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Relating College Students' Learning Approach

to Their Quality of Learning Outcome

Margaret D. Anderson

A Dissertation

in

The Department of Education

Presented in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy at
Concordia University
Montreal, Quebec, Canada

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ABSTRACT

**Relating College Students' Learning Approach
to Their Quality of Learning Outcome**

Margaret D. Anderson, Ph.D.
Concordia University, 1995

Over the past decade there has been a radical shift in conceptualizations of learning, from viewing the learner as a passive recipient of information, to viewing the learner as an active processor of information. As a result, recent theories have attempted to identify personality characteristics and cognitive abilities that mediate learning outcome. However, there is little empirical support for these theories.

The focus of the present study is to empirically test Biggs's (1985) theoretical model of the relationship between specific predictor and criterion variables. It examines the interrelationship among the predictor variables of Locus of Control, Approach to Learning, and Metacognition, and their relationship (singly and in combination) with the quality of learning outcome (structural complexity and depth of cognitive performance).

Rotter's Locus of Control Scale (Rotter, 1966), Biggs's Study Process Questionnaire (SPQ) (Biggs, 1988b), and To-bias's Assessment of Metacognition (Tobias, Everson, Hartman and Gourgey, 1991) were administered to 177 college students from a state university to measure the predictor variables. Essay answers to open ended questions based on three text passages were evaluated using the Structure of the Observed

Learning Outcome (SOLO) taxonomy (Biggs and Collis, 1982) to determine structural complexity. Finally a 50 item multiple choice test consisting of questions designed to measure the upper four levels of Bloom's taxonomy (application, analysis, synthesis and evaluation) was administered to determine depth of cognitive processing.

The results of Pearson Product-Moment correlational analyses indicate a positive correlation between Internal Locus of Control and Deep (r=.23, p<0.01) and Achieving (r=.22, p<0.01) Approaches to learning, and Metacognition (r=.17, p<0.05). A negative correlation between Surface Approach and Metacognition (r=-.21, p<0.01) is indicated. Stepwise multiple regression analyses reveal that Metacognition is the only variable which predicts learning outcome (p<0.01). No relationship between any learning approach and learning outcome is supported.

The present study also examines the psychometric properties of the SPQ and provides support for the factor structure identifying the three Approaches to learning, but questions the strategies/motives subscales.

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CHAPTER ONE

Introduction

Rationale

For nearly one hundred years researchers have been at-
tempting to identify basic faculties that could be used to
predict academic performance (Wissler, 1903). The area of
individual differences and their relationship to performance
seems to be intuitively appealing to a number of educators
and researchers, and some have made it appear deceptively
simple. Lembke (1985) states that three principal points
stand out in the literature. "First, learning styles do ex-
ist. Second, learning styles are not difficult to identify
and diagnose. Third, when students are taught through their
preferred learning styles, academic achievement increases"
(p. 2). Statements of this nature may lead the uninitiated
to believe that the evidence in this domain is conclusive
and in appropriate form to be applied in educational or
counselling situations. In reality, nothing could be far-
ther from the truth.

The past twenty five years have seen increasing inter-
est in understanding the variety of individual differences
in approaches to learning and how these differences relate
to performance. Unfortunately the research in this area has
been somewhat fractured and it is difficult to organize it
into a comprehensive theory. One of the major stumbling
blocks to creating a unified body of research in this domain

has been the discrepant use of relevant terminology. Coupled with this lack of linguistic consistency has been the proliferation of idiosyncratic theories in this field of study. Finally, the use of widely varying research methods and materials has often yielded conflicting results.

Research into individual characteristics and their impact on student performance has been conducted along two different methodological tracks: qualitative and quantitative. The qualitative or phenomenological approach exhibited by Pask (1972, 1976, 1988), Marton and Saljo (1976), and Svensen (1977) has generally focused on in depth interviews and subjective examinations of the learning products of small groups of students. The quantitative approaches of Biggs (1978, 1984, 1985), Entwistle (1979, 1989), and Schmeck (1979, 1988, 1991) have usually been based on the administration and statistical analysis of self-report questionnaires and retrospective examinations of learning outcomes for large groups of students. Despite these different methodological approaches, researchers have consistently identified a dimension that is often called "depth of processing" that students employ when studying material. While there are differences in the terminology and exact characteristics of this dimension, it can usually be related to a continuum varying from a "surface" to a "deep" approach to learning.

Researchers have also been engaged in an attempt to identify the influence of approaches to learning on learning

outcome. Several theoretical relationships have been pro-
posed (Saljo, 1981; Biggs, 1985; Schmeck, 1988) and some em-
pirical research has been conducted in this area (Marton and
Saljo, 1976; Pask, 1976; Biggs, 1978,1985; Schmeck, 1982).
However, the situation has not changed much since Biggs
(1979) stated "in general, it is postulated that the study
process used by a student during learning will be related to
both the amount learned, and the quality of his learning.
Although such a relationship seems obvious, there have been
remarkably few attempts to substantiate it, and more specif-
ically, to describe the nature of the relationship" (p.
381).

A major factor hindering accumulation of solid empiri-
cal support for the relationship between approach to, and
outcome of, learning may be the lack of consistency in the
predictive and performance measures used in research in this
domain. The diversity of methods and materials used in re-
search studies makes direct comparison of results almost im-
possible and has contributed to the inconclusive or incon-
sistent findings.

Recently researchers have proposed that the relation-
ship between outcome and approach is not a simple, direct
one (Ainley, 1993; Wilson, 1988; Wilhite, 1990). The rela-
tionship is probably mediated by a number of other important
individual and environmental factors that need to be studied
in conjunction with a depth of processing dimension to gain
a systemic understanding of the learning process.

Theoretical models representing the relationship among personality variables, learning style and learning outcome have been proposed (Schmeck, 1988; Curry, 1983). While these models do take into account a wide variety of variables that might potentially affect an individual's learning performance, they are only tentative, and are based on an integration of the research literature dealing with single predictor variables. These models have not, as yet, been supported empirically.

Biggs (1985) has proposed a theoretical model of the learning process that focuses on a more limited set of individual characteristics and learning outcomes than those proposed in the inclusive models cited above. He proposes a "model of student learning in which personal and situational factors are linked to performance by three main approaches to learning: deep, achieving, and surface. These approaches involve varying degrees of metacognition and lead to qualitatively different learning outcomes" (p. 185). He further claims that level of metacognitive awareness is determined by such factors as locus of control, ability patterns and motivation. While Biggs has conducted numerous studies based on individual components, he has not empirically validated his entire model in an all inclusive program of research.

Despite the intuitive appeal of a direct link between individuals' approaches to studying, and their learning performance, there is little conclusive empirical support for

any theoretically generated relationship. Perhaps the inability to develop a substantiative body of support can be explained by the diversity of methodological approaches; or by the different statistical analyses performed; or by the variety of materials used; or by the different subject groups; or even by cultural or educational differences. It may also be, however, that the predicted relationship has not been unquestionably demonstrated because, despite it's seemingly obvious nature, it is not possible to directly relate students' learning performance to the learning approach they adopt.

Nature of the Problem

The primary problem that exists in this domain is the determination of the extent to which individuals' approaches to learning influence their performance on measures of learning outcome. The establishment of this relationship will enable researchers, educators and counsellors to predict an individual's performance on learning measures, based on the knowledge of his/her learning approach.

Related problems center around the development and standardization of predictive and performance measures. Those measures currently in use have generally been standardized on unique samples, and the resulting factor structures, norms and indications of reliability and validity may not be appropriate for other populations. Moreover the typical questionnaire's scoring scheme seems to be based on

face validity or construct validity without being standardized against actual learning outcomes.

In order to establish a viable model of learner characteristics and their relationship to learning outcomes it is essential that researchers in this domain agree upon methods and materials for use in conducting empirical studies. Only through the replication of studies and accumulation of data from alternate settings will it be possible to develop a consistent understanding of the role that individual characteristics play in determining performance.

At the same time, it is important for the growth of this field that researchers expand their studies to incorporate a wider variety of predictive variables and their interactions. These studies may require adapting or devising new research designs and analytic measures to accommodate the questions being addressed.

While it is critical to understand how a full range of personality and environmental variables interact to determine learning outcome, it is also important to proceed in this investigation in a systematic and systemic manner. Coupling replication studies with studies including new variables will allow this field to move towards the development of a comprehensive model of individual characteristics and their impact on learning outcome. The development of this comprehensive model is particularly crucial before the knowledge gained from any explorations in this domain can appropriately be incorporated into an applied setting.

The Present Research

The present study addresses the problems cited above, while focussing on Biggs's (1985) model of individual characteristics and their relationship to learning outcome. The present research is designed to empirically test Biggs's theoretical model of the effect of the learning process on the quality of the learning outcome. As such, it is in part a replication of Biggs's (1985) study on the relationship among learning approach, locus of control and metacognition. The present study will involve a different sample of subjects in an attempt to extend Biggs's findings to a different population. To expand on Biggs's work, a reading comprehension measure has been included in the present study to explore the relationship between reading ability and learning style (Schmeck and Phillips, 1982), and metacognition (Kirby, 1984).

Along with determining the relationship among these individual variables, the present study will examine the relationship between these predictor variables and learning outcome. In order to consistently operationalize Biggs's concepts of approach to learning and quality of learning outcome, his measures for predictive and criterion variables will be used in this research. His Study Process Questionnaire (SPQ) (Biggs, 1988b) will be used to determine subjects' approach to learning, and his Structure of the Ob-

served Learning Outcome (SOLO) (Biggs and Collis, 1982) will be used to evaluate subjects' learning outcome.

In an attempt to initiate an objective, replicatable procedure, Tobias's Metacognitive Assessment Measure (Tobias, Everson, Hartman, and Gourgey, 1991) will be used as a more objective method for scoring metacognition than that used by Biggs (1985). In addition, an objectively scored learning outcome measure based on Bloom's taxonomy of educational objectives (Bloom, Engehart, Furst, Hill and Krathwohl, 1956) was created for use in the present re-search. The results generated from this instrument will be compared with the results of the SOLO evaluation to deter-mine whether or not the two instruments measure the same learning outcome. If both measures of learning outcome pro-duce similar results the measure based on Bloom's taxonomy may prove to be an expedient tool for determining learning outcome.

Significance of the Present Study

Through an examination of the interrelationship among the predictor variables, and between the predictor and cri-terion variables, the results of the present study will con-tribute information useful in continuing to develop a com-prehensive model of individual characteristics and their in-fluence on learning outcome. This model will become fully developed only through consistent efforts at standardization of methods and materials used in research, and through

replication of previous studies to confirm and extend the findings of those studies. Once this model is developed it will enable instructional designers to tailor courses to students' characteristics so as to optimize the learning for all students. Such a model will identify the learner characteristics that are most likely to produce a specific learning outcome, thus allowing educators to help students develop those abilities in which they may be deficient. Finally, it will provide individuals involved in designing intelligent computer systems with a model of the learner to incorporate into their mechanical systems.

In addition to extending the body of knowledge concerning the impact individual characteristics have on influencing learning outcome, the present research will also apply a "standardized" measure to a new population. This will allow the psychometric properties of the SPQ to be evaluated on a new sample and possibly enhance the instrument's reputation as a measure of learning style.

Finally, the present study will introduce, and attempt to validate, two new objectively scored instruments. If these instruments are determined to be psychometrically sound, they may facilitate future attempts to standardize research designs in this area.

CHAPTER TWO

Review of the Literature

General Overview

This chapter will provide a review of the literature related to learner characteristics and learning outcome. The general terminology and conceptual issues will be reviewed first to demonstrate that the surface/deep dimension of approaches to learning is a central issue with respect to learning outcome. While this depth of processing dimension is critical to understanding an individual's learning outcome, there is by no means a standard definition of the construct or its critical elements. In order to demonstrate the diversity in orientations to the levels of processing dimensions a thorough analysis of the relevant theoretical literature will be presented. Along with the variety of theoretical orientations, there are a number of different methodological approaches which researchers in this field have employed. The empirical literature relating levels of processing and learning outcome will be reviewed, and methodological problems will be identified. The psychometric properties of Biggs's Study Process Questionnaire (SPQ) (Biggs, 1988b) will be described in order to recommend it as a way of measuring students' approaches to learning. Factors other than alternative measures and methods that may be contributing to the lack of clear findings in the research literature dealing with the relationship between ap-

proach to learning and learning outcome will be reviewed.
These factors include such variables as locus of control,
metacognition, strategy/motive congruency and subject popu-
lations. This review of the literature will demonstrate why
a replication (with specific extensions and modifications)
of Biggs's (1985) study dealing with approaches to learning,
and the measurement of learning outcome, is necessary. At
the conclusion of this chapter the specific research hy-
potheses to be addressed in the present study will be de-
scribed along with the theoretical and operational defini-
tions of relevant terms.

Introduction to the Field

Over the past decade there has been a radical shift in
conceptualizations of learning, from viewing the learner as
a passive recipient of information to viewing the learner as
an active processor of information. As a result, recent
theories have attempted to identify personality characteris-
tics and cognitive abilities that mediate learning.

Until the early 1980s there had been relatively little
systematic experimental investigation of individual differ-
ences in student learning (Richardson, 1983). The majority
of experimental studies that had been conducted generally
focused on changes in group study behavior as a result of
some intervention or training, or limited themselves to the
study of special interest groups such as young children,
disadvantaged individuals or minority groups. Even now,

relatively few research efforts have been conducted to examine the specific effect of individual characteristics on students' academic performance, especially at the college level.

In order to fully understand the impact and importance of individual differences in academic environments Richardson (1983) claims that we need to be concerned with the intersection between three different areas of research: laboratory studies of human learning and memory; educational research into student learning in higher education; and the analysis of individual differences. This intersection would seem to be the same ground upon which much of the field of educational technology has been built. It is because of this ability to draw from a diversity of backgrounds that studies conducted by researchers from the field of educational technology offer great promise in contributing to the body of knowledge concerning how individuals learn and perform in academic settings.

Curry (1990) indicates that the primary objective for the study and application of approaches to learning has been to improve the immediate and long-term results of instruction. However, she claims that there are actually four potential areas of impact for the results of research from this area: 1) curriculum design; 2) instructional methods; 3) assessment methods; and 4) student guidance. Along with these four very practical outcomes of the study of individual differences one could also include the more theoretical

goal of building ` model of the learner. Through the study of the relationships of performance and individual characteristics researchers may continue to develop theories and models of human learners and the factors that influence academic performance.

General Terminology and Conceptual Issues

Terminology. One of the major factors hindering research on the components that impact on human learning is the lack of conceptual clarity or consensus in defining the basic concepts to be studied. Curry (1990) indicates that there are three general areas for continuing concern about operationalization of learning style theory: 1) confusion in definitions; 2) weakness in reliability and validity of measurements; and 3) identification of the most relevant characteristics in learners and instructional settings.

Despite some inconsistency with which various terms are used in the literature, Curry (1990) indicates that there may be some consensus emerging for the terms "style", "strategy" and "tactic". "Style" is used to refer to information processing routines which function in a trait-like manner at the personality level (Entwistle, 1988). "Strategies" is used to refer to cross-situational consistency in how students approach school learning (Entwistle, 1988; Ramsden, 1988). "Tactics" is used to describe the specific, observable activity of learners in a specific learning situation (Snowman, 1986).

Snowman (1986) further defines the concept of learning strategy as a general plan one formulates for determining how to best achieve a set of academic objectives prior to dealing with the learning task itself. A learning tactic is a specific technique one uses in the service of the strategy while confronted with the task. He feels that a learning strategy should combine metacognitive knowledge with strategic and tactical skills. The critical element of a learning strategy is the intentional, effortful, self-selection of a means to an end.

Paris, Lipson and Wixon (1983) believe that a strategic learner possesses declarative and procedural knowledge as well as an ability they termed "conditional knowledge." They introduced the term "conditional knowledge" to capture the dimension of knowing when to invoke strategies, and propose that adept learners have three sorts of knowledge about strategies: 1) declarative, or knowing that; 2) procedural, or knowing how; and 3) conditional, knowing when or why. A learner with only declarative and procedural knowledge about a particular strategy can not adjust behavior to changing tasks.

Despite the recognition of the importance of conditional knowledge, there has been relatively little empirical investigation of the nature or impact of this dimension (Lorch, Lorch and Klusewitz, 1993). The current interest in the components and consequences of metacognition (Van Zile-

Tamsen, 1993) may contribute significantly to advancing our understanding of the role of conditional knowledge.

Cognitive style and cognitive ability. Despite the general consensus outlined above, there is still considerable confusion in the literature which arises from the identification and differentiation of what constitutes a cognitive style. "Cognitive styles" according to Messick (1984) are "characteristic self-consistencies in information processing that develop in congenial ways around underlying personality trends" (p. 61). Messick (1984) proceeds to identify eight variables that represent cognitive styles: broad versus narrow categorizing, cognitive complexity versus cognitive simplicity, field dependence versus field independence, leveling versus sharpening, scanning versus focusing, converging versus diverging, automatization versus restructuring, and reflection versus impulsivity.

Historically there has been additional controversy over the distinction between cognitive styles and cognitive abilities (Zigler, 1963). Recently attempts have been made to clarify the distinction between these two concepts (Tiedemann, 1989). To begin with, the concept of abilities implies the measurement of competences in terms of maximal performance, with the emphasis on accuracy and correctness of response. Cognitive style, on the other hand, implies the measurement of propensities in terms of typical perfor-

mance with the emphasis on a predominant or customary mode of processing.

Moreover, abilities differ from cognitive styles in their breadth of coverage and pervasiveness of application. While abilities are specific to a given domain, styles cut across domains.

Abilities are considered to be enabling variables in that they facilitate task performance in specific areas, whereas cognitive styles are organizing variables. Abilities are considered to be unipolar while cognitive styles are viewed as bipolar. An individual may have a great deal or no ability in a given area such as verbal fluency. In cognitive styles, on the other hand, each pole of the dimension has different implications for cognitive functioning. For example, a field independent person is supposedly more analytical, while a field dependent person is considered to be more socially sensitive.

Furthermore, abilities are value directional (having more of an ability is generally better than having less of it); cognitive styles are value-differentiated (each dimension has value in different circumstances). Neither pole in a cognitive style dimension is considered to be uniformly more adaptive than the other (Tidemann, 1989). These distinctions may be useful in differentiating between styles and abilities in general.

While the difference between ability and cognitive style has been addressed at some length, a new item of con-

fusion has arisen: the distinction between cognitive style and learning style.

Cognitive style and learning style. "Cognitive style" can be defined as the "individual's approach to adapting and assimilating information. This adaptation does not interact directly with the environment; rather it is an underlying and relatively permanent personality level dimension that becomes manifest only indirectly and by looking for universals within an individual's behavior across many learning instances. Habitual time to closure (reflectivity-impulsivity) in the data gathering phase of problem solving is an example of this type of style" (Curry, 1983, p. 3).

"Learning style", on the other hand, refers to the "habitual, cross-situational use of a strategy. A style is an abstraction not necessarily visible in a particular behavior, but evident from the general or global perspective we obtain through repeated longitudinal and cross-situational observations of many behaviors of the same individual" (Schmeck and Geisler-Brenstein, 1989, p. 86).

Several models have been proposed to represent the relationship between these two constructs. Curry's (1983) model represents these constructs using a graphic "onion". At the core of her "onion" is Cognitive Personality Style. She defines this construct as the individual's cognitive information processing habits, which is an underlying and relatively permanent personality dimension. Moving outward on

her "onion" would be the middle layer, the Information Processing Style. This layer represents the individual's intellectual approach to assimilating information which, because it is not directly involved with the environment, is relatively stable. Outermost, and most observable, is the Instructional Preferences "layer", which deals with the individual's choice of environment in which to learn. As this layer interacts directly with the environment, it is the least stable, and, as such, is the most easily influenced level of measurement in the learning styles arena. These three levels as described by Curry most closely correspond to the cognitive style, learning style, strategy/tactic dimensions.

More recently, Schmeck (1988a) has proposed "a tentative model of learning style with suggestions regarding causality" that presents a hypothetical relationship between cognitive style, learning style, learning strategy and tactic. While he refers to the cognitive style dimension as "personality, motivation, and stages of development" in his model, he includes many of the same bipolar dimensions that Messick (1984) identified as comprising cognitive style: reflective versus impulsive, field dependent versus field independent, introvert versus extrovert. Schmeck proposes that an individual's personality characteristics, which are relatively stable, will determine the individual's learning style. The learning style is also somewhat stable, and will predispose the individual towards certain learning strate-

gies. The learning strategies are more flexible in response to the specific task demands, and they will dictate the actual learning tactics an individual will use in a given situation. He claims that:

> I view learning style as lying between personality and learning strategy on the causal continuum that leads to learning outcome. It is not as specific as strategy nor as general as personality. Learning style is the expression of personality within the situational context, i.e. the school setting. Learning style also reflects the student's preferred learning strategy, but it implies more than learning strategy. For example, it includes elements of motivation, attitude, and cognitive style (Schmeck, 1988a, p. 175).

Thus, while cognitive style represents a global, pervasive method of information processing, learning style is influenced by consistent personality traits, but may also be somewhat responsive to the environment.

Dimensions of learning style. Messick (1984) described eight variables that represent "cognitive style"; however, the exact components that constitute "learning style" are still unclear, and individual researchers have focused on different elements of this construct.

In general, research into learning style can be classified into four major categories: 1) preference for environmental conditions; 2) preference for social conditions; 3)

typical engagement level; and 4) preference for cognitive information processing mode (Curry, 1990). Each researcher in this field has a slightly different view of the overall importance of those four dimensions, and of the appropriate manner in which to measure them.

In her Learning and Study Strategies Inventory (LASSI) Weinstein (Weinstein, Zimmerman and Palmer, 1988) identifies learning style by measuring students' responses to questions in ten areas: anxiety, attitude, concentration, information processing, motivation, scheduling, selecting main ideas, self-testing, use of study aids, and test taking strategies.

Kolb (1985) describes learning as a cyclical operation individuals engage in that requires different cognitive processing skills at various stages in the cycle. The individual's preference for using concrete experience versus reflective observation and abstract conceptualization versus active experience may be combined to determine his/her overall learning style and cognitive approach.

One of the most elaborate measures of learning style has been developed by Dunn, Dunn and Price (1989). This test measures students' preferences in five domains: 1) environmental (sound, light, temperature and design); 2) emotional (motivation, persistence, responsibility and structure); 3) sociological (preference for studying with colleagues, in pairs, as a team or alone, and responses to authority); 4) physical (perceptual abilities, mobility, diurnal cycles and food intake); and 5) psychological (analytic

versus global processing, reflectivity versus impulsivity, and cerebral preference).

In reviewing the literature dealing with the identification and measurement of learning styles it becomes apparent that most of the instruments currently in use have questionable reliability, validity and factor analytic values (Curry, 1990b, 1991; Snider, 1990). As a result of these weaknesses, ongoing modifications are being made to most of the measures, and research is being conducted to identify the strengths and weakness of each instrument. Clearly differences do exist in the interpretation of what elements constitute a learning style. Despite the diversity of components identified for study, one dimension, as pointed out earlier, has consistently emerged as a focus of investigation: a deep versus surface approach to learning.

Analysis of the Theoretical Surface/Deep Literature

Deep/surface approach. Over the past twenty five years researchers from different parts of the world, using different methodologies, and working under different theoretical orientations, have consistently identified what Watkins (1983a) refers to as a deep versus surface level of processing. The terms each researcher uses to identify this dimension vary slightly, as does the exact nature of the characteristics they attribute to those dimensions. However, there does appear to be a common construct underlying the dimensions they identify.

The research findings in this area are derived from two distinctive methodological approaches. Despite these differences in approaches, the results display an impressive consistency. Some investigators have employed essentially a qualitative approach to their research, intensively studying small samples of students whose introspections about their approach to learning form much of the data to be analyzed. Other researchers have adopted a more quantitative methodology typified by large sample sizes, structured questionnaires, and sophisticated multi-variate statistical techniques (Watkins and Hattie, 1990).

