in the ATE/DEEP categories is somewhat of a mystery, particularly since this superiority is for the higher-order question subscale.

Nevertheless, the fact that High ATE subjects in the High DEEP group scored an average of 0.80 points higher than their Low ATE/High DEEP counterparts again emphasizes the longer-term (retention) impact of a positive attitude toward economics among students with a deep approach toward learning. Obviously, among students with a less deep approach, the influence of a positive
ATE does not make any appreciable improvement, and in this specific case was associated with a mean decrease of 0.70 points. Thus, the interdependent effect of the ATE/DEEP combination remains uncertain and equivocal when measuring cognitive achievement in microeconomics in this study.

**Computer Anxiety.** Main effect differences were significant for the computer anxiety variable measured by the CAIN index on both the higher-order and lower-order subscales of Posttest I, in each case supporting the original hypothesis: students with lower computer anxiety consistently outperformed their counterparts with higher anxiety. Despite the high reliability of the nationally-normed CAIN index and some research to support a modest claim of basic construct validity, it remains unclear precisely what the CAIN is measuring in relation to individual attitudes towards computer technology.

As reported in the disordinal interaction of treatment and CAIN \(F = 5.28; p = .023\), rule-oriented subjects in the Low Anxiety group scored a mean difference of two points more than High Anxiety subjects receiving the same treatment. The relatively dramatic performance decrease seen in the rule-oriented high anxiety group can be interpreted to reveal more about the
nature of the instructional strategy as implemented via microcomputer courseware than the students in the rule-oriented group. If anxiety were neutralized by the effect of an instructional approach, the results would be similar to those seen in the case of the problem-oriented subjects (a mean difference low to high of 0.20 points). Interestingly, the problem-oriented treatment apparently produced commensurate cognitive performance across the computer anxiety dichotomy.

**Relationship of Computer Anxiety and Treatment.**

Certainly, any prescriptive conclusions based upon these significant but isolated findings would be tenuous. Nevertheless, the result here tends to support that certain components of the problem-oriented strategy ameliorate the influence of computer anxiety on concept acquisition in microeconomics to some degree. It is also notable that this difference became evident only after the two-week delay following the initial posttest, suggesting that treatment x computer anxiety relationships are more subtle and become attenuated over time as seen in cognitive retention effects. In this case, future research needs to (a) systematically examine which features of an instructional courseware strategy are critical to improved performance among individuals.
with higher computer anxiety (more negative attitudes toward computer technology), and (b) that observations of cognitive performance differences related to both treatment and anxiety factors need to be conducted immediately following an instructional intervention as well as repeated after an appropriate period of time delay (in this study, a full two weeks). Thus retention results can serve not only to augment and clarify knowledge of enduring treatment effects, but also serve an important role in the analysis of the affective factors involved in the instruction/learning dynamic.

Relationship of Economic Knowledge, ATE and EAS

As presented in Table 40, significant parallel disordinal interactions between ATE and EAS were observed across all three scales of Posttest I (the Overall, Higher-Order and Lower-Order means) and also on the lower-order subscale of Posttest II. These four interactions confirm that subjects with High ATE/High EAS consistently outperformed other subjects. Interestingly, in each case the greatest difference was seen between the high performers in the High ATE/High EAS group and those subjects in the High ATE/Low EAS group (mean differences of 3.00, 2.80, 1.20, and 2.30 points, respectively).
While not addressing the issue of causality directly, these results support the importance of the relationship between student attitude toward economics as a subject matter (ATE) and the more abstract construct of economic attitude sophistication (EAS). Importantly, EAS appears to represent more of a cognitive rather than an attitudinal assessment, since in each cognitive performance comparison between subjects with a more positive attitude toward economics (High ATE), the repeated superiority of those subjects reporting High EAS can be seen (effects size in standard deviation units = .57, .94, .41 and .84, respectively).

A significant ordinal interaction of treatment and EAS on the lower-order subscale of Posttest I indicates a differential effect of EAS on treatment groups (See Figure 6 in Chapter IV). When comparing High and Low EAS subjects, the problem-oriented group outscored the rule oriented group in both cases. For Low EAS subjects, this difference is marginal (0.10 points), but for the High EAS subjects, there is a significantly better cognitive performance (1.70 points mean difference) for the problem-oriented group. This latter difference is difficult to explain, although the treatment variable was previously shown to produce a significant main effect.
on the Posttest I lower-order score \( F = 4.07; p = .045 \). The treatment may have been the primary factor involved here, but EAS is clearly affecting cognitive performance simultaneously.

The nature of the relationship between treatment and EAS was further clouded, however, by the finding of a significant disordinal interaction between these two factors on the lower-order subscale of Posttest II (See also Figure 7 in Chapter IV). As shown previously in Figures 6 and 7, the treatment x EAS relationship is essentially reversed between the immediate and delayed posttest observations. While Low EAS problem-oriented subjects outscore the Low EAS rule-oriented subjects by a substantial 1.80 points, the converse is true for the High EAS subjects where the rule-oriented group performed a mean of 0.80 points higher. It is also notable that this particular interaction produced the strongest statistical significance of any ANOVA main effect or interaction observed in this study \( F = 7.84; p = .006 \), further indicating the importance of future investigation into the treatment x EAS relationship.

In the case of Posttest II, the retention issue is involved in conjunction with the treatment x EAS interaction. The most interesting finding here is that over the two-week delay between Posttest I and II, High
EAS subjects in the rule-oriented group performed at nearly the same level on the Posttest II, losing a mean of only 0.20 points. The High EAS subjects in the problem-oriented group, however, lost on average 2.70 points over the same period. Low EAS rule-oriented subjects lost an identical 2.70 points, while Low EAS problem-oriented subjects lost only 1.00 points.

The relative stability of High EAS rule-oriented performance across the two posttests supports the value of higher economic attitude sophistication in conventional rule-oriented tutorial instruction in precollege microeconomics. The substantial retention performance decrease by rule-oriented subjects in the Low EAS group also confirms the importance of EAS in rule-oriented economics courseware. Perhaps the least comprehensible result is the significantly poorer knowledge retention of High EAS subjects using the problem-oriented strategy. Specifically, the Graphic Method cognitive strategy was, if learned well, posited to be effective as an analysis tool that would augment the ability to solve domain problems. The acquisition of this ability would then be observable in improved long-term cognitive performance, but this was obviously not supported by the evidence. This result suggests the need for further research into the relationship between
higher-order thinking skills and the knowledge-based construct of attitude sophistication.

The Relationship Between Cognition and Economic Attitudes

All affective measures retain cognitive dimensions to their statements, but the degree of relationship between cognition and the structure of knowledge on the one hand and values, beliefs and opinions on the other has remained open to investigation and controversy.

The EAS predominantly reflects intellectualized attitudes with strong cognitive dimensions while the ATE reflects affective associations (Martin & Briggs, 1987). The ATE measure exemplifies an objective attitudinal index that observes subject related affect (Bloom, 1976) from a personally-referenced valuation of economics as a subject matter (See Appendix G, Statement 5: "I enjoy economics"). By contrast, however, the EAS measure measures the degree of conformity between the perspective of individual beliefs about economic issues and the prevailing consensus of professional economists toward those same issues. Convincingly, the EAS construct has both substantial cognitive and affective components that are a hybrid of objective knowledge and subjective opinion.
The Hybrid Nature of EAS. The highest level of the Bloom et al. taxonomy of the cognitive domain is evaluation, yet it is unclear where the cognitive component of evaluation ends and the affective component of evaluation begins. Economic attitude sophistication is such a construct. The line between individual objectivity and subjectivity in the interpretation and valuation of each EAS statement appears blurred. Indeed, EAS statements may be interpreted as primarily evaluative in nature, a hybrid construct involving various degrees of knowledge, experience, acceptance and preference for certain values.

Some of the criteria of the analysis level of the Bloom et al. taxonomy seem to include criteria of the evaluation level. The "ability to indicate logical fallacies in arguments," for example, is a subset of the analysis of elements and relationships including (a) the ability to recognize unstated assumptions, (b) the skill in distinguishing facts from hypotheses, (c) the ability to check the consistency of hypotheses with given information and assumptions, and (d) the skill in comprehending the interrelationships among the ideas in a passage (Krathwohl et al., 1964, pp. 191-193). The cognitive taxonomy itself is more effectively perceived
as a continuum with a diversity of overlapping and interdependent components.

Also, on the basis of (a) the consistently lower reliability estimates obtained for the EAS index, (b) the results of interactions involving EAS and other variables, and (c) the nature of the EAS statements themselves, there is additional support for the contention that EAS is an ambiguous construct requiring substantial revision and critical validation if it is to become a tenable and salient factor in future economic education research. Higher scores on the EAS were often correlated with poorer performance on the cognitive outcome measures of this study.

One possible explanation is that the factually-oriented statements of the EAS questionnaire can be interpreted in different ways depending on prior factual knowledge of economic policies and their consequences in a market economy, political orientation (e.g., conservative versus liberal), and other unmeasured personological characteristics such as intelligence capable of producing diverse personal interpretations of EAS statements. The statement "Profits should not be regulated by government" would ostensibly produce a 'strongly agree' response by consensus from economists despite opposing perspectives that would support, under
some circumstances, a windfall profits tax regulation. The creation of a National Labor Relations Board and the existence of federally-mediated 'binding arbitration' for the resolution of certain labor-management conflicts would tend to moderate strong disagreement of the statement "When a strike occurs, government should step in and settle the dispute." Federal antitrust regulation and some conflicts in the arena of interstate commerce moderate strong disagreement of the statement "When a business gets big, it should be controlled by government."

Thus, while serious economic educators and theorists might form some level of consensus on the EAS statements, it remains uncertain and equivocal whether contradictory student EAS responses on the precollege level accurately reflect individual levels of economic understanding, misinformation, ideological orientation, or even political indoctrination fostered by parents, teachers, or mass media journalism. These vulnerabilities of the EAS index to multiple interpretations may or may not confound EAS results and at least posit that EAS as presently measured is not a purely attitudinal measure but rather an interesting and potentially insightful hybrid construct and needs additional verification if it
is to become a more useful tool in the precollege economic curriculum.

Despite the fact that the observations in this study support the earlier contention of Siegfried & Fels (1979) that EAS has not yet clearly been established as a measurable output, the intrinsic linkage between evaluation, cognition and affect present a significant opportunity to observe EAS as an indirect bridge between these broader constructs.

Future research in economics education needs to address the hybrid nature of EAS and not assume that the issue as defined has been settled. If a stronger attitudinal component of the EAS is desired, future EAS scale developers should consider (a) reducing the number of statements that could be interpreted as factual, (b) rephrase statements that are open to interpretation as to their precise meaning, and (c) reduce the use of universals or quasi-universals (all, most, everybody, people) that may potentially introduce ambiguity and should be avoided (Edwards, 1957).

**Final Implications and Recommendations**

The implementation of microcomputer courseware in precollege economics is a fertile area for continued
research and development. Computer courseware designed to teach abstract relational concepts, principles and cognitive strategies should probably be integrated as appropriate within a curriculum as opposed to one or two isolated, stand alone intensive instructional units. The social and political nature of economics concepts should be discussed, clarified, elaborated and debated within serious inquiry discussions. In particular, alternative instructional formats involving different problem-oriented approaches ought to be developed in precollege education if the basic goals of the Joint Council on Economic Education are to be realized. New research-based computer and interactive video courseware programs for the teaching of economics should receive priority attention from both private courseware developers and regional educational consortia such as the Centers of Economic Education.

As noted in Chapter II, there is considerable research evidence to confound the results of most media comparison studies and to demonstrate the inadequacy of methodologically contrived computer courseware versus human teacher investigations (Clark, 1985, 1983). Specifically, much research into computer-based applications to instruction in economics has reflected little understanding of the field of educational
computing research, instructional systems design, cognitive psychology, and often major learning theories in general. One of the recurrent leaps in external validation is the advocacy for widespread implementation of a particular courseware strategy or instructional innovation that purports a certain technique is unequivocally the most appropriate for every content or every instructional situation. Most comparative research contrasting pedagogical design or curricular implementation strategies for a content-based courseware program seems to avoid the simultaneous existence of a spectrum of strategies and courseware techniques that may be more appropriate for certain social, interpersonal or individual cognitive and affective instructional goals than others.

Another fallacy common to much research in precollege computer-based instruction and economics education is the artificial evaluation of an instructional intervention or strategy apart from the wider actual context of the learning experience, specifically the dynamic role of the teacher in classroom and school environments as well as curriculum development, and the need for a diversity of high-quality educational experiences in the lives of students. The research project reported here is no exception to this
problem. One possible alternative is for more ethnographic research into how certain advanced instructional technologies can best be designed, tested, revised, continuously improved and tailored to local student populations, individual differences, instructional problems, subject matter and curricular goals. The underlying issue of the instructional alignment of local and state curriculum with the needs and goals of individual school districts is collateral to the efficacious design and implementation of future instructional technology systems.

Learning is widely acknowledged to be a complex process, and that consequently, designing effective instruction involves more than a rigid, narrowly-defined prescriptive set of techniques and strategies. The simplistic quantitative comparison of techniques in vitro common to much experimental research in education serves a functional purpose, principally exploratory, but knowledge of the efficacy of different instructional methods require a much broader and critical investigation in a curricular context to be meaningful to any substantive improvement of educational theory and practice.

