

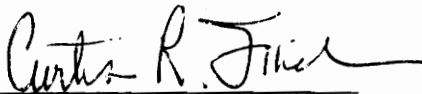
THE EFFECTS OF A SIMULATION CAREER GAME ON THE
ACHIEVEMENT MOTIVATION OF VOCATIONAL STUDENTS
ENROLLED IN DEVELOPMENTAL ARITHMETIC

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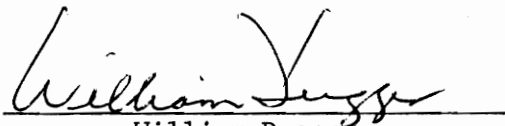
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Dissertation submitted to the Graduate Faculty of the
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in partial fulfillment of the requirements for the degree of
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in
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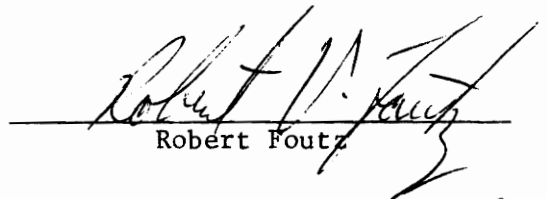
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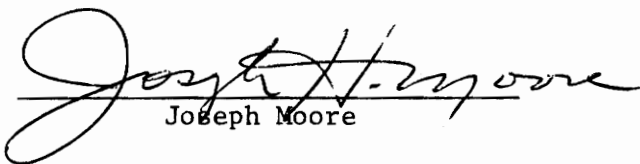
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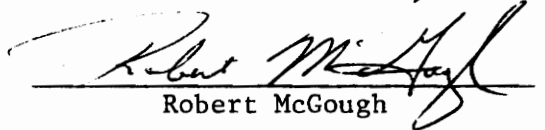
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Chapter 1

INTRODUCTION

Origin and Background of the Study

Motivational development of students is a continuing concern of educators, parents and the public. This concern is evidenced by the 1976 Gallop Poll in which ability to inspire and motivate children was the third most frequently requested quality of teachers (Gallop, 1976:195). Our achievement oriented society expects the educational system to provide a motivating environment to enhance student success in society. Addressing the problem of higher education and the job crisis Klemp suggested colleges should go beyond helping their students acquire cognitive skills important to occupational success. Klemp (Jacobson, 1977:3) suggests a range of interpersonal skills ". . . as well as certain qualities relating to motivation such as cognitive initiative" Thus, motivation is perceived by society as an important element for success in school and in the world of work.

National concern for the motivation of our youth is a common concern for educators at all levels. Since the emergence of the community college and the enrollment of nontraditional students, many community college educators have joined other educators in their concern over how to "motivate" students (Roueche and Mink, 1976:40). This instructional challenge has become increasingly difficult since the open door admissions policy and recent recruitment efforts have increased the enrollment and diversity of students. Many colleges

have assumed responsibility for actually identifying and recruiting individuals in the community who need or can profit from a college program (Roueche, 1976:10). Community colleges are continually being challenged to provide education to these nontraditional students through remedial education. The challenge is affirmed by the recommendation of the Carnegie Commission on Higher Education (1970:22-23) ". . . that community colleges provide remedial education that is flexible and responsive to the individual student's needs, that such programs be subject to continual study and evaluation"

Thus, community college recruitment practices have resulted in increased enrollment of students who vary with respect to aptitude, achievement, socio-economic background, and motivational attitudes more than students in any other educational setting (Roueche, 1974:24). Roueche describes the remedial student as a:

. . . hesitant, conservative low achiever with serious self doubts, lack of confidence, poor mental health and motivation too low to detect. He asks to be taught but does not really believe he can learn because he has experienced a lifetime of academic failures (Roueche and Kirk, 1974:70).

These unique students require innovative instructional strategies which meet their unique needs. The community college's egalitarian open door policy ". . . has meaning if, and only if, these new students are educationally accommodated." (Roueche, 1973:24). Hence, the community college is obligated to provide learning strategies for the poorly motivated student who may not benefit from the traditional lecture/textbook/discussion teaching method. "It is this responsibility that beckons the community college instructor to critically evaluate his

or her own instructional design, his or her own delivery system, in order to promote competency in all students despite their learning differences" (Roueche, Herrscher, and Baker, 1976:5). Instructional development should focus on learning activities that consider the range of abilities found in community college students. Need for innovative instruction in developmental studies is reflected in attrition rates of 80 to 90 percent (Roueche, 1968). The potential value of innovative programs is evidenced by the data of a later study (Roueche and Kirk, 1973) of five selected innovative colleges, in which 75 to 90 percent of all students who enrolled with deficiencies completed the programs.

It is evident that innovative instructional strategies can be developed which approach the concern for enhancing motivation of remedial students. However, it is also clear that current instructional strategies used in developmental programs do not always approach those psychological variables which may increase achievement (Losak, 1973:39). Consequently, ". . . schools will have to take greater responsibility for promoting the growth of attitudes conducive to learning and to continued psychological growth" (McClelland and Alschuler, 1971:37). McClelland suggests that ". . . it is not enough to make opportunities available to people. The opportunities should be accompanied by motivational training that would allow people to take advantage of the opportunities" (McClelland cited in Chapman and Hall, 1971:3.1).

Achievement motivation has been improved through projects conducted by Alschuler and McClelland (1971), Brown (1976), Burris (1958) and Kolb (1965) who supported the use of innovative instructional strategies such as games, which focus on the psychological

attributes of the student. These strategies were applications of McClelland's twelve propositions in which achievement motivation is taught by simply teaching students to think in achievement terms. The following propositions summarize the elements of motive acquisition:

1. The more thoroughly an individual develops and clearly conceptualizes the associative network defining a motive, the more likely he is to develop the motive.
2. The more an individual can link the newly developed associative network to related actions, the more the change in both thought and action is likely to occur and endure.
3. The more an individual can link a newly conceptualized association-action complex (or motive) to events in his everyday life, the more likely the motive complex is to influence his thoughts and actions in situations outside the training experience.
4. The more an individual perceives that developing a motive is required by the demands of his career and life situation, the more educational attempts designed to develop that motive are likely to succeed.
5. The more an individual can perceive and experience the newly conceptualized motive as consistent with the ideal self-image, the more the motive is likely to influence his future thoughts and actions.
6. The more an individual can perceive and experience the newly conceptualized motive as consistent with prevailing cultural values and norms, the more the motive is likely to influence his future thoughts and actions.
7. The more reasons an individual has to believe that he can, will, or should develop a motive, the more educational attempts designed to develop that motive are likely to succeed.
8. The more an individual commits himself to achieving concrete goals in life related to the newly formed motive, the more the motive is likely to influence his future thoughts and actions.
9. The more an individual keeps a record of his progress toward achieving goals to which he is committed, the more the newly formed motive is likely to influence his future thoughts and actions.

10. Changes in motives are more likely to occur in an interpersonal atmosphere in which the individual feels warmly but honestly supported and respected by others as a person capable of guiding and directing his own future behavior.
11. Changes in motives are more likely to occur the more the setting dramatizes the importance of self-study and lifts it out of the routine of everyday life, thereby creating an in-group feeling among the participants.
12. Changes in motives are more likely to occur and persist if the new motive is a sign of membership in a new and continuing reference group. (McClelland and Winter, 1969:48-68)

However, these propositions do not utilize the vocational orientation many remedial students have in the community college setting. One's career orientation appears to be an untapped resource for improving motivation in the school. A motivation theory established by Raynor emphasizes this relationship between one's future goals or career to an immediate activity. Raynor's elaborated theory maintains that future orientation is a separate variable from the concept of perceived task difficulty or the subjective probability of success. Specifically, motivation may be aroused if the instrumentality of an immediate activity is related to one's future goal or career. Clearly, one will be motivated to approach or avoid effort according to the probability and perception of how the outcome will satisfy one's needs. Therefore, Raynor's theory may be an appropriate base for an innovative instructional strategy to improve the achievement motivation of community college students. Using this theory as a base, the study will introduce an instructional strategy to reduce the motivational deficiency of developmental arithmetic students at a community college. The instructional strategy will consist of a simulation game that emphasizes the

relationship between the immediate learning activity and the student's future career.

Statement of the Problem

This study will apply Raynor's elaborated theory of achievement motivation to the motivational problem of developmental arithmetic students who anticipate enrollment in occupational-technical programs and those who are not seeking career preparation. The students will consist of those academically disadvantaged with inadequate arithmetic skills for entering any certificate program or degree program. The problem of this study is to determine the effects of a career simulation math game upon student perception of the career importance (perceived instrumentality) of a developmental math course. Furthermore, the influence of these perceptual changes upon student arithmetic achievement will be measured relative to students' achievement motive orientation (success or avoidant). More specifically, the following hypotheses will be tested:

H_o 1. No difference exists between the mean scores on the Student Plans Questionnaire of students who participate in a simulation game experience and students who do not participate.

H_o 2. No difference exists in the mean arithmetic achievement of students who may be classified as success oriented ($M_s > M_{af}$) and those who may be classified as avoidant oriented ($M_s < M_{af}$).

H_o 3. No difference exists in the mean arithmetic achievement of students who participate in the math game and those who do not participate.

H₀ 4. No difference exists in the mean arithmetic achievement of students who perceive the course as most important to their careers (high perceived instrumentality) and those who perceive it as less important (low perceived instrumentality) to their careers.

H₀ 5. No difference exists in the interaction of arithmetic achievement between the student motive orientation (success and avoidant oriented) and student participation in the game (treatment and comparison groups).

H₀ 6. No difference exists in the interaction of mean arithmetic achievement scores between the motive orientation groups (success and avoidant oriented) and the perceived instrumentality groups (high and low perceived instrumentality).

H₀ 7. No difference exists in the interaction of arithmetic achievement between students who perceive the importance of the course to their career (high and low perceived instrumentality) and student participation in the game (treatment and comparison groups).

H₀ 8. No difference exists in the interaction of mean arithmetic achievement scores between students who perceive the importance of the course to their career (high and low perceived instrumentality), the student participation in the game (treatment and comparison groups) and student motive orientation (success and avoidant oriented).

Scope and Limitations

This study examined the effects of a simulation game on the mathematical achievement of arithmetic students who were not seeking career preparation and those who anticipated enrollment in selected

occupational-technical programs offered at a medium sized community college. Simulation gaming activities, which were based upon Raynor's theory of achievement motivation, were integrated into the instructional materials of a self-paced individualized arithmetic course. The study used a factorial design to examine math achievement with respect to the three independent variables: (1) use of the simulation gaming materials, (2) the achievement motive tendency (success or avoid failure), and (3) perceived instrumentality (perceived future importance of the course). In addition, the influence of simulation gaming upon changes in perceived instrumentality were examined.

The sample of this study was limited to eighty-two developmental arithmetic students who anticipated enrollment in degree and certificate level occupational-technical programs offered by the college. The sample also included those students not formally seeking career training. The sample was randomly selected from Fall quarter (1978) students who were not enrolled full-time in occupational-technical programs because of academic deficiencies. Consequently, results of this study should be generalized with due caution.

Treatment materials were limited to the five selected units of the programmed text used by the students. The treatment materials were also limited to the math applications in the following career areas: airconditioning and refrigeration, automotive diagnosis, machine operator and clerk typist. Furthermore, the assessment of the students' perceived instrumentality of career relevance of an activity was limited to appraisal by a self-report questionnaire. Finally, the assessment of changes in achievement motivation was limited to measurement of arithmetic achievement.

Definition of Terms

1. Motive to achieve success (M_s): the excitatory tendency which dominates over avoidance tendencies and is characterized by realistic aspiration levels, positive feeling aroused by success, independence in interpersonal relationships and a preference for competition (Mehrabian, 1968:494-495).

2. Motive to avoid failure (M_{af}): the inhibitory tendency that functions to oppose and dampen the tendency to undertake achievement-oriented activities (Stephenson, 1970:11). Individuals with this motive possess relatively low or high aspirations, have more negative feelings aroused by success, susceptible to conformity pressures and prefer non-competitive situations (Mehrabian, 1968:494-495).

3. Achievement motivation: the achievement oriented tendency which results when the two opposing tendencies of success and avoidance are combined additively within the individual (Atkinson and Raynor, 1974:18).

4. Perceived instrumentality: is the subjective personal awareness of the relevance between an immediate activity to one's future goals (Atkinson and Raynor, 1974:175).

Summary

The motivational development of the community college student is a national concern of educators, parents, and the public. Improvement of achievement motivation can be accomplished if the importance of an immediate activity toward attaining a future goal is emphasized. This study was designed to determine the effects of a career simulation

game on math achievement of developmental arithmetic students. Furthermore, effects upon the students' perceived instrumentality were examined. In this chapter the origin and background of the problem was explained, the problem was stated, the scope and limitations were presented, and the terms defined.

Chapter 2

REVIEW OF LITERATURE

The major goal of this study was to examine the influences of a simulation game on the math achievement of developmental arithmetic students. Since the simulation game is based upon Raynor's elaborated Expectation-Value theory this chapter will consist of the theoretical support for Raynor's elaboration and simulation gaming research related to motivation. A review will also be made of studies related to developmental arithmetic instruction.