The history of the surface versus deep approach to learning is usually traced back to Craik and Lockhart (1972), (Schmeck and Phillips, 1983; Biggs and Rihn, 1984) who proposed a continuum of levels of processing. These researchers proposed that individuals can analyze information in many ways, from the shallow, sensory kind of processing involved in judgements about the appearance of letters in a word, to the deeper, more complex kind of processing involved in judgements about whether a word's meaning is appropriate for a particular sentence. Furthermore, they proposed that deeper processing of material leads to more permanent retention of the material.

Ausubel (1963) was one of the first researchers to investigate what he termed "meaningful" versus "rote" approaches to learning. The elements of these two approaches can be seen in much of the subsequent surface/deep litera-

ture with "meaningful learning" being evidenced in the process of establishing non-arbitrary relationships among concepts, and "rote learning" being defined as learning concepts in an arbitrary, verbatim and non-substantive way. These two approaches to learning can be found at the core of most of the dimensions of processing levels identified by subsequent researchers.

After 1970 research in the area of learning styles took two very different approaches. The qualitative or phenomenological approach to the study of learning styles is typified by the work of Pask (1976), Marton and Saljo (1976), and Svensson (1977), while the more quantitative, psychometric studies are best represented by the work of Biggs (1978), Schmeck (1977), and Entwistle (1983).

In the 1970s, phenomenological research by independent research groups identified similar dimensions to students' approaches to learning. Working in the United Kingdom, Pask (1976) has been concerned with the different approaches demonstrated by students in situations where understanding of material is the explicit goal. Students were asked to learn principles and procedures well enough to teach them back to others. Pask's methods and goals are unique in that he requires all students to achieve a thorough understanding of the material they are studying, and he is primarily interested in the strategies they use to carry out these tasks. Using these methods of research, Pask identified two general categories of learning style which individuals adopt

to reach a full understanding of material, he referred to
them as "serialist" and "holist".

For Pask, serialists learn, remember and recapitulate a
body of information in terms of string-like cognitive struc-
tures where items are related by simple data links. He as-
sociates this style with "operation learning", which in-
volves a linear task approach on operational details and se-
quential procedures. Since serialists habitually assimilate
lengthy sequences of data, they are intolerant of irrelevant
information. Serialists prefer a narrow focus in learning,
concentrating on simple hypotheses, and step-by-step learn-
ing, often neglecting the broader perspective and links with
other topics.

Holists, on the other hand, learn, remember and reca-
pitulate as a whole, formally, in terms of high order rela-
tions. The holist utilizes "comprehension learning", which
involves a global task approach, a wide range of attention,
reliance on analogies and illustrations, and construction of
an overall concept before filling in details. The individ-
ual applying this approach tends to make more elaborate hy-
potheses, look further ahead, build up a picture of the
whole task, and often rely on personal and idiosyncratic de-
scriptions (Pask and Scott, 1972).

Pask argues that thorough understanding normally in-
volves components of both holist and serialist approaches.
He found that some students have a "versatile" approach

which means they are able to successfully use both of the other two styles.

Working independently in Gothenburg University in Sweden, Marton and Saljo (1976) proposed seemingly similar dimensions to those of Pask (1976). The Gothenburg studies also adopted a qualitative methodology of asking a small (usually 30-40) sample of student volunteers to read and answer questions about a set text - perhaps a newspaper article or a chapter from a book. The students studied the text individually in front of the experimenter and then answered oral or written questions about their understanding of the material. Subjects also gave introspective accounts concerning how they went about their reading and studying. In most of the research studies the experimenter and a colleague independently classified the students' answers according to level of outcome, and their approach to reading as indicating deep or surface processing (Marton and Saljo, 1976).

Using these classifications Marton and Saljo identified two different levels of processing: 1) a deep-processing, conclusion-oriented approach and 2) a surface-processing, description-oriented approach. In the deep processing approach the student is directed towards the intentional content of the learning material (what is signified), i.e. s/he is directed towards comprehending what the author wants to say about a certain topic. The student's intention is to understand the material and relate ideas to personal experi-

ence. On the other hand a student exhibiting a surface pro-
cessing orientation directs his/her attention toward learn-
ing the text itself (the sign), i.e. s/he has a reproductive
concept of learning, which is more or less a rote learning
tactic. His/her intention is to memorize the material, and
a shallow processing approach is adopted, focusing on dis-
crete facts and disconnected information.

Marton and Saljo (1976) indicate that deep and surface
approaches to learning might be hierarchically related, such
that access to the former necessarily implies access to the
latter, but not vice versa. People who usually use a deep
style can adopt a surface approach, but the reverse is not
true.

Svensson (1977) also employed qualitative methods of
interviewing small groups, and arrived at his own distinc-
tion of approaches to learning that he called "atomistic"
and "holistic" cognitive approaches. For him the atomistic
approach is expressed by students who focus on specific com-
parisons, or particular parts of the text sequence. These
students tend to memorize details and direct information,
indicating a lack of orientation towards the content as a
whole. On the other hand, the holist attempts to understand
the overall meaning of the passage, searches for the au-
thor's intent and tries to relate the text to a wider con-
tent.

A more quantitative, factor analytic approach to study-
ing learning styles has been employed independently by a

number of investigators who once again identified the same
basic orientations to learning. Working at the University
of Lancaster in the United Kingdom, Entwistle and Ramsden
(1983) developed a questionnaire which they called The Ap-
proaches to Studying Inventory. Using this inventory they
were able to identify four orientations which they described
as: "achieving", containing components of a strategic ap-
proach, hope for success and vocational motivation;
"meaning", a deep approach and intrinsic motivation;
"reproducing", a surface approach and fear of failure; and a
"non-academic" approach exhibiting disorganized study meth-
ods, negative attitudes, and social motivation (Entwistle
and Waterston, 1988, p. 259).

In the United States, working from a cognitive theories
perspective, Schmeck, Ribich and Ramanaiah (1977) began de-
veloping a measure of learning styles which would eventually
be called the Inventory of Learning Processes. This measure,
which has been continually honed since its conception
(Schmeck, Geisler-Brenstein and Cercy, 1991), continues to
yield four main factors that define a student's approach to
learning: "deep processing" describes the extent to which a
student critically evaluates, conceptually organizes, and
compares and contrasts information being studied;
"elaborative processing" indicates the extent to which stu-
dents translate new information into their own terminology,
apply it to their own lives, generate concrete examples from
their own experience, and use visual imagery for the purpose

of encoding new information; "fact retention" involves per-ceived facility at learning facts and details; and "methodological study" which contains activities recommended by 'how to study' manuals.

Meanwhile, in Australia, Biggs, using a similar self report inventory which he had developed, the Study Process Questionnaire (Biggs, 1976), once again identified comparable learner characteristics. In his early work Biggs (1978) isolated two learning styles which he called "utilizing" and "internalizing". He felt that those two dimensions so closely related the deep and surface approaches described by Marton and Saljo (1976) that he adopted the terminology of the Gothenburg group. Biggs's identification of the similarities of dimensions rested on three characteristics: 1) the dynamic of each was on the strategies a) of coding for meaning, and b) of rehearsing for accurate reproduction; 2) each strategy was related to a motivational or intentional component; and 3) the motive-strategy combination was to be interpreted within an academic context (Biggs, 1993, p. 5).

Biggs (1976) hypothesized that individual learning styles are determined by both the student's motives and their accompanying strategies. These two process factors combine to produce the student's approach to learning: a surface approach involves reproduction through the use of rote strategies; a deep approach is characterized by a focus on the meaning of the content, and involves the student in

reading widely and attempting to relate new information to relevant prior knowledge. To these two basic orientations Biggs added a third: achieving. Achieving strategies involve organizing time and space to promote performance in assessment. Biggs points out that while Deep and Surface approaches describe ways in which students engage the actual task itself, the Achieving Approach describes ways in which students organize the temporal and spatial contexts in which the task is carried out. It is therefore possible for students to combine an Achieving Approach with either a Surface or a Deep Approach.

Similarities among the theoretical dimensions. While each of the researchers cited above has identified slightly different concepts of learning style, it is possible to group the characteristics they have isolated into common dimensions. In some cases inclusion in the groupings is based on the strategy used in the service of the learning style, in others, on the motive involved in the style; wh:le still other dimensions are based on both a strategy and motive combination. At one end of the continuum would be Ausubel's meaningful learning, Marton and Biggs's deep approach, Pask's holist learner, Svensson's holistic learner, Entwistle's meaningful dimension, and Schmeck's deep and elaborative processing. At the other end of the continuum would be Ausubel's rote learning, Marton and Biggs's surface approach, Pask's serialist, Svensson's atomistic learner,

Entwistle's reproducing orientation, and Schmeck's fact re-
tention dimension.

To summarize the characteristics of individuals adopt-
ing the approaches identified above, Biggs and Rihn (1984)
have said: "In sum, it would be generally agreed that a stu-
dent who adopts a deep approach: is interested in the aca-
demic task and derives enjoyment from carrying it out;
searches for the meaning inherent in the task (e.g. if a
prose passage, the intention of the author); personalizes
the task, making it meaningful to his or her own experience
and to the real world; integrates aspects or parts of the
task into a whole (e.g. relates evidence to a conclusion),
and sees relationships between this whole and previous
knowledge; and tries to theorize about the task and forms
hypothesis. A student who adopts a surface approach: sees
the task as a demand to be met, a necessary imposition if he
or she is to reach some other goal (e.g. a qualification);
sees the aspects or parts of the task as discrete and unre-
lated either to each other or to other tasks; is worried
about the time the task is taking; avoids personal or other
meanings the task may have; and relies on memorization, at-
tempting to reproduce the surface aspects of the task (e.g.
the words used, a diagram, or a mnemonic)" (p. 281).

Discrepancies among the theoretical dimensions. One of
the issues yet to be resolved is the extent to which de-
scriptions of learning style should favor mutually exclusive

(bipolar) or combinatorial (e.g. orthogonal) categories (Thomas and Bain, 1984; Watkins, 1983 a). It is not coincidental that the degree to which the various researchers view these characteristics as being dichotomies, or existing along a continuum is to a great extent dependent on their methodological approach. In general the researchers employing a phenomenological approach have viewed learning styles as discrete entities which the individual might or might not choose to use, but which are not scaled in any manner. This view of a particular cognitive dimension should not be surprizing as the notion of quantifying a characteristic is antithetical to the qualitative approach. The quantitative researchers, on the other hand, have tended to view learning styles as a continuum along which individuals could be placed.

Another aspect of learning style about which many theoreticians disagree is the extent to which it is a permanent characteristic of the individual, and how it is affected by the environment and task demands. Once again, the adoption of a particular stance on the issue seems to be dictated by a methodological approach.

Researchers who use a phenomenological approach (Pask, 1976; Marton and Saljo, 1976;) generally focus on the learning task as being critical in defining the learning approach students will adopt. In fact they have indicated that the approach an individual adopts may be influenced by instructions from the experimenter or instructor as well as by stu-

dents' perceptions of task requirements. Ramsden (1988) demonstrated that students switch their learning tactics to suit their perceptions of course demands. In studying 31 science students, Laurillard (1979) discovered that 19 of them demonstrated both surface and deep approaches to learning. She concluded that the two approaches simply represent different tactics that may be called upon in response to the perceived demands of the specific learning task. Richardson (1983) concludes that there is some flexibility in students' approaches to learning, but that there are some restrictions upon that flexibility in the case of at least some learners.

Quantitative researchers (Entwistle and Ramsden, 1983; Schmeck, 1991; Biggs, 1987) suggest that the learning approach students assume is fairly constant across differing tasks. They argue that individual predispositions play a major role in determining the approach that will be adopted.

It should be noted that while researchers disagree about the extent to which the environment or task demands may cause individuals to modify their learning style, little work has been done to identify what environmental or individual characteristics may predispose the learner to adopt a flexible or versatile style.

Analysis of the Empirical Surface/Deep Literature

Methods and measures. The various theoretical approaches reviewed above arise from, and are based on, the

use of very different research methodologies and measurement devices. According to Messick (1994):

> The literature of cognitive and learning styles is pep-
> pered with unstable and inconsistent findings, whereas
> style theory seems either vague in glossing over
> inconsistencies or confused in stressing differentiated
> features selectively. A major source of this concep-
> tual messiness is that different investigators use dif-
> ferent measures to represent the same style constructs,
> use similar measures to represent different constructs,
> or use partial indicators to represent a complex style
> that requires contrasted measurement (p. 131).

As this quotation suggests, the selection of methods and measures used in studying learning style varies depend-ing on the researcher, and often contributes to the incon-sistent research findings evident in this domain. The qual-itative methods are appealing and valuable in that they pre-sent a wealth of information about the individual. However, there are drawbacks to employing that methodology because it usually deals with small sample sizes due to the labor in-tensive nature of individual interviews, relies on subjec-tive interpretation of the information obtained, and does not lend itself to certain types of statistical analysis.

The more quantitative methods, on the other hand, offer the opportunity to test large groups, are more easily stan-dardized, and yield easily empirically verifiable results. However, they have the disadvantage of relying on subject's

self report data in a domain in which many researchers ques-
tion an individual's ability to accurately report. Thomas
and Bain (1984) claim that "it has commonly been assumed
that questionnaires are more suited to the measurement of
learning styles, whereas interviews enable the contextual
variability of learning to be detected" (p. 228). They do
add the caveat that "it is not the method of observation but
the opportunity for within-subject comparison that is cru-
cial to this issue" (p. 228).

If a researcher elects to use a quantitative paradigm
for researching learning styles, there is still the matter
of selecting the appropriate instrument. Curry (1990) indi-
cates that there are over 100 learning style instruments.
Since many of these tests do not have published reliability
or validity information, may be designed for special popula-
tions, such as disabled individuals or specific age groups,
or are cumbersome to administer and interpret, the actual
number of tests to choose from when studying a particular
group of subjects is dramatically reduced.

At the present time there are three inventories that
appear to have a great deal of overlap in the dimensions
they measure, and have also been shown to closely parallel
the findings from the qualitative methods. The Approaches to
Studying Inventory (Entwistle and Ramsden, 1983), the Inven-
tory of Learning Processes (Schmeck, Ribich and Ramanaiah,
1977), and the Study Process Questionnaire (Biggs, 1987) are
designed to measure the depth of processing students' engage

in. The results from these inventories have been shown to closely parallel the surface and deep dimensions that Marton and Saljo (1976) identified using a phenomonological approach (Entwistle and Waterston, 1988).

Based on the dimensions measured, the reliability and validity data (Biggs, 1987) (which are presented along with a description of the test itself in the methods section of this report), the underlying theoretical basis (Biggs, 1987), and the availability of a measure of learning outcome designed by the same author, Biggs's Study Process Questionnaire (Biggs, 1978) was selected for use in the current research project.

Study Process Questionnaire (SPQ). The Study Process Questionnaire (SPQ) (Biggs, 1987) measures three learning style dimensions that Biggs believes offer a parsimonious and theoretically coherent model for conceptualizing the more important ways in which students feel about, and behave towards, their studies.

This instrument consists of a 42 item, self-report questionnaire that yields scores on three basic motives for learning, three learning strategies, and three scores on approaches to learning that are formed by combining the motive and strategy scores. Development of this measure began in the mid 1970s. Since that time it has been administered to thousands of Australian College and University students in order to establish detailed norms for various populations

(Biggs, 1987). The instrument has also undergone rigorous examination by Biggs (1976, 1978, 1985, 1987) and others (Hattie and Watkins, 1981; O'Neil and Child, 1984; Christensen, Massey and Isaacs, 1991; Beckwith, 1991) to determine and validate its factor structure.

The SPQ measures three learning strategies: 1) surface (to limit target to bare essentials and reproduce them through rote learning); 2) deep (to discover meaning by reading widely, inter-relating with previous relevant knowledge); and 3) achieving (to organize one's time and working space; to follow up all suggested readings, schedule time, behave as a 'model student'). It also identified three motives in the student's approach to learning: 1) surface (to meet requirements minimally, a balancing act between failing and working more than is necessary); 2) deep (intrinsic interest in what is being learned, develops competence in particular academic subject); and 3) achieving (to enhance ego and self-esteem through competition, to obtain highest grades, whether or not material is interesting). The student's "approach" to learning is a composite of a motive and a strategy.

It should be noted that these dimensions are potentially orthogonal. A student receives a score between seven and 35 in each category, so could conceivably be high in both Deep and Surface dimensions. It is also not unusual to find students who receive high scores in Deep (or Surface) and Achievement approaches for as Biggs (1985) points out

"Deep and Surface Approaches are different in kind from the Achieving Approach. The strategies involved in the first two describe ways in which students engage the actual content of the task, while the Achieving Strategy describes the ways in which students organize the temporal and spatial contexts in which the task is carried out. There is no inconsistency in rote learning in a highly organized way (Surface-Achieving) or reading for meaning in an organized way (Deep-Achieving)" (p. 187).

Factor structure of the SPQ. Early work with the SPQ (Biggs, 1976) revealed ten distinct factors. While Biggs (1978) believed that each factor had its own justification, both theoretically and empirically, he felt that for practical use the scales were too diverse and administration time was too long. As a result, the ten factors have been considered as sub-scales and organized into the current six factors.

Research into the psychometric properties of the SPQ has produced mixed results. Hattie and Watkins (1981), using Australian and Filipino students, confirmed the internal consistency coefficients and factor structure that Biggs had indicated (1978) for the Australian students, but not for the Filipino students. A study of British higher education students (O'Neil and Child, 1984) confirmed the factor structure proposed by Biggs (1978) for the Deep and Achieving Approaches, but not for the Surface Approach. Using students in their first year of tertiary studies, Beckwith

(1991) again examined the factor structure and internal consistency of the SPQ. He reports alpha coefficients ranging from 0.43 for Surface Strategy to 0.72 for Achieving Motive. He points out that there are some negatively inter-relating items in the Achieving Strategy, and suggests that most scales are carrying items which "while they may be contributing conceptually, are not pulling their weight psychometrically" (p. 24). Beckwith also identified an overlap in the measures of Deep and Achieving Approach. Also using Australian tertiary students, Christensen, Massey and Isaacs (1991) conducted a study designed to explore the factor structure of the SPQ. Their results indicate that "the internal coherence of the Surface Strategy subscale, in particular, was unsatisfactory" (p. 290). They also concluded that "there was considerable overlap on the Deep Motive, Achieving Motive and Achieving Strategies subscales" (p. 294). This latter finding is actually not surprising given the difference between the Deep/Surface and Achieving Approach as outlined above.

Biggs (1987) reports several different profiles that emerge from principal component analysis with Varimax rotation based on different subject groups. For example, he compared the factor structure for four samples and discovered consistent differences between secondary and tertiary samples. The two groups of secondary subjects (age 11 and 14) displayed only two factors: a combination of Surface Motive and Strategy comprised one factor while the other fac-

tor was made up of the Deep and Achieving Motives and Strategies. With both tertiary groups (College of Advanced Education and University students) a similar factor structure is evident with the difference that the Achieving Motive divides evenly between the two factors.

In a similar study Biggs (1985) investigated the factor structure of a parallel instrument (the Learning Process Questionnaire) to the SPQ, using 14 year olds representing four different ability grouping patterns. These groupings were based on reasoning ability (low and high), and memory ability (low and high), creating four distinct cognitive patterns. According to the results from that research "subjects having low reasoning and low memory skills did not make any discriminations at all, either between motive and motive, or even between motive and strategy; the learning process complex must seem opaque and meaningless to them. The low reasoning/high memory group made clear discriminations, putting motive with strategy to form a two-dimensional learning process complex: they ally the Surface Approach with the Achieving Approach to form a composite Surface-Achieving, as might be expected of a group biased towards memory over reasoning. The high reasoning/low memory group do the opposite. They, too, perceive a two-dimensional space, but associate getting-on (achieving) with the Deep Approach, as befits their bias toward reasoning. The students high on both abilities perceive all three dimensions, basically in line with the 'logical' model" (p. 192).

Thus from the research into the factor structure of the SPQ it appears that two clear distinctions emerge. Biggs (1987) reports that "in both secondary and tertiary populations it is possible to characterize students in terms of two dimensions only if desired: a Surface Approach and a Deep/Achieving Approach" (p. 18).

As noted earlier, Biggs (1987) provides extensive normative data to facilitate interpretation of the SPQ scores. These data represent twelve different groups of Australian University and CAE students: male and female groups from the Arts, Education and Science. As the SPQ has also been used with British University students (O'Neil and Child, 1984), and American students at Stanford University (Biggs and Rihn, 1984) it is possible to identify several diverse groups to serve as comparison groups.

In addition to the work on the factor structure and internal consistency of the SPQ, and the normative data, Biggs (1987) also provides documentation for the reliability and validity of the measure. These data will be presented with a description of the measures to be used in the present research project.

Theoretical and Empirical Relationships Between Learning Styles and Performance

Theoretical relationship between learning styles and performance. Using the depth of processing dimension of learning styles, a number of researchers have proposed a re-

lationship between levels of processing and learning out-
come. Saljo (1981) suggested that "the main consequence of
difference in approach may perhaps not be found in how much
people learn in a quantitative sense, but rather in what
kind of information is focused on and learned" (p. 47).

Taking a more quantitative approach Biggs (1985) claims
that "the three approaches (Surface, Deep and Achieving) are
likely to lead to different qualities in the learning out-
come; Surface leads to retention of factual detail and deep
to structurally complex and affectively satisfying outcomes"
(p. 187). He goes on to say "it seems that one may set up a
hierarchy of approaches to learning on the basis of their
relationship (at least) with complexity of outcome. Deep
would be highest, leading to the most complex outcomes; Sur-
face, the least personally involving and leading to low
structure-high factual outcomes, and Achieving in between
these two, but nearer to Deep" (p. 191).

Schmeck (1988) has developed an even more specific
model of learning that represents the relationship between
individual characteristics and performance. He views learn-
ing style as "lying between personality and learning strat-
egy on the causal continuum that leads to a learning out-
come" (p. 175). His model of learning style lists three di-
mensions of learning style: deep, elaborative, and shallow.
He claims that the outcome of someone with a deep learning
style (i.e. concerned with the development of concepts;
whose time is spent constructing abstractions and organizing

them to form hierarchies and theories) tends to be at the analysis, synthesis and evaluation levels in Bloom's (1956) Taxonomy. An individual with an elaborative learning style prefers a personalizing strategy which leads to an outcome that is more related to Bloom's levels of adaptation and application. Using predominantly memorizing learning strategies, an individual with a shallow learning style is most likely to demonstrate Bloom's knowledge level in learning outcome.

While these individuals have proposed theoretical models to represent the relationship between learning style, specifically levels of processing, and learning outcome, there have also been numerous empirical studies that have looked at these same dimensions. Unfortunately, these studies have produced very conflicting results.

Empirical relationship between learning style and performance. Biggs and Rihn (1984) make the relationship between learning style and performance seem to be very clear cut when they state that "a deep strategy, based on wide reading, relating new knowledge to what is already known, etc. results in better learning, whether better is defined as complexity of outcome, satisfaction with performance, self-rated performance in comparison with peers, or examination results" (p. 283). In fact the relationship is not all that clear, and many of the research findings are highly contradictory. Perhaps a large part of the discrepancy in

the empirical results stems from the fact that a wide variety of measures and methods are employed in the research in this area.

Ramsden and Entwistle (1981) warn about the circularity involved in comparing two sets of self ratings, as in the comparison of the results of self report inventories and student opinions of achievement. This caution makes the results from that body of literature suspect at the outset and therefore it will not be included in this review.