The conventional practice of decontextualizing educational and cognitive science research ought to
change, and for economic education scholarship in particular to reflect a movement toward a critical, eclectic, multi-disciplinary research and development agenda that broadly integrates the knowledge of other relevant domains in a sophisticated and comprehensive manner (See Di Vesta & Rieber, 1987). Media comparison studies should be de-emphasized while encouraging inquiry into which components of various instructional strategies and methods are effective under differing conditions of learning, despite the historically endemic problems of internal validity confounding, small effects sizes and equivocal results. Many of these problems may be minimized by the consistent improvement in research designs and statistical techniques that are conceptually and technically appropriate for both computer-based instruction and economics education.

These improved empirical techniques may include, for example, (a) continuous acquisition of on-line computer performance data that can both record and analyze student responses including error patterns and skill mastery, remediation and feedback sequences, precision monitoring of time-on-task, and attention to cuing; (b) repeated measures across an entire semester course or series of courses within a curriculum, (c) a systematic disaggregated data analysis of individual personological
or instructional vectors, and (d) theory-based psychometric modeling using two-stage least squares regression or other tools such as path analysis.

A Final Recommendation

Certainly, learning theorists in cognitive psychology and both researchers and practitioners in instructional systems design must integrate their various perspectives, knowledge and expertise if the next generation of computer-based instructional systems is to make a pragmatic long-term change in precollege student knowledge of content areas and in the development of educated citizens capable of clear, logical reasoning and critical thinking about problems in the real-world. The multidisciplinary fields of instructional technology and economics education have a remarkable potential to make an important contribution to this development, and it is with that belief that the findings of this report are faithfully presented.

Summary of Recommendations and Implications

1) Continued investigations comparing the gross superiority of one instructional strategy with
another are (a) methodologically suspect by a myriad of uncontrollable and potentially confounding variables, (b) cost-ineffective, requiring a substantial investment in research with only marginal results; and (c) probably epistemologically bankrupt on their face. They contribute little empirical or theoretical understanding of the real complexity of the processes of human learning and instruction.

2) Specifically, any future investigations comparing the gross superiority of a "problem-oriented" or a "rule-oriented" instructional strategy will unavoidably encounter, and fail to reconcile, the vast spectrum across the literature of definitions and interpretations of the terms discovery learning, guided-discovery, expository instruction, inductive instruction and deductive instruction, among others. These and similar terms will consistently appear overlapping and ambiguous since their essentially arbitrary definitions are highly dependent upon the perspective of the investigators or other sources of authority. Regarding the ultimate and definitive descriptions of these terms, there is no final authority.
3) Continued research into the psychosocial and psychosomatic mechanisms of human stress as related, identified or in other ways associated with individual perceptions of computer technology are necessary if this phenomenon is to be better understood and appropriate intervention developed. Computer anxiety, for example, may reflect a wider societal problem with advanced technologies in many forms, the technostress syndrome, and may need to be considered in conjunction with human factors and ergonomic research in human-machine interfaces by the next generation of designers and developers of computer-based instructional courseware.

4) More sensitive affective and cognitive instruments and empirical techniques need to be developed to observe and evaluate the computer anxiety issue. Perhaps the unobtrusive use of on-line computer-based cognitive and affective assessments might more accurately acquire human stress information during actual encounters with the perceived object of threat (the computer technology being used).

5) Moreover, current research into human-computer interaction, particularly in precollege populations,
suggests an expanded role for qualitative and ethnographic research methodologies in the context of actual school situations involving computer-based learning technologies (including interactive video, compact disc, local-area networks and electronic mail communication systems).

6) Systematic knowledge of individual learning differences might be expanded if the deep versus surface approach towards learning dichotomy could be developed on a rigorous theoretical and empirical basis. The use of the dichotomy may have potential benefit particularly in relation to instruction in an unfamiliar subject matter to students and in the design of appropriate remediation and intervention involving alternative motivational and learning strategies for students at different places in the deep/surface continuum.

7) A greater understanding of when a deep or a surface approach is optimal for certain learning tasks, and what other affective variables, personological factors and instructional conditions and strategies are interacting in various computer-based learning environments, would provide a greater depth to the
use of this knowledge in future instructional courseware. Considerable improvement of a nationally-normed and validated measure or set of measures that accurately evaluated individual differences in attitude toward learning, particularly in relation to the deep versus surface dichotomy, may augment knowledge in a variety of fields including instructional psychology, instructional design, and teaching on lower-order and higher-order thinking skills and knowledge in a diversity of content areas.

8) Critical questions related to the construct of economic attitude sophistication need to be addressed. Is EAS a clear, unambiguous measurement construct that can be validated across the field of economic education by a majority of experts and on a consistent basis? More important, perhaps, is whether EAS should be considered an affective measure since it relies so heavily on the capacity of students to recognize prevailing economic truths that are essentially knowledge-based and therefore principally cognitive in nature? Is EAS related to attitude, opinion, knowledge—or all three, and if EAS is a hybrid cognitive/affective construct, how
should it be interpreted and its results applied? The EAS index developed by Soper and Walstad, while a valuable and functional tool, could be revised and made more reliable and precise, potentially improving the diagnostic and prescriptive capabilities of the ATE/EAS and TEL (Test of Economic Literacy) instrument triad.

9) If the major goal of an instructional program is improvement in performance means on standardized knowledge-based, multiple-choice achievement tests (e.g., Test of Economic Literacy), then a diversity of instructional approaches, strategies and media may potentially be equally effective in producing desired learning outcomes. But this narrow goal may be inadequate for broader educational objectives such as the teaching of thinking and problem-solving across the curriculum.

10) The results here support, if only to a small degree, the emerging trend in social science education towards more context-based, problem-oriented texts, workbooks, films and other media-based learning materials, particularly in the area of precollege economics. The national Joint Council on Economic
Education and related regional organizations should be encouraged to promote the design, development and widespread implementation of these problem-oriented instructional programs and encourage instructional flexibility to reduce the conventional use of techniques that fail to integrate the relational nature of economic concepts and ignore the active learner role in the personal construction of new knowledge.

11) Specific cognitive strategies and problem-solving techniques could be developed and both (a) taught explicitly and (b) embedded within an instructional task as an integral component of the learning experience. An instructional simulation may have extended motivational and interest-related value for precollege students in economics. Of course, further research and development is still needed in the production of cost-effective, highly engaging, content-based computer-based instructional simulations in economics-related scenarios (See the Tom Snyder instructional simulation, Make Millions, 1984).
LIST OF REFERENCES


APPENDIX A

COMPUTER-BASED RANDOMIZATION PROGRAM
PROGRAM Protoray3;
{ Copyright 1987 by Vincent E. Lasnik *}
{ Turbo Pascal 3.1, Borland, Inc., MS DOS Version *}

VAR
Ray : array[1..30] of integer;

PROCEDURE rayprint; forward;
PROCEDURE rayload; forward;

PROCEDURE rayset;
BEGIN
FOR A:=1 to 30 DO
BEGIN
Ray[A]:=0;
END;
END;

PROCEDURE rayprint;
BEGIN
s:=5;q:=5;
FOR A:=1 to 15 DO
BEGIN
gotoxy (z,s);
Writeln (Ray[A]);
s:=s+1;
END;
FOR A:=16 to 30 DO
BEGIN
w:=z+10;
gotoxy (w,q);
writeln (Ray[A]);
q:=q+1;
END;
z:=w+15;
END;

PROCEDURE genran;
BEGIN
A:=0;
R:=RANDOM (30) + 1;
END;
PROGRAM Protoray3; { Continued }
(* Copyright 1987 by Vincent E. Lasnik *)

PROCEDURE testran;
BEGIN
  A:=A+1;
  H:=Ray[A];
  IF R=H THEN
    BEGIN
      genran;
      testran;
    END;
  ELSE IF R<>H THEN
    IF H=0 THEN
      BEGIN
        rayload;
      END
    ELSE testran
  END;
END;

PROCEDURE rayload;
BEGIN
  Ray[A]:=R;
  X:=A;
  X:=X+1;
  IF X < 31 THEN
    BEGIN
      genran;
      testran;
    END
  ELSE rayprint;
END;

PROCEDURE stochast;
BEGIN
  rayset;
  genran;
  testran;
END;

BEGIN
  clrscr;
  z:=5;
  stochast;
  stochast;
  stochast;
END.
Sample Output for Protorav3 Randomization Program
(e.g., Where $n = 30$)

| 15 | 17 |   |   | 23 | 4 |
| 12 | 18 | 26 | 1 | 16 | 17 |
| 14 | 28 | 19 | 23 | 6 | 24 |
| 29 | 21 | 10 | 9 | 5 | 13 |
| 11 | 19 | 22 | 25 | 22 | 3 |
| 30 | 24 | 14 | 15 | 11 | 18 |
| 7 | 26 | 21 | 12 | 9 | 12 |
| 27 | 25 | 8 | 3 | 20 | 21 |
| 13 | 23 | 5 | 11 | 19 | 10 |
| 5 | 1 | 28 | 7 | 14 | 25 |
| 8 | 9 | 29 | 24 | 30 | 28 |
| 16 | 20 | 13 | 16 | 29 | 15 |
| 10 | 3 | 20 | 30 | 27 | 26 |
| 4 | 2 | 18 | 6 | 7 | 8 |
| 22 | 6 | 17 | 27 | 1 | 2 |
APPENDIX B

DESCRIPTION OF COURSEWARE TREATMENTS
Overview

The following supplemental material provides a detailed description of the two courseware treatments including: (a) a complete list of the microeconomic concepts taught during each courseware lesson set, (b) a brief description of the contents of each lesson disk, and (c) the systematic presentation of a lesson module (there are several modules or sections to each lesson disk) demonstrating the different approaches of the problem-oriented and rule-oriented courseware strategy, respectively.

List of Microeconomic Concepts Taught

The microeconomic concepts and principles taught in each courseware lesson unit included:

A) The concept of microeconomics
   1) Scarcity
   2) The market system (markets & prices)
   3) The law of demand
   4) The law of supply
   5) The principle of equilibrium
      a) Equilibrium price
      b) Equilibrium quantity
      c) The equilibrium point
   6) The demand schedule and curve
   7) The supply schedule and curve
   8) The determinants of demand
   9) The determinants of supply
  10) Changes in demand and quantity demanded
      a) Movement along versus shifts of the demand curve
  11) Changes in supply and quantity supplied
      b) Movement along versus shifts of the supply curve
  12) Independent changes in supply and demand
  13) Simultaneous changes in supply and demand
  14) Surplus and shortage
  15) Consumers and producers
Brief Description of Each Lesson Disk

This section of Appendix B describes the basic contents of each lesson disk, including the topics covered and the source of the software program constructed for that lesson disk. MicroThink and MicroBIZ are the lesson set designations for the rule-oriented and problem-oriented courseware series, respectively (Lesson Disks 1, 2, 4 and 5 for both sets; Lesson Disks 3 are both hybrids adapted and enhanced from existing public domain software). Although authored by the investigator, the MicroThink and MicroBIZ disks are noted as produced by "Knowledge Design Associates". These lesson disks (1, 2, 4 and 5 for each series) are copyright by Vincent E. Lasnik (1987) and are available upon request for research purposes by contacting the author in writing (Note: Costs for diskettes, diskette mailers, and postage must be paid in advance).

RULE-ORIENTED LESSON DISK 1

The introductory rule-oriented lesson contains a general introduction to lesson series and the area of microeconomics. An advanced organizer presents brief name and definition sets for each concept noted in the List of Microeconomics Concepts Taught of this appendix (approximately one third of the lesson). The lesson introduces scarcity and the market system using (a) several expository screens of information and (b) rule-example-practice type sequencing. Corrective feedback identifies the correct choice after each student response to a question. High-resolution graphs of the supply and demand curve are used in conjunction with text information where appropriate. The lesson concludes with similar sequences emphasizing the laws of supply and demand, the supply and demand schedules and curves, and the basic determination of price and quantity on those curves. A brief review summarizes the concept names and definitions taught in LESSON
1. A concise lesson quiz (6 questions) concludes the lesson disk. This program was created by the investigator in the Apple SuperPILOT authoring language.

RULE-ORIENTED LESSON DISK 2

Similar to rule-oriented LESSON 1, this program began with an advanced organizer that consisted of (a) a review of all concept names and definitions in the lesson series, and (b) an emphasis on the concepts to be taught in LESSON 2. The concepts taught in this program included the determinants of supply and demand, and resulting changes in price and quantity corresponding to changes in those determinants and thus changes in the supply and demand curves. Lesson rule-example-practice sequencing, corrective feedback, and the use of graphics was commensurate to LESSON DISK 1. Rule tables emphasizing the change relationships for single and independent change in supply and demand are highlighted in the lesson summary. A brief review summarizes the concept names and definitions taught in LESSON 2. A concise lesson quiz (8 questions) concludes the lesson disk. This program was created by the investigator in the Apple SuperPILOT authoring language.

RULE-ORIENTED LESSON DISK 3

LESSON 3, while similar in overall scope, substance and rule-example-practice instructional sequencing, is a hybrid program derived from a special enhanced version of the JCEE microeconomics lesson disk Marketplace (1985). Parts 1 and 2 of the original Marketplace program were adapted for greater consistency and clarity of presentation. The disk was adapted because (a) the core concepts of supply and demand were systematically reviewed and then integrated in the principle of equilibrium, and was the appropriate content and format for rule-oriented LESSON 3; (b) the presence of high-resolution graphics and corresponding animated changes in the supply and demand curves augmented the textual presentation commensurate to embedding the Graphic Method within the lesson, and (c) the microeconomics content, although needing revision, provided an available source of appropriate question and
feedback sequences with previously unencountered
eamples generally within the format of the rule-
oriented pedagogy. The lesson was originally
written (JCEE, 1985) and subsequently modified in
the Extended BASIC programming language, Apple
version.