Raynor's elaborated theory takes into account the important effects of expected future outcomes on the strength of motivation toward an immediate activity. This theory is an elaboration of Atkinson's Expectation-Value theory of motivation which equates

. . . the strength of the tendency to achieve success (T_s) as expressed in the interest and performance of an individual in some task as a multiplicative function of three variables: (M_s) motive to achieve, conceived as a relatively general and relatively stable dispositions of personality; and two other variables which represent the effect of the immediate environment (P_s) the strength of expectancy (or subjective probability) that performance of a task will be followed by success and (I_s) the incentive value of success, the relative attractiveness of success at the particular activity. In other words,
 $T_s = M_s \times P_s \times I_s$. (Atkinson and Raynor, 1974:14)

The achievement motive variable might be conceived as a capacity for taking pride in accomplishment when success at one or another activity is achieved (Atkinson, 1964:241). In conflict with this tendency is the motive to avoid failure, it is the capacity for reacting with "shame and embarrassment when the outcome of performance is failure" (Atkinson and Raynor, 1974:17). This tendency is ". . . conceived as an inhibitory

tendency that functions to oppose and dampen the tendency to undertake achievement-oriented activities, as the source of the conscious experience of anxiety." (Atkinson and Raynor, 1974:16). This motive to avoid failure is usually assessed by the Mandler-Sarason (1952) Test Anxiety Questionnaire. The two tendencies

. . . combine additively and yield a resultant achievement-oriented tendency which is either approach (excitatory) or avoidant (inhibitory) in character and of certain strength depending upon the relative strength of motive to achieve success and motive to avoid failure in the individual. (Atkinson and Raynor, 1974:18).

Furthermore, Atkinson's Expectation-Value Theory assumed that the incentive value (I_s) increases the more difficult the task and the strength of expectancy of success (P_s) was related as $I_s = 1 - P_s$. It was further concluded that the tendency to achieve was more strongly aroused by tasks having intermediate probability of success than either very easy or very difficult tasks. Accordingly, one can influence motivation by manipulating cues which define an individual's expectations concerning the consequences of his actions and/or the incentive value of the consequences (or goals) produced by the action. Although this theory partially predicts behavior, it has failed to distinguish between anticipation of achieving distant future goals with the anticipation of achieving immediate goals through the immediate activity (Raynor, 1968:1).

Elaborated Expectation-Value Theory

Raynor's theory supplements Atkinson's since it maintains that future orientation is a separate variable from Atkinson's perceived task difficulty or the subjective probability of success. In the present

elaboration when an individual believes that his or her immediate activity can influence the occurrence of both an immediate achievement consequence (success or failure) and a future achievement consequence (success or failure), there is an intensification of his or her characteristic achievement motivation for the immediate activity.

When an individual believes that his immediate activity can influence his immediate and future success there is an increment in his strength of tendency to achieve success (T) in the immediate activity. He is said to be simultaneously^s motivated to achieve immediate and future success. When an individual believes that his immediate activity can influence his immediate and future failure there is an increment in his strength of tendency not to engage in the immediate activity (formerly termed tendency to avoid failure). He is said to be simultaneously inhibited by the threat of immediate and future failure (Raynor, 1968:14).

Studies Related to Raynor's Elaboration

Research by Atkinson, Brown, Entin, Isaacson, Raynor, and Weitzenkorn provide empirical evidence as to how individual differences in future orientation interact with individual differences in achievement-related motives to determine total strength of achievement motivation toward an immediate activity (Atkinson and Raynor, 1974:121).

Isaacson and Raynor (unpublished data) examined the effects of achievement motivation and the perceived instrumentality on academic performance. Perceived instrumentality (PI) was a subjective measure of the student's perceived importance of good grades (i.e., immediate success) toward future career success (Atkinson and Raynor, 1974:124). Male college students were divided into low, intermediate and high groups according to their ratings of (PI) perceived instrumentality. The groups were subdivided according to high and low scores on the

Debilitating Anxiety (Alber and Haber, 1960). The results indicated that the group with relatively low anxiety received significantly higher grades than the students with high anxiety within the high ($p < .01$) and intermediate ($p < .05$) PI groups, but not within the low PI. In addition, the low anxiety group tended to receive higher grades, while the high anxiety group received lower grades as PI increased (Atkinson and Raynor, 1974:125). This interaction between motive and perceived instrumentality approached the conventional level of significance when grades were adjusted using total scores on the scholastic aptitude test as a covariate ($p < .10$), but not without this adjustment (Atkinson and Raynor, 1974). These interactive effects between motives and perceived instrumentality illustrate the influence of perceived instrumentality upon achievement motivation. In contrast, Raynor reported in 1968 ". . . that high-school students received higher grades regardless of motive status when their 'overall' high school grades were seen as important for their future success than when they were not" (cited in Atkinson and Raynor, 1974:132).

Isaacson and Raynor's studies prompted Raynor, Atkinson, and Brown (unpublished data) to investigate the subjective reactions of male college students when faced with a final course examination in introductory psychology. Subjective reactions were studied relative to: (1) achievement related motives, (2) relationship between their examination performance, and (3) their own future goals (PI). The conventional tests of need for Achievement (McClelland et al., 1953) and Test Anxiety (Mandler and Sarason, 1952) were used to measure

motive for success and motive to avoid failure, respectively. Atkinson reported the dominant trend of the results as:

. . . strength of motivation expressed in the self-descriptive ratings, whether approach or avoidant in action implications, is also a function of whether or not a subject views his performance on the examination as related to his own future goals. If he does not, then even though he is confronted by an obvious test on which his performance will be evaluated, he then describes himself as less concerned about his performance. The kind of differences expected among individuals who differ in achievement motivation . . . are greater among those who view the examination as related to future goals. (Atkinson and Raynor, 1974:125)

Raynor (1968) supported previous research in two similar studies using introductory psychology students. In the first study Raynor examined the grades of students divided into two groups according to their motive tendency (success or avoid failure) based on the scores obtained on the Thematic Apperceptive Test (McClelland, Atkinson, Clark, and Lowell; 1953) and the Test Anxiety Questionnaire (Mandler and Sarason, 1952). The groups were subdivided according to the students' perceived instrumentality of their grade toward career plans and career success. The results indicated a significant effect due to motives ($F = 5.56$, $df 1/53$, $p < .05$), in addition to a significant interaction between motives and perceived instrumentality ($p < .05$). Specifically, the success motive group received higher grades than the avoid failure group, but only within the high perceived instrumentality groups. Within the success motive group, students high in perceived instrumentality received higher grades than students low in perceived instrumentality ($p < .05$). Perceived instrumentality by itself was not related to grades ($F < 1$, $df 1/58$, ns). Furthermore, Raynor indicated the difference in grades between high and low perceived instrumentality

was larger in the positive direction (high-low) for the success motive group than for the avoid failure motive group ($p < .025$).

In the second study (Raynor, 1968) students enrolled in introductory psychology were grouped according to the procedures of the first study. In addition to the psychology grade, the semester grade point average was examined. The perceived instrumentality rating for each credit course in which the student was currently enrolled and the respective importance of getting a good course grade was assessed relative to career fulfillment. The results with respect to psychology grades indicate both motive groups (success and avoid failure) received significantly higher grades within high than within the low perceived instrumentality groups ($p < .05$). There was also an interaction between motives and perceived instrumentality ($p < .10$). Within the success motive group, students high in perceived instrumentality received higher grades than students low in perceived instrumentality ($p < .005$), and the difference in grades between high and low perceived instrumentality is larger for this group than for the avoid failure motive group ($p < .05$). "However, the motive classification by itself is not related to groups ($F = 1.29$, $df = 1/77$, ns)" Raynor, 1970:31). The examination of the grade point average between subjects

. . . reveals a main effect due to perceived instrumentality ($p < .10$), while the effect of motive classification and the interaction between motives and perceived instrumentality are both negligible ($F_s < 1$) Raynor, 1970:31).

In addition, subjects in both motive groups received higher grades in their high- than in their low-PI (perceived instrumentality) courses ($F = 4.72$, $df = 1/51$, $p < .05$). Thus, for both the between and within

subjects (analyses of the joint effects of motives and perceived instrumentality of the grade point average) the predicted interaction effect was not found (Raynor, 1970:31). The absence of interactive effects may be because some courses do not easily relate to specific career or all students may not be equally certain to their future career plans on different academic areas (Raynor, 1970:32).

Contingent and Noncontingent Path Studies

Previous studies did not systematically support Raynor's Elaborated Expectation-Value Theory. Therefore, Raynor began a second stage of studies using contingent and noncontingent paths which were experimentally induced to manipulate the subject's future orientation. This research technique eliminated the need for the perceived instrumentality questionnaire. The contingent path implies future performance is dependent upon immediate activity whereas, the noncontingent path does not relate immediate and future activity. This approach was used by Raynor (Raynor and Rubin, 1971) in an experiment with college psychology students who were classified into four groups according to high-low scores on the Thematic Apperceptive Test and the Test Anxiety Questionnaire (developed by McClelland and Mandler and Sarason, respectively). Contingent and noncontingent paths were induced.

. . . A contingent path was created by leading subjects to believe that success or a prior 'test' in a series of four similar arithmetic 'tests' was necessary in order to guarantee the opportunity to take the next tests, while failure on any test ruled out the possibility of taking additional tests. A noncontingent path was created by telling subjects that they would have the opportunity to take each of the four tests, regardless of their performance on any of them. (Raynor and Rubin, 1971:37)

Student performance on the three step-arithmetic test was examined. Students classified in the High TAT-Low TAQ ($M_s > M_{af}$) attempted and answered more problems correctly than the Low TAT-High TAQ ($M_{af} > M_s$) group. The differences in performance were greater in the contingent than the noncontingent condition. Furthermore, students classified in High TAQ-Low TAT ($M_{af} > M_s$) answered significantly fewer problems in the contingent than in the noncontingent condition ($p < .025$). The extreme motive groups were significantly effected by motives and had significant interactions between motives and conditions. The Low TAT-Low TAQ group attempted and correctly answered about the same number of problems under the contingent as the noncontingent condition. The High TAT-High TAQ group scores were not significantly higher in the contingent than in the noncontingent condition (Atkinson and Raynor, 1974:186). Therefore, the study provided direct confirmation of the elaborated theory of achievement motivation concerning the effects of contingent future orientation on level of performance, particularly as measured by the number of problems answered correctly in a three step-arithmetic task (Raynor, 1971:40).

Further studies by Entin and Raynor (1973) using arithmetic tasks investigated whether the shortest possible contingent path (two steps) would produce the predicted pattern of interaction in comparison to the noncontingent path of the same length. The results parallel those of Raynor and Rubin (1971) and suggest that a path of two steps is sufficient to produce effects of contingent future orientation, and that these become even stronger as the length of path is increased. Raynor, Entin, and Raynor (1972) conducted similar studies by inducing

paths of two and four steps using a sample of sixth and eighth grade boys and girls from an inner city school who were mostly black and Spanish-speaking Americans. These studies supported the earlier predictions of performance (Atkinson and Raynor, 1974:133).

Weitzenkorn (1974) replicated the research design of Raynor and Rubin (1971) to provide support for Raynor's elaboration and the use of the Mehrabian Achievement Scale (1968) and the Test Anxiety Questionnaire (1952) as a predictor of performance for both sexes. In the first study college females in the high-motive group performed better while the performance of the low motive group declined as the contingencies became more intense. Therefore, the performance was influenced by the nature of a future oriented contingency. In contrast, for the male subjects in the second study the results only partially support the elaborated theory. No significant interactions were found between the treatment conditions and the motive groups.

. . . However, a significant t test between high- and low-motive groups was found in the norm contingent condition but not in the equivalent noncontingent condition as would be predicted by Raynor's elaborated theory of achievement motivation. (Weitzenkorn, 1974:374)

Finally, the study did provide support for the dual use of the Mehrabian's Achievement Scale and the Test Anxiety Questionnaire as "a measure of resultant achievement motivation since from them performance was predictable" (Weitzenkorn, 1974:374).

. . . Thus, the experimental evidence presented thus far suggest that while contingent future orientation accentuates characteristic differences in aroused achievement motivation, use of performance efficiency to infer differences the motivation requires further systematic study to specify the conditions under which such a relationship can be expected to be linear. (Atkinson and Raynor, 1974:134)

Simulation Gaming Overview

Simulation-gaming research studies have attempted to investigate the impact of educational games and simulations, but few studies offer definitive results. Nevertheless, researchers conclude that:

. . . Simulation games can be one of the foundations for a truly vitalized educational system and . . . this technique, given the right conditions, can make a profound contribution to the growth and development of our young people so that they can be better prepared for life in the modern world. (Lee and O'Leary, 1971:345-346)

Support for simulation-gaming relates to the recent awareness of the need for relevant instruction. Simulation by definition integrates practice and materials as near as possible to the situation in which the learning will be applied (Good, 1973:535). Learning from games with simulated environments is more relevant for two reasons: (1) the player is manipulated to achieve some goal or concrete objective related to the content of classroom learning and (2) the player is provided the opportunity to practice roles which are relevant to their future life roles (Boocock and Coleman, 1966:218). These relevant experiences allow the student to participate in a real world setting and ". . . gain experience that would otherwise be unavailable to them (sometimes because the real thing is too expensive, too dangerous, or too time consuming" (Coombs, 1975). The activity is self-motivating and ". . . gratifying in and of itself and therefore tends to be self-perpetuating." (Coombs, 1975). Sneider (1976) believes this characteristic of simulation gaming has important implications for student motivation. "When the teachers objectives are in the area of motivation, stimulating interest and developing an understanding of a process, it

seems that games are an appropriate teaching device" (Heighberger, 1975:10).