Perhaps the most consistently positive results for the relationship between approach to study and learning outcome has been produced by the Gothenburg school (Marton and Saljo, 1976 a, b; Saljo, 1981; Gibbs, Morgan and Taylor, 1982). However, Saljo (1981) points out that "the main consequence of differences in approach may not be found in how much people learn in a quantitative sense, but rather in what kind of information is focussed on and learned" (p. 47).

The distinction between focusing on the quantity of what an individual learns, especially as measured by a course grade, and the quality of the material learned may help to explain some of the differences in the research findings. Studies that have used course grade or grade point average as their learning measures, have failed to demonstrate any relationship between learning performance and learning approach (Watkins, 1983 b; Beckwith, 1991; Trigwell and Prosser, 1991). While it would be comforting

if this distinction explained all the inconsistencies in the research results, it does not.

Researchers studying the quality of the learning outcome have also produced mixed results. In one of the seminal papers in the area, Biggs (1979) demonstrated marginally higher levels of learning performance, as measured by his Structure of the Observed Learning Outcome (SOLO) for students adopting a Deep Approach (as determined by the SPQ). However, it should be noted that part of the experimental manipulations included instructions to the groups of subjects either to read for: a) the purpose, or b) facts and details, of the articles they would subsequently be tested on. It is probably not surprizing that the highest (SOLO) levels were associated with the instructions to study for meaning rather than with instructions to study for rote fact retention.

Kirby and Biggs (1981) used the Learning Process Questionnaire (a version of the SPQ designed for secondary students) and SOLO measures of poems and creative writings of secondary students to generate more empirical support for their hypothesized relationship between approach to learning and quality of learning outcome. Their results revealed that a Deep Approach was clearly implicated in complex responding, while a Surface Approach correlated with low complexity of responses.

In a later study, also using SOLO to measure the learning outcome, but this time using the Inventory of Learning

Process (ILP) to measure learning style, Schmeck and Phillips (1982) once again demonstrated a positive relationship between a deep approach and performance.

Using a third similar learning style measure, the Approaches to Study Inventory, and SOLO analysis of student responses to questions asking what their course was about, Trigwell and Prosser (1991) "confirmed the hypothesized relationship between approach and outcome at the course level" (p. 265). However, they were unable to confirm the relationship when course grade was used as the learning criterion.

In a recent study using the SPQ and a different measure of quality of learning developed by Weinstein and Mayer (1986), Christensen, Massey and Isaacs (1991) "found no relationship between student's surface, deep and achieving strategy scores on the SPQ and their performance on basic and complex tasks" (p. 290).

Thus, to date the research dealing with the relationship between learning style as measured by the SPQ and performance remains inconclusive. It seems likely that the methods and materials employed may contribute to the varying results. There appears to be less controversy over how to identify the learning style (whether it be via interview, or self-report measure), than on how to define and measure learning performance. While quantitative measures such as course grades do not seem to relate to the individual's learning style, there still appear to be questions concern-

ing the nature of the results obtained by using various qualitative measures.

A number of studies using the qualitative measures of learning outcome have used the interview techniques developed by the Gothenburg group (Gibbs, Morgan and Taylor, 1982). However, this technique is very subjective, and extremely time intensive to administer and interpret. Researchers have been trying to develop more easily administered, objective measures of the quality of learning performance. One such approach that appears to offer an alternative method of assessing students' performance is the Structure of the Observed Learning Outcome (SOLO) (Biggs, 1978).

Structure of the Observed Learning Outcome (SOLO). In an attempt to develop a measure of the quality of learning, Biggs (1978) devised a taxonomy which he felt "coincided with a generalized version of Marton's notion of levels and seemed to provide a means of measuring learning quality" (Biggs, 1979, p. 384). This Structure of the Observed Learning Outcome (SOLO) has been embraced by Watkins (1983 a) as "a significant advance in qualitative evaluation which seems to minimize the problem of subjectivity" (p. 51). He proceeds to state that "this taxonomy resembles a generalized (and standardized) version of Marton's levels of outcome" (p. 51). Others (Schmeck and Phillips, 1982) also agree that "the SOLO taxonomy appears to be a reliable and valid method of assessing levels of processing as dimensions

upon which individuals differ. The technique bases its assessment of the depth to which the students process information upon the quality of their answers to the essay question (the learning outcome). In this sense, Biggs's procedure is similar to the interview method used by Marton, but it is more standardized and thus could be used with larger groups of subjects" (p. 96).

The SOLO taxonomy has also been compared to the Bloom taxonomy (Biggs, 1979; Biggs and Collis, 1982). "While the Bloom taxonomy (Bloom et al, 1956) is probably the best known systematic attempt to provide a structure for assessing levels of learning quality, it is generally used to set questions and items, not to evaluate open-ended responses to existing questions and item types. Thus, the SOLO taxonomy remains the only instrument available for assessing quality retrospectively in an objective and systematic way that is also easily understood by both teacher and student" (Biggs and Collis, 1982, p. xi).

To summarize the current status of the relationship between learning style and performance, Watkins' (1983 b) statement is still very appropriate: "another question still to be satisfactorily answered is the relationship between approach to learning and the quality of learning outcomes as represented by the students' understanding of their course material. Biggs's (1979) SOLO taxonomy seems to hold promise as a research tool in this regard" (p. 36).

Administration and interpretation of SOLO. The Structure of the Observed Learning Outcome (SOLO) Taxonomy (Biggs and Collis, 1982) is designed to qualitatively evaluate the learning of college students. SOLO provides criteria for determining five increasingly complex levels of outcome in discourse structure, and the four transitional stages between these primary levels. The five primary levels, in order of increasing complexity are: 1) Prestructural; 2) Unistructural; 3) Multistructural; 4) Relational; and 5) Extended abstract (see the section on "Instruments and Materials" for a complete description of the five primary and four transitional levels).

Biggs (Biggs and Collis, 1982) indicates that he believes that SOLO levels represent depth of coding, in that the higher levels involve successively higher order structure of the content, while the length of the SOLO response should correspond to the spread of coding. He states that "the different levels of SOLO are cumulative: each one adds something to the previous one. A unistructural response is a prestructural response *plus* a logical link between cue and response; a multistructural response is a unistructural response *plus* at least one other relevant aspect; a relational response is a multistructural one *plus an* overriding linking concept; an extended abstract response is a relational *plus* a superordinate logical principle. In other words, in reaching a particular level, all preceding levels are implied" (p. 173).

The SOLO taxonomy is an attempt not only to develop an objective measure of essay answers and to standardize that measure, but also to make the results quantifiable so that they may be used in various forms of statistical analyses. SOLO provides a measure of the quality of assimilation of information in terms of progressive structural complexity. Biggs (Biggs and Collis, 1982) went so far as to indicate that "there are obvious differences in quality *within* levels. It would of course be possible to introduce a double categorizing system, as we have in part done with the introduction of transitional responses as categorizing them as '.5' of a stage. That is, if prestructural is quantified as 1, then prestructural transitional is a 1.5; unistructural is 2 and unistructural transitional is 2.5, and so on. It is a short step from here to classify a 'good' multistructural as a 3.8, a poor one as a 3.1 or 3.0. For any given task, it would not be difficult to specify the range of responses from 3.0 to 3.9 within the multistructural range" (p. 204).

Other Factors Influencing Learning Outcome

Importance of other factors. As demonstrated above, levels of depth of processing and their influence on learning performance have received a substantial amount of research attention. Christensen, Massey and Isaacs (1991) state that "although these different perspectives have not been resolved, they have been subjected to a great deal of

debate. However, other areas of diversity between perspectives have not been subjected to as much scrutiny. Each of the learning approaches appears to draw from a variety of domains including behaviour related to studying, motivation and cognitive processes, but little work has been conducted regarding the relative impact of these domains on students' performance" (p. 291).

There is a great deal of research being conducted on individual differences and their impact on student performance. Investigators have studied the impact of such individual differences as: learning tactics (Goetz and Palmer, 1991; Lorch, Lorch and Klusewitz, 1993); the importance of prior domain knowledge (Hall and Edmondson, 1992; Royer, Cisero and Carlo, 1993); attention (Reynolds and Shirley, 1988); interest (Hidi, 1990); motivation (Ainley, 1993); metacognition (Van Zile-Tamsen, 1993); and locus of control (Wilhite, 1990).

While a survey of the existing research can provide a systematic examination into the individual variables that might influence students' academic performance, there has been no attempt to approach the issue in a systemic manner. The importance of each predictor variable has been documented, but there is no empirical evidence of how these variables might interrelate, nor of what role each variable plays when it is placed in the context of the whole student and their environment.

In one of the rare empirical studies of the interrelated effects of multiple predictor variables on performance, Biggs (1985) examined the roles of locus of control, strategy and motive congruence, and metacognition on the quality of learning. These variables were selected specifically to test his theoretical model of learning and his claims that: 1) individuals are predisposed by their personality to adopt one approach (surface, deep or achieving) in preference to another; 2) the three approaches are likely to lead to different qualities in the learning outcome 3) optimal results are likely when the strategy used is congruent with the student's prevailing motivational state; and 4) the notion of motive-strategy congruence implies that a student is able to enter into a higher metacognitive state which would be of direct relevance to the study of the student's study processes.

Locus of Control. One personality dimension that has been actively studied in relation to student's learning style and academic performance, is locus of control (Findley and Cooper, 1983). This dimension refers to "an individual's feelings about the placement of control over his or her life events, who is responsible for those events. Locus of control describes an individual's belief regarding the causes of his or her experiences (causal attributions), those factors to which an individual attributes his or her

successes and failures" (Jonassen and Grabowski, 1993, p 351).

Watkins (1984) indicates that if students perceive that they have control over their own learning, they are more likely to use information processing approaches in which they focus on the content as a whole, try to see connections between the parts, and actively think about the structure of the information. Perceived lack of control is most likely to lead to the view of learning as a memory task.

Biggs (1985) demonstrates that, when related to scores obtained from his SPQ measure, internal locus of control consistently correlates positively with Deep scores and negatively with Surface scores. He believes that internal locus of control is implicated in the development of Deep and Achieving approaches to learning. Biggs goes on to point out that a student with an internal locus of control will use a Deep approach more effectively than a student with an external locus of control. A Deep approach works more effectively with internally controlled students independently of ability. However, it does not work at all with low ability externals.

In studies dealing with the relationship between locus of control and quantitative measures of performance, Kletzing (1982) and Wilhite (1990) also report that an internal locus of control is a reliable predictor of superior academic performance.

Metacognition. While the concept of metacognition, or "knowing about knowing" (Garner and Alexander, 1989, p. 143), is not new, empirical studies into the effects of, and relationship to, this concept have dramatically increased in the past five years. Flavell (1976) was one of the first researchers to study metacognition, and defines it as "one's knowledge concerning one's own cognitive processes and products and the active monitoring and consequential regulation of those processes in relation to the cognitive objects or data on which they bear" (p. 232). Van Zile-Tamsen (1993) extends the definition to include:

> The planfulness with which students approach their own learning; knowledge about particular tasks; knowledge about how people learn and process information; knowledge about particular tactics; the ability to predict task difficulty and learning outcomes; the ability to plan one's own learning; and the ability to evaluate the results of each of these steps (p. 2).

An individual may be strong in one of these attributes without necessarily being strong in the others. For example, an individual may have good planning skills, but not have good access to their memory stores; or they may be able to analyze a situation, but not apply the strategy necessary to perform optimally in that situation.

Theoretical views of metacognition propose that this is not a unitary construct, but rather represents a group of abilities. Early work by Kirby (1984) indicates that there

is little evidence for a unitary planning construct. His initial research uncovered 12 variables which were entered into a principal components analysis to yield four factors with eigenvalues greater than 1.0. Four factors also emerged after Varimax rotation, of which factor four is defined mainly by the four metacognition variables of external, internal, other and purpose. Kirby indicates that there is a moderate loading for Verbal Fluency upon this factor which is likely due to the requirement in metacognition performance for the searching of long-term memory for possible solutions. Borkowski and Turner (1991) also propose that metacognition is not a unitary construct, but is comprised of a number of interactive and mutually dependent components. They identify four major components of metacognition: 1) specific strategy knowledge; 2) relational strategy knowledge; 3) general strategy knowledge; and 4) metacognitive acquisition procedures.

In studying the relationship between metacognition and performance Biggs (1987) indicates that increasing degrees of metacognition lead to deeper performance outcomes, specifically "complex structure, high commitment and personal rather than institutional involvement" (p. 6). He had earlier (Biggs, 1985) stated that "metacognition is most likely to be involved with the Deep approach, it is more usually the case that the Surface approach is deployed inappropriately, not as the result of a metacognitive decision, but out of habit or despair" (p. 202).

Applying the elements of metacognition, Mitchell (1993) proposes a cybernetic model of the learner whose central component is the learner as an active agent or control system attempting to attain goals in specific situations, and being aware of one or more meta-strategies suitable for goal-attainment. This model of the learner is very consistent with the notion that the effective learner is highly metacognitive and needs to engage in a number of steps either consciously or unconsciously to reach the desired goal.

Methods of studying metacognition. One of the major problems facing researchers interested in studying metacognition and its relationship to other constructs is the difficulty of measuring metacognition. Richardson (1983) outlines three ways to study metacognition: 1) the outcome of learning can be studied by careful analysis of recall protocols; 2) the process of learning can be studied by means of introspective (or, rather, retrospective) interviews; and 3) the relationship between process and outcome can be compared across individual subjects.

Garner's (1988) review of the methods currently in use to assess metacognitive processes reveal that two of the most commonly used methods are interviews and think-aloud procedures. Both methods suffer from some common problems: 1) a basic concern over the accessibility of cognitive and metacognitive processes for introspective analysis; 2) a concern over the verbal facility of the subject; 3) the fact

that sometimes learners report using cognitive and metacog-
nitive strategies they do not demonstrate using; 4) the
problem of cueing offered by instructions and probes; and 5)
the fact that very few researchers examine the stability of
responses over time. Interview methods suffer from two ad-
ditional problems: 1) there is a large processing-reporting
distance; and 2) they often elicit responses to hypothetical
situations that are difficult for subjects to interpret. On
the other hand, think aloud methods suffer from a possible
disruption of the cognitive and metacognitive processes they
are designed to investigate.

In addition to these subjective measures of metacogni-
tion, there have recently been attempts to develop more ob-
jective measures, such as the Motivated Strategies for
Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia and
Mckeachie, 1991). The MSLQ is an 81 item, self-report ques-
tionnaire which uses a Likert scale. Another self-report
inventory is the 18-item forced-choice Metacognitive Ques-
tionnaire (in Howard-Rose and Winne, 1993). As with the
subjective measures, the issue of the extent to which indi-
viduals can actually be consciously aware of, and accurately
report on, their cognitive processes, has been raised in
questioning the validity of self-report measures (Kellog,
1982; Nisbett and Wilson, 1977). In addition, questionnaire
measures are subject to the standard problems of social de-
sirability in subject responses as well as general reliabil-
ity and validity issues.

In a response to the problems in measurement raised above, Tobias (1991) has developed a more objective method of measuring students' metacognitive abilities. The Metacognitive Assessment Measure (Tobias, Everson, Hartman and Gourgey, 1991) focuses on the idea that one example of metacognitive performance includes an awareness of what one knows and does not know (Royer, Cisero and Carlo, 1993). In this test, students are asked to indicate their knowledge, or lack thereof, of a list of vocabulary words; next they are tested for actual knowledge of those words; subsequently they are presented with an opportunity to master those vocabulary words by studying a passage of text; and finally they are retested for perceived and actual knowledge of the words (a complete description of the test and scoring methods is presented in the materials section). Using Tobias's measure of metacognition one is able to gain an indication of the subject's metacognitive skills while avoiding the problems inherent in the interview, talk-aloud, or self-report measures.

Importance of congruence of motive and strategy. Biggs (1985) proposed that students with a particular motivational predisposition tend to adopt a corresponding, linked strategy. He proceeds to expand on the importance of this congruence by saying "optimal results are likely when the strategy used is congruent with the student's prevailing motivational state: that, for example a Deep Strategy works

most effectively when the student has Deep motivation" (P. 187). This is in contrast to Watkins (1982) view that the congruence scores were not necessarily the significant issue. He felt that it was more important to determine how a strategy related to performance independently of the motive in which it was imbedded.

With regard to the congruence issue, Biggs (1985) indicates that:

> The question of motive-strategy congruence raises two issues: the extent to which students who endorse a particular motive tend also to endorse the cognate strategy; and the extent to which congruent motive-strategy combinations are more effective than non-congruent ones. The first, weaker, aspect of congruence is easily settled. The correlation between any motive and its cognate strategy is considerably higher than that motive and any other strategy (p. 198).

The actual relationship between strategy and motive has been upheld in the research literature (O'Neil and Child, 1984; Beckwith, 1991). However, the second consideration: the relationship between the congruence and actual performance has received little empirical attention.

Summary

This review of the literature reveals that there has been increasing activity over the past twenty five years in studying learning styles and their impact on students' per-

formance. This connection has been of interest to numerous researchers for both theoretical and applied reasons. An understanding of the relationship between individual characteristics and the resulting performance will have an impact on curriculum design, counselling of students, and building a model of the learner. However, before any of these goals can be realized, there are a number of questions that need to be resolved.

Research into learning styles has advanced along two distinct methodological lines: quantitative and qualitative. Individuals adopting both methods of inquiry have consistently identified the same basic approaches to learning used by students. While there are some differences in the terms and distinctions of this deep versus surface approach, there is generally a great deal of consensus concerning the characteristics that comprise this dimension.

Despite the fact that the theoretical proposals for the relationship between learning styles and performance outcome have been consistent, the empirical research dealing with that relationship has produced inconclusive and even contradictory results. This inconsistency in results has caused researchers to probe deeper into the nature of the specific measures used to determine the predictor and outcome variables. It has also led to the realization that it is probably not a simple cause and effect relationship, but rather one that is mediated by a number of other variables such as personality traits, metacognition, motivation, interest or

prior knowledge. This realization has led to the current investigation of the relationship of multiple variables in an attempt to predict students' performance.

The Present Study

The goal of the present study will be to add to the empirical literature concerning the impact of individual characteristics on learning outcome. In order to ensure a consistent theoretical and research orientation Biggs's model will be adopted. His hypothesized relationship among learning style, locus of control, metacognition, and congruence between strategy and motive, and their influence on performance outcome will be investigated. To assure agreement between predictive and outcome measures Biggs's SPQ will be used to assess learning style, and his SOLO taxonomy will be used to evaluate learning outcome.

In addition, the present study will allow for investigation into the factor structure and normative data of the SPQ using a traditional group of research subjects from the United States (i.e. volunteer, undergraduate students from a large state university).

A portion of the present study is designed as a partial replication of Biggs's (1985) work. The individual characteristics of locus of control, metacognition and approach to learning will be measured to determine whether or not the relationships Biggs reported are consistent across diverse samples.

A reading comprehension measure has been included in the present study to further explore the relationship between that ability and learning style and metacognition. Schmeck and Phillips (1982) and Kirby (1984) suggested that as most measures of both learning style and metacognition are heavily dependent on the subjects' ability to process text, they may actually be measuring the subjects' reading comprehension skills and not the cognitive abilities they purport to measure. In order to explore this possibility the test of reading comprehension has been included to ensure that the cognitive tests used in the present research are measuring abilities independent of reading skills.

In an attempt to introduce an easily administered and objectively scored design which can be conveniently replicated by future researchers, two new measures have been included in the present study. A new, and objectively scored method for measuring metacognition (Tobias's Metacognitive Assessment Measure) has been used instead of the previously used analysis of talk aloud procedures. Tobias's measure has the advantages of ease of administration in a group setting, computer analysis of responses, and generation of data suitable for analysis using parametric statistics. Coupled with these procedural advantages is the fact that it clearly measures one of the key components of metacognition: the individuals access to their own knowledge.

In addition, an objectively scored measure of learning outcome (the Test of Cognitive Performance), based on

Bloom's taxonomy of educational objectives (Bloom, Engehart, Furst, Hill and Krathwohl, 1956), has been developed for use in the present research. The results of this new measure will be compared with the results from Biggs's measure of the Structure of the Observed Learning Outcome (SOLO) (Biggs and Collis, 1982) to determine whether or not the two tests are measuring the same abilities. If the two tests do generate similar data the new measure, based on Bloom's work, may provide an expedient means of measuring the depth of subject's cognitive performance on learning outcomes. If the two measures do not generate similar data it may be due to the difference in task characteristics inherent in the two tests.

Thus, the present study is primarily designed to empirically test Biggs's theoretical model of the relationship between: learner characteristics such as locus of control, metacognition, and approach to learning, learning outcome, and the subject's reaction to differences in the nature of the task demands (i.e. open ended questions versus multiple choice formats). The present research also sets the goal of attempting to collect confirmatory data to corroborate previous research findings. At the same time it will explore more objectively evaluated instruments for measuring cognitive abilities and performance.

Research Hypotheses

As a result of the literature just reviewed, the following research hypotheses were generated for investigation in the present study. They are presented below, and are followed by the theoretical and operational definitions of relevant terms.

Hypothesis 1) There is a relationship among the predictor variables of Locus of Control, Learning Style and metacognition. Specifically, subjects demonstrating an Internal Locus of Control will have either a Deep or Achievement Approach and a high level of metacognition. Those subjects demonstrating External Locus of Control will show a Surface Approach and will have a low level of metacognition.

Hypothesis 2) There is a relationship between the predictor variables identified in hypothesis #1 and the criterion measures of cognitive performance and structural complexity. These criterion measures represent the quality of learning outcome. Subjects demonstrating an Internal Locus of Control, a Deep Approach and high metacognition, will demonstrate deeper levels of cognitive performance and greater structural complexity than will subjects displaying different profiles.

Hypothesis 3) There will be a difference in performance on the criterion measures based on the congruence between the subject's indicated motive and strategy. Specifically, subjects with congruent Deep Motive and Deep Strategy will

demonstrate the highest structural complexity and deepest cognitive performance in their responses.

Hypothesis 4) Subjects with incongruent Deep Motive and Deep Strategies will demonstrate a difference in level of performance based on the nature of the task - i.e. subjects with Deep Strategies, but not Deep Motives will perform at a deep level on the Test of Cognitive Performance based on Bloom's taxonomy (i.e. when forced to by being faced with multiple choice options), but not on the SOLO measure (i.e. when faced with open ended essay questions which allow for deep or surface responses). Subjects with incongruent scores such that Deep Motive is higher than Deep Strategy will not demonstrate deep performance on either the Test of Cognitive Performance, or the SOLO measures.

Theoretical Definitions

Locus of Control refers to the perceived relationship between one's actions and the outcomes in one's life. It indicates the degree to which individuals believe that con- sequences are contingent upon their own behaviors.

An *Internal* locus of control refers to an individual's belief that the outcome of any event in his/her life is a direct result of his/her personal behavior. Individuals with an internal locus of control believe that reinforce- ments are contingent upon their own behaviors, capacities, or attributes. These individuals are convinced that they are masters of their own fates and take responsibility for

what happens to them. They believe that whatever rewarding inputs they get from their environment are due to their own actions.

An *External* locus of control refers to an individual's belief that reinforcements are not under his/her control, but rather are under the control of powerful others, luck, chance or fate. Individuals with an external locus of control feel that they have little, if any, influence on the events of their lives, that they are controlled by outside forces. They feel that all good and bad things that happen to them are due to chance rather than to their own actions.

Learning style refers to the individual's preferred learning approach. It is not as specific as a tactic, nor as general as a personality variable, but lies somewhere between the two. It reflects the use of preferred learning tactics, but also includes elements of motivation, attitude, and cognitive style.

Deep Approach refers to the combination of the intention to achieve an understanding of material and the application of a strategy which involves a critical interaction with the content resulting in meaningful links being made between new and existing cognitive structures.

Surface Approach refers to the more impersonal intention of satisfying externally imposed task requirements by remembering and/or reproducing the material through the application of a strategy based on memorization of content.

