

Learning strategies of concurrent enrollment students at Utah Valley State College
by Ted Rulon Ungricht

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University
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Abstract:
The purpose of this study was to identify the relationship between learning strategies and demographic and educational performance variables, and to explore patterns of learning of distinct clusters that existed in a sample of 279 high schools students. Differences in the use of learning strategies were found when the participants were grouped according to age, gender, grade point average, Degrees of Reading Power score, Computer-Adaptive Placement Assessment and Support System scores, and ACT scores.

Several multivariate analyses using discriminant analysis identified five distinct learning processes. The Metacognitive Consciousness process involves a person having faith in their ability to learn. The Calibrating process involves a person who plans and analyzes the best way to proceed with a specific learning task. The Feedback Detachment process indicates the learner is not monitoring the learning process or using human resources to learn. The Metacognitive Adaption process involves analyzing the best way to proceed with a specific learning task and then making changes in the learning process to improve learning. The Critical Differentiating process involves a reflective and tentative review of a solution to determine if adjustments are needed before acceptance.

The multivariate technique of cluster analysis identified five distinct clusters. The Total Physical Response Learner is interested in meaningful and in-depth learning. The Matrix Learner learns best in group settings. The Strategic Learner likes to be given a direction then follows it strictly. The Sequential Learner is able to organize his or her learning and focuses on details. The Creative Learners use higher order thinking skills to approach their learning.

Two major conclusions from this study are: distinct groups of learners exist among young adult learners and that learning strategies are linked to specific educational performance measures. Based on the results in this study recommendations were made for continuing research.

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by

Ted Rulon Ungricht

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APPROVAL

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency and is ready for submission to the College of Graduate Studies.

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Date July 24, 1997

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ABSTRACT

The purpose of this study was to identify the relationship between learning strategies and demographic and educational performance variables, and to explore patterns of learning of distinct clusters that existed in a sample of 279 high schools students. Differences in the use of learning strategies were found when the participants were grouped according to age, gender, grade point average, Degrees of Reading Power score, Computer-Adaptive Placement Assessment and Support System scores, and ACT scores. Several multivariate analyses using discriminant analysis identified five distinct learning processes. The Metacognitive Consciousness process involves a person having faith in their ability to learn. The Calibrating process involves a person who plans and analyzes the best way to proceed with a specific learning task. The Feedback Detachment process indicates the learner is not monitoring the learning process or using human resources to learn. The Metacognitive Adaption process involves analyzing the best way to proceed with a specific learning task and then making changes in the learning process to improve learning. The Critical Differentiating process involves a reflective and tentative review of a solution to determine if adjustments are needed before acceptance.

The multivariate technique of cluster analysis identified five distinct clusters. The Total Physical Response Learner is interested in meaningful and in-depth learning. The Matrix Learner learns best in group settings. The Strategic Learner likes to be given a direction then follows it strictly. The Sequential Learner is able to organize his or her learning and focuses on details. The Creative Learners use higher order thinking skills to approach their learning.

Two major conclusions from this study are: distinct groups of learners exist among young adult learners and that learning strategies are linked to specific educational performance measures. Based on the results in this study recommendations were made for continuing research.

CHAPTER 1

INTRODUCTION

Concurrent Enrollment

Legislation

Adult educators are experiencing a demand to be more flexible in relation to the age of students entering adult education. Many states have legislated or implemented a system of concurrent enrollment where students can receive college credit while still in high school (Vernon, 1979; Greenberg, 1989; Colwell, 1995). As early as 1976 Rhode Island had conducted a study and made recommendations on accelerated programs including concurrent enrollment (Vernon, 1979, p.23-24). In Colorado, the "Postsecondary Enrollment Options Act" was aimed at providing academic excellence to high school eleventh and twelfth graders. The Act stated,

> That high school pupils need to be continually challenged in order to maintain their academic interests; that such challenges must include rigorous academic pursuits; that, for some students, exposure to such academic challenges declines during the last two years of high school as pupils complete their graduation requirements; that there is a high rate of dropouts at the eleventh and twelfth grade levels; that for some students, courses not offered in high school or courses offered in a different setting may stimulate or maintain their interest; that providing a wider variety of options to high

> school pupils by encouraging and enabling secondary pupils to enroll in courses offered by state institutions of higher education provides new and exciting academic challenges to such pupils; and that such enrollment opportunities provide access to excellence in education. (Colorado Postsecondary Enrollment Options Act, p. 173)

Some state legislatures have required colleges and high schools to mediate concurrent enrollment programs with no tuition cost to the student (Florida Administrative Code, 1983; Randall, 1986; Utah Code, 1997).