RULE-ORIENTED LESSON DISK 4

Similar to rule-oriented LESSONS 1 and 2, this
program began with an advanced organizer that
consisted of (a) a review of all concept names and
definitions in the lesson series, and (b) an
emphasis on the concepts to be taught in LESSON 4.
The concepts taught in this program included the
simultaneous changes of supply and demand based on
changes in the determinants of supply and demand,
respectively, and resulting changes in price and
quantity corresponding to those simultaneous changes
in the supply and demand curves. Lesson rule-
example-practice sequencing, corrective feedback,
and the use of graphics was commensurate to LESSON
DISKS 1 and 2. Rule tables emphasizing the change
relationships for simultaneous changes in supply and
demand are highlighted throughout the lesson. A
brief review summarizes the concept names and
definitions taught in LESSON 4. A concise lesson
quiz (8 questions) concludes the lesson disk. This
program was created by the investigator in the Apple
SuperPILOT authoring language.

RULE-ORIENTED LESSON DISK 5

Generally similar to rule-oriented LESSONS 1, 2, and
3, this concluding program began with a review of
all concept names and definitions in the lesson
series, and (b) an emphasis on the concepts taught
in the preceding LESSON 4. The first half of the
lesson consisted of a concept review emphasizing
rule names and definitions, the use of graphic
supply and demand curves, and rule tables
emphasizing the change relationships for both
independent and simultaneous changes in supply and
demand. The second half of the lesson consisted of
a mastery quiz similar in format to the summary
quizzes in LESSONS 1, 2 and 4 but containing 20
questions across the full range of concepts taught
in the preceding four lesson disks. This program
PROBLEM-ORIENTED LESSON DISK 1

The introductory problem-oriented lesson contains a general introduction to the lesson series and the area of microeconomics very similar to that of the rule-oriented lesson disk 1, including an advanced organizer presenting brief name and definition sets for each concept noted in the List of Microeconomics Concepts Taught of this appendix (approximately one third of the lesson). Unlike the rule-oriented lesson disk 1, however, this lesson introduces the concepts of supply and demand as integral to understanding the market system, and presents the principle of equilibrium as the focus of the interrelationship between supply and demand. Following the introduction, the "MicroBIZ" simulation format begins, and the student user is placed in the role of a manager running his or her own company (as described in Experimental Treatments, Chapter III). Simple independent changes in the supply and demand schedules and curves based upon corresponding changes in the determinants are introduced with problem-examples in the latter two-thirds of the lesson. The graphic Method cognitive strategy is taught as a problem-solving tool to analyze each new problem situation and thus predict the behavior of price and quantity. A brief review concludes and debriefs the lesson. This program was created by the investigator in the Apple SuperPILOT authoring language.

PROBLEM-ORIENTED LESSON DISK 2

The second problem-oriented lesson contains an introduction to the lesson series and the area of microeconomics very similar to that of the problem-oriented lesson disk 1, including an advanced organizer presenting brief name and definition sets for each concept noted in the List of Microeconomics Concepts Taught of this appendix (approximately one fourth of the lesson). The rationale for repeating the overview section in the beginning of LESSON DISKS 1 and 2 was (a) a basic review and
reorientation to the lesson content, and (b) to maintain continuity for students missing the first lesson disk due to absence. The "MicroBIZ" role-playing simulation then begins, emphasizing the principle of equilibrium as the focus of the interrelationship between supply and demand, and placing the student user in the role of a manager running his or her own company (as described in Experimental Treatments, Chapter III). Simple independent changes in the supply and demand schedules and curves based upon corresponding changes in the determinants are introduced with problem-examples in the latter three-fourths of the lesson. The graphic Method cognitive strategy is again taught as a problem-solving tool to analyze each new problem situation and thus predict the behavior of price and quantity. A brief review concludes and debriefs the lesson. This program was created by the investigator in the Apple SuperPILOT authoring language.

PROBLEM-ORIENTED LESSON DISK 3

LESSON 3, while similar to the other problem-oriented lessons in overall scope and substance, is a hybrid program derived from two diverse sources: (a) a graphic microcomputer simulation, Shifty, originally designed for college introductory microeconomics courses (Post, 1985), and (b) a special enhanced version of the third section of the JCEE microeconomics lesson disk Marketplace (1985). The Shifty simulation was not modified but was used intact with the permission of the author. A special introductory module (written in Extended BASIC) was added to the beginning of the disk and provided a detailed operational preview of the Shifty simulation. In Shifty, the student is presented with three graphs on a single screen. Each graph corresponds to changes in supply, demand, and equilibrium, respectively. A small menu on the same screen presents five determinants: taxes, complements, substitutes, sellers and input cost. The student first selects one of these factors, or the "None" option, and then chooses to increase or decrease that factor. The student then uses arrow keys on the keyboard to manipulate the supply or demand curve corresponding to the change in the determinant. Then the student records the correct curve behavior by noting whether the price and
quantity would increase, decrease, or remain the same. This procedure is repeated for both main curves (supply and demand). Then the student predicts how the interaction of the supply and demand curves will result in a new equilibrium price and quantity (increase, decrease, or indeterminate). Corrective feedback is provided in each case, and points are accumulated until the student terminates the Shifty program and then proceeds to the second half of the lesson disk. In the second half of LESSON DISK 3, the presence of high-resolution graphics and corresponding animated changes in the supply and demand curves augmented embedding the Graphic Method within the lesson and provided an available source of appropriate question and feedback sequences with previously unencountered examples to serve as an effective debriefing and application of knowledge gained from the Shifty simulation. The Marketplace lesson section was originally written (JCEE, 1985) and subsequently modified in the Extended BASIC programming language, Apple version.

PROBLEM-ORIENTED LESSON DISK 4

The fourth problem-oriented lesson contains a brief review of the lesson series and the area of microeconomics similar to that of the problem-oriented lesson disk 2, including an advanced organizer presenting brief name and definition sets for each concept noted in the List of Microeconomics Concepts Taught of this appendix (approximately one fourth of the lesson). The "MicroBIZ" role-playing simulation then begins, emphasizing the principle of equilibrium as the focus of the interrelationship between supply and demand, and placing the student user in the role of a manager running his or her own company (as described in Experimental Treatments, Chapter III). In this lesson, complex simultaneous changes in the supply and demand schedules and curves based upon corresponding changes in the determinants are introduced with problem-examples in the latter three-fourths of the lesson. The graphic Method cognitive strategy is reviewed as a problem-solving tool to analyze each new problem situation and thus predict the behavior of price and quantity. A brief review concludes and debriefs the lesson. This program was created by the investigator in the Apple SuperPILOT authoring language.
The fifth and final problem-oriented lesson contains a brief review of the lesson series and the area of microeconomics similar to that of the problem-oriented lesson disk 2, including an advanced organizer presenting brief name and definition sets for each concept noted in the List of Microeconomics Concepts Taught of this appendix (approximately one fourth of the lesson). The "MicroBIZ" role-playing simulation then begins, emphasizing the principle of equilibrium as the focus of the interrelationship between supply and demand, and placing the student user in the role of a manager running his or her own company (as described in Experimental Treatments, Chapter III). In this lesson, the learning of various microeconomic principles is evaluated in 10 problem situations presented sequentially to the student "manager". These problems include concepts across the range of concepts covered in lessons 1, 2, 3 and 4. The entire program thus acts to debrief the previous simulation experience. This program was created by the investigator in the Apple SuperPILOT authoring language.
Problem-Oriented Lesson Example: The Law of Supply

[Introduction & review section]:

1. Introduction screen

"Following the introduction, you will jump right into the energizing world of your own business. You will study economics by applying what you learn as you run your own company."

2. Statement of objectives

Listing of all concepts taught in series (See list in beginning of this appendix). (Note: The statement of objectives and the advanced organizer sections are generally identical in both rule-oriented and problem-oriented introductions and overviews).

3. Advanced organizer program structure (submodules):

  a) setdef (introduces equilibrium and markets)
  b) demdef (law of demand)
      i) ddef (determinants of demand)
  c) supdef (law of supply)
      i) sdeter (determinants of supply)
  d) market (introduction to scarcity, prices and quantities, and the market system)
  e) axes (explanation of graphs, horizontal and vertical axes)
  f) 2aodef (content subroutine)
      i) curve1 (demand curve graph & information)
      ii) curve2 (supply curve graph & information)
      iii) curve3 (equilibrium graph & explanation)
      iv) pequil (equilibrium concept review)
      v) eprice (equilibrium price information)
      vi) equant (equilibrium quantity information)
  g) 3aodef (content subroutine)
      i) incdem (independent increase in demand)
      ii) decdem (independent decrease in demand)
      iii) incsup (independent increase in supply)
      iv) decsup (independent decrease in supply)
Lesson Module: Supply (Part I) (Note: each section A, B, etc., is divided as a logical break in the dialogue and does not represent a single screen text per se).

A) "MicroBIZ Problem One" new screen header)

1) Congratulations, (name), you have just graduated from the Brain Trust University School of Business...Better yet, (name), you are about to open your own business in the city of your dreams...We represent MicroBIZ Associates, Inc., a professional consulting firm for young companies such as the one you are starting. Hiring us was the first good business decision you made!

2) Before we go any further (name), it would help if you tell us what it is you are going to produce and sell. That way, we can keep track of things as you move through the tough "real world" of the market system.

[Input]: (name of student product)
[Input]: (name of student company)

( Other motivational frames here )

3) "Six Months Later" (screen header). Well, (name), you have really been hustling during the last six months and have got some eager investors to put up the $90,000 in capital you needed to get your business (Bus. name), Inc., off the ground...Your company (Bus. name), Inc., is now in full production of (Prod. name). As the manager of (Bus. name), Inc., you will receive computer business reports that will be sent to your office from time to time.

4) You will have the chance to study these electronic mail reports as they come in and to review "the figures" in supply and demand schedules. You should also get into the idea of checking out the current business situation using graphs of the supply and demand schedules. As you'll see, the supply and demand curves are always interacting and they reveal the economic causes and effects involved in the changing market conditions of your enterprise. Thus, as you operate your business, you
will use the graphs to make important decisions based upon your growing understanding of microeconomics.

5) "First Quarter Supply Schedule" (screen header). "E-mail" screen border and notice: (name), your first quarter supply schedule is coming out in the electronic mail...

*{ Name of Manager }
*{ Name of Business }
*{ Name of Product }

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10</td>
<td>6500</td>
</tr>
<tr>
<td>8</td>
<td>5500</td>
</tr>
<tr>
<td>6</td>
<td>4500</td>
</tr>
<tr>
<td>4</td>
<td>3500</td>
</tr>
<tr>
<td>2</td>
<td>2500</td>
</tr>
</tbody>
</table>

6) We hope you found the E-Mail interesting. Let's take a moment to analyze your supply schedule and curve...We'll condense the schedule and curve and put them together side by side so that you can observe for yourself the relationship between them and between price and quantity supplied:

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$10</td>
<td>6500</td>
</tr>
<tr>
<td>8</td>
<td>5500</td>
</tr>
<tr>
<td>6</td>
<td>4500</td>
</tr>
<tr>
<td>4</td>
<td>3500</td>
</tr>
<tr>
<td>2</td>
<td>2500</td>
</tr>
</tbody>
</table>

7) (Hypothesis presentation and testing):
(Query): What can you say about the relationship between price (the price you would like to sell your product at) and quantity supplied (the amount of the product you are able and willing to sell in the marketplace)?
Based on your analysis of the supply schedule and curve, which of the hypotheses on the following screen do you feel is true?

1] As the price you sell your product at increases, the quantity you supply decreases.

2]* As the price you sell your product at increases, the quantity you supply increases. (correct hypothesis)*

3] As the price you sell your product at decreases, the quantity you supply increases.

4] I would like to view the supply schedule and curve again to be really sure.

8) { Remediation, corrective feedback logic here}
(Generally parallel to rule-oriented logic and corrective information)

9) (Correct program response): Excellent, (name), you observed that as the PRICE you sell your product at goes higher, so does the amount of (Prod. name) you want to produce and sell.

10) ("Supply Summary" general screen header here): Think for a second...At higher prices, you as a producer have more incentive, or motivation, to sell more of your product. That only makes good (business) sense...You have discovered for yourself what is the fundamental "Law of Supply" in economics: As prices go up, producers want to sell more! As prices go down, producers want to sell less!