An *Achievement Approach* is an orientation toward obtaining the highest grades, whether or not the material is interesting. The Achievement Approach describes ways in which students organize the temporal and spatial contexts of tasks, making it different in kind from the Surface or Deep Approaches which describe ways in which students engage the actual content of the task. Thus it is not inconsistent to see a combination of the approaches as in a Surface-Achieving, or a Deep-Achieving Approach.

Individuals exhibiting a *Deep Motive* report an intrinsic interest in what is being learned. They strive to develop competence in academic subjects.

Deep Strategy refers to the goal of discovering meaning by reading widely and interrelating material with previous relevant knowledge.

Surface Motive is demonstrated by individuals whose goal is to meet requirements minimally. They are continually involved in a balancing act between failing, and working more than is necessary.

Surface Strategy refers to a reproducing orientation towards learning with a heavy reliance on rote learning.

Achievement Motive is geared toward enhancing ego and self esteem through competition; to obtaining highest grades, whether or not the material is interesting.

Individuals employing an *Achievement Strategy* organize their time and work environment. They follow up all sug-

gested readings, schedule their time, and behave as the 'model student'.

Strategy/Motive congruence refers to the situation in which an individual employs similar strategies and motives: that is a deep strategy and a deep motive; a surface strategy and a surface motive; or an achieving strategy and an achieving motive.

Strategy/Motive incongruence refers to the situation in which an individual employs dissimilar strategies and motives: a deep strategy and either a surface or achieving motive; a surface strategy and either a deep or achieving motive; or an achieving strategy and either a deep or surface motive.

Metacognition refers to one's knowledge of one's own cognitive processes and products, and the active monitoring and consequential regulation of those processes in relation to the cognitive objects or data on which they bear.

Quality of Learning Outcome refers to the depth of responses an individual produces in specific learning situations. These responses may be evaluated based on the cognitive depth or structural complexity of their content. Deeper levels of cognitive performance or higher levels of structural complexity are indications of greater quality in terms of learning outcome.

Cognitive Performance refers to the response an individual produces in a given learning situation. Responses demonstrating an ability to apply, analyze, synthesize or

evaluate material indicate greater depths of cognitive per-
formance than responses which only demonstrate recall and/or
comprehension of the material.

Level of Complexity refers to the level of structural
complexity an individual demonstrates in a particular re-
sponse to a learning situation. Four main dimensions are
used to categorize responses: working memory capacity, oper-
ations relating task content with question, consistency
within a response and relative necessity for closure in mak-
ing that response, and general overall structure, which re-
sults from the interaction between previous dimensions. Re-
sponses may vary from those demonstrating low levels of
structural complexity as indicated by answers consisting ex-
clusively of recalled material, to those responses consist-
ing of elaboration on and demonstrated comprehension of the
material, indicating high structural complexity.

Reading Ability refers to an individual's capability to
comprehend printed verbal material.

Operational Definitions

Internal and *External Locus of Control* will be opera-
tionalized as the subject's score on Rotter's Locus of Con-
trol scale (Rotter, 1966). Subjects will receive a score of
1 - 20, with one indicating most external and 20 being most
internal.

Learning Style will be operationalized as the subject's
score on Biggs's Study Process Questionnaire (SPQ) (Biggs,

1988b). The 42 self report items are scored by summing the subject's responses (using a five-point Likert scale) to the seven items that comprise each subscale. The test yields six subscale scores: three Motives (Surface, Deep and Achieving) and three Strategies (Surface, Deep and Achieving). The sum of the related motive and strategy subscale scores yields the Approach scale score (Surface, Deep and Achieving).

Surface Motive (SM) will be operationalized as the sum of the subject's responses to items designated on the SPQ to represent this dimension (questions 1,7,13,19,25,31 and 37). Subject's scores will be between seven and 35, with higher scores indicating a stronger SM.

Surface Strategy (SS) will be operationalized as the sum of the subject's responses to items designated on the SPQ to represent this dimension (questions 4,10,16,22,28,34 and 40). Subject's scores will be between seven and 35, with higher scores indicating a stronger SS.

Deep Motive (DM) will be operationalized as the sum of the subjects' responses to items designated on the SPQ to represent this dimension (questions 2,8,14,20,26,32 and 38). Subject's scores will be between seven and 35, with higher scores indicating a stronger DM.

Deep Strategy (DS) will be operationalized as the sum of the subjects' responses to items designated on the SPQ to represent this dimension (questions 5,11,17,23,29,35 and

41). Subject's scores will be between seven and 35, with higher scores indicating a stronger DS.

Achievement Motive (AM) will be operationalized as the sum of the subjects' responses to items designated on the SPQ to represent this dimension (questions 3,9,15,21,27,33 and 39). Subject's scores will be between seven and 35, with higher scores indicating a stronger AM.

Achievement Strategy (AS) will be operationalized as the sum of the subjects' responses to items designated on the SPQ to represent this dimension (questions 6,12,18,24,30,36 and 42). Subject's scores will be between seven and 35, with higher scores indicating a stronger AS.

Surface Approach (SA) will be operationalized as the subjects' combined scores on the SPQ for Surface Motive and Surface Strategy. The resulting score will be between 14 and 70, with higher scores representing a more surface orientation.

Deep Approach (DA) will be operationalized as the subjects' combined scores on the SPQ for Deep Motive and Deep Strategy. The resulting score will be between 14 and 70, with higher scores representing a deeper orientation.

Achievement Approach (AA) will be operationalized as the subjects' combined scores on the SPQ for Achievement Motive and Achievement Strategy. The resulting score will be between 14 and 70, with higher scores representing a stronger achievement orientation.

Strategy/Motive congruence will be operationalized by determining correlation coefficients between strategy and motive scores. If the correlation of a motive to its cognate strategy is stronger than the correlation of that motive to any other strategy, congruence will be evidenced.

Strategy/Motive incongruence will also be operationalized by determining correlation coefficients between strategy and motive scores. If the correlation of a motive to any strategy other than its cognate strategy is stronger than the correlation of that motive to its cognate strategy, incongruence will be evidenced.

Metacognition will be operationalized as the subject's score on Tobias's Assessment of Metacognition (Tobias, Everson, Hartman and Gourgey, 1991). Subjects will receive a total score of between zero and 76, with zero indicating no metacognitive abilities, and 76 representing the highest degree of metacognition. This score is arrived at by summing a discrepancy measure of the first estimation and test of vocabulary knowledge with the second estimation and test of vocabulary knowledge.

Quality of Learning Outcome consists of the measured depth of the student's responses and will be operationalized by scores on two measures.

1) *Cognitive performance* will be operationalized using the Test of Cognitive Performance (Anderson, in preparation). Subjects will receive a score between zero and 50 based on their responses to objectively scored questions

constructed from items designed to measure the upper levels of Bloom's Taxonomy (1956). The higher the subject's score, the more deep (application, analysis, synthesis and evaluation) level processing they display.

2) *Level of Complexity* will be operationalized using the Structure of the Observed Learning Outcome (SOLO) Taxonomy (Biggs and Collis, 1982) to evaluate subjects' responses to three essay questions based on passages developed by Biggs and Collis (1982). Biggs and Collis provide criteria for determining five increasingly complex levels of outcome in discourse structure, and the transitional stages between each level. Subjects will receive a zero if they do not attempt to answer the question. They will receive a score between one and nine to correspond to the five primary and four transitional stages in the following manner: 1) Prestructural. Student avoids the question (denial), repeats the question (tautology), a firm closure based on transduction. 2) Transitional one. Student attempts to answer the question, but only partially grasps a significant point. 3) Unistructural. An answer is based on only one relevant aspect of the presented evidence so that the conclusion is limited and likely dogmatic. 4) Transitional two. An attempt to handle two aspects of the evidence is made, but they may be inconsistent and hence no firm conclusion is reached. 5) Multistructural. Several consistent aspects of the data are selected, but any inconsistencies or conflicts are ignored or discounted so that a firm conclu-

sion is reached. 6) Transitional three. Any inconsistencies are noted: Several aspects are recognizable but the student is unable to reconcile them. 7) Relational. Most or all of the evidence is accepted, and attempts are made to reconcile. Conflicting data are placed into a system that accounts for the given context. 8) Transitional four. There is a hint that closure, or a firm conclusion, is not inevitable. There is a suggestion that a relating principle might account for the situation, but this is not spelled out. 9) Extended abstract. There is recognition that the given example is an instance of a more general case. Hypotheses about *not* given examples are entertained, and the conclusions are held open.

Reading Ability will be operationalized as the subject's score obtained by using the CLOZE procedure as described by Bernard and Lundgren (1994). The higher the number of words a subject correctly inserts into the blanks in a passage of text, the higher their level of reading ability will be evaluated.

CHAPTER THREE

Method

Subjects

Subjects consisted of 174 students who were enrolled in Introductory and Cognitive Psychology courses at the State University of New York College at Plattsburgh during the spring of 1994. These students volunteered to participate in the research project and were awarded activity points to be applied towards their course grades. A total of 189 students volunteered to participate in the research; however, eight did not show up on the testing evening. Seven of the students who participated in the study incorrectly recorded their answers on the scantron sheets and their data had to be excluded. The subjects represented a wide range of academic majors; all four academic years; had an age range of 18 to 70 years with a mean of 22 years; 29% were male, while 71% were female.

Design

This research primarily used a multivariate design to examine the relationships between the predictor and criterion variables. In addition confirmatory factor analysis was conducted on the Study Process Questionnaire. Finally, statistical comparisons were performed between the results of the present study and those previously reported by other researchers.

Predictor Variables

Eight subject characteristics were identified based on scores on standardized measures and are used as predictor variables. The eight predictor variables used were derived from the following measures:

1) Locus of Control score

2-7) Study Process Questionnaire

     subscores of - Surface Motive

            - Deep Motive

            - Achievement Motive

            - Surface Strategy

            - Deep Strategy

            - Achievement Strategy

8) Metacognition score

Scores from these eight predictor variables were used independently and were also combined for use in subsequent statistical analyses. Scores for subjects' Surface, Deep and Achievement Approaches were generated following Biggs's formula (Biggs, 1988b) by combining the appropriate motive and strategy scores, i.e. Surface Motive scores were combined with Surface Strategy scores to determine a Surface Approach score, Deep Motive scores were combined with Deep Strategy scores to yield a Deep Approach score, and Achievement Motive scores were combined with Achievement Strategy scores to determine the subject's Achievement Approach score. In addition subject's strategy/motive congruence or

incongruence was determined by establishing correlation co-efficients between the corresponding motives and strategies.

Criterion Measures

Criterion or output variables consist of the subject's performance on the essay questions and on a 50 item objective test. A total of three criterion measures are used in the current study.

Two criterion measure scores were obtained from the subjects' responses to the essay questions. Subjects were awarded a single score for each of their essay answers. These scores were used in two different ways for this research project: 1) the average of each subject's three scores (mean SOLO) were used to represent that subject's modal response to essay questions; and 2) the highest score that a subject received on any of the essay answers (Hi SOLO) was used to represent the highest level of structural complexity that the subject displayed.

The third criterion measure was derived from the subjects' responses to the set of 50, objectively scored, multiple choice questions, derived from Bloom's Taxonomy. Subjects received a single score (Bloom) that indicates their depth of cognitive processing, and is determined by the total number of questions they answered correctly.

Control Measure

Subjects' scores on the test of reading comprehension (CLOZE) were used as a control to determine the extent to which students' scores on the criterion measures were independent of their depth of cognitive processing (Schmeck and Phillips, 1982) and metacognitive abilities.

Instruments and Materials

Informed consent form. This was a one page form that provided subjects with information concerning the design and reason for conducting the research they were about to participate in. Subjects were assured that the data they provided would be treated anonymously, that their participation was voluntary, and they could withdraw at any point at no penalty. Students were asked to sign the consent form indicating their willingness to volunteer as a subject. This form was approved by the Psychology Department at the State University of New York College of Plattsburgh, as well as by the College Committee For The Use Of Human Subjects. (See Appendix A for a copy of the form).

Reading Comprehension Test. This test, based on the cloze procedure, consists of a passage of text of approximately 800 words, with 100 blanks for missing words distributed throughout the passage. The passage used for this research was adapted from a Reader's Digest article and developed for use by Bernard and Lundgren (1994). Subjects were instructed to read the passage and fill in each blank

with one missing word that seems to best fit the meaning of the text. Tests were subsequently scored by relating the words subjects use to a list of appropriate synonyms. "The cloze procedure measures readability in terms of an individual student's understanding on an actual passage from the text. In a sense, it is the sum of a variety of linguistic variables estimated independently by other techniques" (Bernard and Lundgren, 1994). (See Appendix B for a copy of the test).

Rotter's Locus of Control (Rotter, 1966). This is a 20 item forced choice questionnaire designed to assess the degree to which a person believes the outcome of an event is due to fate (external) or is related to his/her own behavior (internal). Test-retest measures of reliability for this measure have been consistent with scores of up to .84 being reported. Internal consistency estimates of reliability are also high, averaging .73. Discriminate validity has also been substantiated for this measure (Rotter, 1966, and Joe, 1971). (See Appendix C for the questions used to measure Locus of Control).

Study Process Questionnaire (SPQ) (Biggs, 1988). This self-report questionnaire is designed to assess motives, strategies and approaches to studying and learning used by university students. Students are presented with seven statements related to each of six dimensions (for a total of 42 questions) and asked to indicate (using a 5-point Likert scale) if the statement is or is not like them. Scores for

each dimension are totalled to yield scores for Surface Mo-
tive, Deep Motive, Achieving Motive, Surface Strategy, Deep
Strategy and Achieving Strategy. These subscale scores can
then be combined to yield the student's Approach to studying
- Surface, Deep or Achieving. Biggs (1987) provides norma-
tive statistical data on the SPQ based on a representative
sample of two thousand students from university and other
advanced educational sectors within the Australian educa-
tional system. With respect to the internal consistency of
the measure, all dimensions yielded an alpha coefficient of
between .61 and .85. The Surface Motive showed the least,
and the Deep Approach the greatest consistency. Validity
data includes an assessment of construct validity obtained
by using students' own estimates of their performance, how
satisfied they were with their performance, and correlations
with performance on exams. The correlation coefficients
ranged from -0.15 for the relationship between Surface Ap-
proach and performance, to 0.20 for the Deep Approach corre-
lation to performance, and a 0.30 correlation coefficient
representing the relationship between the Achieving Approach
and performance. Biggs (1985) claims that these are "highly
significant statistically, given the Ns involved" (p. 189).
(Note, the N was 2373 tertiary level students). (See Ap-
pendix D for a copy of the questions used in this measure).

   Metacognitive Assessment Measure (Tobias, Everson,
Hartman and Gourgey, 1991). This metacognitive evaluation
procedure measures: a) the accuracy with which students de-

termine their vocabulary knowledge; b) how effectively they can update that knowledge by learning the meanings of previously unknown words; and c) students' accuracy in assessing their updated vocabulary knowledge. Students receive a 38 item word list and indicate whether they know or do not know each word. Subsequently a multiple choice vocabulary test containing the same words is administered to determine the accuracy of the students' judgement. A text passage is presented next in which all the words are explicitly defined, before again administering the same word list and vocabulary test. A single score representing metacognitive ability is generated by summing a discrepancy measure of the first estimation and test of vocabulary knowledge with the second estimation and test of vocabulary knowledge. The possible range of scores is from zero, indicating the lowest metacognitive ability to 76, indicating the highest level. While this measure is still in the developmental stages, initial data (Tobias, Everson, Hartman and Gourgey, 1991, and Tobias and Everson, in preparation) indicate that it is well correlated with the Descriptive Test of Language Skills, Reading and Comprehension. (See Appendix E for a copy of the metacognitive measure).

Reading passages and essay questions. Three passages, and associated essay questions, were selected from examples presented by Biggs (Biggs and Collis, 1982). These readings were developed for use in 11th and 12th grade history courses and are accompanied by templates representing possi-

ble answers at each of the SOLO levels. Each passage is between 150 and 200 words in length, is written at the grade 11 - 13 reading level, and presents material on two sides of a particular issue. After reading each passage the subjects are asked to respond to an opinion based question relating to the material presented in the passage. The subjects' responses to the questions are evaluated using the template answers based on the Structure of the Observed Learning Outcome (SOLO) Taxonomy. The passages which were used in this research had each been experimentally demonstrated to yield an interrater reliability of between +.71 and +.83 (Biggs and Collis, 1982). (See Appendix F for the text passages used, and the questions relating to each passage that were asked).

The Structure of the Observed Learning Outcome (SOLO) Taxonomy (Biggs and Collis, 1982) is designed to qualitatively evaluate the learning of college students. SOLO provides criteria for determining five increasingly complex levels of outcome in discourse structure, and the four transitional stages between these primary levels. The five primary levels, and four transitional levels, in order of increasing complexity, are: 1) Prestructural - student avoids the question (denial), repeats the question (tautology), produces a firm closure based on transduction; 2) Transitional - student attempts to answer the question but only partially grasps a significant point; 3) Unistructural - an answer is based on only one relevant aspect of the presented

evidence so that the conclusion is limited and likely dog-
matic; 4) Transitional - An attempt to handle two aspects of
the evidence is made, but they may be inconsistent and hence
no firm conclusion is reached; 5) Multistructural - several
consistent aspects of the data are selected, but any incon-
sistencies or conflicts are ignored or discounted so that a
firm conclusion is reached; 6) Transitional - any inconsis-
tencies are noted: several aspects are recognizable but the
student is unable to reconcile them; 7) Relational - most or
all of the evidence is accepted, and attempts are made to
reconcile conflicting data are placed into a system that ac-
counts for the given context; 8) Transitional - there is a
hint that closure, or a firm conclusion, is not inevitable,
there is a suggestion that a relating principle might ac-
count for the situation, but this is not spelled out; 9) Ex-
tended abstract - there is a recognition that the given ex-
ample is an instance of a more general case, hypotheses
about *not* given examples are entertained, and the conclusion
is held open. Interjudge reliability using this taxonomy
has ranged from .71 to .95 (Biggs and Collis, 1982). Test-
retest reliability is difficult to determine due to the
learning effect inherent in taking the test. Regarding the
criterion validity of the measure, Biggs and Collis (1982)
report that:

> A canonical correlation showed that SOLO level was as-
> sociated with school achievement in math and English,
> simultaneous synthesis, and to some extent, with suc-

cessive synthesis; and independently with intrinsic mo-
tivation, a meaning strategy, avoidance of rote learn-
ing, and to a slight extent, an organized approach to
learning (p. 204).

Test of Cognitive Performance (Anderson, in prepara-
tion). This test consists of 50 questions (with multiple
choice alternative answers provided), extracted from texts
dealing with Bloom's Taxonomy of Cognitive Abilities (Bloom,
Engehart, Furst, Hill and Krathwohl, 1956; Gronlund and
Linn, 1990). These questions are designed to measure stu-
dents' performance on the upper levels (application, analy-
sis, synthesis and evaluation) of Bloom's Taxonomy. Each
question was specifically designated by Bloom, Engehart,
Furst, Hill and Krathwohl (1956) or Gronlund and Linn (1990)
to be representative of one of the upper levels of the tax-
onomy. The questions on this test require subjects to read
a brief passage of text, or review material presented in a
graph or table, and then answer several questions based on
that material. In order to answer the questions students
are provided with multiple choice options. Using a scantron
answer sheet they have to indicate the option they feel best
answers the question. As the questions require the use of
application, analysis, synthesis, or evaluation to arrive at
the correct answer they are considered to indicate the depth
of cognitive processing subjects engage in. As Bloom's Tax-
onomy is hierarchical, a student who is only able to perform
application, but not analysis, synthesis, or evaluation,

would only be able to answer those questions requiring that cognitive strategy. Thus, they would receive a low score on the test, indicating a lower level of cognitive processing than exhibited by students able to perform the upper three levels of the hierarchy. Subjects are awarded one point for each correct answer, the higher scores (to a maximum of 50) indicating a greater tendency toward deep cognitive processing. This test was compiled for use in the present research to operationalize Bloom's Taxonomy of Cognitive Abilities. Questions on the test were reviewed by a specialist in Cognitive Psychology, Dr. Peter Hornby, and a specialist in Educational Test and Measurement, Dr. Karen Agne (both Professors at the State University of New York College at Plattsburgh), to ensure appropriate use of the individual questions. The test was administered to a pilot group of 50 subjects to determine the time required for completion, and to identify any difficulties students might have in understanding the instructions for completing the test. Item analysis of this test indicated a Kuder Richardson 20 (KR-20) score of 0.72, demonstrating acceptable internal consistency reliability for a new test (Nunnally and Bernstein, 1994). The range of scores on the test were five to 40, with a mean of 27.7 and a standard deviation of 5.7. (See Appendix G for the questions used in this measure).

Procedure

Three weeks prior to conducting the research, students at the State University of New York College at Plattsburgh who were enrolled in any of three psychology courses (General Psychology, Introductory Psychology Laboratory, and Cognitive Psychology) were informed of the opportunity to participate in a research project. They were provided with a brief description of the activities they would engage in, the anticipated length of the research activity, and advised that they would receive bonus points that could be used toward their course grade. The students were then invited to register for the research on a form in the Psychology Department office. Two days prior to the date scheduled to run the research project all students who had volunteered as subjects were telephoned to remind them of their commitment.

This research project was conducted in the largest lecture hall at SUNY Plattsburgh which has a seating capacity of 400, thus allowing students to be seated with an empty seat between them during testing. The testing session lasted from 6:30 to 9:00 p.m. one Wednesday evening. The tests were administered by the primary investigator with the assistance of four undergraduate research assistants who monitored the subjects to ensure that they complied with instructions. All tests consisted of paper and pencil items, and were answered on a computer scannable answer sheet or on the actual test booklets. All tests were timed, and stu-

dents were informed prior to commencing each test of the time allocation for that activity.

The instructions necessary for students to understand the various tasks, and the times required for completion of each test, had been determined by administering the tests to a pilot group of 77 subjects the previous semester. The pilot group consisted of subjects from the same university as those used in the present study. They also were enrolled in introductory psychology courses, and received extra course credit for their participation in the experiment. Subjects in the pilot group were allowed unlimited time to complete each of the tests. The maximum time required for completion, by all subjects, for each test, was used to establish the time limits for the current study. Administering the tests to the pilot group allowed the primary investigator and the teaching assistants to standardize their administration and scoring procedures prior to conducting the current research project.

When subjects arrived at the testing facility they were requested to remain outside until the scheduled start time. At 6:30 the doors to the room were opened and subjects were instructed to select a seat with a test booklet on the desk, but not to begin work until instructed to do so.

When all subjects had been seated, the primary investigator provided a brief introduction to the research project they were about to become involved in. She explained the tasks the subjects would engage in, the general purpose of

the research, and the manner in which the results would be analyzed and reported, assuring the subjects of the anonymity of their data. She then requested that the subjects sign the consent form for the use of human subjects in a research project. Following this, the students entered their social security numbers, year of birth, sex, and year in school onto the scantron sheets.

The first test consisted of the reading comprehension test. Subjects were provided with a brief oral description of the format of the test, and some general instructions for its completion. They were advised to progress rapidly through the entire test and not to get hung up on filling in any one blank. They were then told that they would have 15 minutes to work on the task, and told to turn the page and begin. Subjects had been told not to continue with the other parts of the test when they completed the first part. Written instructions at the end of the comprehension test reminded them not to continue with the other tests in the booklet.

After 13 minutes the subjects were advised that they had two minutes remaining in the first portion of testing. After 15 minutes they were asked to stop working. They were then provided with a brief description of the format (but not of the dimensions measured) of Rotter's Locus of Control test which was the second test. They were instructed that they should mark their answers on the scantron sheet, and the answering system was reviewed with them. They were al-

lowed five minutes to complete that measure, and were reminded again not to continue to the next test when they completed the Locus of Control measure.

The third component of the research project consisted of the Study Process Questionnaire (SPQ). Once again the measure and the response options, but not the variables measured, were reviewed with the subjects. Subjects were allocated 15 minutes to complete this measure.