Studies Relating Motivation
to Simulation Games

Alschuler (1973), Troyka (unpublished data), Lucas, Postma, and Thompson (1974), Boocock (1963), Cherryholmes (1966), and Edwards (1971) have researched the influence of simulation-gaming upon motivation. Alschuler did extensive work with the use of games to enhance achievement motivation. He suggests that ". . . learning the Achievement Action Strategies through games, exercises, and role plays will be more effective than learning to conceptualize and alter ones pattern of thought, . . ." at least until the child develops intellectually (1963:67). Furthermore, in order to

. . . arouse students' motivation more systematically in the classroom, learning should have the formal properties of a game, i.e., rules that are clearly specified in advance, and defined classes of behavior, obstacles to be overcome, and a well specified scoring system. (Alschuler, 1973:117)

An experiment (Alschuler, 1971) conducted with a typing class in a large suburban high school indicated that simulation gaming could change the class structure from power-compliance to a structure which encouraged affiliation and achievement motivation. The new structure included: (1) collaboration between teacher and students to determine standards for different letter grades, (2) students individually made daily records of their progress on graphs, (3) students set short and long term scoring goals, (4) students took speed tests according to their goals and were recorded accordingly (Alschuler, Tabor, and McIntyre, 1971:119).

. . . In summary, students had opportunities to take greater personal responsibility for setting moderate risk goals. They explored to a far greater extent whatever personal obstacles they faced and whatever instrumental activity might help overcome them. (Alschuler, Tabor, and McIntyre, 1971:120)

As a result, ". . . the tenth-grade typing class at the end of the year averaged fifty-six percent greater typing speeds than a match comparison group . . . taught by the same teacher . . ." (Alschuler cited in Chapman and Hall, 1971:3.34).

Alschuler (1971) reported an experiment which structured a fifth-grade mathematics class into a "Math Game".

. . . Each student contracted with the teacher to produce a chosen percentage of correct answers in each chapter of the text. Contracts were made for one chapter at a time. The student chose his own deadline for completion of the chapter. (Alschuler, 1973:133)

The student's success in learning math was rewarded by the amount of play money earned which was directly proportional to the goal set. The higher the percentage of correct answers bid for and produced, the more money earned (Alschuler, 1973:133-134). The results of the new structure indicate ". . . the fifth-grade math classes gain over one year in computational and reasoning ability, as measured by the Stanford Achievement Test (SAT), was three years . . ." (Alschuler cited in Chapman and Hall, 1971:3.34). Similar classroom structures were integrated into the developmental studies program at Jamestown Community College to provide special help to problem students.

. . . As much as 50 per cent of class time was spent in examining the relevance of the subject matter to the individual lives of the students. Negotiations with the students to decide collaboratively the course content were undertaken. (Alschuler, 1972:583).

The subjective evaluation of these changes suggests increased enthusiasm and motivation among students and faculty.

Furthermore, Troyka (unpublished data) integrated simulation gaming into remedial English courses at Queensborough Community College of City University of New York. Poor student motivation had been observed and discontent from enrollment in a noncredit course was obvious. Four simulations were developed:

Surfside, a pollution-crises game to elicit writing developed by facts; Syndicate, a game about neighborhood crime to elicit writing developed by deductive reasoning; Drugs, a game about a campus drug problem to elicit writing developed from incidents; and Fleets, a taxicab purchase game about the advantages of various models, to elicit writing developed by descriptive comparison. (Coombs, 1975)

Students participating in the simulation demonstrated greater prose competence than did the students in the control groups as measured by the CEEB's English Composition Test and the English Expression section of the Sequential Test of Educational Progress (STEP). Furthermore, increased enthusiasm, involvement and rapport within student groups was observed (Coombs, 1975).

Lucas, Postma, and Thompson (1974) examined the effects of twenty-five hours of simulation gaming experience on high school history students. No significant differences were determined in the immediate cognitive achievement of students who participated in the simulation game. However,

. . . the students who were exposed to simulation gaming techniques performed significantly better on a delayed internal post-test measure of cognitive retention than students exposed to the traditional lecture discussion techniques. (Lucas, Postma, and Thompson, 1974)

This study supports the claims for the lasting value of games. Furthermore, Lucas, Postma, and Thompson suggest simulation gaming is a pedagogical tool which enhances the learning of those exposed when compared to traditional lecture.

"Boocock (1963) found that high school students who participated in an election campaign game read and talked more about local elections than did students who had not played the game" (Boocock cited in Edwards, 1971:2). Cherryholmes (1966) reviewed ". . . studies by Anderson, 1964; Boocock, 1963; Boocock and Coleman, 1965; Cherryholmes, 1963; Garvey and Seiler, 1966; and Robinson, Anderson, Hermann and Snyder, 1966 . . ." which encompassed the Inter-Nation Game, the Election Game the Career Game, the Legislative Game and the Disaster Game. Cherryholmes concludes ". . . that simulation does produce more student motivation and interest, but there are no consistent or significant differences in learning, retention, critical thinking or attitude change" (Cherryholmes, 1966:6).

Robinson (1966) compared the interest and learning outcomes of undergraduate political science students participating in a simulation game to those using case studies. Half of the students participated in a simulation section and the other half of the 134 students used case studies. Interest and learning outcomes were examined relative to intelligence, grade-point average, cognitive style, and motivations toward achievement, affiliation, and power. Students participating in the simulation gaming displayed more interest, as expressed through attendance.

. . . This was true for the aggregate of all students, for all men, for all women, and for men with a low n ach, men with high n aff, men with high n power, men with low n power, with the most complex cognitive style, and women with most concrete cognitive style. (Robinson and others, 1966:60)

In addition, student discussion in the laboratory section was significantly greater in the simulation gaming environment for all personality characteristics (motivations toward achievement, affiliation and power) except men with moderately complex cognitive styles. The relations between simulation and learning outcomes revealed no direct and unmediated relation.

Edwards (1971) integrated a business simulation game into the activities of a community college business course. The results support claims that games are self-judging, increase student motivation, and increase students' efficacy in areas related to the game, but not the claim that games have special value for low-achieving students (Edwards, 1971:iii). After participation in the simulation game ". . . students felt that the game had stimulated their interest and motivated them to do more work" (Edwards, 1971:12). An important finding of the Edwards study was "Students who did not understand why the instructor was using the game were less likely to report increased motivation due to the game" (1971:12). Edwards also found the realism of the business game enhanced student motivation (1971:24).

Developmental Mathematics Studies

Concern for improved instruction in developmental math is reflected in recent studies that either identified variables which hinder instruction or justified current strategies. Since more

developmental programs are relatively new and previous administrative concerns have been focused on the mechanics of existence, research has been limited in quantity and scope, and seldom based on psychological theories (Kendrick and Thomas, 1970:171). Roueche and Kirk after reviewing the related literature conclude the following:

. . . 1) There is a pronounced lack of research on the effectiveness of remediation efforts in community colleges in terms of assessing academic performance, persistence, and attitudes of high risk students. 2) Even with the dearth of research the evidence indicates that remedial courses and programs in two-year colleges . . . have largely been ineffective in remedying student deficiencies. 3) There is an increasing number of critics of the open-door college and its implied promise to provide successful learning experiences for all its students. (1974:7)

Therefore the studies which follow are either descriptive of the instructional problems or evaluative of instructional strategies.

Instructional deficiencies were identified by Sutton (1970) in a study conducted in four junior colleges in Southern Illinois. It was concluded, "That the criteria used to assign students to remedial mathematics classes do not lend themselves to the identification of individual student strengths, weaknesses and gaps." (Sutton, 1970:3845A). Furthermore, the remedial teachers are not trained in remedial education and do not structure their instruction to utilize strengths. Sutton reveals serious instructional deficiencies which are supported by Simpson (1972) who concludes that the California Community Colleges' remedial course offerings fail to reach the large percentage of students. Simpson emphasizes the need for instructional innovation to meet the unique needs of the student.

Kimes (1974) added another dimension to developmental mathematics research by identifying attributes of students who were successful. It was suggested that students who complete developmental math have significantly higher intelligence scores, self-concept scores, and were significantly older than the students who did not complete the course. Kimes concludes that the following attributes are independent of course completion: student's attitude toward mathematics, sex, enrollment status, employment status, future plans after completion of studies at a community college, and the educational levels of parents (Kimes, 1974).

Edwards (1972) developed a prediction of success equation for remedial mathematics using students in Massachusetts and Connecticut community colleges. The subscores from the Cooperative Guidance and Placement battery (CGP) and the Dutton (1954) attitude test were used for prediction.

It was concluded that prediction of success in remedial mathematics courses can be made correctly 71 percent of the time using five selected predictors: high school average, mathematics test score (CGP), attitude toward mathematics (Dutton Test), sentence test score (CGP), and mathematics interest score (CGP). (Edwards, 1972:160)

In contrast to Kimes study, Conroy (1971) indicated no significant differences in the achievement of remedial Algebra I students with respect to sex. However, it was concluded that as students' age increases the ability to achieve in remedial algebra increased (Conroy, 1971:92). Conroy recommended that a study be undertaken to evaluate the effects of motivation of the mathematical achievement of community college developmental students.

The above studies are primarily descriptive and delineate some of the current instructional problems and related student attributes.

The studies to follow will focus on the effectiveness of current instructional strategies.

Bankston (1975) studied the effects of the various readability levels of instructional materials on achievement for community college students. It was concluded that the student group using materials written at the lowest readability level scored higher on the posttest than the other students using material at higher reading levels. The student group using materials written at the middle readability level scored higher than the student group with the materials written at the highest level of readability.

White (1970) revealed no significant differences in the math achievement of students taught by linear programmed texts and those taught by traditional lecture discussion procedures. Although, subjectively students participating in the study indicated an appreciation for the self-pacing aspect of programmed texts. In a similar study (Olsen, 1974) there appeared to be no significant differences ($p < .05$),

. . . in either the rate of attrition or mathematics performance of community college students taught remedial mathematics under an individualized instruction program as compared with those students taught under the traditional lecture - textbook instruction program. (Olsen, 1974:7522-3A)

Furthermore, a study (King, 1959) comparing mathematical achievement of television taught students with conventionally taught students resulted in no significant differences.

However, Carman (1975) examined the effects of tutoring developmental mathematics on the academic performance, attrition, and attitudes of 190 community college students. Carman concluded the following effects of tutoring: (1) a positive change in attitudes and self-

concept reflected in increased persistence in the course, in the college and in other courses during the semester of the tutoring, (2) a marked increase in the persistence of tutored students in courses and in the college for three semesters after tutoring, (3) no improvement in grade averages during the semester of the tutoring in subsequent semesters, and (4) tutored students expressed during personal interviews substantial positive changes in attitude toward mathematics and other college courses as well as the college in general (Carman, 1975:624-4A).

Finally, Pierce (1969) conducted a study which related instructional strategies to motivation. The effectiveness of three instructional methods was compared: (1) conventional lecture - discussion, (2) printed - programmed - a printed linear program, and (3) audio-programmed - a coordinated system of taped narration, printed programmed materials and specially prepared printed materials. Scores for four predictor variables were obtained: motivation, attitude, reading comprehension and pretreatment achievement. The criterion variable from the results of these tests were attitude gain, achievement gain, achievement at three levels as defined in The Taxonomy of Educational Objectives: Cognitive Domain. The results of the study were:

. . . High reading students were found to learn more than low reading students under each method. Low predictor level students made more achievement gain under the printed-programmed method. The printed-programmed method produced less attitude gain than the other methods and caused a decrease in the attitude of positive attitude students. The conventional method was found to be best for producing achievement at the first cognitive level but the three methods were equal in effectiveness to produce achievement at the second and third cognitive levels. Reading comprehension was the only significant predictor of learning in the conventional group,

reading comprehension and motivation were both significant predictors in the printed-programmed group, and pretest achievement was the only significant predictor in the audio-programmed group. (Pierce, 1969:4692A)

SUMMARY

The review of research relating to achievement motivation reveals the following: (1) The perceived importance of an activity to one's future goals significantly effects performance of an immediate activity which interacts with ones motive orientation. As the perceived importance of a course increases students with low anxiety tend to receive higher grades than students with high anxiety, (Isaacson and Raynor, unpublished data; Raynor, Atkinson, and Brown, unpublished data; Raynor, 1971; Raynor and Rubin, 1971). (2) The Mehrabian scale for achieving tendency will successfully discriminate motive orientation according to Raynor's elaboration theory (Weitzenkorn, 1974). (3) A path of two steps is sufficient to produce the effects of a contingent future orientation, and that these become even stronger as the length of path increase. (Entin and Raynor, 1973)

Furthermore, research related to the use of simulation games reveals the following: (1) Simulation gaming designed to improve achievement motivation improves achievement at the elementary, secondary and community college levels (Alschuler, 1971, 1972). (2) Simulation gaming as a teaching strategy has improved achievement of remedial students in community colleges (Alschuler, 1972; Troyka, 1975). (3) Students participating in a simulation game score higher than lecture taught students on a time delayed post-test of cognitive retention

(Lucas, Postma, and Thompson, 1974). (4) Simulation games have been used to increase interest and motivation in the classroom (Boocock, 1963; Cherryholmes, 1963). (5) The effects of simulation games on interest as reflected by attendance is related to one's motivation toward achievement, affiliation, and power (Robinson, 1966). (6) Simulation gaming is not of special value for low achieving students (Edwards, 1971).