Benefits

Arthur Greenberg (1991) wrote, "The potential benefits of concurrent enrollment programs and the costs of denying moderately achieving students access to such programs are numerous and substantial. Students, parents, high schools, colleges, and society as a whole might prosper from broader application of dual enrollment designs" (p. 27). In an earlier study, Greenberg (1989) reviewed eight concurrent enrollment programs throughout the nation and found significant benefits of the programs for the students, parents, high schools, colleges and society. The benefits included: a chance to earn college credits before leaving high school, reduced tuition costs, an assessment of a student's ability to do college work, reduced "senioritis," open lines of cooperation between high schools and colleges, recruiting, and increased access to higher education.

A number of programs have been established to take advantage of one or several benefits. One notable program in his review was the Syracuse University's Project Advance. In their model, courses are taught at the high school by high school faculty who are specially selected and trained. Students take the course over the duration of the high school year and take a final exam designed by the university. Credit is granted on an official university transcript. In the state of Washington, The Running Start Program allows students to earn both high school and college credits, and in some cases allows a student to graduate with a high school diploma and Associate degree at the same time (Colwell, 1995).

Utah Valley State College (UVSC) in Orem, Utah, and participating school districts in the Mountainland Region have agreed to grant college and high school credit from approved high school teachers who instruct approved classes contracted between the high school teacher and the appropriate college department. Concurrent enrollment classes are college-level classes offering both high school and college credit while students attend their regular high school; concurrent enrollment students are enrolled in high school and college at the same time. While earning high school credit, students earn official college credit, which is recorded on a Utah Valley State College transcript.

Another option for high school students is through interactive television courses. UVSC is the originating site at which selected core classes are broadcast over both the UVNET and Utah EDNET to high school sites throughout the state. These courses are taught by UVSC instructors. Again, students receive both high school and college credit for the courses taken through interactive TV. Concurrent enrollment at UVSC has seen a 475 percent increase in enrollment since the 1991-1992 school year.

These efforts to bring college level courses to the high school student are in response to a call for reform in the educational paradigm of secondary schools, to the need for improvement of the high school curriculum so students do not waste their senior year in high school, and to the increasing cost of college attendance to students. Darkenwald and Knox (1984) identified cost for young adults as " the principal self-reported deterrent to participation in continuing education" (p. 23).

The high school student who participates in concurrent enrollment at UVSC pays only the application fee and for books in the interactive TV courses (Utah Code, 1997). The student realizes an average savings of $238 per 3 credit hour course. This has allowed more than 3,000 high school students to earn more than 18,000 credit hours during the fall semester of 1996. Regardless of the form taken by

concurrent enrollment, high school students are embarking on educational levels previously reserved for adults.

Statement of the Problem

Young adults are faced with a unique period in an adult's life. They are faced with the issues of independence, intimacy, and identity. Along with these issues they face the responsibilities of new occupations, family, and community. Darkenwald and Knox (1984) pointed out:

> The psychological issues of independence, identity, and intimacy are manifested in the arenas of work, family, and community. However psychologically independent a young adult might be, our culture requires that one also be a contributing member of society before adult status in conferred. Preparing for and starting an occupation, getting married and having children, and assuming some civic responsibilities are earmarks of a socially mature person. Certainly not all young adults accomplish all of these tasks between their late teens and early thirties. There is also great variation in the timing of these tasks depending upon social class and sex. Nevertheless, this particular configuration of issues and tasks confronts all young adults, and it is this fact that makes young adulthood an identifiable stage of life, for which continuing educators can plan meaningful programs. (pp. 11-12)

It is extremely important that students learn how to learn at this time in their life in order to keep up with the fast paced changes occurring in society today. Smith and Haverkamp (1977) discussed the importance of learning how to

learn. They defined learning how to learn as "the adult's having, or acquiring, the knowledge and skills essential to learning effectively in whatever (learning) situation he encounters" (p.4). Fellenz (1994) stated that "learning strategies are the skills and techniques that an individual elects to use in order to accomplish a real-life learning task" (p.1). Conti and Fellenz (1991) addressed the meaning of which strategies are key to learning by pointing out, "Rather than skills in note taking, outlining, and test passing, learning strategies tend to focus on solving real problems involving metacognitive, memory, motivational, and critical thinking strategies" (p.1). The literature sheds little light on the learning strategies that concurrent enrollment students use in their learning. The problem is that there is little research data on the learning strategies used by young adults.

Purpose of the Study

The purpose of this study was to describe the learning strategies used by high school concurrently enrolled students at Utah Valley State College. To achieve this the study first determined what learning strategies concurrent enrollment students use. Second, it determined if different learning strategies are used by students depending on their age, gender, performance on writing, math and reading

assessments, and academic achievement. Third, it explored whether there are identifiable clusters of concurrent enrollment students. Finally, both quantitative cluster analysis and qualitative focus groups were used to determine and describe groups of learners.