When the time allocated for completion of the SPQ expired, subjects were provided with a description of the fourth measure, Tobias's Metacognitive Assessment Measure. Subjects were advised that there were five components to this particular measure; that they should proceed through all five components in sequence and should not return to a component after completing it; and that they should not continue to the next portion of the test upon completion of the metacognitive measure. The time allotted for this test was 25 minutes.

The next component of the research project consisted of three brief reading passages, each followed by an essay question. Subjects were allowed five minutes to read each passage and answer the related question. The questions were answered in the test booklet itself.

The final item in the test booklet consisted of the Test of Cognitive Performance. Subjects were instructed to answer the 50 objective questions on their scantron sheet. They were reminded that they could use the test booklet it-

self to make any notes or calculations they wished, and were advised that they had 30 minutes to complete the test.

Subjects were asked to remain in their seats until the experimenter indicated that the testing session was terminated. At that time subjects were thanked for their participation, and instructed to leave their test booklet and answer sheets on their desks. The primary investigator and the research assistants subsequently collected these materials.

Scoring Procedures

Scoring of the reading comprehension test (CLOZE). The reading comprehension test was scored by the investigator, using a list of synonyms appropriate for insertion in each blank. The list of synonyms was complied from those used by Bernard and Lundgren (1994) with the addition of words (generated by four upper division research assistants) that were appropriate for, and likely to be used by, the subjects in the present study. Subjects were awarded one point for each word they used that appeared on the synonyms list. In addition novel words that subjects used were evaluated for suitability, and a point was awarded if the word was appropriate for use in that instance. The number of blanks correctly filled in was totalled to arrive at a score of reading comprehension for each subject.

Scoring of the objective tests. Subjects' responses for Rotter's Locus of Control, Biggs's Study Process

Questionnaire, Tobias's Metacognitive Assessment Measure, and the Test of Cognitive Performance were computer scored and a data base of the raw scores was created. Subsequently, scoring programs were written in BASIC to evaluate the data from each of the measures listed above and generate individual scores for each subject for each test. These test scores were then entered into a data base for subsequent statistical analysis using the Crunch Software Interactive Statistical Package (CRISP) (Bostrom and Stenger, 1984) or the Statistical Package for the Social Sciences (SPSS)(1990) as necessary to conduct the required analysis.

Procedures for evaluating the answers to the open ended essay questions. The primary investigator and two upper level research assistants each evaluated the subjects' essay answers to all of the reading passages. This evaluation was conducted in accordance with the guidelines provided by Biggs (Biggs and Collis, 1982) for using the Structure of the Observed Learning Outcome (SOLO) taxonomy. The evaluations were based on model answers (Biggs and Collis, 1982) for each primary and transitional level of the SOLO taxonomy. These template answers were available for the questions related to each of the readings used in the present study. The same three evaluators had employed the same evaluation system, and the same template answers the previous semester to score responses to the essay questions submitted by the pilot group. Correlations among the three evaluators for subjects' responses during the pilot study

was +.93 (N=77). The essay answers for the pilot study, and the present research project were evaluated in the following manner: 1) a list of subjects' social security numbers was generated; 2) this list was given to the three evaluators; 3) each evaluator read all of the responses to the first question and made a qualitative, categorical evaluation of each subject's response which they entered beside the subjects' social security number. Categories ranged from 0 to 9 to indicate the SOLO level it represented based on similarity with the template answers; 4) after the first 20 responses had been categorized, the evaluators met to discuss any discrepancies in the categories they had assigned; 5) the evaluators proceeded to classify the remainder of the responses to the first essay question; 6) this procedure was repeated for the second and third essay answers, using clean social security number lists. In this manner nine individual SOLO categories were generated for each subject (rankings for each of three questions by each of three evaluators), each evaluation was performed without knowledge of other evaluators rankings, and without knowledge of rankings for other essay answers. These numerical categories were then treated as scores following the guidelines outlined by Biggs and Collis (1982). Mean scores were then generated for each subject for each essay, yielding three scores per subject. Interrater agreement for categorizing the three passages was 91%.

Scoring method of the SOLO taxonomy. While this scale (along with most psychological measures) is probably most correctly considered an ordinal scale, there has been ample precedence for its use in parametric statistical analysis. It has been used in several correlational analyses (Biggs and Collis, 1982, p. 186, 188; Watkins, 1983 a) as well as in canonical correlations (Biggs, 1981). One-way analyses of variance have been performed on the results of SOLO administrations (Biggs and Kirby, 1981; Schmeck and Phillips, 1982), and main effects have been determined (Biggs, 1979). Kirby and Biggs (1981) subjected SOLO scores to principal component analysis with Varimax rotation in a factor analytic study. Trigwell and Prosser (1991) even modified the results of the ordinal learning outcomes scale derived from the classification into a ratio scale to facilitate their interpretation.

The application of parametric statistics to the SOLO measure is certainly justified in a research arena as specified by Nunnally and Bernstein (1988) "qualification permits the use of more powerful methods of mathematical analysis that are often essential to the elaboration of theories" (p. 7). They proceed to ask:

> an important question is what difference does it make if the measure does not have the same zero point or proportionally equal intervals? If the scientist assumes, for example, that the scale is an interval scale when it really is not. How seriously would such a mis-

treatment affect the progress of the behavioral sci-
ences? At present, the usual answer is 'very little'.
Most results are reported as either correlations or
mean differences. We have stressed and will stress
that correlations are little affected by monotonic
transformations on variables. These correlations are
the basis of still more powerful methods like factor
analysis. However, we stress that justifying rank or-
der is vital. Even if one accepted the representa-
tional point of view about measurement scales, what
sense does it make to sacrifice powerful methods of
correlational analysis just because there is no way of
proving the claimed scale properties of the measure?
(p. 23).

Their caveat remains:

don't categorize. Countless studies in personality,
educational and social psychological research have be-
gun with continuous measures which are then catego-
rized. We cannot stress sufficiently that a great deal
of meaningful information is lost since the person who
scores one point above the median is treated in the
same way as the person who obtains the highest score
(p. 128).

Not only have researchers applied parametric statistics
to results obtained from administration of the SOLO taxon-
omy; similar statistical methods have been applied to a nine
point scale developed by the Educational Testing Service

(1961) to evaluate essay answers. Recently the California Learning and Assessment System (in McDaniel, 1994) has developed a six point scale that is also used to evaluate and quantify students' responses to essay questions so that the results may be used in parametric analysis. While it is impossible to say that the difference between each of the levels in these various scales are equal, the taxonomies are sufficiently reliable in their administration to make them valuable research tools.

Use of the criterion scores. Subjects' three scores for their essay answers were entered into the data base with their scores for the reading comprehension test, Rotter's Locus of Control, each subscale score for Biggs's SPQ, Tobias's Metacognitive Assessment Measure, Objective Test for Depth of Processing and their demographic data, for subsequent statistical analysis.

CHAPTER FOUR

Results

The statistical analyses were conducted using two statistical programs. CRunch Software Interactive Statistical Package (CRISP) (Bostrom and Stenger, 1984) was used to carry out the descriptive statistics, the Pearson product-moment correlations and the multiple regression analyses. The Statistical Program for the Social Sciences (SPSS)(1990) was used to carry out principal factor analysis followed by Varimax and oblique rotation.

Factor Structure of the Study Process Questionnaire (SPQ)

There have been several attempts (Hattie and Watkins, 1981; O'Neil and Child, 1984; Beckwith, 1991) to substantiate the original factor structure that Biggs identified for the SPQ (Biggs, 1978). These studies have yielded mixed results when conducted with groups of Australian, Filipino and British university level students. The psychometric properties of the SPQ have never been studied with students from a public university in the United States. For these reasons it was deemed advisable to examine the factor structure of the SPQ based on the subjects involved in the present research prior to using the results of the SPQ in subsequent analyses. It was also necessary to compare the results of the descriptive statistics generated from the administration of the SPQ to the present sample, with those previously re-

ported in the literature (Biggs, 1987; Biggs and Rihn, 1984; O'Neil and Child, 1984; Christensen, Massey and Isaacs, 1991; Beckwith, 1991) in order to establish a comparative framework.

In order to examine the factor structure of the SPQ, the subjects' responses to the 42 individual questions on the SPQ were analyzed using the SPSS package for factor analysis. Initially a principal components factor analysis was performed using iterations to obtain an estimate of the communalities. Subsequently orthogonal rotation using the Varimax solution for principal factors having eigenvalues greater than one was conducted. Finally, oblique rotation using the Oblimin method were undertaken. Fourteen principal factors had eigenvalues greater than one and these were rotated. Following Varimax and Oblimin rotations (using 0.25 as the minimum level for a salient loading as had been done by Biggs, 1978 and O'Neil and Child, 1984), fourteen factors with eigenvalues of greater than one remained.

For purposes of comparing the results of this study to previously reported factor analytic studies of the SPQ (Biggs, 1978; O'Neil and Child, 1984; Christensen, Massey and Isaacs, 1991; Beckwith, 1991), the top six factors were considered. These six factors combined accounted for 42.2 percent of the variance with each factor contributing at least 3.9 percent of the variance. The first factor accounted for 15.4 percent of the variance. The total of 14

factors with eigenvalues of greater than one accounted for a total of 65.7 percent of the variance.

As the results of the oblique rotation did not yield significantly different patterns of factors from those present after Varimax, the results of the oblique rotation will not be presented.

The ordering of the SPQ questions shown in Table 1 represents the group of six questions that combine to produce the subscores that are measured by the test (Surface Motive, Surface Strategy, Deep Motive, Deep Strategy, Achievement Motive and Achievement Strategy).

While the factors that emerge from this analysis are not in the same order previously reported in the literature (Biggs, 1987; O'Neil and Child, 1984; Christensen, Massey and Isaacs, 1991; Beckwith, 1991), there are some clear patterns that emerge. The strongest factor appears to consist of the questions primarily designed to measure Achievement Strategy. The second factor is made up mostly of questions from the Deep Motive group. The third factor consists mainly of Deep Strategy questions. Questions designed to measure both Surface Strategy and Surface Motive combine to create factor four. It appears that factors five and six represent a mix of questions primarily from the Achievement Motive grouping. However, questions from Deep and Surface Strategy also contribute to the final factors. This combination is not unusual considering the fact that Achievement

Table 1
Factors resulting from Varimax rotation related to SPQ questions

SPQ QS #	One	Two	Empirical Factors Three	Four	Five	Six
1				.494		
7						
13						
19						
25						
31						
37				.419		
4						
10	.502		.299		.274	
16				.340	.297	.488
22	-.469					
28				.259		
34				.572		
40				.775		
2		.716				
8						
14		.560				.253
20		.753				
26		.471			.340	
32						
38		.436				
5			.491			
11			.560			
17		.371				
23			.829			
29					.737	
35		.469			.462	
41			.692			.303
3						.758
9	.439	.301				.530
15						
21						
27					.326	
33		.257			.330	.411
39					.675	
6						
12	.747					
18	.695					
24	.570				.353	
30	.387		.336			.425
36				.456		
42	.683					

Motive is context dependent whereas the Deep and Surface Strategies are more closely related to general cognitive processes (Watkins and Hattie, 1990). Overall the factors that emerged appear to indicate that there is a clear difference between the Surface, Deep and Achievement dimensions, but not between strategy and motive components within those dimensions.

Using the factor scores obtained for the individual items on the SPQ in the present research, the subjects' scores were recalculated giving each subject a new set of scores for the measure. These new scores, called Factor 1 through Factor 6 were then correlated with the original scores obtained by the subjects on the SPQ when scored using Biggs scoring procedure.

Results of the Pearson product-moment correlation coefficients presented in Table 2 indicate high relationships between the theoretical factors proposed by Biggs and the empirical factors that emerged in this study.

Since Biggs advocates combining the Motive and Strategy dimensions to produce the three Approaches, it was decided to collapse the corresponding Factors and analyze the resulting correlation between the original Approaches and the resulting Factor combinations. For this correlation Factor 4 was used as one component (Component 1), Factor 2 was combined with Factor 3 for a second component (Component 2), and Factors 1, 5, and 6 were used for the third component

Table 2
Pearson Product-Moment Correlation Coefficients between Theoretical and Empirical Factors of the SPQ

Theoretical Factors	Empirical Factors					
	1	2	3	4	5	6
Surface Motive				62		
Surface Strategy				80		
Deep Motive		90				
Deep Strategy			87			
Ach. Motive					77	79
Ach. Strategy	90					

Decimal points omitted
p<0.0001 for all values

(Component 3). The resulting correlation coefficients between those three empirically determined components, and the three Approaches identified by Biggs, are presented in Table 3.

Table 3
Pearson Product-Moment Correlation Coefficients between Approaches and Empirical Components of the SPQ

Approaches	Empirical Components		
	1	2	3
Surface	80		
Deep		94	
Achieving			93

Decimal points omitted
p<0.0001 for all values

Thus while the relative ordering of the factors in this study and those reported earlier differ, and even the questions included in the dimensions differ to some extent, there are clearly three identifiable factors that correlate very highly with the Approaches designated by Biggs. Since

there is no apparent difference between using the factors

representing the empirical or theoretical approaches, the

original theoretical dimensions identified by Biggs (1988b)

will be used in future analyses so that the results of this

study can more readily be compared with data from previously

published studies.

Results of the Study Process Questionnaire

Table 4 represents the means of strategies and motives

on the SPQ for this group of subjects and previous groups

reported in the literature (Biggs, 1987; Biggs and Rihn,

1984; Beckwith, 1991). These data, for each of the six

standard subscores, are presented here as they will be re-

ferred to in subsequent analyses in the present research. At

this point it is sufficient to note that the Surface and

Achievement Motives for the present group of subjects is

markedly higher than for subjects of any previously pub-

lished group, with the exception of the Surface Motive re-

ported by Beckwith (1991).

Biggs (Biggs and Rihn, 1984) points out "the major in-

terest here is on the overall profiles rather than on the

individual comparisons along particular scales" (p. 287). As

can be seen from Table 4 the Motive and Strategy profiles of

the Plattsburgh students are quite different from any of

those identified previously.

Biggs (1987) reports data comparing the mean Surface, Deep

and Achievement Approach scores for four different

Table 4
Mean SPQ scores for Strategies and Motives

| Group	Surface		Deep		Ach	
Number	Mot	Str	Mot	Str	Mot	Str
1	25.3	21.5	22.0	21.2	24.5	21.0
2	21.4	19.0	23.8	23.1	19.9	20.0
3	21.1	19.3	23.2	22.8	19.3	21.8
4	21.6	19.8	23.6	22.3	18.3	18.9
5	21.2	19.5	23.4	23.0	18.7	21.3
6	21.7	21.9	21.9	22.1	20.7	20.4
7	21.8	21.9	21.7	21.6	20.2	22.5
8	22.6	22.0	22.1	22.2	21.3	18.9
9	20.5	20.0	23.5	22.8	19.5	20.0
10	22.6	21.2	20.8	21.5	20.1	18.1
11	22.6	20.9	21.4	22.2	19.9	20.2
12	22.5	22.2	21.1	21.9	19.9	19.6
13	22.8	21.9	21.7	22.0	19.1	21.6
14	21.5	20	23	23	19.5	21
15	22.5	22.5	23	20	23	18.5
16	21.2	20.5	22	21	21.5	20
17	25.1	23	21.9	21.6	21.3	22.2

Subject Group Number
1 - Plattsburgh students (N=173)
2 - University Arts Males (N=111)
3 - University Arts Females (N=294)
4 - University Education Males (N=72)
5 - University Education Females (N=135)
6 - University Science Males (N=139)
7 - University Science Females (N=109)
8 - CAE Arts Males (N=56)
9 - CAE Arts Females (N=40)
10 - CAE Education Males (N=298)
11 - CAE Education Females (N=673)
12 - CAE Science Males (N=228)
13 - CAE Science Females (N=247)
14 - Australian University Students (N=883)
15 - Stanford Learning Assistance Center (N=99)
16 - Stanford Comparison Group (N=53)
17 - Australian Introductory Psychology Students (N=105)

Subject group 1 is comprised of subjects participating in the
present research project. Subject groups 2-7 represent Aus-
tralian University students studied by Biggs (1987). Subject
groups 8-13 consist of the students from the Australian College
of Advanced Education who completed the SPQ (Biggs, 1987).
Subject group 14 consists of subjects from five different
Australian institutions, while subject groups 15 and 16 are
comprised of subjects from Stanford University who took part in
a strategies intervention study (Biggs and Rihn, 1984). Group
17 consists of students enrolled in an Introductory Psychology
course at an Australian university (Beckwith, 1991).

groups of Australian Colleges of Advanced Education students. The results from that study and the present study are compared graphically in Figure 1. It is important to note that the Surface and Deep Approach scores of the Plattsburgh students are most similar to those of the Australian terminal group (i.e. students not planning to continue with their studies after completion of the program in which they were currently enrolled). However, the subjects in the present study have a mean Achievement Approach score that is quite a bit higher than any of the Australian groups.

Figure 1
Approach scores for Plattsburgh and Australian students
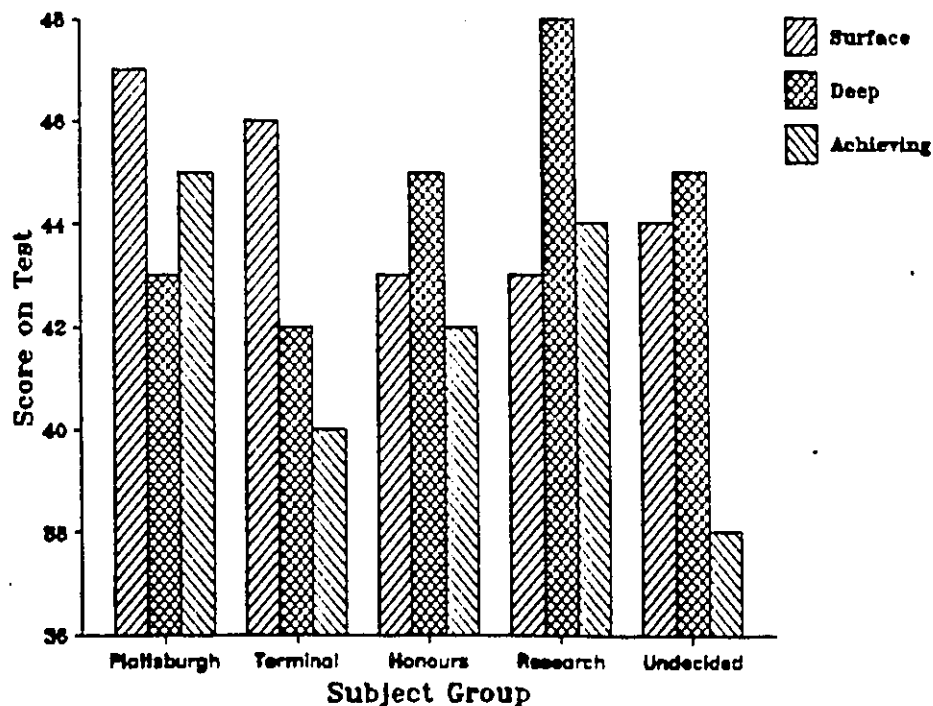
Results Relating to Hypothesis One

Hypothesis one states that there is a relationship among the predictor variables of Locus of Control, Learning Style and metacognition. Specifically, subjects demonstrating an Internal Locus of Control will have either a Deep or Achievement Approach and a high level of metacognition. Those subjects demonstrating External Locus of Control will show a Surface Approach and have a low level of metacognition. In order to address this hypothesis concerning the relationship among the predictor variables, Pearson's product-moment correlations were calculated. However, it was first necessary to determine whether or not Approach scores could be used to represent the combination of Strategy and Motive dimensions, as has been done in previous studies (Biggs, 1987; Beckwith, 1991).

Derivation of the three Approaches. Biggs (1987) indicates that the subscale scores for the corresponding Motives and Strategies may be combined to produce the subjects' learning Approach. In order to determine if this method was appropriate for this group of subjects, and if the three Approaches (rather than the six Motives and Strategies) could be used in subsequent analyses, Pearson's product-moment correlation coefficients were calculated between the motives and strategies for each dimension. The results of those correlations indicate that:

1) There is a positive correlation between Surface Motive and Surface Strategy, $r = .53$ ($p<0.001$).

2) There is a positive correlation between Deep Motive and Deep Strategy, r = .64 (p<0.001).

3 There is a positive correlation between Achievement Motive and Achieving Strategy, r = .46 (p<0.001).

The results of the present study are presented in Table 5, along with data reported by Biggs (1981), O'Neil and Child (1984) and Beckwith (1991). The comparison of these data will be reviewed later. They are presented here to indicate the correlation between corresponding motives and strategies, and to establish the similar pattern of results . to those reported in the literature.

Table 5
Pearson Product-moment Correlation Coefficients Between Strategies and Motives

Motive and Strategy	Reported Results			
	Biggs 1981@	O & C	Beckwith	Anderson
sm & ss	41	49*	42	53*
sm & ds	02	-06	11	07
sm & as	11	13	08	17
dm & ss	-11	-11	13	11
dm & ds	58	50*	59	64*
dm & as	35	34*	48	39*
am & ss	20	36*	31	41*
am & ds	32	21	39	46*
am & as	31	41*	45	46*

sm = surface motive
ss = surface strategy
dm = deep motive
ds = deep strategy
am = achievement motive
as = achievement strategy
Decimal points omitted
@ p values not available
* P < 0.001

As the results of the analysis in this study are similar to those obtained by Biggs (1981), O'Neil and Child (1984) and Beckwith (1991), it was felt that the subscales could appropriately be combined in the prescribed manner (Biggs, 1987) to produce the resultant three Approaches: Surface Approach = Surface Motive + Surface Strategy; Deep Approach = Deep Motive + Deep Strategy; Achievement Approach = Achievement Motive + Achieving Strategy. The resulting Approach scores were used in subsequent statistical analyses.

Locus of Control and approach to learning. Pearson product-moment correlation analysis revealed the following relationships between Locus of Control and approach to learning: Internal Locus of Control and Deep Approach r = .23 (P<0.01); Internal Locus of Control and Achievement Approach r = .22 (p<0.01). As predicted in hypothesis one, these data indicate that there is a positive, albeit low, relationship between Internal Locus of Control and both a Deep or Achieving Approach. However, the anticipated relationship between an External Locus of Control and a Surface approach was not evidenced.

Metacognition, Locus of Control and approach to learning. With regard to the relationship among metacognition, Locus of Control and approach to learning the following re-

lationships were discovered: 1) metacognition is positively correlated with an Internal Locus of Control, r = .17 (p<0.05); and 2) metacognition is negatively correlated with a Surface Approach, r= -.21 (p<0.01).

Thus the predicted relationship between metacognition and an Locus of Control as indicated in hypothesis one, was supported. Specifically individuals with an Internal Locus of Control demonstrated high levels of metacognition, while individuals exhibiting an External Locus of Control scored lower on the measure of metacognition. However, while metacognition was negatively related to a Surface Approach as predicted, the data failed to reveal any relationship between metacognition and either a Deep or Achievement Approach.

Results Associated with Hypothesis Two

The second hypothesis proposes that there is a relationship between predictor variables and outcome measures. Specifically, that subjects demonstrating an Internal Locus of Control, a Deep Approach and high metacognition, will demonstrate deeper levels of cognitive performance than will subjects displaying differing profiles.

In order to address this hypothesis stepwise multiple regression analyses were performed using three criterion variables and five predictor variables. One variable (reading comprehension or CLOZE score) was forced into the regression analysis as a covariate.