Finally, the review of research concerning developmental mathematics revealed the following: (1) Developmental mathematics teaching strategies do not utilize student strengths (Sutton, 1970; Simpson, 1972). (2) Intelligence, self-concept, and age are positively related to completion of developmental mathematics (Kimes, 1974). (3) High school average, math entrance scores, attitude toward math, interest in math and sentence test scores may be used to accurately predict developmental mathematics success (Edwards, 1972). (4) Students using materials of a lower reading level had higher math achievement than those using materials of higher reading levels (Bankston, 1975). (5) Tutoring students increases their persistence, attitude and self-concept (Carman, 1975). (6) A superior instructional method for developmental math could not be identified (White, 1969; Olsen, 1974; King, 1959). (7) Motivation is a significant predictor in the achievement of students using printed-programmed materials (Pierce, 1969).

Chapter 3

RESEARCH METHODOLOGY

This study examined the effects of a simulation game upon the mathematical achievement of developmental arithmetic students at the community college level. Included in this chapter is information concerning the research designs, instructional content, sample and population, procedure, instrumentation and data analysis.

RESEARCH DESIGNS

The experimental research method was used under controlled conditions to accurately observe the effects of the simulation gaming experience (Edwards, 1968:10). Advantages of the experimental study are:

1. The experimenter makes the event happen at a certain time and place and so is fully prepared to make an accurate observation.
2. Controlled conditions being known conditions, the experimenter can set up his experiment a second time and repeat the observation, and-what is very important in view of the social nature of scientific investigation-he can report his conditions so that another experimenter can duplicate them and check the data.
3. The experimenter can systematically vary the conditions and note the concomitant variation in the results. (Woodworth cited in Edwards, 1968:10)

This method was used with a two by two by two factorial design as an extension of the posttest-only control group design to determine the influence of the simulation game upon math achievement (Y_m). A second design, the pretest-posttest control group, was used to analyze differences in the perceived instrumentality (Y_{PI}) resulting from

participation in the simulation game. The two by two by two factorial design was efficient since it allowed for assessment of each of the three independent variables separately as well as their conjoint or simultaneous effects (Tuckman, 1972:111). Furthermore, the randomization feature of the design was most important to the assumption of approximate preexperimental equality of the experimental groups in all possible independent variables (Kerlinger, 1973:356). The strength of the posttest-only control group design lies in its protection from the following sources of invalidity (Campbell and Stanley, 1963:8):

1. History, the influence of an extraneous variable which may contribute to math achievement.
2. Maturation, the contaminating influence of academic growth of the student during the study.
3. Testing, the effect of pretesting upon math achievement.
4. Instrumentation, the autonomous changes in the measuring instrument or the procedure itself.
5. Regression, assessment of a group selected for their extreme scores.
6. Selection, group differences because subjects were selected into groups on bases independent of the research purposes.
7. Mortality, the effects of attrition during the experiment.
8. Interaction of Testing and X, an external source of invalidity in which student sensitivity is increased to the dependent variable through a pretest.
9. Interaction of Selection and Maturation, the conjoint effect of subject selection and subject maturation.

However, the design has questionable protection against the following external sources of invalidity:

1. Interaction of Selection and X, or . . . the samples drawn for the study are not representative of the larger population, then it will be difficult to generalize findings from the samples to the population.
2. Reactive Arrangements, of the experiment or the experience of participating in it may create sufficient artificiality to limit the possibility that the results will be generalizable to a nonexperimental test of the treatment (Tuckman, 1972:80)

The two by two by two factorial design is represented in Figure 1. The students were (R) randomly selected and assigned to either the (X) experimental or the (-) comparison groups. The two attribute variables were the student's achievement motive ($M_s > M_{af}$ or $M_s < M_{af}$) and the student's perception of the career importance of developmental arithmetic (PI_{high} or PI_{low}). The active variable consisted of either the (X) treatment (the simulation game) or the (-) comparison group. The dependent variable (Y_m) reflected the scores from form B of the Basic Skills in Arithmetic Test (Wrinkle, Sanders, and Kendel, 1945).

The second design, the pretest-posttest comparison group was used to analyze changes in perceived instrumentality (Y_{PI}). This design has the same protection from sources of internal validity as the above posttest-only control group design. By the utilization of a comparison group, which has all the same experiences as the experimental group other than the experience of the treatment itself, this design controls for history, maturation, and regression. Through the randomizing of subjects across experimental and control conditions both selection and mortality are controlled (Tuckman, 1972:108). However, this design does not have equivalent protection from external validity threats. The Interaction of Testing and X is not controlled for in this design.

There is no control for a testing effect (i.e., gain on the posttest due to experience on the pretest) which may reduce internal validity; nor is there any control for the possible sensitization to the treatment that a subject might gain by having the pretest experience, thus affecting external validity. (Tuckman, 1972:108)

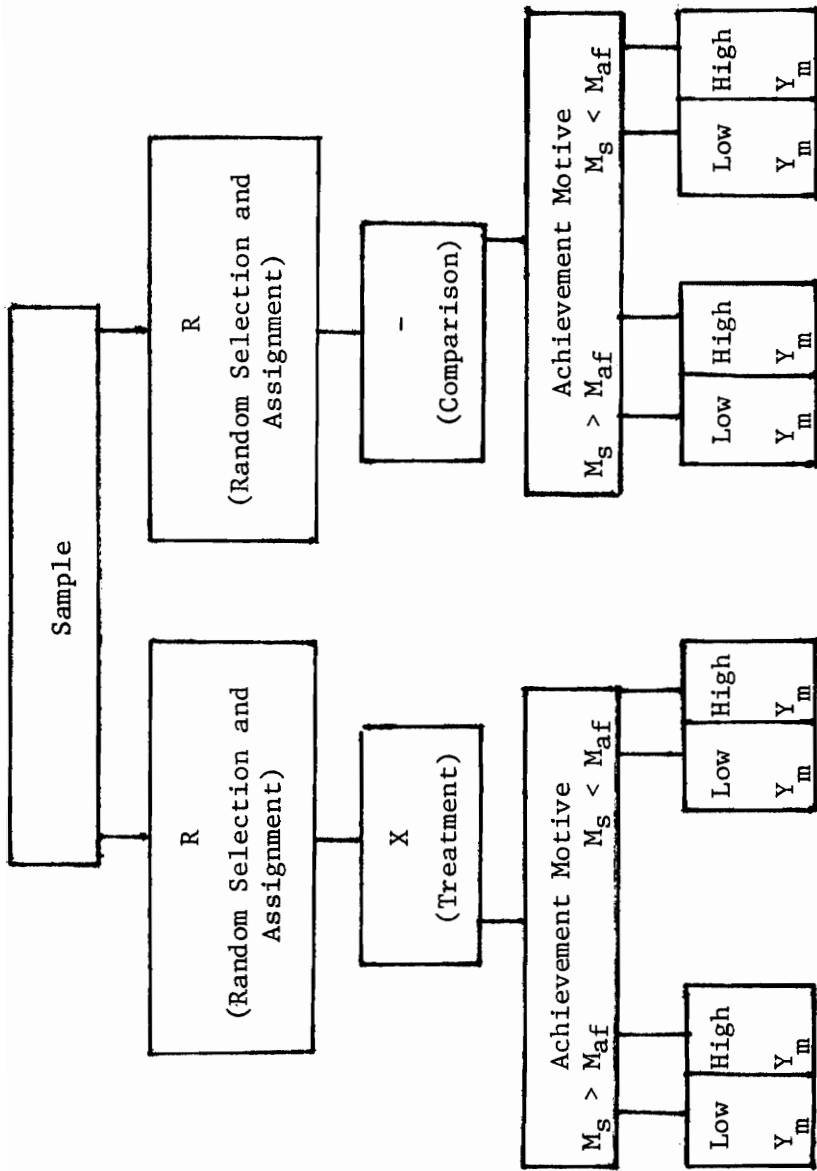


Figure 1

Two by Two by Two Factorial Design

Furthermore, the design has the same questionable protection against the Interaction of Selection and X and the Reactive Arrangements as the posttest-only control group design.

The design is represented below:

R	Y_{PI}	X	Y_{PI}
R	Y_{PI}	-	Y_{PI}

The students were (R) randomly selected and assigned as in the above factorial design, but the subpartitions according to achievement motives or level of perceived instrumentality were ignored. Therefore, half the students were either in the (X) treatment group or in the (-) comparison group. The dependent variable (Y_{PI}) perceived instrumentality score, was obtained from the pretest and posttest scores of the Student Plans Questionnaire.

INSTRUCTIONAL CONTENT

The treatment materials were integrated into all individualized arithmetic sections which had students who anticipated enrollment in occupational-technical programs and those not formally seeking career training. The arithmetic course provided a review of arithmetic principles and computations, designed to develop the mathematical proficiency necessary for selected curriculum entrance (see Student Guide, Appendix A). Audio tapes were used to augment the self-paced programmed text, Basic Arithmetic by R. G. Moon, A. H. Konrad, G. K. Klentos, and J. Newmyer (1977). Since the course was programmed, the teacher's role was limited to test administration and individual assistance. Course evaluation was measured by eight unit tests and a final examination.

The student was required to score at least 80 percent on the unit tests and 75 percent on the final examination to obtain the satisfactory grade "S", otherwise a repeat grade "R" was awarded requiring the student to repeat units until the course requirements were met.

Math Game Description
(Treatment)

The career simulation game (see Appendix B) consisted of on-the-job math problems and job clusters representing various levels of a career. The career simulation math game was integrated into the following units: Four-Multiplication of Whole Numbers, Six-Solving Verbal Problems by Reduction and Expansion, Sixteen-Verbal Problems and Equations Involving Fractions, Nineteen-Addition and Subtraction of Decimals, and Twenty-five-Three Types of Percent Problems. Written instructions were given to each student concerning math game procedures which included a list of substituted units and the purpose of the job descriptions for various levels within the chosen career and a graphic of their career ladder. The student was aware that performance on the unit tests merited promotion on the career ladder. The student also kept a record of his/her progress on the career ladder. The career related problems were verbal problems substituted for the review exercises of the text. These problems simulated on-the-job problems which required mathematical solutions.

Job clusters representing various levels within a career provided the student an opportunity to simulate his/her career progression based upon arithmetic performance. Upon completion of the review exercises, the student indicated on the career ladder his or her first,

second, and third job choice within the job cluster. Jobs in the cluster for each of the five units required an increasing amount of experience, therefore, the list of jobs for the last unit included those jobs requiring the most experience and expertise. A unit test was administered and score determined the career choice available to the student. Students with scores of ninety-four to one hundred were awarded their first choice, scores ninety-three to eighty-seven were awarded second choice, and scores eighty-six to eighty were awarded third choice. The student recorded the job choice awarded on the career ladder for each of the selected units. The career ladder graphically represented the student's career progression.

Math Game Rationale

The simulated math game was selected for accentuating achievement motivation because of the successful use of similar games by Alschuler and McClelland (1971). Therefore, the game materials were developed according to the following recommendations of Alschuler and McClelland: (1) non-zero-scoring system, (2) internal obstacles for gaining points, and (3) personal decision making. A zero score was impossible with the non-zero-scoring system since the game was played by oneself without direct external competition. The player was free to earn as many points as he or she could through individual initiative without regard to how many points others made. Furthermore, it was important that the student relate his or her effort to the achievement of individual goals. The non-zero-sum scoring, therefore, emphasized student achievement goals since it gave greatest value to independent,

self-reliant accomplishment (McClelland and Alschuler, 1971:81). In addition, with internal obstacles for gaining points the game utilized the player's self-reliance and encouraged achievement motivation (Alschuler, 1969:20). The personal decision making characteristic of the game relates to the importance of decision making in achievement motivation.

In addition to the theoretical rationale, the game was designed to include units most appropriate for career application. These units were selected since the authors of the text had emphasized verbal problems in these unit exercises and the units were judged by the researcher to most applicable to the respective careers. The review problems substituted were developed by the researcher based upon the recommendations of a committee of experts, consisting of the program heads from selected curriculum areas, two developmental mathematics instructors, one technical mathematics instructor and a reading instructor. The committee verified the problems for career relevance, appropriate reading level (sixth grade level), and equality of mathematical concepts.

PROCEDURE

College Placement Procedures

Prior to enrollment, the Basic Skills in Arithmetic Test form A (Wrinkle, Sanders, and Kendel:1945) was administered to determine placement of potential certificate level occupational-technical students into developmental arithmetic. Moreover, the John Tyler Community College Mathematics Placement Test was used to determine placement of students who anticipated enrollment in degree level programs. Those students

not placed by the Basic Skills in Arithmetic Test were required to take this test during the first week of classes.