11) The knowledge you have gained here will serve you well as you get more involved in the realistic business problems and decisions you will make in the future. { Go on to "Law of Demand" section next }

* * * * * * * * * * * *
The preceding section demonstrating the general tone and pattern of the problem-oriented strategy is compared to the rule-oriented strategy in the later section of this appendix. A basic concept (supply) was chosen for the comparison for the purpose of clarity. In the case of the problem-oriented strategy, the complexity of the role-playing scenario rapidly escalates as the simultaneous changes of supply and demand are presented in the new problem situation. The emphasis from the beginning is on the change relationships between supply and demand, with the focal point being equilibrium. The Graphic Method is presented as a specific tool that the student "manager" can approach the resolution of each new problem situation. An actual example from later in the problem-oriented lesson set is presented below to demonstrate how this portion of the instruction is delivered to the student:

a) "A Plan of Attack" new screen header).
There is a very useful technique you can use when trying to figure out what is going on in one of your business situations in terms of supply, demand, prices and quantities...

b) You can predict what will most likely happen if you apply the Graphic Method to your analysis. You should approach each problem looking for several important things:

1] What are the MAIN ELEMENTS in the situation?
2] What is CHANGING in the situation?
3] What is the general outcome or result?
4] Why is the outcome happening? (The cause)

c) After you observe the situation and have a sense what is happening, PUT THE MAIN FACTORS INTO A GRAPH to be able to predict what the outcome will be. Follow these steps:

1] Draw a small graph like the one you see at the left (Note not shown here: an "X" graph with stationary supply and demand curves in a central equilibrium state), with the prices and quantities and the
supply and demand curves meeting in the center at a clear Equilibrium Point.

2] Then draw in the new curves as they have changed (increased, decreased, or remained the same).

3] Find the new price and quantity by following the Equilibrium Point out to the price and quantity axes.

** (Problem Situation Example: Change in demand due to a change in a determinant: consumer expectations)

d) (Text) The Christmas selling season is coming soon. Consumers ANTICIPATE you will soon lower your price for (Prod. name) during this year-end sale. People will tend to buy less now hoping to buy more later when your sale prices fall.

e) (Query) What will this do to your demand curve now? And what do you predict will happen to the new equilibrium price and equilibrium quantity of your product?

f) ("Applying the Graphic Method" screen header) Use the following strategy to analyze and understand most economic problems you will face in this business adventure:

1] OBSERVE the problem.

2] TAKE the problem apart and identify the main elements (supply, demand, quantities and prices).

3] FIND what the problem is asking for and what causes the result or, due to certain changes, what will the result be.

4] APPLY the Graphic Method.

5] SOLVE the problem!
The student then analyzes the problem ostensibly using this problem-solving method and then chooses the correct hypothesis (noted earlier in the supply example) corresponding to the current problem. Appropriate remediation and corrective feedback are subsequently delivered. The correct graphing of the situation is presented to all students with a summarizing explanation.

g) (Text) As you can observe in the graphic at left (Not shown here), the new graph shows a decrease in the demand curve for (Prod. name), a shift to the left <--. You now know two things: 1) the new equilibrium price is LOWER and 2) the new equilibrium quantity has decreased.

* * * * * * * * * * * * *

Rule-Oriented Lesson Example: The Law of Supply

[Introduction & review section]:

A. Introduction screen

"Microeconomics concerns the way people manage their personal finances, as well as the fundamental rules under which all businesses, sellers and buyers (including YOU) operate."

Overview Structure

1] Objectives  (complete concept list in sequence)
2] Concept Relations  (concept diagram)
3] Definition of Terms  (concept definitions)

1. Statement of objectives

Listing of all concepts taught in series (See list in beginning of this appendix). (Note: The statement of objectives and the advanced organizer sections are generally identical in both rule-oriented and problem-oriented introductions and overviews. The rule-oriented courseware includes the sequence of lessons and a 'Concept Relations' section that
presents the learning of concepts as requiring critical and variable attributes, examples and non-examples, and a superordinate/subordinate concept hierarchy).

2. { "Concept Relations: Supply" new screen header }

```
SUPPLY
   Law of Supply
       Determinants
       Supply Schedule
           Movement
           Shift
```

3. { "Definition of Terms" screen header } Advanced organizer program structure (submodules):

   a) setdef (introduces equilibrium and markets)
   b) demdef (law of demand)
      i) ddeter (determinants of demand)
   c) supdef (law of supply)
      i) sdeter (determinants of supply)
   d) market (introduction to scarcity, prices and quantities, and the market system)
   e) 2aodef (content subroutine)
      i) curve1 (demand curve graph & information)
      ii) curve2 (supply curve graph & information)
      iii) curve3 (equilibrium graph & explanation)
      iv) pequilt (equilibrium concept review)
      v) eprice (equilibrium price information)
      vi) equant (equilibrium quantity information)
f) 3aodf (content subroutine)
   i) incdem (independent increase in demand)
   ii) decdem (independent decrease in demand)
   iii) incsup (independent increase in supply)
   iv) decsup (independent decrease in supply)

4. Lesson Module: Supply (Part I) (Note: each section A, B, etc., is divided as a logical break in the dialogue and does not represent a single screen text per se).

A) MicroThink Lesson One: "Section Four: Supply"
   (screen header)

1) (Text) In economics, SUPPLY is the ability and willingness of producers to sell a particular good or service. When we talk about supply, we are concerned about the prices producers are able and willing to charge, at a point in time, for a certain good or service.

2) (Text) The price that Wrangler, Levi Strauss, or Jordache companies are willing to sell their jeans at is related to their SUPPLY of jeans. Changes in PRICES cause changes in the quantity of a good supplied, but there is an important difference between SUPPLY and Quantity Supplied that will be seen later. Producers want to produce more of a good or service when the price is higher and less when the price is lower.

3) "Related Elements of SUPPLY" new screen header:

   [1] The good or service itself
   [2] The price producers will charge
   [3] The quantity supplied at various prices
   [4] The supply schedule and curve, listing the change in quantity supplied at various prices
   [5] Shifts of the supply curve
   [6] Movement along the supply curve
   [7] The determinants of supply
If you think carefully about the concept of supply, you will see how each element is related to another. This section of the lesson introduces the "Law of Supply" and the rules you will need to understand supply fully.

Supply is defined here as: The WILLINGNESS and the ABILITY of producers to SELL a good or service at each and every price. The Law of Supply states that:

a) AS PRICES GO UP, PRODUCERS SUPPLY MORE (Quantity Supplied Increases)

b) AS PRICES GO DOWN, PRODUCERS SUPPLY LESS (Quantity Supplied Decreases)

Critical and Variable Attributes:

<table>
<thead>
<tr>
<th>CRITICAL</th>
<th>VARIABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A willingness to produce a good or service</td>
<td>Type of good or service</td>
</tr>
<tr>
<td>An ability to offer a good or service for sale</td>
<td>Amount of willingness and ability</td>
</tr>
<tr>
<td>Prices and Quantity Supplied</td>
<td>Amount of the price and the quantity supplied</td>
</tr>
</tbody>
</table>

[ Recall Question ]("Please answer this question:"): In addition to needing producers with a willingness and an ability to sell a certain good or service, the SUPPLY for that good consists of:

A) Buyers
B) Prices and quantity supplied
C) Buyers and surplus
D) Prices and supply demanded
330

(* = correct choice) (Standard Corrective feedback & Remediation sequence if needed by student)

8) The Law of Supply states that:
   a) AS PRICES GO UP, PRODUCERS SUPPLY MORE (Quantity Supplied Increases)
   b) AS PRICES GO DOWN, PRODUCERS SUPPLY LESS (Quantity Supplied Decreases)

9) [ Recall Question ] {"Please answer this question"): According to the "Law of Supply", as the prices producers can sell their goods at increase, they:
   A)* increase the quantity supplied
   B) decrease the quantity supplied
   C) decrease the supply and demand
   D) make more profits

(* = correct choice) (Standard Corrective feedback & Remediation sequence if needed by student)

10) { "Some Examples of Supply": Various examples of limited supply schedules here. Example:

<table>
<thead>
<tr>
<th>GOOD</th>
<th>SELLER</th>
<th>Price</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jeep</td>
<td>Chrysler</td>
<td>$15999</td>
<td>21/month</td>
</tr>
<tr>
<td>Jeep</td>
<td>Chrysler</td>
<td>$13699</td>
<td>17/month</td>
</tr>
<tr>
<td>Jeep</td>
<td>Chrysler</td>
<td>$11999</td>
<td>13/month</td>
</tr>
<tr>
<td>Jeep</td>
<td>Chrysler</td>
<td>$ 9300</td>
<td>10/month</td>
</tr>
</tbody>
</table>
11) [Elaboration Question] ("Please answer this question"):

<table>
<thead>
<tr>
<th>GOOD</th>
<th>SELLER</th>
<th>Price</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>jeans</td>
<td>Gitano</td>
<td>$39.00</td>
<td>95/week</td>
</tr>
<tr>
<td>jeans</td>
<td>Gitano</td>
<td>$25.00</td>
<td>70/week</td>
</tr>
<tr>
<td>jeans</td>
<td>Gitano</td>
<td>$19.00</td>
<td>54/week</td>
</tr>
</tbody>
</table>

HIGHER prices of Gitano jeans are associated with:

A)* increasing the quantity supplied  
B) decreasing the quantity supplied  
C) impossible to tell  
D) it varies in each example  

(* = correct choice) (Standard Corrective feedback & Remediation sequence if needed by student)

12) [Second Elaboration Question] ("Please answer this question"):

<table>
<thead>
<tr>
<th>GOODS</th>
<th>PRICES</th>
<th>Associated With</th>
</tr>
</thead>
<tbody>
<tr>
<td>jeans</td>
<td>$17.50</td>
<td>Supply</td>
</tr>
<tr>
<td>jeans</td>
<td>14.99</td>
<td>Demand</td>
</tr>
<tr>
<td>pizza</td>
<td>12.75</td>
<td>Supply</td>
</tr>
<tr>
<td>pizza</td>
<td>9.85</td>
<td>Demand</td>
</tr>
</tbody>
</table>

SUPPLY always appears associated with:

A) higher costs  
B)* higher prices than demand  
C) lower prices than demand  
D) truly impossible to tell  

(* = correct choice) (Standard Corrective feedback & Remediation sequence if needed by student)

*****[ END of Lesson Module: Supply ]************
APPENDIX C

COGNITIVE ACHIEVEMENT PRETEST MEASURE
1. According to the "law of supply and demand", if twice as many heads of lettuce were grown this year because of good weather as were grown last year, then:

A. The price of lettuce would go up this year.
B. The supply of lettuce would stay the same this year.
C. The demand for lettuce would go down this year.
D. The price of lettuce would go down this year.

2. Which of the following factors is NOT a determinant of demand?

A. The number of producers in the market.
B. Consumer preferences or tastes.
C. The number of consumers in the market.
D. The prices of other products.

3. Three of the four events below might reasonably be expected to shift the position of the entire supply curve for butter, at least to some extent. Which one of the following events would NOT shift the supply curve for butter?

A. A decision by consumers to purchase a smaller quantity of butter and a larger quantity of margarine.
B. A new technology for improved butter production adopted by most dairy producers.
C. A lengthy drought which effects milk production.
D. A rise in dairy farm labor costs.

4. Which of the following conditions is NOT true?

<table>
<thead>
<tr>
<th>when DEMAND</th>
<th>and SUPPLY</th>
<th>then PRICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>increases</td>
<td>remains stable</td>
<td>increases</td>
</tr>
<tr>
<td>decreases</td>
<td>remains stable</td>
<td>decreases</td>
</tr>
<tr>
<td>remains stable</td>
<td>increases</td>
<td>decreases</td>
</tr>
<tr>
<td>remains stable</td>
<td>decreases</td>
<td>decreases</td>
</tr>
</tbody>
</table>
5. If the current demand curve for Wrangler jeans shifts to the right, while the supply curve for Wrangler jeans shifts to the right at the same time, what can be said to be true of the new market situation?

A. There will be a surplus of Wrangler jeans on the market, and the equilibrium price will decrease.
B. The equilibrium quantity must increase, but the new equilibrium price is indeterminate.
C. There will be a shortage of Wrangler jeans on the market, and the equilibrium price will increase.
D. The equilibrium quantity is indeterminate, but the new equilibrium price must decrease.

6. If there is an increase in the supply of calculators and the demand remains the same, which of the following is most likely to happen?

A. Price will increase, and producers will sell less.
B. Price will decrease, and producers will sell less.
C. Price will increase, and producers will sell more.
D. Price will decrease, and producers will sell more.

7. If there is an increase in the demand for a fixed supply of felt-tipped pens, consumers will most likely:

A. buy fewer felt-tipped pens.
B. stop buying felt-tipped pens.
C. pay a lower price for felt-tipped pens.
D. pay a higher price for felt-tipped pens.

8. Which one of the following conditions means that there MUST have been a change in the demand schedule of a good?

A. The production of the good has increased.
B. More of the good can be sold at the same price.
C. The good sells at a higher price than previously.
D. Less of the commodity is being purchased than previously.
9. Both of the graphs above represent two equally possible outcomes when both the supply and demand for Product X change simultaneously. Refering to both of the graphs above, if the current DEMAND curve for Product X shifts to the left, while the SUPPLY curve for Product X shifts to the left at the same time, what can be said to be true of the new market situation?

A. There will be a sudden decrease in the quantity of Product X on the market, and the equilibrium price will fall due to the decreased demand.

B. There will be a surplus of Product X on the market, and the equilibrium price will increase.

C. The new equilibrium quantity will be less than before shifts in supply and demand occurred, while the equilibrium price is indeterminate since the amount of the shifts cannot be determined.

D. Both the new equilibrium price and quantity are indeterminate, since the actual amount of the shifts in supply and demand cannot be determined.

10. Which of the following factors is NOT a determinant of supply?

A. Consumer preferences or tastes.

B. The number of producers in the market.

C. The technology available for production.

D. The prices of other products.
11. Both of the graphs above represent two equally possible outcomes when both the supply and demand for Product X change simultaneously. Referring to both of the graphs above, if the current DEMAND curve for Product X shifts to the left, while the SUPPLY curve for Product X shifts to the right at the same time, what can be said to be true of the new market situation? [See TEST I, Q. 19]

A. There will be a sudden decrease in the quantity of Product X on the market, and the equilibrium price will fall due to the decreased demand.