The three criterion variables were identified as:

1) Bloom = the subject's score on the Bloom measure (possible range 0 - 50, minimum score = 5, maximum score = 40, mean = 27.7, SD = 5.7);

2) Hi SOLO = the subject's highest score on the three SOLO passages (possible range 0 - 9, minimum = 1, maximum = 9, mean = 5.2, SD = 1.7);

3) Mean SOLO = the subject's average score for the three SOLO passages (possible range 0 - 9, minimum = 0.66, maximum = 7.8, mean = 3.9, SD = 1.3).

With 173 subjects, the mean SOLO score for the first passage was 3.23 with a standard deviation of 1.89. The mean score for the second passage was 4.31, with a standard deviation of 1.91. The third passage mean was 4.20, with a standard deviation of 1.72. These results were analyzed to ascertain whether or not there was a significant difference based on the individual passage, or the order of presentation. A within subjects analysis of variance with 346 degrees of freedom indicated an F value of 28.6 with $p<0.0001$. Post-hoc comparison using Scheffe's test indicated that there was a significant ($p<0.0001$) difference between the first and second passage, and between the first and third passage, but no difference between the second and third passages. This analysis indicates that while there was a difference between the first passage and both the second and third passages, there was no effect based on the order of presentation of the passages.

The five predictor variables were:

1) Locus of Control (possible range = 0 indicating extreme external to 20 indicating extreme internal, minimum = 5, maximum = 20, mean = 14.7, SD = 2.6);

2) Metacognition (possible range = 0 indicating very low metacognition to 38 indicating very high metacognition, minimum = 14, maximum = 35, mean = 25.4, SD = 4.0);

3) Surface Approach (possible range = 14 to 70, minimum = 14, maximum = 67, mean = 46.8, SD = 8.2);

4) Deep Approach (possible range = 14 to 70, minimum = 21, maximum = 65, mean = 43.2, SD = 8.3);

5) Achieving Approach (possible range = 14 to 70, minimum =19, maximum = 64, mean = 45.5, SD = 8.5).

Subject's scores on the CLOZE test of reading comprehension were used as a covariate (possible range 0 to 100, minimum = 3, maximum = 79, mean = 45.1, SD = 17.9).

Results of the multiple regression analyses. The results of the three stepwise multiple regression analyses are presented in Tables 6, 7 and 8. The method used was forward stepwise regression with the following parameters: F-to-enter = 1, F-to-remove = 1, min. tol. = 0.001.

Table 6 presents the results of stepwise multiple regression using mean SOLO score as the dependent variable and CLOZE, Locus of Control, metacognition, Surface Approach, Deep Approach and Achievement Approach scores as independent

variables, with four degrees of freedom, an F value of 6.9 and p<0.0001.

Table 6
Stepwise Multiple Regression: Mean SOLO score and Predictor Variables

Variable	B	Beta	F-to-remove	P-Value
Metacog.	0.079	0.234	8.56	0.0039
L of C	0.074	0.150	4.08	0.0449
SA	0.023	0.145	3.98	0.0476
CLOZE	0.008	0.115	2.09	0.1500

constant = -0.649
Multiple R = 0.3799

Results of stepwise multiple regression using Hi SOLO as the dependent variable and CLOZE, Locus of Control, metacognition, Surface Approach, Deep Approach and Achievement Approach scores as independent variables, with three degrees of freedom, F = 6.9, p<0.001 are presented in Table 7.

Table 7
Stepwise Multiple Regression: Hi SOLO score and Predictor Variables

Variable	B	Beta	F-to-remove	P-Value
Metacog.	0.123	0.286	12.49	0.0005
SA	0.023	0.118	2.54	0.1123
CLOZE	0.007	0.080	1.00	0.3185

constant = 0.622
Multiple R = 0.3339

Table 8 presents the results of a stepwise multiple regression using Bloom as the dependent variable and CLOZE, Locus of Control, metacognition, Surface Approach, Deep Approach and Achievement Approach scores as independent vari-

ables, with four degrees of freedom, an F value of 23.4, and
p<0.0001.

Table 8
*Stepwise Multiple Regression: Bloom score and Predictor
Variables*

Variable	B	Beta	F-to-remove	P-Value
Metacog.	0.574	0.397	32.97	0.0000
CLOZE	0.082	0.261	14.32	0.0002
L of C	0.299	0.141	4.84	0.0291
SA	0.072	0.107	2.92	0.0891

constant = 1.5255
Multiple R = 0.6043

The results of these three regression analyses indicate
that in all three cases, metacognition scores were the best
single predictor of performance. Locus of Control scores
appeared in the regression analysis for the Bloom test and
mean Solo measure, but not on the hi SOLO measure. The only
learning approach that is even entered into any of the re-
gression analyses is the Surface Approach and this is at a
very low value. Subjects' scores on the CLOZE test ac-
counted for a portion of the performance variance on the
Bloom test, but not on the SOLO measures. The results of
the CLOZE scores in these analyses indicate that this vari-
able is not redundant with the measures for a Deep Approach,
or metacognition, thus indicating that those variables are
determined by more than the student's reading ability.

*Stepwise multiple regression using the empirically
determined factors.* Using the three components that were

identified earlier as resulting from the empirical factors
emerging from the factor analysis of the present subjects'
responses to the SPQ, stepwise multiple regressions were
also performed using the same three dependent variables as
before (Mean SOLO, Hi SOLO, and Bloom) and the new indepen-
dent variables of Metacognition, Locus of Control and Compo-
nents 1, 2, and 3. The patterns that emerged for all three
of the new analyses were not substantially different from
those that were reported earlier, and so are not reported
here, or considered in subsequent analyses.

Results Related to Hypothesis Three

Hypothesis three predicts that there will be a differ-
ence in the level of structural complexity, as indicated by
Mean SOLO and Hi SOLO scores, and depth of cognitive perfor-
mance, determined by Bloom scores, based on the congruence
between the subject's indicated preference for motive and
strategy. Specifically, subjects with congruent Deep Motive
and Deep Strategy will demonstrate the highest structural
complexity and deepest cognitive performance, in their cri-
terion measures.

In order to perform the analyses necessary to address
hypotheses three and four the subjects' raw scores for Deep
Strategy and Deep Motive were converted to z scores. Next
the Deep Motive z scores were subtracted from the Deep
Strategy z scores to yield a single score representing the
subjects' congruence between Deep Motive and Deep Strategy.

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Resulting scores indicated three possibilities: 1) subjects'
Deep Motive and Deep Strategy scores were congruent and in
balance (a score of 0); 2) negative scores indicating sub-
jects had higher Deep Motive scores than Deep Strategy
scores; or 3) positive scores indicating that subjects were
incongruent and had higher Deep Strategies than Deep Mo-
tives. Scores on the three criterion measures were analyzed
for each of the groups indicated above.

There was no significant difference in performance on
any of the three criterion measures between subjects demon-
strating congruent Deep Motive and Deep Strategy scores and
the remainder of the subjects. There was also no signifi-
cant difference in scores on any of the three criterion mea-
sures between those subjects displaying both high Deep Mo-
tive (one standard deviation above the norm) and high Deep
Strategy scores when compared with the other subjects.

Results Associated with Hypothesis Four

The fourth hypothesis is that subjects with incongruent
Deep Motive and Deep Strategy will demonstrate a difference
in level of cognitive performance based on the nature of the
task - i.e. subjects with Deep Strategies, but not Deep Mo-
tives will perform at a deep level on the Bloom test (i.e.
when forced to), but not on the SOLO test (i.e. when given
the option of performing at a deep or surface level). Sub-
jects with Deep Motive higher than Deep Strategy will per-

form at a lower level on all three performance measures when compared to subjects with congruent Motives and Strategies.

Results for subjects with incongruent Deep Motive/Strategy profiles: Deep Strategy higher than Deep Motive. As represented in Table 9, subjects with incongruent strategy/motive profiles having higher Deep Strategies than Deep Motives demonstrated a significant difference in performance when compared with the rest of the subjects on both methods of analyzing SOLO scores.

Table 9
Performance measures for subjects with incongruent Deep Strategy higher than Deep Motive and all other subjects.

Group	Measure	Mean	SD
DS>DM	Bloom	28.5	6.1
Others	Bloom	27.7	5.7
DS>DM	HiSOLO	4.6*	1.4
Others	HiSOLO	5.2	1.7
DS>DM	MeanSOLO	3.4*	0.9
Others	MeanSOLO	3.9	1.3

* $p < 0.05$

The results associated with the fourth hypothesis indicate that subjects who have the Deep Strategies, but not the Deep Motivation, do not perform in a statistically different manner from the rest of the subjects when the task demands deep processing (Bloom).

*Results for subjects with incongruent Deep Mo-
tive/Strategy profiles: Deep Motive higher than Deep Strat-
egy.* Results for subjects with incongruent scores such that
Deep Motive scores were higher than Deep Strategy scores,
indicate that there is no difference in performance between
this group and the rest of the sample on any of the three
criterion measures.

CHAPTER FIVE

Discussion

The present research was designed to empirically test Biggs's theoretical model of the relationship between learner characteristics of Locus of Control, Metacognition and Approach to learning and the quality of the learning outcome. The present study was also designed to replicate portions of previous research projects to contribute to the accumulation of data that is needed to develop a viable model of the learner and the process and outcome of learning. In addition, some new measures were introduced to attempt to determine their value as objective instruments which could be used in future research projects.

The results of the present study will be discussed in two distinct sections. The first section will review the significance of the results generated in response to the specific questions directing the present study. The second section will consist of a more general discussion of the results of the present study. Possible interpretations of the results, the overall significance and implications of the findings of the present research project will be covered in the second section.

Significance of Specific Results

Psychometric properties of the Study Process Question-naire (SPQ). As described in the results, it was believed

to be important to examine the factor structure of the SPQ prior to basing subsequent analyses on the data generated by that instrument. Several identifiable factors emerged from the data from the present study. The clearest factors were: 1) the combination of questions identified by Biggs (1988) as representing the Surface Motive/Strategy; 2) an Achieving Strategy factor; and 3) a mix of Deep Motive/Strategy and Achieving Motive.

These empirically determined factors do not demonstrate the clear distinction between strategy and motive that was originally identified by Biggs (1978). However, other researchers attempting to confirm the proposed factor structure (Christensen, Massey and Isaacs, 1991; Beckwith, 1991) have also failed to replicate the same six distinct factors identified by Biggs. It appears from these previously published articles and from the present study that there is a clear distinction between a factor representing the Surface Approach (comprised of the Surface Strategy and Surface Motive), and a factor (or factors) consisting of some combination of Deep and Achievement Approaches. Biggs (1987), recognizing the possible collapse of the clear factors he had previously identified, indicates that an overlap in Deep and Achievement Approaches is not unexpected as the two are actually different in kind, and thus it is not inconsistent for an individual to demonstrate both approaches simultaneously.

Thus, despite the fact that empirically determined factors paralleling the strategies and motives factors Biggs identifies were not evident, a combination of the empirical factors along the lines Biggs suggests to determine overall Approach to learning, did yield similar patterns of results. When the empirically determined "approach" components were used in the regression analyses the same pattern of results was obtained as when the three approaches identified by Biggs were used (i.e. metacognition was the best predictor of performance on all three criterion variables, and no approach to learning entered into the regression analyses). Since there was no apparent difference between using the factors representing the empirical or the theoretical approaches, the original theoretical dimensions identified by Biggs were used so that the results of this study could more readily be compared with data from previously published studies.

Relationships among predictor variables. The first research question addressed in this study concerned the relationship among the predictor variables of Locus of Control, Learning Style and metacognition. Specifically, subjects demonstrating an Internal Locus of Control were predicted to have either a Deep or Achievement Approach and a high level of metacognition. Those subjects demonstrating External Locus of Control were expected to show a Surface Approach and have a low level of metacognition.

While the results of the present research do not sup-
port the strong relationships predicted by Biggs (1985),
somewhat similar patterns were identified. Specifically,
Biggs reports that an Internal Locus of Control consistently
correlates negatively with Surface and positively with Deep
scores. The data from the present study indicate that, as
predicted, an Internal Locus of Control is positively corre-
lated with both Deep and Achievement Approaches. However, a
Surface Approach was not found to be associated with any of
the Locus of Control scores.

Biggs (1985) reports that subjects with a Deep Approach
to learning are most likely to exhibit high levels of
metacognition. While the data from the present study do not
reveal any relationship between metacognition and either a
Deep or Achieving Approach, they do indicate a negative re-
lationship between metacognition and a Surface Approach.

With respect to the first research question concerning
the interrelationship of the predictor variables, it appears
from the present study that subjects with an Internal Locus
of Control do display Deep or Achieving Approaches, and
demonstrate high metacognitive awareness. On the other
hand, subjects with an External Locus of Control (which was
not directly related to any learning approach) demonstrate a
low metacognitive level.

*Relationship between predictor and performance vari-
ables.* The second research question postulated a relation-

ship between predictor variables and criterion measures. Specifically, based on the work of Biggs (1979, 1985, 1987), Joe (1971), Wilhite (1990) and Jonassen and Grabowski (1993), it was proposed that subjects demonstrating an Internal Locus of Control, a Deep Approach and high metacognition, would demonstrate deeper levels of cognitive performance and greater structural complexity than would subjects' displaying different profiles.

The correlational analyses from the present investigation yield mixed results concerning the relationship between predictor and criterion variables. The strongest relationships between these variables for subjects in the present study is between metacognition and all three of the criterion variables (Mean SOLO, Hi SOLO and Bloom). While the statistical analyses indicate a positive relationship between high metacognitive scores and scores on all of the criterion variables, this relationship was most pronounced for the Test of Cognitive Performance (Bloom).

The statistical results of the relationship between Locus of Control and performance as indicated by the three criterion variable scores are slightly weaker than those for the relationship between metacognition and the predictor variables. They indicate that there is a positive relationship between subjects Internal Locus of Control scores, and their scores on Mean SOLO, and on the Bloom measure, but that there is no relationship between Locus of Control and Hi SOLO scores.

It is interesting to note that although the CLOZE scores (indicating reading comprehension) were forced into the regression analysis, they only accounted for a significant (p > .05) amount of variance of criterion measure scores on the Test of Cognitive Performance (Bloom). The findings from the three regression analyses indicate that the metacognitive measure and learning approaches (as measured by the SPQ), are clearly not redundant with the measure of reading comprehension.

Probably the most surprising finding of the present study is that there is no relationship between any of the three approaches to learning (as measured by the SPQ) and scores on any of the three criterion measures (Mean SOLO, Hi SOLO and Bloom). The results from the multiple regression analyses emphasize this relationship, indicating that metacognition accounts for the greatest amount of variance in criterion measure scores, and that Locus of Control generally contributes to variance in criterion measures. Thus, from the present study, it would appear that the single best predictor of a subject's performance on the Test of Cognitive Performance, or on SOLO measures (Mean SOLO or Hi SOLO), is level of metacognition. In addition, Internal Locus of Control also contributes to the ability to predict students' scores on two of the three criterion measures employed in the present research (Mean SOLO and Bloom). However, the approach to learning that a subject displays (as measured by the SPQ), does not appear to be related to the

quality of their performance as measured by any of the criterion measures used in the present study. It is interesting to note that in the present study learning approach was not related to performance even when the other predictor variables were factored out of the multiple regression analysis.

Biggs (1985) reports that first order correlations between approach to learning and performance are often relatively small, and sometimes non-significant. He indicates that one needs to look at the interaction among variables to determine predictive ability. For example, he claims that a student with an Internal Locus of Control would use a Deep Approach more effectively than a student with an External Locus of Control. In order to address this proposed interaction, as well as other possible interactions between predictor variables, and their influence on criterion scores, post hoc statistics were performed.

The statistical analyses of the interaction between predictor variables, and criterion measures indicate that there is no relationship between internal Locus of Control, Deep Approach and scores on any of the three criterion measures used in the present research. Further analyses confirmed that using either high (above the mean) Internal Locus of Control, or very high (one standard deviation above the mean) Internal Locus of Control, and Deep Strategy, Deep Motive or Deep Approach as predictor variables, there is

still no relationship to scores on any criterion measure used in the present research.

Additional post hoc statistical analyses also confirmed that there is no interaction between high metacognition, Deep Strategy, Deep Motive or Deep Approach and any performance on any of the criterion measures.

Thus, the present study does not reveal any relationship, either direct, or mediated, between any of the strategies, motives or approaches to learning as identified by the SPQ and performance on any of the criterion measures (Mean SOLO, Hi SOLO or Bloom).

Performance based on congruent motives and strategies. The third research hypothesis predicted that there would be a difference in performance based on the congruence between the subject's indicated preference for motive and strategy. Specifically, subjects with congruent Deep Motive and Deep Strategy would demonstrate the highest structural complexity, and the deepest cognitive performance on the criterion measures.

Biggs (1985) indicates that "the question of motive-strategy congruence raises two issues: the extent to which students who endorse a particular motive tend also to endorse the cognate strategy; and the extent to which congruent motive-strategy combinations are more effective than non-congruent ones" (p. 198).

The first, weaker, aspect of congruence has received repeated support in the research literature (O'Neil and Child, 1984; Beckwith, 1991). The correlation between any motive and its cognate strategy is consistently higher than that between that motive and any other strategy. The findings of the present study definitely support the proposed strategy/motive relationship.

The second aspect of congruence referred to by Biggs (1985), deals with the effect of the congruency between strategy and motive, and subjects' performance on criterion measures. While Biggs proposed that subjects' with congruent strategy/motive scores would demonstrate greater structural complexity in their learning outcomes, the present study revealed no relationship between congruence and performance on any of the three criterion measures used in the present research.

Watkins (1982) felt that congruency scores were not necessarily the critical issue. He felt it was more important to determine how a strategy related to performance independently of the motive in which it is imbedded. The data from the present study were analyzed to explore the relationship of strategy to criterion measures, independent of motive. It was determined that, in this study, there is no relationship between strategy and scores on any of the criterion measures.

Further analyses indicate that there is also no relationship between any motive (independent of strategy) and any criterion measure used in the present study.

These post hoc analyses of the data re-emphasize the findings reported earlier in this discussion that, in the present study, there appears to be no relationship between any aspect of learning approach as measured by the SPQ (including congruence between strategies and motives), and level of structural complexity or depth of cognitive performance as measured by the criterion measures used in the present research.

Performance based on incongruent strategies and motives. The fourth research question of the present study concerned the relationship between incongruent strategy /motive combinations and quality of learning outcome. It proposed that subjects with incongruent Deep Motive and Deep Strategy scores would demonstrate a difference in quality of learning outcome based on the nature of the task. Specifically, subjects scoring high on Deep Strategies, but not Deep Motives would perform at a deep level on the Test of Cognitive Performance (Bloom measure) (i.e. when required to engage in deep cognitive processing in order to select the correct multiple choice option to a specific problem), but would not demonstrate high structural complexity as measured by SOLO (i.e. when allowed to perform at either a deep or a surface level in answering an openended essay question).

Their lack of motivation should reduce their spontaneous use of deep strategies. It was further postulated that subjects demonstrating Deep Motive but not Deep Strategy would perform at a lower level than the other subjects (desire to succeed would not be able to overcome a lack of ability).

While Biggs and Rihn (1984) demonstrated a difference in performance as a result of subjects having Deep Motive higher than Deep Strategy, the present study was unable to replicate those findings. The results of the present study show no difference in the learning outcome, as indicated by the three criterion measures, between those subjects with Deep Motive higher than Deep Strategy, and the rest of the sample.

There was, however, a clear difference in learning outcome between those subjects with Deep Motive lower than Deep Strategy, and the rest of the sample. Specifically, subjects with incongruent Deep Strategy/Motive profiles scored higher on the Bloom measure than the rest of the subjects in the study. This difference in scores would seem to imply that subjects with a learning profile of higher Deep Strategy than Deep Motive can perform at a deep level when they are forced to (i.e. objective Bloom test); but when given the option, will not expend the effort necessary to produce a structurally complex response (i.e. essay answer).

General Discussion

The results from the present research support some of the research hypotheses that were suggested by a review of the literature. Some of the hypotheses were unsubstantiated by the present study. And, some of the results from the present study have raised questions that will need to be examined in subsequent empirical studies.

Importance of the results of the psychometric properties of the Study Process Questionnaire (SPQ). In general the factor structure of the Study Process Questionnaire was found to yield the strong distinction between a Surface and a Deep dimension that has been reported by previous researchers (Christensen, Massey and Isaacs, 1991; Beckwith, 1991). However, the Achievement dimension seems to be spread between the two primary dimensions, and is not a clear factor of its own. Also, the present study did not find the clear distinction between the strategy and motive dimensions that Biggs (1978) reports the SPQ identifies. Thus, it would appear from the present research that the factors which the SPQ purports to measure are evident, but with much less distinction than the author of the test indicates. While the factors representing the combined Approaches are evident, the motive/strategy distinction seems more difficult to isolate.

While the findings of the present study may have occurred as a result of the internal structural properties of

the SPQ, they may also be due to the nature of the present sample. Prior to its use in the present study, there has been no published report of the SPQ being administered to a group of students in a public university in the United states. Comparing the data from the present study to those reported by Biggs (1985), the present results appear to most closely resemble the results from his low reasoning/high memory group of 14 year olds: they display two factors, and the Achievement Approach is combined with both the Surface and Deep Approaches. Perhaps this is the profile that most closely represents subjects from the present research. In any case, the subjects who made up the present sample were not those on whom the SPQ had been standardized, and their results did not conform to those of subjects from the normative group. This would suggest that before the SPQ is used to measure approaches to learning of a wider population, it should be standardized on those groups.

Confirmation of the research hypotheses. The relationship among predictor variables was generally found to be that which had been proposed in the research hypothesis: an Internal Locus of Control is positively correlated with a Deep or Achieving Approach; a Surface Approach is negatively correlated with metacognitive ability; and metacognition is positively related to Locus of Control (i.e. the more Internal the Locus of Control, the higher the level of metacognition, while the more External Locus of Control in-

dicates lower levels of metacognitive performance). The fact that these relationships appear to be so consistent across situations and subjects is reassuring and should provide data useful to researchers engaged in developing a model of the individual learner.

Several of the elements of the hypothesis concerning the relationship between predictor and criterion variables were supported. The positive correlation which had been predicted between an Internal Locus of Control, and level of complexity and depth of cognitive performance, was confirmed in the present study.

Perhaps the most interesting finding of the present study is the strong relationship which was revealed between metacognition and all three criterion measures. The study of metacognition has gained momentum in the past ten years, but much is still unknown about this construct. It is possible that the measure of metacognition that was used in the present study may somehow have been measuring the same underlying cognitive ability that was measured by the criterion variables. As the results from the CLOZE scores indicated that the metacognition test was not redundant to the reading comprehension measure, the common factor should not be a simple matter of reading ability. The metacognitive measure that was used in the present study did involve an aspect of verbal memory, and it is possible that this facet of cognition was also highly involved in the criterion measures. If this were the case, the underlying construct con-

tributing to the high relationship between metacognition and quality of performance on both learning outcome tests might be a component of memory. This hypothesis corresponds with Wilhite's (1990) finding that of the 18 predictor variables he used in his study, scores on self-assessment of memory ability were the best predictor of final course grades. The ability to accurately self-assess memory reflects a component of metacognition dealing with one's ability to accurately assess one's own knowledge, a similar task to that required on Tobias's test of metacognition. On the other hand, it is possible that Tobias has created an effective measurement device for assessing metacognition objectively, and that variable is accurate in predicting learning outcome. In either case, more research will need to be done in this area to explore the nature of memory and its relationship to both metacognition and performance on learning measures.

The final hypothesis that was confirmed concerned the relationship between incongruent Deep Strategy and Deep Motive (when Deep Motive was lower than Deep Strategy) and scores on criterion measures. Subjects with this learning profile appear to be able to perform at a deep level when they are forced to (i.e. objective Bloom test); but when given the option, will not expend the effort necessary to produce a structurally complex response (i.e. essay answer). These results suggest that subjects indicating the presence of deep strategies, but the absence of deep motives would

not benefit from a strategies training program as they already possess the ability to perform at a deep cognitive level. What they may need, is to somehow, be motivated to engage their material in a deep manner.