Sample

The accessible population consisted of all students enrolled in developmental arithmetic at John Tyler Community College who anticipated enrollment in certificate and degree level occupational-technical programs and those not seeking career training. The college is a comprehensive community college serving students from seven counties and four cities. The accessible population included day and evening students enrolled part-time and full-time, both male and female ranging in age from seventeen to fifty-nine. According to college placement procedures the students' reading level was sixth grade or above. The ninety-two students in the accessible population were selected for the study, however, ten students withdrew from the arithmetic course before completion of the study. Therefore, the sample consisted of eleven students enrolled in one of the following certificate programs: automotive diagnosis (n = 2), air-conditioning and refrigeration (n = 3), clerk typist (n = 2), machine operator (n = 1), and welding (n = 3). Twenty-eight students were enrolled in one of the following two-year degree programs: data processing (n = 9), secretarial science (n = 9), architectural technology (n = 3), science (n = 1), mechanical technology (n = 1), industrial technology (n = 1), nursing (n = 2), business management (n = 1), and accounting (n = 1). The remaining forty-three students were classified as curriculum pending (n = 19), nondegree (n = 2), developing skills

(n = 1), career exploration (n = 4), transient (n = 1), no curriculum (n = 8), and personal satisfaction (n = 8).

Assignment to Groups

The Student Plans Questionnaire, the Test Anxiety Questionnaire (Mandler and Sarason, 1952), and The 1969 Achieving Tendency Scale for Males (Mehrabian) were used to place the eighty-two students with respect to the two attribute variables. These three tests were administered during the first week of classes by the instructor. Student perception of the instrumentality of the course toward future goal attainment was assessed by the Student Plans Questionnaire. Those students with scores above the median were considered high PI (perceived instrumentality).

An adjusted score was obtained for each student by subtracting the Z scores of the Test Anxiety Questionnaire from The 1969 Achieving Tendency Scale for Males. The resulting distribution of scores was dichotomized about the median score to place students according to their achievement motive. Students with scores above the median were considered $M_s > M_{af}$, and students with scores below the median were considered $M_s < M_{af}$. These two groups were then divided according to high and low perceived instrumentality. Specifically, students were assigned to High PI- $M_s > M_{af}$ cell of the factorial design by selecting students (n = 19) with scores above the PI and achievement motive medians. The Low PI- $M_s < M_{af}$ cell was assigned by selecting students (n = 23) with scores below the PI and achievement motive medians. Students (n = 20) were selected for the Low PI- $M_s > M_{af}$ cell if their scores were below

the PI median, but above the achievement motive median. Finally, students ($n = 20$) were selected for the High $PI-M_s < M_{af}$ cell if their score was above the PI median, but below the achievement motive median. Names of the students within each of the four cells were then alphabetized and given numbers one through N. Using these numbers half the students within the cells were selected within the cells using a table of random numbers. The selected student groups were then randomly assigned by flip of a coin to either the treatment group or the comparison group. Because of attrition the minimum cell size was nine students.

Simulation Game Administration

The simulation game materials were administered by faculty who attended a one hour orientation session conducted by the researcher before the start of classes. During the orientation session the following were explained: (1) achievement motivation concepts, (2) the purpose and administration of tests and questionnaires, and (3) the use of the simulation game materials. The selected students were then given the simulation gaming materials which included activities for units four, six, sixteen, nineteen, and twenty-five. When the student progressed to each of these units he/she performed the career simulated review problems in substitute for problems in the text. Upon completion of the review exercises the student read and performed the activities on the Job Selection Sheet. These activities included their selection of first, second, and third job choices from the list of job descriptions. A record of these choices was indicated on the career ladder graphic. After completing the corresponding unit test the students compared

their earned test grade with the test grade requirements for obtaining first, second, and third job choices. The earned job choice was self-scored by the student who circled the earned job title on the career ladder graphic. These simulation gaming activities continued until all five selected units were completed. Since the dependent variables for this study were scores from the Basic Skills in Arithmetic form B (Wrinkle, Sanders, Kendel, 1945) and the Student Plans Questionnaire, these instruments were administered upon student completion of unit twenty-five or by the end of the twelfth week.

INSTRUMENTATION

Student Plans Questionnaire

The Student Plans Questionnaire was used to assess the student's perceived instrumentality of the course toward fulfilling the career goal. The questionnaire is similar to Raynor's (1970) Student Plans Questionnaire which he used to determine students' perceived instrumentality of getting a good grade in introductory psychology for having their career plans work out. Student grouping based upon this questionnaire (Raynor, 1970) indicates higher grades are earned by students of high perceived instrumentality than students of low perceived instrumentality for those classified as an achievement greater than test anxiety ($t = 1.76$, $df = 58$, $p < .05$). In addition, a similar questionnaire was used in a study (Raynor, 1970) in which the subject was requested to relate his/her perceived instrumentality of courses taken during the semester. Classification with this instrument indicates ". . . students receive higher grades in their high-than in their low-

perceived instrumentality courses. . . ." ($F = 4.72$, $df = 1/51$, $p < .05$). Therefore, the questionnaire has been successfully used to discriminate between students according to their subjective perceived instrumentality of an immediate activity toward a future goal as measured by significant differences of academic performance between the groups.

The questionnaire used was similar to Raynor's except the course title in the question was changed to "developmental arithmetic" and the student's response was indicated on a continuous scale. The continuous scale represented the continuum of the student's perception of the value of the course toward fulfillment of career goals. Student responses were marked along a fifteen centimeter graphic scale with endpoints representing either "very important" or "not important at all" perceptions. The measured distance between the student's mark and the endpoint representing least importance for both questions was summed to represent the student's score. These questionnaire changes allowed the instrument to yield continuous data with an increased range for student responses. The changes facilitated data analysis using a test of differences to analyze changes in the pretest to posttest scores.

Test Anxiety Questionnaire and Achieving Tendency Scales

Scores from the Test Anxiety Questionnaire (Mandler and Sarason, 1952) and The 1969 Achieving Tendency Scale for Males were subtracted to obtain an adjusted score of the student's achievement motive. The Test Anxiety Questionnaire (TAQ) was used by Raynor and Rubin (1971) in similar studies to classify students according to their motive to avoid failure. To reduce the study's interference upon student-teacher

contact time only the first third of the questionnaire was used. Scores on the first third of this questionnaire have been correlated between .84 and .90 with total scores (Smith, 1964). Below each question was a fifteen centimeter rating scale with the mid-point and endpoints indicated. The endpoints represented opposing attitudes and the student marked on the continuum a point representing his/her feeling or attitude relative to the endpoint. The score consisted of the sum of distances for the twelve questions between the student's mark and the endpoint representing low anxiety. The split-half reliability (odd vs. even questions) of the anxiety questionnaire was .91 (Spearman-Brown prophecy estimate). The face validity of the questionnaire was obtained through a significant agreement ($\phi = .59$) between the questionnaire ratings and the subject's manifestation of overt anxiety (Mandler and Sarason, 1952:168-169).

The other instrument used for assessing student achievement motive was The 1969 Achieving Tendency Scale for Males (Mehrabian, 1969). Although most research on Raynor's elaborated theory used the Thematic Apperception Test and the Test Anxiety Questionnaire to assess achievement motives, Weitzenkorn (1974) developed support in two studies for the dual use of the Personal Reaction Inventory (Mehrabian, 1968) and the Test Anxiety Questionnaire with tests of Raynor's theory. Weitzenkorn subtracted the student scores on the Personal Reaction Inventory from the Test Anxiety Questionnaire scores to obtain an adjusted score which was trichotomized. "Those in the top third were considered $M_s > M_{af}$ while those in the bottom third were considered $M_{af} > M_s$ " (Weitzenkorn, 1974:363). It was concluded that:

. . . with college and high school females and high school males, data available from the two measures employed to assess motives allowed discrimination between high-and low-performing S's [subjects] to the extent that the high motive groups consistently performed significantly better than the low motive groups. (1974:374)

Weitzenkorn's studies were designed to replicate Raynor and Rubin (1971) but were only partially supportive of the elaborated theory of achievement motivation.

The Personal Reaction Inventory has been revised by Mehrabian (1969) Achieving Tendency Scale for Males and The Achieving Tendency Scale for Females. "The resulting 26 item scales correlated .94 and .92 with earlier male and female versions, respectively. Consequently, the revised measures are for empirical purposes, identical to the originals . . ." (Mehrabian, 1975:1). Additional support for the validity of the measure was established by the significant correlation ($r = .25$) between Mehrabian's scale and the resultant scores of the TAT-TAQ for high school males (Mehrabian, 1975:9). Furthermore,

. . . Because the Mehrabian measures are constructed to reflect the TAT n achievement minus TAQ score, negative correlations between the Mehrabian measure and the TAQ are expected. In fact, Mehrabian (1968) found negative correlations between the two measures for males ($r = -0.16$, $p > .05$) and for females ($r = -.30$). Mehrabian (1969) obtained a significant negative relationship with males ($r = -.26$) but did not replicate the earlier significant result with female subjects. (Mehrabian, 1975:4)

Kuder-Richardson internal reliability coefficients of .72 and .61 were obtained based on 102 male and 100 female undergraduates, respectively. These estimates

. . . were based in the achieving tendency items embedded in a much larger questionnaire; a procedure which attenuated the obtained reliabilities it appears that the reliabilities for the 26 item forms are on the average of .70 and .60 for the male and female scales, respectively. (Mehrabian, 1975:2)

The female form was not used in this study since Mehrabian assumed certain sex role stereotypes which are not appropriate for college age females. Specifically, questions concerning meal planning and involvement in women's groups are not appropriate for community college students (Little, 1977). The male form does not consist of questions which assume sex stereotypes. Therefore, the male form was used to obtain the achieving tendency of males and females.

Since the scale was used with students not familiar with algebra, Mehrabian's response system which utilized positive and negative numbers was not appropriate. Guilford (1954:264) suggested that the use of positive and negative numbers in numerical scales may be bewildering and unnatural to respondents not versed in algebra. Therefore, students responded to the statements using nine positive numbers (one through nine). A strength of this numerical scale is the responses may approach interval measurement since the numbers may represent equal intervals in the mind of the observer (Kerlinger, 1973:547).

Mehrabian's scales were suitable for this study because of their relative economy of time and ease of analysis. The traditional Thematic Apperception Test measure of need achievement requires considerable training and scoring is time consuming (Mehrabian, 1968:493). Therefore, in order to optimize the student's laboratory time and prevent undue interferences by the research, Mehrabian's achieving tendency was used.

Basic Skills in
Arithmetic Test

The Basic Skills in Arithmetic Test (Wrinkle, Sanders, and Kendel, 1973) was used to measure the dependent variable-arithmetical achievement. The test is not timed and designed for grades six through twelve. There are two forms available

. . . each consisting of 68 test items rather well distributed over the fundamental skills: whole numbers, common decimal fractions, and percents. The test is designed to measure command of forty-three fundamental skills in arithmetical operation. (Wren and Sears, cited in Buros, 1949:335)

The reliability of the test was computed by the use of the Kuder-Richardson formula. The reliability estimates were .86 for sixth grades, and .98 for the ninth and twelfth grades (Wrinkle, Sanders, and Kendel, 1945:50).

ANALYSIS OF DATA

Data analysis was conducted on the criterion measures perceived instrumentality and math achievement. A test of differences was used to compare the treatment and the comparison group perceived instrumentality scores as obtained from the Student Plans Questionnaire. The student's math achievement scores of the comparison and treatment groups were analyzed by a two by two by two analysis of covariance using the ANOVA subprogram of the Statistical Package for the Social Sciences (Nie, et al., 1975). Covariates were scores on the math placement test (Basic Skills in Arithmetic), high school grade point average, and age. Edwards (1972:160) indicated that predictions of success in remedial mathematics courses can be made correctly seventy percent of the time

using five selected predictors: high school average, the Dutton attitude toward mathematics score, and the following sub-scores from the Cooperative Guidance and Placement battery-mathematics test score, sentence test score, and mathematics interest score. Furthermore, Conroy (1971) found the variable age caused a significant difference in the achievement of remedial algebra students. These covariates were used since the analysis compensated for students with different backgrounds which might have excelled with less motivational stimulus.

Other possible covariates such as sex, socioeconomic status, intelligence quotient, reading test scores, and grade point average were discounted through a study (Alschuler, 1973) of tenth grade students who received twenty-two hours of achievement motivational training. Alschuler found these factors were not related to the benefits gained from the motivational training, but these factors may be related to the level of initial achievement motivation (Alschuler, 1973:96).

SUMMARY

The research design of this study was an extension of the post-test-only control group design providing a two by two by two factorial design. The students were randomly selected and assigned to experimental and comparison groups of the factorial design. However, the students were assigned to groups according to the attribute variables achievement motives and perceived instrumentality. The group assignment was based upon scores on the Student Plans Questionnaire, the Test Anxiety Questionnaire, and The 1969 Achieving Tendency Scale for

Males. The experimental group participated in a career simulation game which consisted of on-the-job math problems and job clusters representing various levels of a career. The students ($n = 82$) were enrolled in developmental arithmetic and either anticipated enrollment in selected occupational-technical programs or were not seeking career training. The reliability and validity for the Student Plans Questionnaire, the Test Anxiety Questionnaire, the Achieving Tendency Scale, and the Basic Skills in Arithmetic Test were presented. The data analysis consisted of a t-test on the perceived instrumentality scores and a two by two by two analysis of covariance on the math achievement scores.