B. There will be a surplus of Product X on the market, and the equilibrium price will increase.

C. The new equilibrium price will be lower than before shifts in supply and demand occurred, while the equilibrium quantity is indeterminate since the amount of the shifts cannot be determined.

D. Both the new equilibrium price and quantity are indeterminate, since the actual amount of the shifts in supply and demand cannot be determined.

12. Which of the following represents a change in demand rather than a change in the quantity demanded?

A. A store sold 150 ball-point pens at $1.00 each in April; 301 pens were sold for $.49 each in May.

B. Last week a store sold 59 bottles of Dr. Diablo cola for $.69 a bottle; this week it sold 84 bottles at $.59 a bottle.

C. During the month of March a store sold 9 swimsuits for $12.50 each; in June the store sold 72 swimsuits at the same price.

D. Five years ago a small store sold 37 hand-held calculators for $43.00 each; this year the store sold 480 calculators at $9.00 each.
13. Referring to the graph above, if the price of Good X stood temporarily at a level of $6.00, what would be the new situation?

A. Quantity offered for sale would exceed quantity demanded, and competition among sellers would drive the price higher.

B. Quantity demanded would exceed quantity offered for sale, and competition among buyers would drive the price higher.

C. Quantity demanded would exceed quantity offered for sale, and competition among sellers PLUS buyer awareness of the shortage would drive price lower.

D. Quantity demanded would be less than quantity offered for sale, and competition among sellers would drive the price lower.

14. An increase in the quantity of goods or services that consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.

B. a shift of the demand curve to the left.

C. a shift of the demand curve to the right.

D. an immediate decrease in the market clearing price.
15. The "law of downward-sloping demand" refers to a particular kind of behavior among buyers with so few exceptions that it is considered a fundamental principle of microeconomics. Which of the following statements does NOT illustrate or describe the law of demand?

A. If the price of Good X falls, at least some buyers will increase the quantity of X they purchase by some amount.
B. Demand is influenced by both the number of producers competing in a given market, and the technology available to improve efficiency.
C. Demand curves normally slope downward as they run to the right (their general direction is from northwest to southeast, with a negative slope).
D. When the price of Good X rises significantly, people tend to reduce the quantity of Good X that they buy.

16. If the government were to levy a tax of one dollar on every pair of pants sold, which of the following situations would most likely result?

A. Consumers would pay a higher price and buy fewer pairs of pants.
B. Consumers would pay a higher price and producers would sell more pants.
C. Consumers would pay a higher price and suppliers would make larger profits.
D. Suppliers would increase the quantity sold to make up for the taxes paid to the government.

17. If many people increase their demand for a product or service, but the supply remains about the same, the price of this product or service will probably:

A. fall.
B. rise.
C. be very high.
D. be very low.
18. Referring to the graph above, if the price of Good X stood temporarily at a level of $3.00, what would be the new situation?

A. Quantity offered for sale would exceed quantity demanded, and the competition among sellers would drive the price higher.
B. Quantity demanded would exceed quantity offered for sale, and competition among buyers PLUS seller awareness of the shortage would drive the price higher.
C. Quantity demanded would exceed quantity offered for sale, and competition among sellers PLUS buyer awareness of the shortage would drive the price lower.
D. Quantity demanded would be less than the quantity offered for sale, and competition among sellers would drive the price lower.

19. What is meant by the statement that every economic system faces the fact of scarcity?

A. There are times when some products can be purchased only at high prices.
B. Poor nations face scarcity, but rich nations have overcome this problem.
C. There are never enough productive resources to satisfy all human wants.
D. All economies have depressions during which scarcities exist from time to time.
Which of the graphs above best illustrates the following:

20. The U.S. Government declares that it is prepared to purchase any and all gold supplied to it by domestic commercial gold mines at a price of $525.00 an ounce.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.

21. A patient with an unusual illness must purchase a specific quantity of an experimental drug, but cannot buy more than that quantity due to restrictions on the new drug’s distribution. The patient will pay any price, if necessary, to obtain this vital medication.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.

22. If the price of Commodity X falls, its suppliers are not motivated to offer for sale as much as they did before the price decreased. This means they reduce the quantity of Commodity X that they supply.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.
23. The price at which the quantity supplied by producers is equal to the quantity demanded by consumers, and at which there is no pressure for price to change, is called:

A. the market floor.
B. the equatorial price.
C. the market ceiling.
D. the market clearing price.

24. Which of the following statements accurately defines the meaning of "the supply curve for commodity X"?

A. How much of X would be bought at the equilibrium price
B. The amounts of X that would be bought each period, at each and any price, assuming other factors remain constant.
C. The amounts of X to be supplied in each period, at each and any price, assuming other things being equal.
D. How the amount of money people spend to purchase X changes as the price they must pay for it changes.

25. If the current demand curve for Wrangler jeans shifts to the left, while the supply curve for Wrangler jeans shifts to the right at the same time, what can be said to be true of the new market situation?

A. There will be a surplus of Wrangler jeans on the market, and the equilibrium price will decrease.
B. The equilibrium quantity must increase, but the new equilibrium price is indeterminate.
C. There will be a shortage of Wrangler jeans on the market, and the equilibrium price will increase.
D. The equilibrium quantity is indeterminate, but the new equilibrium price must decrease.

26. In an open market economy, the social purpose of profits is to:

A. get businesses to follow government regulations.
B. get businesses to produce what consumers demand.
C. provide funds to pay workers better wages.
D. transfer income from the poor to the rich.
27. A decrease in the quantity of goods or services consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the demand curve to the right.
D. an immediate decrease in the market clearing price.

28. If the demand curve for Commodity X shifts its entire position to the left, one reasonable explanation for this shift would be:

A. the available supply of X has been decreased.
B. the price of X has increased, and in consequence people have decided to buy less of X than before.
C. consumer tastes have shifted in favor of Commodity Z, a substitute product of Commodity X, and consumers buy less Commodity X at any given price.
D. the price of X has fallen, and in consequence many consumers have decided to buy more of commodity X than they did before the price fell.

29. The change from Point S1 to Point S2 on the curve above indicates:

A. an increase in supply.
B. an increase in quantity supplied.
C. a decrease in supply.
D. a decrease in quantity supplied.
30. The change from Point D1 to Point D2 on the curve above indicates:

A. an increase in demand.  
B. an increase in quantity demanded.  
C. a decrease in demand.  
D. a decrease in quantity demanded.

31. Which of the following represents a change in supply rather than a change in the quantity supplied?

A. A company offered for sale 125 color televisions for $300.00 each last year; this year they offered 230 color televisions for $600.00 each.  
B. Five years ago, High Tech Corp. produced and offered for sale 2500 solar calculators at $69.00 each; this year, High Tech Corp. offered 4800 solar calculators for sale at $95.00 each.  
C. During June and July, LA FEM, Inc., offered 16,400 swimsuits for sale at $49.50 each; during September and October, LA FEM offered 10,350 swimsuits for sale at $22.95.  
D. During the first six months of 1986, a major corporation offered 3500 advanced personal personal computers at $7500.00 each; during the last six months of 1986, they offered 8300 personal computer units at the same price.
32. Uncle Bob's (Inc.) All-Natural Blueberry Pies uses 9.4 tons of raw sugar each month for its nationally-marketed pies and cakes. Due to a major loss of the sugar cane crop this year across the world, the price of raw sugar rises considerably. What do you predict the effect of this event will be on the supply of Bob's Blueberry Pies?

A. Bob's, Inc., will offer for sale less of the pies at the same or higher prices.
B. The supply curve for Bob's Blueberry Pies will shift to the right, and the prices of the pies will fall.
C. Bob's will offer for sale more of the pies at the same or lower prices.
D. The price of Bob's Pies supplied will decrease, and the quantity supplied will decrease.

33. Which of the following conditions does NOT indicate that there has necessarily been a change in the market demand of a particular good?

A. The quantity demanded increases while price remains constant or increases.
B. The quantity demanded increases while price decreases.
C. The quantity demanded decreases while price remains constant or decreases.
D. The quantity demanded either increases or decreases as price remains the same.

34. The change from Point S1 to Point S2 on the curve above indicates:

A. an increase in supply.
B. an increase in quantity supplied.
C. a decrease in supply.
D. a decrease in quantity supplied.
**Pretest Answer Key**

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APPENDIX D

COGNITIVE ACHIEVEMENT POSTTEST I MEASURE
1. An increase in the quantity of goods or services that consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the demand curve to the right.
D. an immediate decrease in the market clearing price.

2. In a free enterprise economic system, such as in the United States, who has the most influence in deciding what will be produced?

A. Labor unions.
B. The federal government.
C. Consumers.
D. Corporations.

3. "Americans are a mixed-up people. Everyone knows that baseball is far less necessary than food and steel. Yet they pay ball players a lot more money than farmers and steelworkers." Why?

A. The employers of the ball players are monopolists.
B. Ball players are really entertainers rather than producers.
C. There are fewer professional ball players than farmers or steelworkers.
D. Good ball players are more scarce, given the demand for their services.

4. A large multinational corporation produces 45% of the world supply of MICROWIDGETS. Recently, demand for microwidgets has been increasing by a factor of 30%. If the company wants to increase the sale price of its product, what must happen?

A. Supply must increase exactly by a factor of 30%.
B. Supply must increase by a factor greater than 30%.
C. If supply increases, the increase in demand must be greater than the corresponding increase in supply.
D. If demand increases, the increase in supply must be greater than the corresponding increase in demand.
5. If many people increase their demand for a product or service, but the supply remains about the same, the price of this product or service will probably:

A. fall.
B. rise.
C. be very high.
D. be very low.

6. The price at which the quantity demanded by consumers equals the quantity supplied by producers, and at which there is no pressure for price to change is called:

A. The market floor.
B. The equilibrium price.
C. The market ceiling.
D. The marginal market price.

7. Which of the following factors is NOT a determinant of demand?

A. The number of producers in the market.
B. Consumer preferences or tastes.
C. The number of consumers in the market.
D. The prices of other products.

8. The engineering research and consulting firm of Fine & Point, Inc., has recently announced the development of a more efficient procedure to convert gasoline-powered vehicles to solar-powered vehicles. The adoption of the Fine-Point technique will be speeded up by:

A. the discovery and development of new oil deposits.
B. increased demand for petroleum products by the "developed" economies.
C. the invention of a remarkable, cheap, high-quality synthetic gasoline.
D. a major reduction in the price of oil by OPEC, the Organization of Petroleum-Exporting Countries.
9. If the current demand curve for Wrangler jeans shifts to the right, while the supply curve for Wrangler jeans shifts to the left at the same time, what can be said to be true of the new market situation?

A. There will be a surplus of Wrangler jeans on the market, and the equilibrium price will decrease.
B. There will be a shortage of Wrangler jeans on the market, and the equilibrium price will increase.
C. The equilibrium quantity must increase, but the new equilibrium price is indeterminate.
D. The equilibrium quantity is indeterminate, but the new equilibrium price must increase.

10. The price of shoes is likely to be increased by:

A. new machines reducing the cost of shoe production.
B. more capital investment by shoe producers.
C. a decrease in the demand for shoes.
D. a decrease in the supply of shoes.

11. In an open market economy, the social purpose of profits is to:

A. get businesses to follow government regulations.
B. get businesses to produce what consumers demand.
C. provide funds to pay workers better wages.
D. transfer income from the poor to the rich.

12. A decrease in the quantity of goods or services consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the demand curve to the right.
D. an immediate decrease in the market clearing price.

13. Which of the following conditions is true?

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<td>D. remains stable</td>
<td>decreases</td>
<td>decreases</td>
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14. If there is an increase in the supply of calculators and the demand remains the same, which of the following is most likely to happen?

A. Price will increase, and producers will sell less.
B. Price will decrease, and producers will sell less.
C. Price will increase, and producers will sell more.
D. Price will decrease, and producers will sell more.

15. Suppose a large city is investigating the elimination of rent controls on housing at a time when the demand for housing is extremely high. Rent controls have kept the rental cost to consumers at an artificially low ceiling, resulting in a shortage of available housing units. Which of the following is most likely to occur if rent controls are eliminated?

A. No change in rents, since price controls are usually set where supply and demand curves intersect.
B. A decrease in rents, followed by a decrease in the number of housing units supplied.
C. An increase in rents, followed by an increase in the number of housing units supplied.
D. An increase in the demand for housing, followed by a decrease in the number of housing units supplied.

16. Assume that the demand increases for bread produced by many competitive firms. The resulting rise in the price of bread will usually lead to:

A. more being produced.
B. less being produced.
C. no change in production.
D. elimination of inefficient businesses from the market.

17. If there is an increase in the demand for corn this year, while the market clearing price for corn actually decreases, which of the following is most likely to occur this year?

A. The supply and price of corn will both increase.
B. The quantity supplied and price of corn will both increase.
C. The supply of corn will increase and the price will decrease.
D. The price of corn will decrease and the quantity supplied will increase.
18. The "law of downward-sloping demand" refers to a particular kind of behavior among buyers with so few exceptions that it is considered a fundamental principle of microeconomics. Which of the following statements does NOT illustrate or describe the law of demand?