Lack of confirmation for research hypotheses. The present study generated no data to substantiate the predicted relationship between approach to learning and performance on any of the criterion measures. While this lack of corroborating data is disconcerting, there are a number of possible explanations for the findings of the present study.

The research hypothesis predicting that subjects demonstrating an Internal Locus of Control, a Deep Approach to learning, and high metacognition would demonstrate deeper levels of cognitive performance and greater structural complexity than subjects with different profiles, was generated from theoretical hypotheses of the relationship between learner characteristics and performance outcome (Marton and Saljo, 1976; Pask, 1976; Schmeck, 1988a; Biggs, 1985). It is important to keep in mind that while the proposed relationship may be intuitively appealing, and theoretically sound, it does not actually have a strong empirical base. In fact, much of the previous research in this area has produced inconclusive or inconsistent results.

As discussed in the introduction, there are a number of explanations for the diverse research results that have been

generated when studying approaches to learning and their re-
lationships to learning outcome.

Possibly one of the greatest factors leading to the
varying research results in this domain is the diversity of
methods and materials used to study the relationship between
predictor and criterion variables. The methods employed in
studying this topic range from qualitative studies of small
groups, using indepth personal interviews, and subjects' in-
trospective reports; to quantitative research based on in-
terpretation of questionnaires administered anonymously to
large groups of subjects.

Similarly, the materials used by researchers adopting
either methodology are quite varied. Among the qualitative
researchers the primary tools are openended questions re-
quiring subjective interpretation, which are not easily
standardized. Even within the quantitative orientation
there is a tremendous range of predictive measures designed
to identify a wide range of individual characteristics, and
an equally large number of performance measures that are
then related to the idiosyncratic individual measures.

Another factor likely to contribute to the discrepant
research findings in this domain is the subjects used in the
studies. Previous studies into the relationship between
learning approach and outcome performance have used students
from Australian, British and Swedish Universities, as well
as from a prestigious private university in the United
States. The differences in these samples was evident when

one compared the norms from previous studies and the results from the present study for performance on the SPQ. The learning profiles generated in the present study differ markedly from those previously reported. It is interesting to note that two dimensions (Surface and Deep) of the learning profiles reported by the present study most closely resemble those of a group Biggs (1987) described as terminal students (planning to leave after the present degree). The fact that the mean score for the Achieving Approach is so high for the subjects from the present study may be a reflection of their school system, and the culture within which it is embedded. The differences in educational systems, personal goals and self-images of the students engaged in the various research projects may contribute considerably to the variation of the overall learning profiles reported in this study and earlier ones.

Theoretical implications of the present study. The results from the present study do not support the theoretical relationship between predictor and criterion variables as specified by Biggs (1985). The apparent inability to develop a consistent, comprehensive theory to explain the relationship between predictor and criterion variables may be the result of an overreliance by some researchers on one set of procedures, and a simultaneous tendency to ignore other previously proven methods.

The overreliance may be seen in the seemingly excessive reliance on significance testing (Meehl, 1978). For decades

psychologists and educators have focused on experimental designs and parametric statistics in attempting to develop coherent theories and models of learning. Wilson (1988) claims that in the early stages of development of a new field of inquiry, the premature closure inherent in ANOVA designs may prevent discovery of important outcomes and interactions. The development of a comprehensive model of the learner, and the importance of that model for predicting subsequent performance, is a complex field of inquiry, and perhaps the traditional parametric approaches are not appropriate. It may be time to explore alternative research designs and statistical methods for continuing to fully analyze the elements and interrelations within that model.

While clinging to classic statistical methods, researchers in this domain seem to be forgetting the basic guidelines that have been proven to work in the older sciences: replication and the cumulative character that is evidenced in other disciplines (Cohen, 1994; Meehl, 1978). Attempts to develop models of the learner and the process of learning are progressing along multiple parallel paths. There is little continuity or effort taken to replicate findings in alternate settings. If a concerted effort is not made to systemically and systematically explore all the variables related to a particular theory of learning and performance it is likely that these theories, like many others, "will come and go, more as a function of baffled boredom than anything else" (Meehl, 1978, p. 807).

Conclusions

With respect to the overall goals of the present study: no empirical support was generated for Biggs's theoretical model of the effect of learner characteristics on learning outcome; some of the findings of Biggs's (1985) study on the relationship among predictor variables were replicated; and the objectively scored measures of metacognition and depth of cognitive processing do appear to discriminate among subjects.

The findings of the present study may be a result of the materials or methods employed. It is possible that the Study Process Questionnaire does not effectively measure a subject's approach to learning; that Tobias's Metacognitive Assessment measure is measuring some other underlying construct; or that the Test of Cognitive Performance and Structure of the Observed Learning Outcome are not accurately measuring depth of learning outcome. It is equally possible that the results are due to the application of the statistical analyses employed, and that it is not possible to quantify cognitive processes for the use of parametric statistical analyses. The results may be due to the nature of the sample of subjects used in this research, and be representative only of that population. Perhaps the design of the research influenced the results of the study due to subjects' lack of motivation or fatigue.

It is also possible that the results of the present research accurately represent the fact that it is not possible

to predict a subject's performance based on a knowledge of specific individual characteristics.

In interpreting the results of the present study it is important to keep the limitations of the design in mind. The subjects did not represent a random sample and as such their data should not be generalized to a larger population. The subjects in the present study participated in a one shot study consisting of a two and a half hour testing session so fatigue and lack of motivation could be consideratiions in interpreting the data. Also, the materials used to obtain the criterion scores required no prior knowledge, thus from a cognitive developmenta¹ perspective subjects might not have been able to use deep strategies as they lacked sufficient domain knowledge to form the base of association strategies.

Almost 100 years ago Wissler (1903) was one of the first researchers to use Pearson's correlational method to study the relationship between ten tests of "basic faculties" (e.g. reaction time, color naming, dynamometer strength and memory for letters) and academic performance measures (e.g. class standing). His research indicated that there was no correlation between any predictor and criterion variable. His conclusion was that only academic performance predicts academic performance. Since that time numerous researchers have attempted, unsuccessfully, to confirm a predictive relationship between individual characteristics and performance. However, it intuitively seems that there must

be some way to predict outcome based on a knowledge of the individual, and so with the hope in new methods and materials, the search continues.

Future Directions

Based on the results of the present study several directions for future research are suggested.

It is apparent that while the Study Process Questionnaire (SPQ) does distinguish between Surface and Deep Approaches to learning, there are questions concerning the measurement and interpretation of the Achievement Approach. This, coupled with the mixed results from various examinations of the psychometric properties of the SPQ would seem to indicate that perhaps a revision of the instrument is in order. More studies also need to be conducted to standardize the SPQ for different populations. At this time it would appear that until more research is conducted on psychometric properties of the SPQ it should not be used as a prescriptive measure in an applied setting.

While the Structure of the Observed Learning Outcome (SOLO) measure does appear to distinguish among subjects' responses, it is time consuming to administer and score. An outcome measure that objectively identifies subjects' depth of cognitive functioning, and is expedient to administer and analyze needs to be developed and standardized. Perhaps the Test of Cognitive Performance, based on Bloom's taxonomy, that was created for use in the present study could be fur-

ther developed and standardized for use as an outcome measure.

More effort needs to be devoted to studying the individual components that contribute to the learning process. Special attention needs to be paid to the construct of metacognition and to developing an understanding of its underlying structure and relation to learning outcome.

Future research needs to explore the interrelationship between a wider range of individual and environmental characteristics, and their influence on learning outcome. Ainley (1993) points out that variables representing students' beliefs and goals in learning have been studied as separate variables, and their influence on learning has been assessed as an independent effect. She points to the importance of studying the interdependence of the set of goals that guide learning.

Of paramount importance to the growth of this area, and to the development of a theory of the learning process, is a continued research effort directed at accumulating replicatable results. It is also critical that practitioners realize the nascent nature of this domain and refrain from using measures in applied settings before their psychometric properties have been empirically evaluated.

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APPENDIX A

Informed Consent Form

TO PROSPECTIVE RESEARCH PARTICIPANTS

The PSUC Psychology Department wishes to emphasize that it is your right to decide freely whether or not to participate in this particular study. The following description of the study is intended to give you a basis for making this decision.

In this research you will be asked to answer a series of questions that deal with your approach to studying. After answering these questions you will be asked to complete a series of exercises dealing with material that will be presented to you in this booklet. The purpose of this study is to investigate the various learning approaches of college students. At no time will your individual results be identified. The overall results for the entire project will be analyzed to determine patterns of learning traits of college students.

If you do decide to participate in this study, you will retain your right to withdraw at any time without penalty, you will be assured that your individual responses will never be publicly identified with your name, and, after the study is over, you will be entitled to a full explanation of the nature of the study as well as, if possible, a summary of the results.

A.   Consent for persons 18 years of age and older

I have read the above and, being at least 18 years of age, agree to participate in this study.

_____
      (Signature of Prospective Participant)

B.   Consent for persons under 18 years of age

I have read the above, and being a parent or guardian of

_____. I agree to
              (Name of Prospective Participant)

his/her participation in this study.

_____
       (Signature of Parent or Guardian)

APPENDIX B

Reading Comprehension Test

Instructions:

This test requires that you fill in blanks
with words which seem to fit the meaning of the text. There
is only ONE single word to be found for each deletion
(hyphenated words count as one word). Deletion lines are
always of the same length, regardless the length of the
words to be found. Proper names have not been deleted.

A noted social observer examines the evidence

First, Last or Middle Child - The Surprising Differences

As a last-born child I have been intrigued--and perhaps a
bit miffed--by the seeming preeminence of first-born
offspring in the world. Also, having a special concern with
the role that status plays in our lives, I am interested in
how birth order influences the way we are treated.

In recent years hundreds of behavioral specialists have
pondered, (1) _____ and measured people for evidence
of the possible impact (2) _____ being the oldest,
middle, last--or only--child. I (3) _____ examined
about 60 of these studies and made a modest (4) _____
myself. No exact conclusion can be drawn about (5) _____
particular child, and on certain points the investigators

disagree (6) _____ themselves. Still, some startling differences emerge when sizable groups (7) _____ people are compared on the basis of birth (8) _____.

Take the matter of achievement. A variety of studies (9) _____ searched for any link between birth order and (10) _____ or genius. Behavioral scientist Stanley Schachter of Columbia (11) _____ sums them up by saying that first-borns predominate (12) "_____ astonishing consistency". They are overrepresented in Who's Who. (13) _____ the first 23 astronauts to go on U.S. (14) _____ missions, 21 were either eldest or only children (remarkable), (15) _____ you consider that later-borns outnumber first-borns by (16) _____ two to one in the general U.S. population). (17) _____ a recent analysis of 1618 finalists (18) _____ National Merit Scholarships in the United States showed (19) _____ nearly 60 percent of them were first-born.

(20) _____ know of no reliable evidence that first-borns (21) _____ more brainpower. Rather, the way they are (22) _____ makes them more bookish and more achievement-oriented. (23) _____ for economic reasons--more of them manage (24) _____ go to college.

One of the more (25) _____ analyses was made as a part of (26) _____ Study of Adult Development at Harvard University. (27) _____ more than a decade, psychologist Charles McArthur (28) _____ social anthropologist Margaret Lantis studied some 200 (29)_____ graduates as they started their families. These (30)_____ parents reported on themselves as well as their (31)_____. Analyzing these accounts, and systematically observing the (32) _____, the researchers found that the first-borns did (33) _____ different personality patterns from later-borns--and there (34) _____ clear-cut agreement on what those differences were. "(35) _____ family constellation", McArthur concluded, "is an important (36) _____ of personality". Here are my impressions (37) _____ why--and how-- we tend to (38)_____ our children differently according to their (39)_____ order.

The first-born child, at time (40) _____ birth, is likely to be a (41) _____ most wanted child--they are proving (42) _____ capacity to have progeny, and in (43) _____ way assuring their own immortality. They (44) _____ expect more of this first child (45) _____ of later children. They are likely (46) _____ snap their photograph more often, talk (47) _____ romp with them more, but also (48) _____.

worry and fret more over them. (49) _____ in the
art of parenthood, (50) _____ tend to be tense.

A calmer environment (51) _____ prevails when the
second child arrives, (52) _____ there has been an
interval of two (53) _____ or more. Two thirds of
(54) _____ young Harvard-study parents said that
with (55) _____ second-born they were more relaxed,
less (56) _____, and administered spankings only
half as (57) _____. As later children come along,
parents (58) _____ not only to diffuse their
attention (59) _____ them all, but also become less
(60) _____ with the child-rearing role. Later
children may (61) _____ that they are more on their
(62) _____.

An eldest-born gets close attention (63) _____ its
parents, and develops an (64) _____ orientation
toward them. But then (65) _____ or she is
dethroned by (66) _____ second-born. This
dethroning, many psychiatrists (67) _____ can be
severely threatening to (68) _____ child if ineptly
handled by (69) _____ parents. At any rate, the
(70) _____ loses the status of being (71) _____
"only", and tends gradually to (72) _____ the
responsibility of being Big (73) _____ or Big Sister

thrust upon (74) _____, especially in larger

families.

Middle (75) _____ lack the authority of the (76)

_____ and the freedom-from-pressure of the (77)

_____. Dr. Louis Bates Ames, of (78) _____

Gesell Institute of Child Development (79) _____ New

Haven, Conn., finds that (80) _____ of these

children feel "squished (81) _____ the middle". On

the (82) _____ hand, they have less (83)_____

of being dethroned as (84) _____ children come

along. Also, (85) _____ oriented to siblings, they

(86) _____ to be less concerned (87) _____

winning our approval. One (88) _____ on mental

health contends (89) _____ the in-between child

actually (90) _____ the "most comfortable" position

(91) _____ all in the birth (92) _____.

The youngest, being last, (93)_____ almost as much

devoted (94)_____ from its mother as (95)_____ only

child. But usually (96)_____ doesn't sense as much

(97)_____ pressure to be achievement-oriented.

(98)_____ youngest-borns feel "picked on" (99)_____

older brothers and sisters, (100)_____ in fact, they

are usually the most made-over, the most babied, in the

family.

APPENDIX C

LOCUS OF CONTROL SCALE

INSTRUCTIONS: Using the enclosed answer sheet, for each question, please indicate whether you agree more with statement a. or b. Select only one option for each statement. For each question, use the number 1 option if you agree more with the "a" statement, and use the number 2 option if you agree more with the "b" option.

1. a. Grades are a function of the amount of work students do.
   b. Grades depend on the kindness of the instructor.

2. a. Promotions are earned by hard work.
   b. Promotions are a result of being in the right place at the right time.

3. a. Meeting someone to love is a matter of luck.
   b. Meeting someone to love depends on going out often so as to meet many people.

4. a. Living a long life is a function of heredity.
   b. Living a long life is a function of adopting healthy habits.

5. a. Being overweight is determined by the number of fat cells you were born with or developed early in life.
   b. Being overweight depends on what and how much food you eat

6. a. People who exercise regularly set up their schedules to do so.
   b. Some people just don't have the time for regular exercise.

7. a. Winning at poker depends on betting correctly.
   b. Winning at poker is a matter of being lucky.

8. a. Staying married depends upon working at the marriage.
   b. Marital breakup is a matter of being unlucky in choosing the wrong marriage partner.

9. a. Citizens can have some influence on their governments.
   b. There is nothing an individual can do to affect governmental function.

10. a. Being skilled at sports depends on being born well coordinated.
    b. Those skilled at sports work hard at learning those skills.

11. a. People with close friends are lucky to have met someone to be intimate with.
    b. Developing close friendships takes hard work.

12. a. Your future depends on whom you meet and on chance.
    b. Your future is up to you.

13. a. Most people are so sure of their opinions that their minds cannot be changed.
    b. A logical argument can convince most people.

14. a. People decide the direction of their lives.
    b. For the most part, we have little control of our futures.

15. a. People who don't like you just don't understand you.
    b. You can be liked by anyone you choose to like you.

16. a. You can make your life a happy one.
    b. Happiness is a matter of fate.

17. a. You evaluate feedback and make decisions based upon it.
    b. You tend to be easily influenced by others.

18. a. If voters studied nominees' records, they could elect honest politicians.
    b. Politics and politicians are corrupt by nature.

19. a. Parents, teachers, and bosses have a great deal to say about one's happiness and self-satisfaction.
    b. Whether you are happy depends upon you.

20. a. Air pollution can be controlled if citizens would get angry about it.
    b. Air pollution is an inevitable result of technological progress.

APPENDIX D

STUDY PROCESS QUESTIONNAIRE

On the following pages are a number of questions about your
attitudes towards your studies and your usual ways of
studying. There is no right way of studying. It all
depends on what suits your own style. If you think that
your answer to a question would depend on the subject being
studied, give the answer that would apply to the subject(s)
most important to you.

Use this scale to mark your answers to the following
questions on the answer sheet.

1 - this item is <u>never</u> or <u>only rarely</u> true of me.
2 - this item is <u>sometimes</u> true of me.
3 - this item is true of me about <u>half the time</u>.
4 - this item is <u>frequently</u> true of me.
5 - this item is <u>always</u> or <u>almost always</u> true of me.

21. I chose my present courses largely with a view to the
job situation when I graduate rather than out of their
intrinsic interest to me.

22. I find that at times studying gives me a feeling of
deep personal satisfaction.

23. I want top grades in most or all of my courses so that
I will be able to select from among the best positions
available when I graduate.

24. I think browsing around is a waste of time, so I only
study seriously what's given out in class or in the course
outlines.

25. While I am studying, I often think of real life
situations to which the material that I am learning would be
useful.

26. I summarize suggested readings and include these as
part of my notes on a topic.

27. I am discouraged by a poor mark on a test and worry
about how I will do on the next test.

28. While I realize that the truth is forever changing as
knowledge is increasing, I feel compelled to discover what
appears to me to be the truth at this time.

29. I have a strong desire to excel in all my studies.

1 - this item is <u>never</u> or <u>only rarely</u> true of me.
2 - this item is <u>sometimes</u> true of me.
3 - this item is true of me about <u>half the time</u>.
4 - this item is <u>frequently</u> true of me.
5 - this item is <u>always</u> or <u>almost always</u> true of me.

30. I learn some things by rote, going over and over them until I know them by heart.

31. In reading new material I often find that I'm continually reminded of material I already know and see the latter in a new light.

32. I try to work consistently throughout the term and review regularly when the exams are close.

33. Whether I like it or not, I can see that further education is for me a good way to get a well-paid or secure job.

34. I feel that virtually any topic can be highly interesting once I get into it.

35. I would see myself basically as an ambitious person and want to get to the top, whatever I do.

36. I tend to choose subjects with a lot of factual content rather than theoretical kinds of subjects.

37. I find that I have to do enough work on a topic so that I can form my own point of view before I am satisfied.

38. I try to do all of my assignments as soon as possible after they are given out.

39. Even when I have studied hard for a test, I worry that I may not be able to do well in it.

40. I find that studying academic topics can at times be as exciting as a good novel or movie.

41. If it came to the point, I would be prepared to sacrifice immediate popularity with my fellow students for success in my studies and subsequent career.

42. I generally restrict my study to what is specifically set as I think it is unnecessary to do anything extra.

43. I try to relate what I have learned in one subject to that in another.

44. After a lecture or lab I reread my notes to make sure they are legible and that I understand them.

1 - this item is <u>never</u> or <u>only rarely</u> true of me.
2 - this item is <u>sometimes</u> true of me.
3 - this item is true of me about <u>half the time</u>.
4 - this item is <u>frequently</u> true of me.
5 - this item is <u>always</u> or <u>almost always</u> true of me.

45. Lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.

46. I usually become increasingly absorbed in my work the more I do.

47. One of the most important considerations in choosing a course is whether or not I will be able to get top marks in it.

48. I learn best from lecturers who work from carefully prepared notes and outline major points neatly on the blackboard.

49. I find most new topics interesting and often spend extra time trying to obtain more information about them.

50. I test myself on important topics until I understand them completely.

51. I almost resent having to spend a further three or four years studying after leaving school, but feel that the end results will make it all worthwhile.

52. I believe strongly that my main aim in life is to discover my own philosophy and belief system and to act strictly in accordance with it.

53. I see getting high grades as a kind of competitive game, and I play it to win.

54. I find it best to accept the statements and ideas of my lecturers and question them only under special circumstances.

55. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.

56. I make a point of looking at most of the suggested readings that go with the lecturers.

57. I am at college mainly because I feel that I will be able to obtain a better job if I have a college degree.

58. My studies have changed my views about such things as politics, my religion, and my philosophy of life.

1 - this item is <u>never</u> or <u>only rarely</u> true of me.
2 - this item is <u>sometimes</u> true of me.
3 - this item is true of me about <u>half the time</u>.
4 - this item is <u>frequently</u> true of me.
5 - this item is <u>always</u> or <u>almost always</u> true of me.

59. I believe that society is based on competition and schools and universities should reflect this.

60. I am very aware that lecturers know a lot more than I do and so I concentrate on what they say is important rather than on my own judgement.

61. I try to relate new material, as I am reading it, to what I already know on that topic.

62. I keep neat, well-organzed notes for most subjects.

APPENDIX E

Metacognitive Assessment Measure

Please indicate whether you know, or do not know each of the words listed below. Use the following key for each word, and mark your answers on the answer sheet.

1 - Know the word
2 - Do Not Know the word

63 - Abuse

64 - Acute

65 - Ascribe

66 - Attenuate

67 - Attributed

68 - Benign

69 - Cholesterol

70 - Coronary

71 - Deterrent

72 - Diagnosis

73 - Efficacy

74 - Emanating

75 - Entities

76 - Epidemiologists

77 - Esoteric

78 - Etiology

79 - Fatalities

80 - Genre

81 - Gravity

82 - Guarded

83 - Implicated

84 - Incidence

85 - Infarction

86 - Ingesting

87 - Ischemia

88 - Maladies

89 - Median

90 - Myocardium

91 - Obesity

92 - Oblivious

93 - Optimal

94 - Prevalent

95 - Prognosis

96 - Regenerate

97 - Residual

98 - Therapy

99 - Transitory

100 - Viable

For each word select the answer which means most nearly the same thing as the first word. Mark your answers on the answer sheet.