Chapter 4

RESULTS

This chapter will describe the data and the results of the data analysis. The data were gathered to determine the effects of a career simulation game on the perceived instrumentality and math achievement of developmental arithmetic students. Data from the dependent variable, perceived instrumentality described the effects of the career simulation math game on students' perceptions of the career importance of developmental arithmetic courses. In addition, the data described effects of the stimulation game on students' achievement motive orientation (success or avoidant) and perceived instrumentality. The data were analyzed by means of the t test and analysis of variance subprograms of the Statistical Package for the Social Sciences (Nie et al., 1975). A description of the sample and the data analyses of the eight research hypotheses are presented below.

Description of the Sample

The sample consisted of thirty-nine males and forty-three females. These eighty-two developmental arithmetic students were seeking enrollment in certificate and degree level occupational-technical programs. In addition, the sample consisted of students not formally seeking career training. Comparisons among these groups on the covariates (math placement test score, high school grade point average, and age) are presented below.

Math placement test scores indicated the math achievement of students before enrollment in developmental arithmetic. The mean math placement test scores and standard deviations of students grouped according to their anticipated program enrollment are provided in Table 1. A one way analysis of variance was conducted to determine if there were differences in the mean math placement test scores among students grouped according to anticipated program enrollment. A summary of the analysis of variance for math placement test scores is presented in Table 2. Since the F value was 1.85 with a probability of .165 there was no differences among the mean math placement test scores of students grouped according to anticipated program enrollment.

Differences in high school grade point average among groups classified according to anticipated program enrollment were examined to describe the student's high school achievement. The mean high school grade point average and standard deviations of students grouped according to their anticipated program enrollment is presented in Table 1. The one way analysis of variance was used to determine if there were differences in high school grade point averages among students grouped according to anticipated program enrollment. Results of this analysis are presented in Table 2. An F value of .416 with a probability of .661 indicated there was no differences among groups in terms of their high school grade point averages.

Finally, the covariate, age, was examined to determine if there were differences among student groups according to anticipated program enrollment. The mean ages and standard deviations of students grouped according to anticipated program enrollment are presented in Table 1.

Table 1
Means and Standard Deviations for Math
Placement Test Scores, High School
Grade Point Average and Age

Covariate	n	Mean	Standard Deviation
Placement Test Score			
Certificate Level Occupational- Technical Program	11	29	13.3
Degree Level Occupational- Technical Program	28	37	10.1
Not Seeking Career Training	43	34.6	12.2
High School Grade Point Average			
Certificate Level Occupational- Technical Program	11	1.94	.60
Degree Level Occupational- Technical Program	26	2.07	.73
Not Seeking Career Training	37	2.04	.52
Age			
Certificate Level Occupational- Technical Program	11	22.4	4.92
Degree Level Occupational- Technical Program	28	22.5	8.09
Not Seeking Career Training	43	25.3	10.39

Table 2

Analysis of Variance Summary for Math Placement

Test Scores, High School Grade

Point Average, and Age

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance of F
Math Placement Test Score					
Between Programs	505.8	2	252	1.85	.165
Within	10820.2	79	137		
High School Grade Point Average					
Between Programs	.594	2	.297	.416	.661
Within	56.36	79	.713		
Age					
Between Programs	159.6	2	79.8	.96	.386
Within	6550.1	79	82.9		

A one way analysis of variance was conducted to determine if differences among the mean ages of the groups existed. A summary of the analysis of variance using age as a covariate is presented in Table 2. The F value was .96 with a probability of .386 which indicates there were no differences. In conclusion, there were no differences in the personal characteristics of the three groups in terms of math placement test scores, high school grade point average and age. Data analyses were, therefore, conducted on the combined groups without respect to programs.

The mean, standard deviation, raw regression coefficients, and levels of significance of the covariates for the entire sample are presented in Table 3. As indicated in this table, the math placement test was significant ($p < .001$). Specifically, the dependent variable scores were adjusted by the math placement test scores to obtain an analysis of covariance sensitive to group differences. Therefore, the math placement test scores were most useful in removing extraneous variation from the analyses of the dependent variable.

Hypothesis One

The criterion measure associated with the first hypothesis was perceived instrumentality as measured by the Student Plans Questionnaire. This instrument was administered before and after the treatment. The first hypothesis tested was: no difference exists between the mean scores on the Student Plans Questionnaire of students who participated in a simulation game experience and those who did not participate. The mean perceived instrumentality difference scores (perceived instrumentality pretest minus perceived instrumentality

Table 3

Mean, Standard Deviation, Raw Regression Coefficients,
F Value, and Level of Significance
for the Covariates

Covariates	Mean	Standard Deviation	Raw Regression Coefficients	F	Level of Significance
Math Placement Test	34.7	11.82	.540	42.6	<.001
High School Grade Point Average	2.04	.61	-.719	.356	.552
Age	23.95	9.1	.106	.932	.338

posttest), standard deviations, t value, and two tail probability values are presented in Table 4. Since the t value of .59 was not significant at the .05 level, the null hypothesis was retained. Therefore, the simulation game did not significantly effect student scores on the Student Plans Questionnaire.

Hypothesis Two

The criterion measure of the remaining hypotheses was math achievement as measured by the Basic Skills in Arithmetic Test (Wrinkle, Sanders, and Kendel, 1973). Math achievement scores were analyzed by a two by two by two analysis of covariance. The second hypothesis dealt with arithmetic achievement (measured by the Basic Skills in Arithmetic Test) relative to achievement motive orientation (measured by the Test Anxiety Questionnaire and the 1969 Achieving Tendency Scale for Males). This hypothesis was: no difference exists in the mean arithmetic scores of students who are classified as success oriented ($M_s > M_{af}$) and those classified as avoidant oriented ($M_s < M_{af}$). Since the F value was .322 (Table 5) with a probability of .566 the null hypothesis was retained. A summary of the analysis of covariance for math achievement scores is presented in Table 5. The mean scores and standard deviations associated with math achievement of students classified as success oriented and avoidant oriented are presented in Table 6.

Hypothesis Three

The third hypothesis dealt with arithmetic achievement relative to participation in the simulation math game. The hypothesis was: no difference exists in the mean arithmetic achievement of students who

Table 4

Mean, Standard Deviation and t Value of
Perceived Instrumentality Scores

Simulation Game Participation	Mean Difference Score	Standard Deviation	n	t Value	Two Tail Probability
Participated	21.8	34.6	41	1.19	.238
Did Not Participate	13.3	29.8	41		

Table 5

Analysis of Variance Summary for

Math Achievement Scores

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Significance of F
Between Motive Orientation (Success, Avoidant)	23.9	1	23.9	.332	.566
Between Simulation Game (Participate, Did Not Participate)	.012	1	.012	<.001	.990
Between Perceived Instrumentality (High, Low)	37.9	1	37.9	.527	.470
Interaction of Motive Orientation x Game Participation	66.1	1	66.1	.918	.341
Interaction of Perceived Instru- mentality x Motive Orientation	14.3	1	14.3	.199	.657
Interaction of Game Participation x Perceived Instrumentality	321.6	1	321.6	4.47	.038
Interaction of Perceived Instru- mentality x Motive Orientation x Game Participation	2.83	1	2.83	.039	.843
Residual	5113.62	71	72.02		

Table 6
 Mean Scores and Standard Deviations of Students
 Grouped by Achievement Motive Orientation

Motive Orientation	n	Mean Score	Standard Deviation
Success Oriented ($M_s > M_{af}$)	39	50.8	10.98
Avoidant Oriented ($M_s < M_{af}$)	43	50.9	9.77

participate in the math game and those who do not participate. This hypothesis was retained since the F value was not significant (Table 5). The mean scores and the standard deviations of students grouped according to participation in the math game are presented in Table 7.

Hypothesis Four

The fourth hypothesis dealt with arithmetic achievement as related to perceived instrumentality. The hypothesis was: no difference exists in the mean arithmetic achievement of students who perceive the course as most important to their careers (high perceived instrumentality) and those who perceive it as less important (low perceived instrumentality) to their careers, was retained. The F value was .527 with the probability of .470 (Table 5). The mean scores and standard deviations of students grouped according to their perceived instrumentality are presented in Table 8.

Hypothesis Five

The factorial design was employed to test for interactions in the fifth hypothesis. This hypothesis was: no difference exists in the interaction of arithmetic achievement between the student motive orientation (success and avoidant oriented) and student participation in the game (treatment and comparison groups). The F value for this test was .918 with a probability of .341 (Table 5). The hypothesis was, therefore, retained. The mean scores and standard deviations of students grouped according to motive orientation and game participation are presented in Table 9.

Table 7
Mean Scores and the Standard Deviations of Students
Grouped According to Math Game Participation

Math Game Participation	n	Mean Scores	Standard Deviation
Participated in Math Game	41	50.95	9.34
Did Not Participate	41	50.78	11.29

Table 8

Mean Scores and Standard Deviations of Students Grouped
According to Perceived Instrumentality

Perceived Instrumentality	n	Mean Score	Standard Deviation
High	39	50.5	10.86
Low	43	51.2	9.89

Table 9
 Cell Mean Scores and Standard Deviations of
 Students Grouped by Motive Orientation
 and Game Participation

	Motive Orientation	
	Success ($M_s > M_{af}$)	Avoidant ($M_s < M_{af}$)
Did Participate	X = 50.2 SD = 10.1	X = 51.6 SD = 8.77
Did Not Participate	X = 51.5 SD = 12.1	X = 50.2 SD = 10.8

Hypothesis Six

The sixth hypothesis dealt with the interaction of arithmetic achievement scores among orientation groups and perceived instrumentality groups. The hypothesis was: no difference exists in the interaction of mean arithmetic achievement scores between the motive orientation groups (success and avoidant oriented) and the perceived instrumentality groups (high and low perceived instrumentality). This hypothesis was retained, since the F value was .199 with a probability of .657 (Table 5). Table 10 shows the mean scores and standard deviations for students grouped according to motive orientation and perceived instrumentality.

Hypothesis Seven

The seventh hypothesis tested the interaction between perceived instrumentality and simulation game participation. The hypothesis was: no difference exists in the interaction of arithmetic achievement between students who perceive the importance of the course to their career (high and low perceived instrumentality) and student participation in the game (treatment and comparison groups). A F value of 4.47 with a probability of .038 was obtained (Table 5). With 1 and 71 degrees of freedom the F value was significant with $\alpha = .05$. The mean scores and standard deviations of this interaction are presented in Table 11. Furthermore, the relationship between perceived instrumentality and game participation is illustrated in Figure 2.

Table 10
 Mean Scores and Standard Deviations Grouped
 by Motive Orientation and Perceived
 Instrumentality

Achievement Motive	Perceived Instrumentality	
	High	Low
Success ($M_s > M_{af}$)	X = 49.9 SD = 10.1	X = 51.7 SD = 11.9
Avoidant ($M_s < M_{af}$)	X = 51.2 SD = 11.7	X = 50.7 SD = 7.97

Table 11
 Cell Mean Scores and Standard Deviations of Students
 Grouped by Game Participation and Perceived
 Instrumentality

Game Participation	Perceived Instrumentality	
	High	Low
Did Participate	X = 52.3 SD = 8.85	X = 49.7 SD = 9.84
Did Not Participate	X = 48.7 SD = 12.6	X = 52.6 SD = 9.97

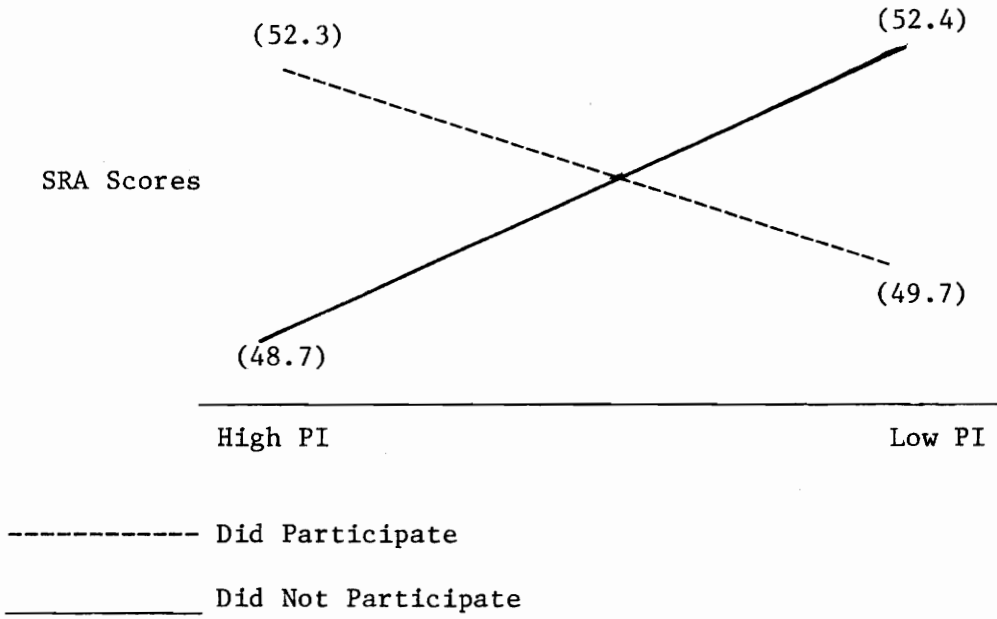


Figure 2
Interactions Between Game Participation
and Perceived Instrumentality

Hypothesis Eight

The eighth hypothesis: no difference exists in the interaction of mean arithmetic achievement scores between students who perceive the importance of the course to their career (high and low perceived instrumentality), the student participation in the simulation game (treatment and comparison groups) and student motive orientation (success and avoidant oriented), was not rejected. The F value was .039 with a probability of .843 (Table 5). The mean scores and standard deviation for students grouped according to participation in the same, perceived instrumentality and motive orientation are presented in Table 12.