A. If the price of Good X falls, at least some buyers will increase the quantity of X they purchase by some amount.

B. Demand is influenced by both the number of producers competing in a given market, and the technology available to improve efficiency.

C. Demand curves normally slope downward as they run to the right (their general direction is from northwest to southeast, with a negative slope).

D. When the price of Good X rises significantly, people tend to reduce the quantity of Good X that they buy.

19. The change from Point D1 to Point D2 on the curve above indicates:

A. an increase in demand.

B. an increase in quantity demanded.

C. a decrease in demand.

D. a decrease in quantity demanded.

20. Crop failures reduce the supply and increase the price of wheat on the open market. In precise terms, these events constitute a:

A. decrease in quantity supplied followed by a decrease in demand.

B. decrease in supply followed by a decrease in demand.

C. decrease in supply followed by a decrease in quantity demanded.

D. decrease in quantity supplied followed by a decrease in quantity demanded.
21. During the last 30 years, the demand for physicians has actually decreased among the more developed nations in the Western Hemisphere, while at the same time more students are entering medical school than ever before. As the number of medical school graduates (i.e., assuming they become certified doctors) continues to grow, the equilibrium quantity of physicians:

A. is indeterminate.
B. has increased.
C. has actually decreased.
D. has actually remained stable.

22. Referring to the situation described above in Question 21, what can be predicted to happen to the equilibrium price of physicians services?

A. Equilibrium price is indeterminate.
B. Equilibrium price has increased.
C. Equilibrium price has actually decreased.
D. Equilibrium price has actually remained stable.

23. Several new business firms have recently entered the solar panel industry and increased the supply of solar panels. If the demand for solar panels remains stable, what is most likely to happen to the price of solar panels?

A. Price will decrease.
B. Price will increase.
C. Price will remain the same.
D. Price will increase and then decrease.

24. If there were a steady decrease in the demand for automobiles over a three-year period, at the end of the three years there would probably be:

A. more workers producing steel.
B. higher unemployment among automobile workers.
C. more automobile dealers selling new automobiles.
D. higher dividends paid to owners of automobile stock.
25. Referring to the graph above, if the price of Good X stood temporarily at a level of $6.00, what would be the new situation?

A. Quantity offered for sale would exceed quantity demanded, and competition among sellers would drive the price higher.
B. Quantity demanded would exceed quantity offered for sale, and competition among buyers would drive the price higher.
C. Quantity demanded would exceed quantity offered for sale, and competition among sellers PLUS buyer awareness of the shortage would drive price lower.
D. Quantity demanded would be less than quantity offered for sale, and competition among sellers would drive the price lower.

26. The long lines of consumers waiting outside many stores in the Soviet Union indicate that many consumer goods are probably:

A. priced too low.
B. not in great demand.
C. priced too high.
D. very popular.
27. Which of the following represents a change in demand rather than a change in the quantity demanded?

A. A store sold 150 ball-point pens at $1.00 each in April; 301 pens were sold for $.49 each in May.
B. Last week a store sold 59 bottles of Dr. Diablo cola for $.69 a bottle; this week it sold 84 bottles at $.59 a bottle.
C. During the month of March a store sold 9 swimsuits for $12.50 each; in June the store sold 72 swimsuits at the same price.
D. Five years ago a small store sold 37 hand-held calculators for $43.00 each; this year the store sold 480 calculators at $9.00 each.

28. Three of the four events below might reasonably be expected to shift the position of the entire supply curve for butter, at least to some extent. Which one of the following events would NOT shift the supply curve for butter?

A. A decision by consumers to purchase a smaller quantity of butter and a larger quantity of margarine.
B. A new technology for improved butter production adopted by most dairy producers.
C. A lengthy drought which effects milk production.
D. A rise in dairy farm labor costs.

29. Suppose that the price of pineapple decreases a great deal because of an increase in supply. In the event of no other changes, generally what will happen as far as the amount of product substitution by the consumer?

A. Product substitution will increase.
B. Product substitution will decrease.
C. Product substitution will not change.
D. Nothing, since there is no real substitute for pineapple.

30. Which of the following factors is NOT a determinant of supply?

A. Consumer preferences or tastes.
B. The number of producers in the market.
C. The technology available for production.
D. The prices of other products.
31. Both of the graphs above represent two equally possible outcomes when both the supply and demand for Product X change simultaneously. Refering to both of the graphs above, if the current DEMAND curve for Product X shifts to the left, while the SUPPLY curve for Product X shifts to the right at the same time, what can be said to be true of the new market situation?

A. There will be a sudden decrease in the quantity of Product X on the market, and the equilibrium price will fall due to the decreased demand.
B. There will be a surplus of Product X on the market, and the equilibrium price will increase.
C. The new equilibrium price will be lower than before shifts in supply and demand occurred, while the equilibrium quantity is indeterminate since the amount of the shifts cannot be determined.
D. Both the new equilibrium price and quantity are indeterminate, since the actual amount of the shifts in supply and demand cannot be determined.

32. If the current demand curve for Wrangler jeans shifts to the left, while the supply curve for Wrangler jeans shifts to the left at the same time, what can be said to be true of the new market situation?

A. There will be a surplus of Wrangler jeans on the market, and the equilibrium price will decrease.
B. There will be a shortage of Wrangler jeans on the market, and the equilibrium price will increase.
C. The equilibrium quantity must decrease, but the new equilibrium price is indeterminate.
D. The equilibrium quantity is indeterminate, but the new equilibrium price must increase.
33. Referring to the graph above, if the price of Good X stood temporarily at a level of $2.00, what would be the new situation?

A. Quantity offered for sale would exceed quantity demanded, and the competition among sellers would drive the price higher.

B. Quantity demanded would exceed quantity offered for sale, and competition among buyers PLUS seller awareness of the shortage would drive the price higher.

C. Quantity demanded would exceed quantity offered for sale, and competition among sellers PLUS buyer awareness of the shortage would drive the price lower.

D. Quantity demanded would be less than the quantity offered for sale, and competition among sellers would drive the price lower.
34. The change from Point S1 to Point S2 on the curve above indicates:

A. an increase in supply.
B. an increase in quantity supplied.
C. a decrease in supply.
D. a decrease in quantity supplied.
Posttest I Answer Key

1. D  18. B  
2. A  19. C  
3. A  20. D  
5. B  22. A  
6. D  23. D  
7. D  24. C  
8. B  25. D  
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11. C  28. C  
12. C  29. D  
15. B  32. A  
16. A  33. B  
17. B  34. A  

### POSTTEST I (Immediate) SUBSCALE CATEGORIZATION

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APPENDIX E

COGNITIVE ACHIEVEMENT POSTTEST II MEASURE
1. The "law of downward-sloping demand" refers to a particular kind of behavior among buyers with so few exceptions that it is considered a fundamental principle of microeconomics. Which of the following statements does NOT illustrate or describe the law of demand?

A. If the price of Good X falls, at least some buyers will increase the quantity of X they purchase by some amount.
B. Demand is influenced by both the number of producers competing in a given market, and the technology available to improve efficiency.
C. Demand curves normally slope downward as they run to the right (their general direction is from northwest to southeast, with a negative slope).
D. When the price of Good X rises significantly, people tend to reduce the quantity of Good X that they buy.

2. "Economic supply" of a product, good, or service refers to how much of the product, good, or service:

A. remains on the open market after consumer demand has been fully met.
B. people are willing to buy at a particular price.
C. is currently in stock in both warehouses and retail stores in a given location.
D. is available for sale throughout the marketplace at a particular price and at a certain time.

3. The price at which the quantity demanded by consumers equals the quantity supplied by producers, and at which there is no pressure for price to change is called:

A. The market floor.
B. The equilibrium price.
C. The market ceiling.
D. The marginal market price.

4. Which of the following factors is NOT a determinant of supply?

A. Consumer preferences or tastes.
B. The number of producers in the market.
C. The technology available for production.
D. The prices of other products.
Which of the graphs above best illustrates the following:

5. The U.S. Government declares that it is prepared to purchase any and all gold supplied to it by domestic commercial gold mines at a price of $525.00 an ounce.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.

6. A patient with an unusual illness must purchase a specific quantity of an experimental drug, but cannot buy more than that quantity due to restrictions on the new drug’s distribution. The patient will pay any price, if necessary, to obtain this vital medication.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.

7. If the price of Commodity X falls, its suppliers are not motivated to offer for sale as much as they did before the price decreased. This means they reduce the quantity of Commodity X that they supply.

A. Graph A.
B. Graph B.
C. Graph C.
D. Graph D.
8. The price of shoes is likely to be increased by:
   A. new machines reducing the cost of shoe production.
   B. more capital investment by shoe producers.
   C. a decrease in the demand for shoes.
   D. a decrease in the supply of shoes.

9. The engineering research and consulting firm of Pine & Point, Inc., has recently announced the development of a more efficient procedure to convert gasoline-powered vehicles to solar-powered vehicles. The adoption of the Pine-Point technique will be speeded up by:
   A. the discovery and development of new oil deposits.
   B. increased demand for petroleum products by the "developed" economies.
   C. the invention of a remarkable, cheap, high-quality synthetic gasoline.
   D. a major reduction in the price of oil by OPEC, the Organization of Petroleum-Exporting Countries.

10. "Economic demand" for a product refers to how much of the product:
    A. consumers are willing and able to buy at each price.
    B. consumers want, whether they can buy it or not.
    C. the government orders to be made.
    D. is available for sale in the marketplace.

11. A large multinational corporation produces 45% of the world supply of MICROWIDGETS. Recently, demand for microwidgets has been increasing by a factor of 30%. If the company wants to increase the sale price of its product, what must happen?
    A. Supply must increase exactly by a factor of 30%.
    B. Supply must increase by a factor greater than 30%.
    C. If supply increases, the increase in demand must be greater than the corresponding increase in supply.
    D. If demand increases, the increase in supply must be greater than the corresponding increase in demand.
12. Which of the following conditions is NOT true?

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<tr>
<th>DEMAND</th>
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<th>PRICE</th>
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13. Suppose a large city is investigating the elimination of rent controls on housing at a time when the demand for housing is extremely high. Rent controls have kept the rental cost to consumers at an artificially low ceiling, resulting in a shortage of available housing units. Which of the following is most likely to occur if rent controls are eliminated?

A. No change in rents, since price controls are usually set where supply and demand curves intersect.
B. A decrease in rents, followed by a decrease in the number of housing units supplied.
C. An increase in rents, followed by an increase in the number of housing units supplied.
D. An increase in the demand for housing, followed by a decrease in the number of housing units supplied.

14. Assume that the demand increases for bread produced by many competitive firms. The resulting rise in the price of bread will usually lead to:

A. more being produced.
B. less being produced.
C. no change in production.
D. elimination of inefficient businesses from the market.

15. Three of the four events below might reasonably be expected to shift the position of the entire demand curve for butter, at least to some extent. Which one of the following events would NOT shift the demand curve for butter?

A. An increase in the personal income of many consumers.
B. Anticipation by many consumers of a notable increase in the price of butter.
C. Consumer demand for bread increases.
D. An improvement in dairy farm farm production technology.
16. Both of the graphs above represent two equally possible outcomes when both the supply and demand for Product X change simultaneously. Refering to both of the graphs above, if the current DEMAND curve for Product X shifts to the left, while the SUPPLY curve for Product X shifts to the right at the same time, what can be said to be true of the new market situation?

A. There will be a sudden decrease in the quantity of Product X on the market, and the equilibrium price will fall due to the decreased demand.
B. There will be a surplus of Product X on the market, and the equilibrium price will increase.
C. The new equilibrium price will be lower than before shifts in supply and demand occurred, while the equilibrium quantity is indeterminate since the amount of the shifts cannot be determined.
D. Both the new equilibrium price and quantity are indeterminate, since the actual amount of the shifts in supply and demand cannot be determined.

17. A decrease in the quantity of goods or services consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the demand curve to the right.
D. an immediate decrease in the market clearing price.
18. If the demand curve for Commodity X shifts its entire position to the right, one reasonable explanation for this shift would be:

A. the available supply of X has been decreased.
B. the price of X has increased, and in consequence people have decided to buy less of X than before.
C. consumer tastes have shifted in favor of commodity X, and they want to buy more of it than they did before at any given price.
D. the price of X has fallen, and in consequence many consumers have decided to buy more of Commodity X than they did before the price fell.

19. The change from Point D1 to Point D2 on the curve above indicates:

A. an increase in demand.
B. an increase in quantity demanded.
C. a decrease in demand.
D. a decrease in quantity demanded.

20. An increase in the quantity of goods or services that consumers are willing and able to buy at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the demand curve to the right.
D. an immediate decrease in the market clearing price.
For each question, which of the graphs above best shows the effects of the economic situation described?

21. The costs of producing Commodity X increase.
   A. Graph A.
   B. Graph B.
   C. Graph C.
   D. Graph D.

22. Consumer tastes shift away from Commodity X and in favor of other (competitive) products.
   A. Graph A.
   B. Graph B.
   C. Graph C.
   D. Graph D.

23. The price of Good Y, another commodity, and one which consumers regard as a good substitute for Commodity X, rises substantially.
   A. Graph A.
   B. Graph B.
   C. Graph C.
   D. Graph D.
24. Which of the following conditions is true?

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<td>D. remains stable</td>
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25. According to the "law of supply and demand", if twice as many heads of lettuce were grown this year because of good weather as were grown last year, then:

A. The price of lettuce would go up this year.
B. The supply of lettuce would stay the same this year.
C. The demand for lettuce would go down this year.
D. The price of lettuce would go down this year.