101) Prevalent
  1 - stronger
  2 - winning
  3 - frequent
  4 - prior

102) Attributed
  1 - caused
  2 - ovation
  3 - stream
  4 - tax

103) Optimal
  1 - best
  2 - opening
  3 - eyeball
  4 - cheerful

104) Obesity
  1 - listen
  2 - fat
  3 - apology
  4 - obsolete

105) Acute
  1 - pretty
  2 - serious
  3 - heavy
  4 - often

106) Ascribe
  1 - refer
  2 - written
  3 - question
  4 - bed

107) Transitory
  1 - move
  2 - temporary
  3 - carry
  4 - train

108) Median
  1 - stripe
  2 - divider
  3 - middlemost
  4 - negotiate

109) Ingest
  1 - joke
  2 - eat
  3 - enter
  4 - exit

110) Residual
  1 - lasting
  2 - live
  3 - income
  4 - clever

111) Infarction
  1 - tooth decay
  2 - particle
  3 - rule violation
  4 - muscle death

112) Fatalities
  1 - fatty tissue
  2 - deaths
  3 - fateful
  4 - take in stride

113) Incidence
  1 - new cases
  2 - an example
  3 - exciting
  4 - event

114) Attenuate
  1 - listen
  2 - reduce
  3 - pay attention
  4 - try

115) Guarded
  1 - uncertain
  2 - optimistic
  3 - degrees
  4 - watchful

116) Viable
  1 - energetic
  2 - visible
  3 - practical
  4 - causeway

117) Esoteric
   1 - acid
   2 - mysterious
   3 - medicine
   4 - chemical

118) Benign
   1 - cancerous
   2 - favorable
   3 - start
   4 - generous

119) Etiology
   1 - cause
   2 - science
   3 - religion
   4 - biological

120) Implicated
   1 - decided
   2 - suggested
   3 - cursed
   4 - freed

121) Therapy
   1 - treatment
   2 - outcome
   3 - diagnosis
   4 - medication

122) Abuse
   1 - humorous
   2 - overuse
   3 - privilege
   4 - indecent

123) Genre
   1 - type
   2 - sex
   3 - heredity
   4 - common

124) Deterrent
   1 - custody
   2 - prevention
   3 - explosive
   4 - mistake

125) Efficacy
   1 - fragility
   2 - masculinity
   3 - femininity
   4 - competence

126) Gravity
   1 - deathly
   2 - seriousness
   3 - digging
   4 - weight

127) Emanating
   1 - dieting
   2 - spirit
   3 - coming from
   4 - going to

128) Entities
   1 - completely
   2 - partly
   3 - systems
   4 - something holy

129) Cholesterol
   1 - serious illness
   2 - coal pollution
   3 - fat in the blood
   4 - type of alcohol

130) Ischemia
   1 - unusual story
   2 - sting operation
   3 - mild heart damage
   4 - medium heat damage

131) Myocardium
   1 - shortsighted
   2 - heart muscle
   3 - card game
   4 - fatty tissue

132) Diagnosis
   1 - treatment
   2 - cure
   3 - x-ray
   4 - identification

133) Prognosis
  1 - back illness
  2 - unbeliever
  3 - division
  4 - outcome

134) Coronary
  1 - corn product
  2 - crowning a king
  3 - dealing with the heart
  4 - tobacco product

135) Epidemiologist
  1 - give vaccinations
  2 - study community myths
  3 - study community diseases
  4 - check hearing

136) Maladies
  1 - type of jam
  2 - laziness
  3 - feminine
  4 - illnesses

137) Oblivious
  1 - self evident
  2 - poor vision
  3 - ignorant
  4 - irrelevant

138) Regenerate
  1 - kinky
  2 - powerful
  3 - king's son
  4 - bring back to life

Read this passage carefully:

Jim was shocked when his father developed coronary or heart disease and decided to learn more about this illness to help his Dad recover. While health workers are also worried about other maladies like cancer, AIDS, Jim was only interested in learning about coronary disease. He became afraid for his father when he read that coronary problems cause more than half the fatalities or deaths in the United States. Jim's worry increased when he learned that 55% of the deaths, or more fatalities than for all the other illnesses combined, may be ascribed to coronary disease. Not only is coronary disease responsible for the greatest number of fatalities but it is also the most prevalent, or frequent, of all the serious illnesses. Jim realized that coronary disease is more prevalent than the other serious conditions combined. Once started, Jim couldn't stop reading about heart disease.

Jim learned that the incidence, that is the number of new cases, of coronary disorders is higher among men than women. When he also read that the incidence of heart disorders is higher for cigarette smokers than non-smokers, Jim wished his father had stopped smoking when his mother had asked him to. He remembered the many arguments at home about his father's use of liquor and drugs, and when Jim read that a higher incidence of coronary disease was attributed to alcoholism, drug addiction, and tobacco, Jim resolved to try again to have his father break these habits. He learned that

the etiology, or causes, of coronary disease are not completely clear but excessive use or abuse of alcohol and the other substances is often linked to coronary disease. Jim also read that tension, air pollution, weighing too much, and not exercising enough are also implicated as causes of heart disease.

Jim found that the gravity of heart disease is a function of the magnitude of coronary damage. The heart is basically a muscle, similar to the others in his father's body. The amount of damage to the heart muscle, or myocardium, determines the seriousness of the illness. Jim became anxious when he realized that his father had the most serious type of damage, called myocardial infarction, which occurs when the heart muscle dies. One major difference between the myocardium and other muscles in the human body is that the others heal after being damaged. Jim's fear increased when he learned that once the heart muscle dies it cannot regenerate. He was distressed to realize that the coronary damage from infarction meant that his father's heart was permanently damaged.

Jim read that ischemia described the least severe damage to the heart. Many people may have attacks of ischemia from various factors including exhaustion. Ischemia is very transitory, that is, it lasts for a very short time and then disappears. Jim wondered if his father's former complaints of different pains were actually ischemia attacks since people are quite oblivious of having them. Therefore,

ischemia is considered the most benign or harmless coronary disorder. Jim read that the word injury is used to describe heart damage of median seriousness. Injury is more severe than ischemia, but less acute than infarction.

Jim became most anxious while reading that the prognosis, or chances of recovery, for his dad depended on the amount of muscle death that had taken place. The prognosis for major infarctions like his Dad's is very guarded since they are usually accompanied by large amounts of muscle death. The chances of recovery from injury are quite good because medium types of coronary disorder usually leave little residual, or remaining heart damage. Jim wished that his father had ischemia because it disappears so quickly that complete recovery is usually certain in this genre of disorder.

Jim found out that advances in research and technology improved the development of more accurate techniques for the diagnosis and early detection of heart disease. He was pleased to learn that research has also led to more effective types of therapy, or treatment to deal with coronary disorders. Jim was hopeful for his dad's recovery after learning that, as in all disease entities, early identification greatly increased the probability of surviving a heart attack and of being completely cured.

Jim learned about the work of epidemiologists, who study the incidence of diseases in various communities, and have compared the prevalence of heart disease in the United

States and in other countries. These scientists also examined the efficacy of different treatments for heart disease. Jim was surprised to learn their conclusion that the optimal or best way of dealing with heart disease is not found in treatments using technology. Neither is it found in surgery, or in the use of new or esoteric medications. The most viable treatment for coronary disorders is to prevent them from developing in the first place.

Jim took careful notes about the ways the risk of further heart disease could be reduced. Ingesting less fat is of major importance in lowering the risks of developing coronary disease. Limiting fat intake reduces weight and the resulting obesity. It also lowers the concentrations of cholesterol, or fatty substances in the blood. High concentrations of cholesterol are found in foods emanating from animals. Therefore, Jim's father should avoid his favorite foods, fatty meats such as hamburgers, hot dogs, and other fast foods. He hoped that his father would also eliminate smoking and other forms of substance abuse, and exercise regularly, since these were all deterrents to the development of coronary disorders. Jim wrote to the Heart Association for free pamphlets describing effective ways to attenuate, or reduce the risk of developing heart disease.

APPENDIX E

Metacognitive Assessment Measure

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2 - Do Not Know the word

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73 - Efficacy

74 - Emanating

75 - Entities

76 - Epidemiologists

77 - Esoteric

78 - Etiology

79 - Fatalities

80 - Genre

81 - Gravity

82 - Guarded

83 - Implicated

84 - Incidence

85 - Infarction

86 - Ingesting

87 - Ischemia

88 - Maladies

89 - Median

90 - Myocardium

91 - Obesity

92 - Oblivious

93 - Optimal

94 - Prevalent

95 - Prognosis

96 - Regenerate

97 - Residual

98 - Therapy

99 - Transitory

100 - Viable

For each word select the answer which means most nearly the same thing as the first word. Mark your answers on the answer sheet.

101) Prevalent
 1 - stronger
 2 - winning
 3 - frequent
 4 - prior

102) Attributed
 1 - caused
 2 - ovation
 3 - stream
 4 - tax

103) Optimal
 1 - best
 2 - opening
 3 - eyeball
 4 - cheerful

104) Obesity
 1 - listen
 2 - fat
 3 - apology
 4 - obsolete

105) Acute
 1 - pretty
 2 - serious
 3 - heavy
 4 - often

106) Ascribe
 1 - refer
 2 - written
 3 - question
 4 - bed

107) Transitory
 1 - move
 2 - temporary
 3 - carry
 4 - train

108) Median
 1 - stripe
 2 - divider
 3 - middlemost
 4 - negotiate

109) Ingest
 1 - joke
 2 - eat
 3 - enter
 4 - exit

110) Residual
 1 - lasting
 2 - live
 3 - income
 4 - clever

111) Infarction
 1 - tooth decay
 2 - particle
 3 - rule violation
 4 - muscle death

112) Fatalities
 1 - fatty tissue
 2 - deaths
 3 - fateful
 4 - take in stride

113) Incidence
 1 - new cases
 2 - an example
 3 - exciting
 4 - event

114) Attenuate
 1 - listen
 2 - reduce
 3 - pay attention
 4 - try

115) Guarded
 1 - uncertain
 2 - optimistic
 3 - degrees
 4 - watchful

116) Viable
 1 - energetic
 2 - visible
 3 - practical
 4 - causeway

117) Esoteric
1 - acid
2 - mysterious
3 - medicine
4 - chemical

118) Benign
1 - cancerous
2 - favorable
3 - start
4 - generous

119) Etiology
1 - cause
2 - science
3 - religion
4 - biological

120) Implicated
1 - decided
2 - suggested
3 - cursed
4 - freed

121) Therapy
1 - treatment
2 - outcome
3 - diagnosis
4 - medication

122) Abuse
1 - humorous
2 - overuse
3 - privilege
4 - indecent

123) Genre
1 - type
2 - sex
3 - heredity
4 - common

124) Deterrent
1 - custody
2 - prevention
3 - explosive
4 - mistake

125) Efficacy
1 - fragility
2 - masculinity
3 - femininity
4 - competence

126) Gravity
1 - deathly
2 - seriousness
3 - digging
4 - weight

127) Emanating
1 - dieting
2 - opinic
3 - coming from
4 - going to

128) Entities
1 - completely
2 - partly
3 - systems
4 - something holy

129) Cholesterol
1 - serious illness
2 - coal pollution
3 - fat in the blood
4 - type of alcohol

130) Ischemia
1 - unusual story
2 - sting operation
3 - mild heart damage
4 - medium heat damage

131) Myocardium
1 - shortsighted
2 - heart muscle
3 - card game
4 - fatty tissue

132) Diagnosis
1 - treatment
2 - cure
3 - x-ray
4 - identification

133) Prognosis
   1 - back illness
   2 - unbeliever
   3 - division
   4 - outcome

134) Coronary
   1 - corn product
   2 - crowning a king
   3 - dealing with the heart
   4 - tobacco product

135) Epidemiologist
   1 - give vaccinations
   2 - study community myths
   3 - study community diseases
   4 - check hearing

136) Maladies
   1 - type of jam
   2 - laziness
   3 - feminine
   4 - illnesses

137) Oblivious
   1 - self evident
   2 - poor vision
   3 - ignorant
   4 - irrelevant

138) Regenerate
   1 - kinky
   2 - powerful
   3 - king's son
   4 - bring back to life

APPENDIX F

Text Passages and Associated

Open Ended Questions

Read the following letter and then answer the question on the next page. Take as long as you need to read the letter, but once you turn the page, do not return to it.

Experiences of a Convict, 1835

Dear Mother and Father,
     This comes with my kind love to you, hoping to find you in good health as, thank God, it leaves me at present very comfortable indeed. I have a place at a farmhouse, and I ave got a good master. I works the same as I were at home, I have plenty to eat and drink, thank God for it. I am allowed two ounces of tea, one pound of sugar, 12 pounds of meat, 10 pounds and a half of flour, two ounces of tobacco, the week, three pairs of shoes, two suits of clothes, four shirts, a year; that is the allowance from the Government. But we have as much to eat as we like, as some masters are a great deal better than others. All a man has got to mind is to keep a still tongue in his head, and do his master's duty, then he is looked upon as if her were at home; but if he don't he may as well be hung at once, for they would take you to the magistrates and get 100 of lashes, and then be sent to a place called Port Arthur to work in irons for two or three years, and then he is disliked by everyone.

                    From
                    your loving son.

Question: How difficult was a convict's lot?

Below are two views of the conditions in Britain in the 1830s. Read them both and then answer the question on the following page. Take as long as you need to read this passage, but once you turn the page to answer the question, do not return to this page.

The working classes in Britain, though they have their grievances and distresses, are, on the whole, better off as to physical comforts than any other European working class. They have a more plentiful supply of food, better clothing, and better furniture and for this reason suffering is more acutely felt. Yet we firmly believe that, in spite of heavy taxation, a war, and a huge public debt, the country is becoming richer and richer.

Factory workers are working from 3:00 A.M. until 10:00 P.M. for three shillings and seven pence halfpenny, a quarter of which they lose if they arrive five minutes late for work. Children of 6 years old are working in these factories under the most atrocious conditions. The overlookers often beat their workers, but no compensation is paid for injuries received at work.

The worker's houses consist of one room with an earthen floor. These houses are packed tightly together around the factory and this together with lack of proper sanitation make for very unhealthy, if fact dangerous conditions.

Question: Do you think the British worker was well off?

Read the passage below, then answer the question on the
following page. Take as long as you need to read this
passage, but once you turn the page to answer the question,
do not return to this passage.

The Function of Stonehenge

Stonehenge is in the South of England, on the flat
plain of Salisbury. It consists of a ring of very big
stones. Some of the stones have fallen down and some have
disappeared from the place. The people who lived in England
in those days we call Bronze Age Men. Long before there
were any towns, Stonehenge was a temple for worship and
sacrifice. Some of the stones were brought from the nearby
hills, but others which we call Blue Stones, we think came
from the mountains of Wales.

Question: Do you think Stonehenge might have been a fort
and not a temple? Why do you think that?

APPENDIX G

Test of Cognitive Performance

For the following questions you will be given a brief passage of text, and then some instructions about how to answer the subsequent questions. Mark your answers on the second computer scoring answer sheet.

A. Jane is faced with the problem of selecting material for a school dress. The dress will receive lots of wear and will be laundered frequently. Use the following code to indicate how the items listed below would affect her decision on which material to select?

Key:
1 - choose this fabric
2 - reject this fabric
3 - no effect on decision

QS. 1. Material is colorfast to washing

QS. 2. Material is crease resistant

QS. 3. Material is in a contemporary print and color

QS. 4. Material is easily cared for

QS. 5. Material is soft and will drape easily

QS. 6. Weave is firm, close and smooth

QS. 7. Material requires dry cleaning

QS. 8. Material will not show soil easily

QS. 9. Design is printed with the grain

B. For items 10 - 15, assume that in doing research for a paper about the English language you find a statement by Otto Jespersen which contradicts some point of view on language which you have always accepted. Indicate which of the statements would be significant in determining the value of Jespersen's statement. For the purpose of these questions, you may assume that all these statements are accurate.
Key:
1 - Significant positively -- i.e. might lead you to trust his statement and to revise your own opinion.

2 - Significant negatively -- i.e. might lead you to distrust his statement.

3 - Has no significance.

QS. 10. Mr Jespersen was Professor of English at Copenhagen University.

QS. 11. The statement in question was taken from the very first article that Mr. Jespersen published.

QS. 12. Mr. Jespersen's books are frequently referred to in other works that you consult.

QS. 13. Mr. Jespersen's name is not included in the Dictionary of American Scholars.

QS. 14. So far as you can find, Jespersen never lived in England or the United States for any considerable period.

QS. 15. In your reading of other authors on the English language, you find that several of them went to Denmark to study under Jespersen.

C. Questions 16 - 20 relate to the following resolution:

Resolved: That the term of the President of the United States should be extended to six years.

Some of the statements in questions 16-20 support the resolution, either directly or indirectly, some could be used in arguing against the resolution, and some have no bearing on the issue at all. Use the following key to mark your answers.

Key:
1 - You feel the statement could be used to support the resolution.

2 - You feel the statement could be used against the resolution.

3 - You feel the statement has no bearing on the issue.

QS. 16. Efficiency increases with experience.

QS. 17. According to the principles upon which the United States was founded, the people should have a frequent check on the President.

QS. 18. The party system has many disadvantages.

QS. 19. During most of a presidential election year the economic life of the nation is depressed by the uncertainty as to the outcome of the election.

QS. 20. The people should have the opportunity to keep a satisfactory President as long as they wish.

D. Questions 21 - 24 relate to the following passage.

A group of college students were discussing the relative merits of two grading systems. It had been suggested that only two grades be used: S (satisfactory) and U (unsatisfactory), instead of the A-B-C-D-F system then in use at the college. One student made the following statement:

"People go to college to learn, not just to get grades. Grades are no indication of absolute degree of learning, they are purely relative and then mostly determined by chance or probability (guessing, multiple-choice tests, etc.). The student is a better judge of how he is doing than the professor. Therefore, an S-U system would be better since it would cut down the amount of differentiation between grades given and give a better picture of how the student is doing."

QS. 21. Which of the following statements is least essential as a part of the argument?
1 - Grades are no indication of absolute degree of learning.
2 - An S-U system would cut down the amount of differentiation between grades.
3 - An S-U system would give a better picture of how the student is doing.
4 - Grades are determined by chance or probability.
5 - The student is a better judge of how he is doing than the professor.

QS. 22. The conclusion of this student's argument is that:
1 - grades should be abolished.
2 - students do not care about their grades.
3 - students should grade themselves.
4 - a new grading system could be substituted for the present one.
5 - the present grading system is better than the proposed substitute.

QS. 23. The conclusion depends fundamentally on the proposition that:
1 - people do not go to college just to get grades.
2 - the student is the best judge of how he is doing.
3 - grades are very inaccurate indications of what students have learned.
4 - one grading system is better than the other.
5 - multiple-choice tests are used in determining grades.

QS. 24. An important unstated assumption involved in this argument is that:
1 - the accuracy of the A-B-C-D-F system cannot or will not be significantly improved.
2 - people go to college to learn.
3 - the student is a better judge of how he is doing than the professor.
4 - an S-U system would be better.
5 - grades have no importance.

E. Questions 25 and 26 refer to the following paragraph:

"For what men say is that, if I am really just and an not
2 also thought just, profit there is none, but the pain and loss
on the other hand is unmistakable. But if, thought unjust, I
4 acquire the reputation of justice, a heavenly life is promised
to me. Since then appearance tyrannizes over truth and is lord
6 of happiness, to appearance I must devote myself. I will de-
scribe around me a picture and shadow of virtue to be the
8 vestibule and exterior of my house; behind I will trail the
subtle and crafty fox."

QS. 25. Which of the following best states the major premise of the
argument?
1 - "For what men say is" (line 1).
2 - "if I am really just" (line 1).
3 - "profit there is none" (line 2).
4 - "appearance tyrannizes over truth and is lord of happiness"
(line 5).
5 - "to appearance I must devote myself" (line 6).

QS. 26. Which of the following best states the conclusion of the
argument?
1 - "For what men say is" (line 1).
2 - "if I am really just" (line 1).
3 - "profit there is none" (line 2).
4 - "appearance tyrannizes over truth and is lord of happiness"
(line 5).
5 - "to appearance I must devote myself" (line 6).

F. Questions 27, 28 and 29 refer to the following passage:

When on Thursday, February 8, 1951 a Chicagoan, Mrs. Dorothy Mae
Stevens, was found unconscious in a passageway after a night of
exposure to 11 degree subzero weather, she was literally frozen stiff.
Her temperature had dropped to an unprecedented 64 degrees
(Fahrenheit). Twenty hours after her arrival at Michael Reese
Hospital, her temperature had risen to 98.2 degrees. Early Friday
morning it was 101 and later 100. On Saturday it was also 100
degrees. When she was first found, her respiration was slowed to 3 a
minute. By Saturday it was up to 24 a minute. Her blood pressure was
zero on Thursday, by Saturday it was 132 over 80. On Thursday her
pulse rate was 12 a minute; on Saturday it was 100. Cortisone was
administered early.

QS. 27. At a body temperature of 64 degrees:
1 - the blood carries more oxygen to the cells than normally, because more gasses dissolve in fluids at low temperatures rather than high temperatures.
2 - the blood vessels of the skin are dilated, because the vasoconstrictior muscles are relaxed.
3 - the heart beats more rapidly, because the cold stimulates the heart center in the medulla.
4 - most activities slow down, because all chemical activities decrease as the temperature falls.

QS. 28. The immediate cause of Mrs. Stevens' unconsciousness was probably due to the:
1 - lack of sufficient amount of oxygen to the brain cells.
2 - lowering of the external temperature.
3 - slow pulse rate.
4 - decrease in muscle tone.
5 - low breathing rate.

QS. 29. When Mrs. Stevens was found in the subzero weather her heart was beating:
1 - 12 times a minute
2 - 3 times a minute
3 - 0 times a minute
4 - the normal number of times a minute, with normal vigor.
5 - subnormally, but there is nothing in the article to indicate how many times.

G. Questions 30 - 34 refer to the information provided in the following table. Read each statement and mark your answer sheet according to the key provided.

Mortality of White Persons from Motor Vehicle Accidents in the United States, 1957-1958.

AGE PERIOD (YEARS)	DEATH RATE PER 100,000	
	MALES	FEMALES
all ages	32.9	11.1
1-4	10.5	8.0
5-14	10.4	5.4
15-19	54.2	16.4
20-24	76.3	12.7
25-44	35.6	9.1
45-64	33.1	12.9
65 and over	58.4	22.5

Key:
1 - the statement is supported by the data in the table.
2 - the statement is refuted by the data in the table.
3 - the statement is neither supported not refuted by the data in the table.

QS. 30. The death rate from motor vehicle accidents is higher for men than for women.

QS. 31. Motor vehicle accidents are a major cause of death among young men between the ages of 20 and 24.

QS. 32. Men over 65 years of age drive no more safely than do teenage boys between 15 and 19 years of age.

QS. 33. The largest number of people killed in motor vehicle accidents are 65 years of age or over.

QS. 34. When all ages are combined, only about 11 percent of female deaths can be attributed to motor vehicle accidents.

H. Questions 35 - 45 refer to the following passage. Use the key provided after the text to mark your answers on the answer sheet.

By the close of the thirteenth century there were several famous universities established in Europe, though of course they were very different from modern ones. One of the earliest to be founded was one of the most widely known. This was the University of Bologna, where students from all countries came who wished to have the best training in studying Roman Law. Students especially interested in philosophy and theology went to the University of Paris. Those who wished to study medicine went to the Universities of Montpellier or Salerno.

Key:
1 - the statement may be inferred as true.
2 - the statement may be inferred as untrue.
3 - no inference can be drawn from the paragraph.

QS. 35. There were law suits between people occasionally in those days.

QS. 36. The professors were poorly paid.

QS. 37. In the Middle Ages people were not interested in getting an education.

QS. 38. There were books in Europe at that time.

QS. 39. Most of the teaching in these medieval universities was very poor.

QS. 40. There was no place where students could go to study.

QS. 41. There were no doctors in Europe at this time.

QS. 42. There was no way to travel during the Middle Ages.

QS. 43. If a student wanted to be a priest, he would probably attend the University of Paris.

QS. 44. There were no universities in Europe before the thirteenth century.

QS. 45. There was only one language in Europe at this time.

I. Questions 46 - 50 refer to the data presented in the following table. Based on the data in this table mark your answers to questions 46-50 using the key provided.

	Occupational distributions in	
	male college graduates	whole population
OCCUPATIONS	PERCENTAGES	
Executives, minor officials, partners, proprietors	23.5	9.1
Professional workers	51.3	4.7
Salesmen	6.0	less than 1%
Skilled workers	7.1	33.8
Clerical workers	8.7	13.4
Unskilled workers	1.7	26.1
Farmers	1.7	13.0

Key:
1 - if the data in the table alone are sufficient to prove the statement true.
2 - if the data in the table alone are sufficient to prove the statement is probably true.
3 - if the data in the table are not sufficient to indicate whether there is any degree of truth or falsity in the statement.
4 - if the data in the table alone are sufficient to prove the statement is probably false.
5 - if the data in the table alone are sufficient to prove the statement is false.

QS. 46. Typically farmers are completely uneducated.

QS. 47. The professions absorb a larger percentage of male college graduates than any other group in the country.

QS. 48. Sons of unskilled workers and sons of farmers have an approximately equal chance to go to college.

QS. 49. Educational opportunity for the lower classes is increasing.

QS. 50. The same proportions of farmers and of unskilled workers are college graduates.