SUMMARY

A description of the sample in terms of selected variables was presented in this chapter. Results of the data analyses were presented for the eight null hypotheses. The analyses indicated a significant interaction ($\alpha = .05$) of math achievement scores among students grouped according to perceived instrumentality and game participation. However, the remaining seven null hypotheses were retained.

Table 12
 Mean Scores, and Standard Deviation for Students
 Grouped According to Game Participation,
 Perceived Instrumentality, and
 Motive Orientation

Game Participation	Perceived Instrumentality			
	High		Low	
	Motive Orientation		Motive Orientation	
	Success	Avoidant	Success	Avoidant
Did Participate	X = 51.6 SD = 7.62	X = 52.9 SD = 10.1	X = 49.1 SD = 12	X = 50.3 SD = 7.4
Did Not Participate	X = 48.4 SD = 12.2	X = 49 SD = 13	X = 54.9 SD = 11.7	X = 51 SD = 8.7

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A summary of the study is included in this chapter. Furthermore, conclusions based on the results and recommendations for further study are presented.

Summary

The motivational development of students is a growing concern of the general public and community college educators. Educators are challenged to provide instruction to nontraditional students who often lack adequate motivation for success in traditional programs. Therefore, educational experiences for nontraditional students must give consideration to students' motivational needs.

The goal of this study was to examine the effects of a career simulation game on the math achievement of post secondary students enrolled in developmental arithmetic. Effects of the simulation experience on student perceived instrumentality were examined with a pretest-posttest comparison group research design. The criterion measure, math achievement, was examined with the posttest-only control group design utilizing a two by two by two factorial design. The factors included in this design were achievement motive orientation (success and avoidant), perceived instrumentality (high and low) and game participation (treatment and comparison groups). Students were assigned to achievement motive orientation and perceived instrumentality groups based upon their scores on the Student Plans Questionnaire, the Test

Anxiety Questionnaire and The 1969 Achieving Tendency Scale for Males. However, students were randomly selected and assigned to experimental and comparison groups of the factorial design. The math achievement criterion was measured via the Basic Skills in Arithmetic Test (Wrinkle, Sander, and Kendel, 1973) while perceived instrumentality was measured by the Student Plans Questionnaire.

The experimental groups participated in a career simulation game consisting of on-the-job math problems, a job selection activity, and a career ladder graphic for five selected units of the self instructional course. After completing career related problems, each student selected a first, second, and third job choice from a list of job descriptions provided on the job selection sheet. The job choice was earned by satisfying the unit test grade requirement which was recorded by the student on a graphic representation of the career ladder.

Students in the sample consisted of those anticipating enrollment in certificate and degree level occupational-technical programs and students not formally seeking career training. The sample size numbered eighty-two. These students were enrolled in individualized arithmetic courses at John Tyler Community College.

Data analysis of perceived instrumentality used the t test statistic. The difference scores, obtained by subtracting pretest and posttest scores, were compared between the treatment and comparison groups. However, there was no difference between the mean perceived instrumentality scores for the treatment and comparison groups.

Math achievement was analyzed via three way analysis of covariance. Previous studies indicated that age, math placement test

scores, and high school grade point average may effect student performance in developmental mathematics. These variables were, therefore, used as covariates. Three hypotheses forming on effects and four hypotheses associated with interactions were retained. Specifically, there was no main effect in math achievement because of game participation, perceived instrumentality levels or achievement motive orientation levels. Examination of one hypothesis indicated an interaction at the .038 level between game participation and perceived instrumentality. The disordinal interaction indicates that students with high perceived instrumentality scores, who did not participate in the career simulation game, received lower grades than those having low perceived instrumentality scores. In addition, game participants with high perceived instrumentality received higher grades than those with low perceived instrumentality. The remaining null hypotheses tested were retained.

Conclusions

Data from the hypothesis testing for differences between the mean scores on the Student Plans Questionnaire, appears to indicate that student participation in the career simulation math game did not significantly effect student perceptions. This suggests the career simulation math game did not effectively intensify student characteristic achievement motivation.

Futhermore, the data from the hypothesis testing for differences in the mean arithmetic achievement of students, appears to indicate that participation in the career simulation game did not significantly effect

student performance on the Basic Skills in Arithmetic Test. This suggests the career simulation math game did not effectively intensify the student's characteristic achievement motivation. Therefore, a relationship between the immediate activity and one's future orientation was not intensified. Student failure to react to the game may be due to career immaturity. The achievement motive proposition that: "The more an individual commits himself to achieving concrete goals in life related to the newly formed motive, the more the motive is likely to influence his future thoughts and actions" (McClelland and Winter, 1969:48-78) suggests that motive acquisition may be dependent upon achievement oriented life goals. Therefore, the simulation game may have failed to relate the immediate educational experience to future activities because the students were not specifically pursuing career related studies. Students may not have developed an adequate career orientation to which the simulation game could relate developmental arithmetic.

Similarly, there may have been a mismatch between the students' future career goals and the aspects of that career as described in the career simulation math game. Alschuler, Tabor, and McIntyre (1971:84) suggest that motivational changes may not always be reflected in the school setting. Clearly, evidence of increased achievement motivation may be found in the student's leisure time activities.

The data from the hypothesis testing for difference in the mean arithmetic achievement of students grouped as success oriented and avoidant oriented, did not reveal a significant main effect between levels of achievement motive orientation. Previous research by Raynor

(1970) did not produce a significant interaction effect with perceived instrumentality. However, studies by Raynor (1968), Raynor and Rubin (1971) and Weitzenkorn (1974) did produce a significant main effect between levels of achievement motive orientation. Therefore, the absence of a significant main effect in this study is in conflict with previous studies related to the elaborated theory of achievement motivation.

Data from the hypothesis testing for differences in the mean arithmetic achievement of students grouped according to perceived instrumentality (high and low perceived instrumentality), did not reveal a significant main effect based on perceived instrumentality. Raynor (1968) did not find perceived instrumentality by itself related to grades, but there was a significant interaction between motives and perceived instrumentality. However, in a later study Raynor (1968) found a main effect due to perceived instrumentality, but there was no interaction with achievement motives. Therefore, lack of a clear career goal or homogeneous career goals within the sample could have contaminated the student's response on the Student Plans Questionnaire.

Data from the hypothesis testing for differences in the interaction of arithmetic achievement between students grouped according to motive orientation and student participation in the simulation game, revealed no significant interaction. There was no apparent difference in the effect the game had on students possessing success motives or avoidant motives. Since there have been no previous studies using similar simulation game materials, it is difficult to conclude whether an interaction should have occurred. Therefore, the researcher finds

the lack of an interaction effect provides an awareness that the game may be equally as effective (or ineffective) for students of both motive groups.

The failure to obtain a significant interaction in testing the hypothesis for differences in mean arithmetic achievement scores between the motive orientation groups and the perceived instrumentality groups was in conflict with previous research. Isaacson and Raynor (unpublished study) and Raynor (1968) found a significant interaction between motives and perceived instrumentality. Raynor (1968) found the success motivated group received higher grades than the group motivated to avoid failure, but only within the high perceived instrumentality groups. Furthermore, Raynor, and Rubin (1971) and Entin and Raynor (1973) found an interaction pattern between motive orientation and contingent-noncontingent conditions. It was this interaction which prompted Raynor to develop the elaborated theory of achievement motivation. The absence of this interaction provides no support to Raynor's elaborated theory. However, heterogeneity of career goals may have interfered with the development of this interaction.

The hypothesis testing for differences in the interaction of arithmetic achievement between students grouped according to perceived instrumentality (high and low perceived instrumentality) and participation in the simulation game (treatment and comparison groups), reveals there was a significant interaction at the .038 alpha level. Previous research had not measured the experimental interactive effects between perceived instrumentality and game participation. This interaction indicates that students who did not participate in the career simulation

game with high perceived instrumentality scores received lower grades than those with low perceived instrumentality scores. However, career simulation game participants with high perceived instrumentality received higher grades than those with low perceived instrumentality. The absence of a main effect between these two variables complicates an explanation. The interaction indicates that game materials are most helpful to students with high perceived instrumentality, but those with low perceived instrumentality will perform best if they do not use the career simulation game.

This interaction may possibly occur since students with high perceived instrumentality have adequate career goals for Raynor's elaborated theory to be effective. If these goals are absent, as may be the case with the low perceived instrumentality group, the student may become bored and resist participation in the career simulation game. Furthermore, the structure of the course, without the use of the simulation game, may be more compatible to those of low perceived instrumentality than those of high perceived instrumentality. These conditions suggest that the course materials do not tend to encourage development of career goals. Therefore, the interactions suggest that course materials without the career simulation game are most beneficial to students with low perceived instrumentality.

Finally, the results of the hypothesis testing for differences in the interaction of mean arithmetic achievement scores among students grouped according to perceived instrumentality (high and low perceived instrumentality), student participation in the simulation game (treatment and comparison groups) and student motive orientation (success and

avoidant oriented), revealed no significant interaction. Previous research had not tested the interaction of perceived instrumentality, motive orientation and game participation. The test of this hypothesis suggests that there are no unique combinations of variables which produce superior achievement. Finally, the above conclusions should only be generalized to students and instructional settings similar to those used in this study.

Recommendations for Further Study

The results of this study provide a basis for recommending additional research on achievement motivation and developmental arithmetic. Recommendations for further research are presented below.

Since Raynor's theory of achievement motivation requires the immediate activity be related to ones future goals, it may be necessary to restrict the sample to students with developed life goals. Specifically, the sample could be restricted to students who had expressed or planned the steps necessary for attaining their future goals. This procedure would allow the researcher to relate the treatment to an immediate activity.

Enrollment in occupational-technical courses should increase the student's future orientation. Therefore, if a study were conducted with a sample of students enrolled in occupational-technical courses, the treatment materials could relate to the specific math application for solving technical problems.

Since algebra and geometry may be more related to some occupational areas than others, it is recommended that the simulation game

materials be tested in these developmental courses. According to Raynor's elaborated theory of achievement motivation, if the immediate activity is related to future goals, the achievement motivation will be accentuated. Therefore, the content of algebra and geometry courses may allow the level of application to be more involved in the physical principles and concepts used in an occupational area. Hence the achievement motivation may increase.

The simulation game may be more effective if selected units were included in the series of required developmental courses. Specifically, the simulation game activities could be tested in selected units of arithmetic, algebra, and geometry. This type of study would allow the student's final exam in each of the courses to be used as the dependent variable. Furthermore, a repeated measures design could be used with the dependent variable, perceived instrumentality. This design would allow more time for changes in perceived instrumentality to occur since, the simulation game activities would be distributed among several courses.

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APPENDIX A

BASIC ARITHMETIC MATH 05 (0-5-5)

**John Tyler Community College
Chester, Virginia
July, 1977**

Basic Arithmetic (0-5-5)

- I. Course Description: A developmental course in review of arithmetical principles and computations, designed to develop the mathematical proficiency necessary for selected curriculum entrance.

This course allows the student to proceed at his own rate through a combination of workbook and tapes. The course consists of completing Units 1-25, 33 and additional assigned units depending upon the student's intended program of study.

The following units will be added.

- A. Units 26-31. Accounting
Business Administration
Business Management
Data Processing
Secretarial Science
Clerk Typist
- B. Units 32, 34, 38 . . . Funeral Service
Nursing, Science
- C. Units 35, 36 Liberal Arts
Pre-Teacher
- D. Unit 35. Teacher Aide

- II. Course Prerequisites: Testing—Administered by the counseling department.

- III. Course Placement: The in-house Math placement test is used to place the student in the correct math course needed for his curriculum. If the student scores below 12 on Part I of the Math Placement Test he is placed in Basic Arithmetic.

- IV. Course Objectives: Basic Arithmetic is designed to be completed in one quarter (10 weeks). The course objectives include Units 1-24, 33, and additional units according to the student's curriculum and the final exam. If a student does not accomplish the objectives in one quarter, he may re-enroll for Basic Arithmetic the following quarter with no penalty. If the course objectives are not achieved during or by the end of this second quarter, the student will receive a penalizing grade. When a student has successfully completed the course a final grade of "S" will be given. If he needs to re-enroll, a grade of "R" will be given for the first quarter, and when he successfully completes the objectives during or by the end of the second quarter, a grade of "S" will be given. If the student does not master the skills in two quarters, a grade of "U" usually will be given, which will require him to meet with the Academic Standards Committee.