26. A change in "quantity demanded" means that:

A. a change in the quantities that producers will offer for sale at each and every possible price, due to some change in background conditions such as an increase in production costs.
B. a change in the particular quantity which producers offer for sale, due to a change in market price.
C. a change in the particular quantity which consumers buy, due to a change in market price.
D. a change in the quantities that consumers will buy at each and every possible price, due to some change in background conditions such as a change in tastes or consumer incomes.

27. Beef supplies are sharply reduced because of drought in the beef-raising states. If consumers regard pork as a good substitute for beef, then we could expect this to affect the market for pork as follows:

A. The entire demand curve will move right.
B. The entire supply curve will move left.
C. The entire demand curve will move left.
D. The demand curve will move right and the supply curve will move left.
28. The change from Point D1 to Point D2 on the curve above indicates:
A. an increase in demand.
B. an increase in quantity demanded.
C. a decrease in demand.
D. a decrease in quantity demanded.

29. Which of the following factors is NOT a determinant of demand?
A. The number of producers in the market.
B. Consumer preferences or tastes.
C. The number of consumers in the market.
D. The prices of other products.

30. Three of the four events below might reasonably be expected to shift the position of the entire demand curve for butter, at least to some extent. Which one of the following events would NOT shift the demand curve for butter?
A. A significant increase in the price of bread.
B. A widespread advertising campaign undertaken by butter producers.
C. A rise in the price of margarine.
D. A rise in the price of butter.
31. An increase in the quantity of goods or services that producers are willing and able to sell at a particular price is indicated by:

A. a shift of the supply curve to the right.
B. a shift of the demand curve to the left.
C. a shift of the supply curve to the left.
D. an immediate increase in the market clearing price.

32. In recent years, Japanese electronics companies have sold large amounts of inexpensive "chips" and other computer parts on the U.S. market. Labor costs are lower in Japan, and as a result many of their electronics products, while of high quality, are less expensive than similar U.S. products. In an effort to counter this problem, the U.S. government has enacted high tariffs and other restrictions on many Japanese electronics products. This action will have the effect of:

A. decreasing the demand for Japanese electronics products.
B. increasing the demand for similar products made in the United States.
C. decreasing the quantity demanded for those Japanese products affected by the tariffs.
D. both B and C.

33. A change in "quantity supplied" means that:

A. a change in the quantities that producers will offer for sale at each and every possible price, due to some change in background conditions such as an increase in production costs.
B. a change in the particular quantity which producers offer for sale, due to a change in market price.
C. a change in the particular quantity which consumers buy, due to a change in market price.
D. a change in the quantities that consumers will buy at each and every possible price, due to some change in background conditions such as a change in tastes or consumer incomes.

34. Which of the following conditions does NOT indicate that there has necessarily been a change in the market supply of a particular good?

A. The quantity supplied increases while price increases.
B. The quantity supplied either increases or decreases as price remains the same.
C. The quantity supplied increases while price remains constant or decreases.
D. The quantity supplied decreases while price remains constant or increases.
**Posttest II Answer Key**

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**POSTTEST II (Delayed) SUBSCALE CATEGORIZATION**

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APPENDIX F

COMPUTER ANXIETY INDEX (CAIN)
Computer Anxiety Index (CAIN)

(+) 1. Having a computer available to me would improve my productivity.

(+) 2. If I had to use a computer for some reason, it would probably save me some time and work.

(+) 3. If I use a computer, I could get a better picture of the facts and figures.

(+) 4. Having a computer available to me would improve my general satisfaction.

(-) 5. Having to use a computer could make my life less enjoyable.

(+) 6. Having a computer available to me could make things easier for me.

(-) 7. I feel very negative about computers in general.

(+) 8. Having a computer available to me could make things more fun for me.

(-) 9. If I had a computer at my disposal, I would try to get rid of it.

(+) 10. I look forward to a time when computers are more widely used.

(-) 11. I doubt if I would ever use computers very much.

(-) 12. I avoid using computers whenever I can.

(+) 13. I enjoy using computers.

(-) 14. I feel that there are too many computers around now.

(+ ) 15. Computers are probably going to be an important part of my life.

(+) 16. A computer could make learning fun.
(+ 17. If I were to use a computer, I could get a lot of satisfaction from it.

(-) 18. If I had to use a computer, it would probably be more trouble than it was worth.

(-) 19. I am usually uncomfortable when I have to use computers.

(-) 20. I sometimes get nervous just thinking about computers.

(-) 21. I will probably never learn to use a computer.

(-) 22. Computers are too complicated to be of much use to me.

(-) 23. If I had to use a computer all the time, I would probably be very unhappy.

(-) 24. I sometimes feel intimidated when I have to use a computer.

(-) 25. I sometimes feel that computers are smarter than I am.

(+ 26. I can think of many ways that I could use a computer.

Note. The basic coding scheme was: Very Strongly Disagree = 0; Strongly Disagree = 1; Disagree = 2; Agree = 3; Strongly Agree = 4; and Very Strongly Agree = 5. Using the certainty estimate scheme, positive-scored items (+) were recoded as follows: Very Strongly Disagree = 0; Strongly Disagree = 4; Disagree = 7; Agree = 9; Strongly Agree = 12; and Very Strongly Agree = 16. Negative-scored items (-) were reverse coded as follows: Very Strongly Disagree = 16; Strongly Disagree = 12; Disagree = 9; Agree = 7; Strongly Agree = 4; and Very Strongly Agree = 0.
APPENDIX G

SURVEY ON ECONOMIC ATTITUDES
Attitude Towards Economics Index (ATE)

(+) 1. I enjoy reading articles about economic topics.
(-) 2. I hate economics.
(+) 3. Economics is easy for me to understand.
(-) 4. Economics is dull.
(+) 5. I enjoy economics.
(-) 6. Studying economics is a waste of time.
(-) 7. Economics is one of my most dreaded subjects.
(+) 8. On occasion I read an unassigned book in economics.
(+) 9. I would be willing to attend a lecture by an economist.
(-) 10. Economics is a very difficult subject for me.
(+1 11. Economics is one of my favorite subjects.
(+1 12. I use economic concepts to analyze situations.
(+1 13. Economics is practical.
(-) 14. Economic ideas are dumb.

Note. The basic coding scheme was: Very Strongly Disagree = 0; Strongly Disagree = 1; Disagree = 2; Agree = 3; Strongly Agree = 4; and Very Strongly Agree = 5. Using the certainty estimate scheme, positive-scored items (+) were recoded as follows: Very Strongly Disagree = 0; Strongly Disagree = 4; Disagree = 7; Agree = 9; Strongly Agree = 12; and Very Strongly Agree = 16. Negative-scored items (-) were reverse coded as follows: Very Strongly Disagree = 16; Strongly Disagree = 12; Disagree = 9; Agree = 7; Strongly Agree = 4; and Very Strongly Agree = 0. (Applied to both ATE and EAS indexes)
Economic Attitude Sophistication Index (EAS)

(-) 1. Government should control the price of gasoline.

(-) 2. Inflation is caused by greedy business and business leaders.


(-) 4. People should not have to pay taxes.

(-) 5. Free medical care should be provided for all Americans.

(-) 6. Banks should not charge interest on loans to customers.

(-) 7. Most people who don't have jobs are too lazy to work.

(-) 8. When a business gets big, it should be controlled by government.

(-) 9. New factories are not needed.

(-) 10. People should not be told how to spend their money.

(-) 11. If everybody had more money, we'd all be better off.

(+) 12. Profits should not be regulated by government.

(-) 13. Most unemployed people are lazy.

(+ 14. When a strike occurs, government should step in and settle the dispute.
APPENDIX H

LEARNING ATTITUDE SURVEY
Deep Approach Towards Learning Index (DEEP)

(+)

1. I enjoy studying for my subjects in school.

2. When reading an article or book, I try to learn the intention of the author.

3. When doing something new and different I try to form hypotheses about the activity.

4. When doing a task in school, I try to think only about that particular task.

5. When studying for a class in school, I try to see how the topic or material fits into the "real world".

6. In approaching a new situation, I try to see how parts of the new situation are related to previous experiences I have had.

7. I look forward to studying and learning new things.

8. I personally enjoy learning about new subjects, and improving in those subjects with which I am already familiar.

Note. The basic coding scheme was: Very Strongly Disagree = 0; Strongly Disagree = 1; Disagree = 2; Agree = 3; Strongly Agree = 4; and Very Strongly Agree = 5. Using the certainty estimate scheme, positive-scored items (+) were recoded as follows: Very Strongly Disagree = 0; Strongly Disagree = 4; Disagree = 7; Agree = 9; Strongly Agree = 12; and Very Strongly Agree = 16. All items in the DEEP index were positively scored.
Surface Approach Towards Learning Index (SURF)

(-) 1. When in class or doing homework, I often worry about how much time the task is taking.

(-) 2. When doing a particular task, I try to see how it will help me advance or reach some other goal.

(-) 3. I will usually memorize information (words, diagrams, etc.) when learning new materials.

(-) 4. I seldom think about how one subject or topic I study is related to other subjects or topics.

(-) 5. I seldom think about the personal implications that are involved in a school learning assignment.

(-) 6. Most of the subjects in school are boring or too time-consuming.

(-) 7. The best way to learn a new subject is to memorize the material.

(-) 8. I study and try to get good grades because they may help me get into a good college.

Note. The basic coding scheme was: Very Strongly Disagree = 0; Strongly Disagree = 1; Disagree = 2; Agree = 3; Strongly Agree = 4; and Very Strongly Agree = 5. Using the certainty estimate scheme, negative-scored items (-) were reverse coded as follows: Very Strongly Disagree = 16; Strongly Disagree = 12; Disagree = 9; Agree = 7; Strongly Agree = 4; and Very Strongly Agree = 0. All items in the SURF index were negatively scored.
APPENDIX I

FINAL DATA COLLECTION SCHEDULE
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<td>10/30/87</td>
<td>10/15/87</td>
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<tr>
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<td>11/3/87</td>
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<td>11/5/87</td>
<td>10/22/87</td>
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<tr>
<td>10</td>
<td>10/22/87</td>
<td>11/19/87</td>
<td>11/5/87</td>
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</table>
APPENDIX J

JURYING INSTRUCTIONS
PROCEDURES FOR COMPLETING THE JURY TASK

(Content Validation: Microeconomics)

You are requested to review the test instruments provided with these instructions. Each instrument (i.e., Pretest, Posttest I, and Posttest II) consists of 34 multiple-choice questions, and are all standard format, 4-choice, one-correct/three incorrect type achievement questions measuring student concept learning and knowledge in microeconomics. These test instruments were constructed using items from the Test of Economic Literacy (I and II), the Test of Understanding in College Economics, and various other sources. Your task will be to: (1) observe each question, paying special attention to whether each item clearly and accurately is related to the basic concepts of supply, demand and equilibrium; then (2) answer each question with what you consider to be the BEST ANSWER, circling your answer on the numbered response sheets included with the test; and finally (3), please briefly confirm whether the given answers provided at the end of each test (i.e., on the end page of each test) agree with the answer YOU selected as BEST for that item. If the answers are the same, continue checking each item on the test. If your answer is DIFFERENT from the answer listed on the end sheet as correct, PLEASE PROVIDE A VERY BRIEF EXPLANATION NEXT TO THE ITEM ON THE TEST ITSELF (1-2 sentences) describing why the answer you chose is correct or the given answer is incorrect. Any comments you can add in relation to any problem with any item will be very helpful in improving and correcting the instrument and the scoring of the test.

(Construct Validation and Item Categorization)

There are two parts to this activity. The first part consists of 16 statements broadly related to student attitude toward learning and school. Your task will be to assign each statement to one of two categories as defined below. You will then be asked to assign a level of agreement or certainty to which category you have assigned each statement (on a scale from 1 to 5). When you have completed this task, you will be done with PART ONE (approx. time to complete: 15-20 minutes).
The second part of the jury task consists of a somewhat similar procedure, but this part consists of 34 multiple-choice questions (these are all standard format, 4-choice, one-correct/three incorrect type achievement questions measuring concept learning in economics). Your task will be to assign each question to one of two categories as defined below. You will then be asked to assign a level of agreement or certainty to which category you have assigned each question (on a scale from 1 to 5). You are not to answer the questions, nor is prior knowledge of microeconomics necessary when doing this activity. When you have completed this task, you will be done with PART TWO (approx. time to complete: 30-40 minutes), and the jurying activity will be over!

NOTE: The jurying activities are designed to be performed at your own pace, but it is best to work quickly, trust your own judgment, and do not think too long on any one question or statement. Remember, this is a "forced-choice" type of task, and that each item needs to be categorized one way or another, if only to the smallest degree. This is the function of the "degree of certainty" to which you feel each item should be categorized (with 1 being the least certain and 5 being the most certain).

*********************************************************

JURY INSTRUCTIONS: PART ONE

Please follow the following procedures and use the criteria described below for your categorization task:

(1) Read each statement on the following page

(2) On the answer sheet provided on the next page after the statements, mark each item one at a time as you read it, with the number that corresponds to that statement (e.g., mark a category, D (DEEP approach) or S (SURFACE approach), for statement #105 at response #105).

(3) Repeat this procedure for each of the 16 statements, until completed (105-120).
(4) Then, go back to the beginning, and rate on a
scale of 1 to 5, the DEGREE to which you feel
CERTAIN that the item belongs in that
category. Do each item #105 through #120.
Feel free to review each statement as you
are both "categorizing" and "rating".