When a student has successfully completed the course and does not need Algebra for his curriculum, he may be excused from class. Otherwise, the student should begin Algebra.

The student should attend all classes. A maximum of five (5) absences are allowed for a day class and two (2) absences are allowed for a night class. If over-cutting occurs, the student may be automatically withdrawn from the class.

A student may want to spend more than the regular assigned classtime in the learning labs. The labs are open for student use usually from 8-3 everyday, and Monday through Thursday nights. The student is encouraged to progress as rapidly as possible, and use of the learning labs at times in addition to classtime can be of great help.

By the end of the course the student will have mastered the following objectives:

- Module 1 - Operating with Whole Numbers
- Module 2 - Operating with Fractions
- Module 3 - Operating with Decimals
- Module 4 - Introduction to Percent
- Unit 33 - The Metric System of Measurement

V. Course Materials:

A. Text Material

1. Basic Arithmetic, 2nd Edition, Moon, Robert G., et. al., Charles E. Merrill Publishing Co.
2. Tape series prepared by publisher.
There are some long pauses between certain frames of the tape. The tape should be kept on until you come to the next frame explanation.

VI. Evaluation and Requirements:

The student must complete all of the study exercises in each unit and correct all of the errors. At the end of each unit the student must work and correct the review exercises. A unit test must be passed with a grade of 80% or better in order to proceed to the next unit. All errors must be corrected by the student and checked by the instructor. If the grade on a unit test is below 80%, the student must restudy the unit, correct the errors on the first test, work and correct the supplementary problems, and pass a retest with a grade of 80% or higher. If the retest is not passed, the student must schedule a conference with the instructor. After the student has passed satisfactorily all unit tests he or she takes a two hour exam over all the material in the course. Passing is 75%. If the student does not achieve 75%, a retest is given after the student has reviewed the material and corrected the errors on the first exam. The student must make a 75% or higher on the retest. If 75% is not made, the student must schedule an appointment with the instructor.

VII. Course Format/Class Assignment

Each student will receive a tape at the beginning of each class on his particular unit. He will proceed as the tape directs but can ask the classroom instructor any questions or items he doesn't understand or if he needs further explanation.

The student will work through the following schedule in taking his unit test.

Test IUnits 1-3	Test IXUnit 33
Test IIUnits 4-7	a. Test XUnits 26-28
Test IIIUnits 8-9	b. Test XIUnits 29-31
Test IVUnits 10-13	c. Test XUnits 32, 34, 38
Test VUnits 14-16	d. Test XUnits 35, 36
Test VIUnits 17-19	d. Test XUnit 35
Test VIIUnits 20-22	Final Exam.Units 1-26, 33, additional
Test VIII.Units 23-25	Units a, b, c, or d

APPENDIX B
PROBLEMS AND LADDER

JOB SELECTION SHEET

Complete this sheet after you finish the review exercise for unit 19

This game sheet consist of a list of jobs and job descriptions related to your career interest. Please read each job description and indicate which job would be your first, second, and third choices if you were seeking employment. When making your selection you may assume you are qualified for any of the jobs. Mark your first job choice by placing the number 1 (one) inside the circle located to the right of the job description of your first choice. Mark your second and third choices in the same manner.

For each unit after your job selection write the job titles of your first, second, and third choices to the left (Column C) on the career ladder (see back cover for career ladder).

COMBINATION WELDER A welder who knows both arc and gas welding is called a combination welder, someone who has a basic knowledge of at least four processes of welding. Obviously, these people demand a higher rate of pay and are more in demand by most companies because they are versatile and equipped to deal with a variety of problems. Knowledge of arithmetic is required and used on the job frequently.

WELDER FITTER A welder fitter is a person who possesses the manipulative skill of a trained manual welder plus the knowledge of jigs, welding symbols and blueprints. Here a knowledge of math is important and very useful in terms of advancement and position. He is the key man and can progress far on operational levels.

WELDER TECHNICIAN: The welding technician stands between the welding engineer, who originates the work, and those who are concerned with completing the work. He adapts theory to production. Draftsmanship may be needed by the technician: he may have to complete a series of tests, mount the samples, analyze the work and render a report. He uses drawing instruments and gages, he collects data, performs laboratory test, builds, supervises and controls machinery and testing equipment. In addition to basic arithmetic the technician should know algebra.

WELDING INSPECTOR: Inspection is the means by which quality is maintained. A certain standard of quality is determined, and it's the duty of the inspector to examine the work and reject any which falls below the standard required. This a position of responsibility that extends beyond the range of physical work. Basic math is used in measurement.

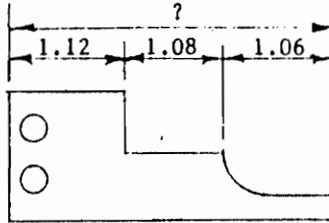
WELDING SUPERVISOR: The welding supervisor has usually worked as a welder-fitter-or in a similar capacity-and possesses equal skill and knowledge. He is often chosen for his ability to handle men as well as his skill in manual welding. Many companies select men with the desired aptitude and train them to be supervisors, responsible for a team of welders. Basic arithmetic and business mathematics is required in performing these job activities.

Unit 19

REVIEW EXERCISES

(24)

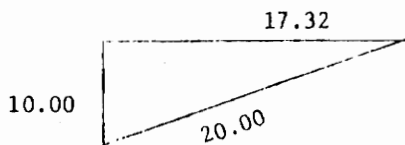
1. A wide flange beam is 81.7 feet long. The beam is to have a 1.68 foot extension welded to its end. What is the total length with the extension?
2. Find the total dimension of the guard below.



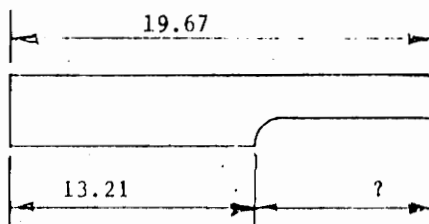
3. A welder agrees to build a steel stair for \$256.50. The materials cost \$78.49. What will be his profit?
4. A. A beam is 85.25 feet long. If 3.66 feet is cut from the beam, what length remains?
B. A beam is 92.785 feet long. If 4.25 feet is added, what is the total length of the beam?
5. A shipment of steel has arrived with the following invoice. What is the total cost of the materials?

Cost: \$32.61
 \$76.87
 \$23.89
 \$13.35

6. A bar must be welded around the perimeter of the triangle illustrated below. What is the total length of the bar welded?



7. Find the missing dimension indicated below.



Unit 19

SOLUTIONS TO REVIEW EXERCISES

(24)

1.
$$\begin{array}{r} 81.7 \\ + .68 \\ \hline 82.38 \end{array}$$
 total length
2.
$$\begin{array}{r} 1.12 \\ 1.08 \\ \hline 1.06 \\ 3.26 \end{array}$$
 unknown dimension
3.
$$\begin{array}{r} 256.50 \\ -78.49 \\ \hline 178.01 \end{array}$$
 profit
- 4a.
$$\begin{array}{r} 85.25 \\ - 3.66 \\ \hline 81.59 \end{array}$$
 remaining length
- 4b.
$$\begin{array}{r} 92.785 \\ + 4.250 \\ \hline 97.035 \end{array}$$
 total length
5.
$$\begin{array}{r} \$32.61 \\ 76.87 \\ 23.89 \\ \hline 13.35 \\ \$146.72 \end{array}$$
 total cost of materials
6.
$$\begin{array}{r} 10.00 \\ 17.32 \\ \hline 20.00 \\ 47.32 \end{array}$$
 total length of weld
7.
$$\begin{array}{r} 19.67 \\ -13.21 \\ \hline 6.46 \end{array}$$
 missing dimension

CAREER LADDER SHEET

The purpose of this sheet is to give you an opportunity to record your unit test score for tests covering units 4, 6, 16, 19, and 25. In addition you will record your previously selected job choices for each of the above units as well as the job title you earned through your unit test grade.

Instructions

1. Record your first, second, and third job choices in the blanks to the right of the career ladder in Column C.
2. After each unit test write your grade in the appropriate blank on the left of this sheet in Column A.
3. Compare your test grade with the grade requirement for first second and third job choices, then circle the job choice you earned in Column B.

JOB GRADE REQUIREMENTS

Grades 94-100 earn first choice
 Grades 93-87 earn second choice
 Grades 86-80 earn third choice

TEST GRADE (Column A)	JOB EARNED (Column B)	JOB CHOICES (Column C)
	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____
Unit 25 Test Grade _____	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____
Unit 19 Test Grade _____	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____
Unit 16 Test Grade _____	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____
Unit 6 Test Grade _____	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____
Unit 4 Test Grade _____	1	1st job choice _____
	2	2nd job choice _____
	3	3rd job choice _____

BEGIN HERE

VITA

William G. Wyatt was born October 11, 1949 in Hopewell, Virginia. He graduated from Hopewell High School in June 1967. In the fall of 1967 he enrolled in Architectural Technology at John Tyler Community College and was awarded the Associate in Applied Science degree in June, 1970. He transferred to Eastern Kentucky University in Richmond, Kentucky and earned a Bachelor of Science degree in Industrial Technology May 1972. In August 1974 he completed the Master of Science degree in Industrial Technology at Eastern Kentucky University. He pursued additional graduate work at Virginia Commonwealth University, Richmond, Virginia and Virginia State College, Ettrick, Virginia. He received an Education Professional Development Act (EPDA) award and pursued advanced graduate work in General Vocational Technical Education at Virginia Polytechnic Institute and State University, Blacksburg, Virginia. In June, 1977 he was awarded a Certificate of Advanced Graduate Study and completed requirements for the Doctor of Education degree in April, 1978.

He is a member of the following professional organizations:

American Vocational Association, American Society for Engineering Education, American Metric Association, Phi Delta Kappa, Phi Kappa Phi, and Phi Theta Kappa.

Mr. Wyatt has been employed in construction and manufacturing as well as community college teaching. In June 1967 he was employed at Hopewell Craft Shop in Hopewell, Virginia. Also, he was employed at Brown and Williamson Tobacco Company in Petersburg, Virginia during

the summer of 1969 and Baskervill and Son, Richmond, Virginia in the summer of 1970. His present position, Associate Professor of Drafting at John Tyler Community, Chester, Virginia, was assumed September, 1972.

William Wyatt

THE EFFECTS OF A SIMULATION CAREER GAME ON THE
ACHIEVEMENT MOTIVATION OF VOCATIONAL STUDENTS
ENROLLED IN DEVELOPMENTAL ARITHMETIC

by

William George Wyatt

(ABSTRACT)

The motivational development of students is a concern of the public and community college educators. Educators are challenged to provide instruction to nontraditional students who often lack adequate motivation for success in traditional programs. Therefore, educational experiences for the nontraditional student must consider their motivational needs.

This study examined the effects of a career simulation game upon the math achievement of post secondary students enrolled in developmental arithmetic. Effects of the simulation experience upon student perceived instrumentality were examined with a pretest-posttest comparison group research design. The criterion measure, math achievement, was examined with the posttest-only control group design utilizing a two by two by two factorial design. The factors included in this design were achievement motive orientation (success and avoidant), perceived instrumentality (high and low) and game participation (treatment and comparison groups). Students were assigned to achievement motive orientation and perceived instrumentality groups based upon their scores on the Student Plans Questionnaire, the Test Anxiety Questionnaire, and The 1969 Achieving Tendency Scale for Males. However, students were

randomly selected and assigned to experimental and comparison groups of the factorial design. Math achievement was measured by the Basic Skills in Arithmetic Test (Wrinkle, Sanders, and Kendel, 1973) while perceived instrumentality was measured by the Student Plans Questionnaire.

The experimental groups participated in a career simulation game consisting of on-the-job math problems, a job selection activity, and a career ladder graphic for five selected units of the self instructional course. After completing career related problems, students selected a first, second, and third job choice from a list of job descriptions provided on the job selection sheet. The job choice was earned by satisfying the unit test grade requirement which was recorded by the student on a graphic representation of the career ladder.

Students in the sample consisted of those anticipating enrollment in certificate and degree level occupational-technical programs and students not formally seeking career training. The sample size numbered eighty-two. These students were enrolled in the individualized arithmetic courses at John Tyler Community College, Chester, Virginia.

Data analysis of perceived instrumentality used the t test statistic. The difference scores, obtained by subtracting pretest and posttest scores, were compared between the treatment and comparison groups. However, there was no difference between the mean perceived instrumentality scores of the treatment and comparison groups.

Math achievement was analyzed via three way analysis of covariance. Previous studies indicated that age, math placement test scores, and high school grade point average may effect student perfor-

mance in developmental mathematics. These variables, therefore, were used as covariates. Three hypotheses forming on effects and four hypotheses associated with interactions were retained. Specifically, there was no main effect in math achievement because of game participation, perceived instrumentality levels or achievement motive orientation levels. Examination of one hypothesis indicated an interaction at the .038 level between game participation and perceived instrumentality. This interaction indicated that students who did not participate in the career simulation game with high perceived instrumentality scores received lower grades than those with low perceived instrumentality scores. In addition, game participants with high perceived instrumentality received higher grades than those with low perceived instrumentality. The remaining null hypotheses tested were retained.