(5) You're done (nice job!). Now go on to PART 2.

The statements are to be put in one of the following
categories: Category "D" (representing DEEP approaches/
attitudes towards learning and school); or Category "S"
(representing SURFACE approaches/attitudes towards
learning and school). For the purpose of this jurying
task, these categories will be broadly defined as
follows:

DEEP APPROACH: The student: 1) is interested in the
academic task and enjoys carrying it out; 2) searches for
the inherent meaning of a task; 3) personalizes the task;
4) integrates aspects or parts into a whole; 5) seeks
relationships and meaning between new and previous
knowledge; 6) tries to form hypotheses about the task.

SURFACE APPROACH: The student: 1) sees the task as a
demand to be met, or as a means to reach some other goal;
2) avoids personal or other meanings the task may have;
3) sees parts of the task as discrete or unrelated; 4) is
worried about how much time the activity is taking; 5) is
relies on memorization to learn new material.

JURY INSTRUCTIONS: PART TWO

Please follow the following procedures and use the
criteria described below for your categorization task:

(1) Read each question on the following pages

(2) On the answer sheet provided on the next page
after the question set, mark each item one at a
time as you read it, with the number that
corresponds to that question (e.g., mark a
category, HI (for Higher-Order level questions)
or LO (for Lower-Order level questions), for
question #1 at response #1).

(3) Repeat this procedure for each of the 34
statements, until completed (1-34).
(4) Then, go back to the beginning, and rate on a scale of 1 to 5, the DEGREE to which you feel CERTAIN that the item belongs in that category. Do each item #1 through #34. Feel free to review each question as you are both "categorizing" and "rating".

(5) You're COMPLETELY DONE: Many THANKS!

The statements are to be put in one of the following categories: Category "HI" (representing HIGHER-ORDER level of questioning/cognition); or Category "LO" (representing LOWER-order level of questioning/cognition. For the purpose of this jurying task, these categories will be broadly defined using the well-known taxonomy described by Bloom et al. (1956) that is paraphrased as follows:

LOWER-ORDER: These questions require specific KNOWLEDGE, COMPREHENSION, or elementary APPLICATION of relevant facts, definitions or information that is recalled and/or identified. Lower-level questions focus on the direct recall of previously learned or memorized information, and on simple application of this information to examples.

HIGHER-ORDER: These questions require a more complex application of principles or methods to new examples or situations, and ANALYSIS of relationships between elements of a situation or problem. Higher-order questions focus on hypothesis testing, SYNTHESIS of diverse factors, the use of inference beyond the information given, and the EVALUATION of arguments, assumptions, and outcomes.

EXAMPLE RESPONSE SHEET

Corresponding to the appropriate number of each item, please circle either "LO" (i.e., Lower-order questions) or "HI" (i.e., Higher-order questions), and also the degree to which you are certain that your categorization is correct and accurate (1 is least certain, 5 is most certain!):

1.     LO / HI  1 2 3 4 5
2.     LO / HI  1 2 3 4 5
APPENDIX K

COLLATERAL DESCRIPTIVE DATA
Table 41

Summary Data on Major Affective Variables by Gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
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<tr>
<td>Computer Anxiety Index (CAIN)</td>
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</tr>
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<td>Mean</td>
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<td>2.68</td>
<td>2.74</td>
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<td>1.99</td>
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Note. Scale technical midpoint = 8.0. Range = 17. Scale minimum = 0, maximum = 16.
Table 42

Summary Data on Major Affective Variables by Treatment

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<th>Problem-Oriented</th>
</tr>
</thead>
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Note. Scale technical midpoint = 8.0. Range = 17. Scale minimum = 0, maximum = 16.
Table 43

Summary Data on Major Cognitive Variables by Gender

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Table 44

Summary Data on Major Cognitive Variables by Treatment

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<th>Problem-Oriented</th>
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APPENDIX L

COLLATERAL INFERENTIAL DATA
Table 45

Summary Data and Analysis of Variance: Overall

Posttest I Scores by Treatment

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Note. (p = .231)

Table 46

Summary Data and Analysis of Variance: Overall

Posttest II Scores by Treatment

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<td>15.50</td>
<td>0.84</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>2754.36</td>
<td>18.49</td>
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</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>2769.86</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .361)
Table 47

**Summary Data and Analysis of Variance: Higher-Order Posttest I Scores by Treatment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rule-Oriented</th>
<th>Problem-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>77.00</td>
<td>73.00</td>
</tr>
<tr>
<td>Mean</td>
<td>6.48</td>
<td>6.56</td>
</tr>
<tr>
<td>SD</td>
<td>3.16</td>
<td>2.88</td>
</tr>
</tbody>
</table>

**Source**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>0.25</td>
<td>0.25</td>
<td>0.03</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1355.19</td>
<td>9.16</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1355.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** (p = .870)

Table 48

**Summary Data and Analysis of Variance: Higher-Order Posttest II Scores by Treatment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rule-Oriented</th>
<th>Problem-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>78.00</td>
<td>73.00</td>
</tr>
<tr>
<td>Mean</td>
<td>5.12</td>
<td>5.06</td>
</tr>
<tr>
<td>SD</td>
<td>2.35</td>
<td>2.36</td>
</tr>
</tbody>
</table>

**Source**

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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>0.143</td>
<td>0.14</td>
<td>0.02</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>827.38</td>
<td>5.55</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>827.51</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** (p = .877)
Table 49

Summary Data and Analysis of Variance: Lower-Order Posttest II Scores by Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rule-Oriented</th>
<th>Problem-Oriented</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>78.00</td>
<td>73.00</td>
</tr>
<tr>
<td>Mean</td>
<td>5.83</td>
<td>6.53</td>
</tr>
<tr>
<td>SD</td>
<td>3.03</td>
<td>2.47</td>
</tr>
</tbody>
</table>

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<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
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<td>18.53</td>
<td>18.53</td>
<td>2.41</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>1147.00</td>
<td>7.70</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>1165.53</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .123)
### Table 50

**Summary Data and Analysis of Variance: Overall Posttest I Scores by Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Mean</td>
<td>14.88</td>
<td>13.84</td>
</tr>
<tr>
<td>SD</td>
<td>5.38</td>
<td>5.41</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>40.56</td>
<td>40.56</td>
<td>1.40</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>4304.00</td>
<td>29.08</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>4344.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** (p = .240)

### Table 51

**Summary Data and Analysis of Variance: Overall Posttest II Scores by Gender**

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>75.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Mean</td>
<td>11.32</td>
<td>11.22</td>
</tr>
<tr>
<td>SD</td>
<td>3.92</td>
<td>4.66</td>
</tr>
</tbody>
</table>

<table>
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<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>.35</td>
<td>.35</td>
<td>.02</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>2769.52</td>
<td>18.59</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>2769.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** (p = .891)
Table 52
Summary Data and Analysis of Variance: Higher-Order Posttest I Scores by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Mean</td>
<td>6.88</td>
<td>6.16</td>
</tr>
<tr>
<td>SD</td>
<td>3.11</td>
<td>2.89</td>
</tr>
</tbody>
</table>

<table>
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<tr>
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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>1</td>
<td>19.44</td>
<td>19.44</td>
<td>2.15</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1336.00</td>
<td>9.03</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1355.44</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .144)

Table 53
Summary Data and Analysis of Variance: Lower-Order Posttest I Scores by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>75.00</td>
<td>75.00</td>
</tr>
<tr>
<td>Mean</td>
<td>8.00</td>
<td>7.68</td>
</tr>
<tr>
<td>SD</td>
<td>2.88</td>
<td>3.12</td>
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<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
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<td>3.84</td>
<td>3.84</td>
<td>.43</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>1336.32</td>
<td>9.03</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>1340.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .425)
Table 54
Summary Data and Analysis of Variance: Higher-Order Posttest II Scores by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>75.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Mean</td>
<td>5.12</td>
<td>5.08</td>
</tr>
<tr>
<td>SD</td>
<td>2.21</td>
<td>2.50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
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<td>.06</td>
<td>.06</td>
<td>.01</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>827.44</td>
<td>5.55</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>827.50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .915)

Table 55
Summary Data and Analysis of Variance: Lower-Order Posttest II Scores by Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>MALE</th>
<th>FEMALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>75.00</td>
<td>76.00</td>
</tr>
<tr>
<td>Mean</td>
<td>6.20</td>
<td>6.14</td>
</tr>
<tr>
<td>SD</td>
<td>2.66</td>
<td>2.93</td>
</tr>
</tbody>
</table>

<table>
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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
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<td>.12</td>
<td>125</td>
<td>.02</td>
</tr>
<tr>
<td>Error</td>
<td>149</td>
<td>1165.40</td>
<td>7.82</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>150</td>
<td>1165.52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .904)
Table 56

Summary Data and Analysis of Variance: Overall

Posttest I Scores by Attitude Towards Economics

<table>
<thead>
<tr>
<th>ATE Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>69.00</td>
<td>81.00</td>
</tr>
<tr>
<td>Mean</td>
<td>14.36</td>
<td>14.36</td>
</tr>
<tr>
<td>SD</td>
<td>5.66</td>
<td>5.21</td>
</tr>
</tbody>
</table>

<table>
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<th>Source</th>
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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>4344.56</td>
<td>29.36</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>4344.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .996)

Table 57

Summary Data and Analysis of Variance: Overall

Posttest II Scores by Attitude Towards Economics

<table>
<thead>
<tr>
<th>ATE Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>68.00</td>
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</tr>
<tr>
<td>Mean</td>
<td>10.85</td>
<td>11.65</td>
</tr>
<tr>
<td>SD</td>
<td>4.44</td>
<td>4.28</td>
</tr>
</tbody>
</table>

<table>
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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATE</td>
<td>1</td>
<td>22.96</td>
<td>22.96</td>
<td>1.21</td>
</tr>
<tr>
<td>Error</td>
<td>145</td>
<td>2744.61</td>
<td>18.90</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>2767.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .273)
Table 58
Summary Data and Analysis of Variance: Overall
Posttest I Scores by Economic Attitude Sophistication

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>84.00</td>
<td>66.00</td>
</tr>
<tr>
<td>Mean</td>
<td>13.89</td>
<td>14.96</td>
</tr>
<tr>
<td>SD</td>
<td>5.28</td>
<td>5.54</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Source</th>
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<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAS</td>
<td>1</td>
<td>41.66</td>
<td>41.66</td>
<td>1.43</td>
</tr>
<tr>
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<td>4302.90</td>
<td>29.07</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>4344.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .233)

Table 59
Summary Data and Analysis of Variance: Overall
Posttest II Scores by Economic Attitude Sophistication

<table>
<thead>
<tr>
<th>EAS Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>84.00</td>
<td>66.00</td>
</tr>
<tr>
<td>Mean</td>
<td>11.21</td>
<td>11.38</td>
</tr>
<tr>
<td>SD</td>
<td>4.41</td>
<td>4.30</td>
</tr>
</tbody>
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<table>
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<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
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<td>EAS</td>
<td>1</td>
<td>1.05</td>
<td>1.05</td>
<td>0.06</td>
</tr>
<tr>
<td>Error</td>
<td>145</td>
<td>2766.52</td>
<td>19.08</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>2767.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .815)
Table 60

Summary Data and Analysis of Variance: Overall

Posttest I Scores by Computer Anxiety

<table>
<thead>
<tr>
<th>Computer Anxiety</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>60.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Mean</td>
<td>15.15</td>
<td>13.83</td>
</tr>
<tr>
<td>SD</td>
<td>5.40</td>
<td>5.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>1</td>
<td>62.41</td>
<td>62.41</td>
<td>2.16</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>4282.15</td>
<td>28.93</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>4344.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .144)

Table 61

Summary Data and Analysis of Variance: Overall

Posttest II Scores by Computer Anxiety

<table>
<thead>
<tr>
<th>Computer Anxiety</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>57.00</td>
<td>90.00</td>
</tr>
<tr>
<td>Mean</td>
<td>12.00</td>
<td>10.82</td>
</tr>
<tr>
<td>SD</td>
<td>4.40</td>
<td>4.29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIN</td>
<td>1</td>
<td>48.41</td>
<td>48.41</td>
<td>2.58</td>
</tr>
<tr>
<td>Error</td>
<td>145</td>
<td>2719.16</td>
<td>18.75</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>146</td>
<td>2767.57</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. (p = .110)
Table 62  
**Summary Data and Analysis of Variance: Overall**  
**Posttest I Scores by Deep Approach Toward Learning**

<table>
<thead>
<tr>
<th>DEEP Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>87.00</td>
<td>63.00</td>
</tr>
<tr>
<td>SD</td>
<td>14.89</td>
<td>13.64</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>ss</th>
<th>ms</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEEP</td>
<td>1</td>
<td>57.11</td>
<td>57.11</td>
<td>1.97</td>
</tr>
<tr>
<td>Error</td>
<td>148</td>
<td>4287.45</td>
<td>28.97</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>149</td>
<td>4344.56</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** (p = .162)

Table 63  
**Summary Data and Analysis of Variance: Overall**  
**Posttest II Scores by Deep Approach Toward Learning**

<table>
<thead>
<tr>
<th>DEEP Score</th>
<th>LOW</th>
<th>HIGH</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>86.00</td>
<td>61.00</td>
</tr>
<tr>
<td>SD</td>
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**Note.** (p = .646)