Research Questions

This study investigated the relationship between learning strategies used by concurrent enrollment students in both high school and distance learning programs at selected off campus learning sites of UVSC. It used both a quantitative and qualitative approach to identify relationships and possible groups of learners. The cluster grouping allowed further description of the ways concurrent enrollment students learn through qualitative focus group interviews. Four research questions were addressed in the study:

Research Question 1: What learning strategies are employed by high school concurrent enrollment students as measured by the Self-Knowledge Inventory of Lifelong Learning Strategies which measures 15 learning strategies?

Research Question 2: When comparing groups of learners, do high school concurrent enrollment students use different learning strategies based on demographics

such as age and gender, performance on the Computerized-Adaptive Placement Assessment and Support System test, ACT, Degrees of Reading Power test, and academic achievement measured by high school Grade Point Average (GPA)?

Research Question 3: Are there distinct clusters of concurrent enrollment students?

Research Question 4: If distinct clusters exist among concurrently enrolled students, what are their characteristics?

Significance of the Study

The last two years of high school are a pivotal period in the development of young adults. However, in many cases, students do not take advantage of the opportunities offered for their learning of important life skills. Parnell (1990) explained:

> For many students in many high schools the twelfth grade experience does not amount to much. Students arrive at that point in their high school experience needing only two or three credits to graduate. As a consequence, the twelfth grade becomes a "goof off" year, a phenomenon that has seemed to increase since the late 1960's. Far too many high school seniors appear to be enrolled in unstructured and unfocused programs lacking in substance. Many educators are asking if excellence can be cultivated and a first-rate education achieved when half or more of high

> school seniors do not see this as a very important year of learning for them? (p 17)

Acquiring more information about the learning strategies of high school students has significant importance for the future of advanced high school study programs like the concurrent enrollment program. It can provide validation in terms of the efficacy of colleges reaching down into the high schools to help guide curriculum decisions. The information on learning acquired from this study could be used to help school districts provide better educational materials for student use. The results of this study could enable high school instructors to provide better counseling, teaching, and learning environments for students. This study has served as the basis for an inservice training workshop for concurrent enrollment teachers at Utah Valley State College.

Definition of Terms

COMPASS: An acronym for the Computerized-Adaptive Placement Assessment and Support System. This assessment is a "comprehensive software and operational support package developed by American College Testing (ACT) to help postsecondary institutions place students into appropriate entry-level courses and to diagnose specific areas of strengths and weaknesses" (The American College Testing Program, 1994).

Concurrent Enrollment: an articulated program that is designed to provide high school students the opportunity to receive college credit for the courses they take at the high school. High school teachers are approved and trained by the academic departments to

teach their classes at the same level as the college.

Critical Thinking: Brookfield (1987) identifies the following components of critical thinking: Identifying and challenging assumptions, challenging importance of context, imagining and exploring alternatives, and reflective scepticism (pp. 7-9) (Brookfield, 1987, p. 12).

DRP: an acronym for the Degrees of Reading Power test. This test attempts "as much as is possible in a testing situation. These tests determine how well a student reads under real-life conditions in and out of school" (Touchstone Applied Science Association, 1986).

GPA (Grade Point Average): The method commonly used by schools to report the overall average of grades received by a student. Grades in this study are on a 4.0 scale.

Learning Strategies: "The techniques and skills that an individual elects to use in order to accomplish a specific learning task. Such strategies vary by individual and by learning objective. Often they are so customary to learners that they are given little thought; at other times much deliberation occurs before a learning strategy is selected for a specific learning task" (Fellenz & Conti, 1989, p. 1).

Memory: Learning strategies which help adults in remembering in real-life learning situations. These include rehearsal of information, organization and elaboration of information, use of external aids, and the application of self-knowledge about memory and use of mnemonic techniques (Fellenz, 1994, p. 5).

Metacognition: "The knowledge, awareness, and monitoring of one's own cognitions are called metacognition" (Leahey & Harris, 1993, p. 236). "Thinking about the process of learning and emphasizing self-regulatory tactics to insure success in the learning endeavor" (Fellenz, 1988, p. 1).

Metamotivation: A concept developed from a model developed by Keller (1987). The SKILLS model emphasizes attention, anticipating reward, fostering confidence, and enjoying learning activities.

Resource Management: The "identification of appropriate

resources, critical use of such resources, and the use of human resources in learning" (Fellenz, 1994, p. 3).

SKILLS: An acronym for the Self-Knowledge Inventory of Lifelong Learning Strategies. This is a learning strategies inventory with established validity and reliability which asks respondents to rate 15 learning strategies in scenarios found in everyday life and which call for a learning effort on the part of the respondent (Fellenz, 1994, p. 2).

Delimitations and Assumptions

The study was confined to the Alpine school district in the Mountainland Region of Utah. Other school districts in the region did not give permission to conduct the skills survey or focus groups. Most of the randomly selected classes were extremely cooperative, but some teachers due to time constraints were unable to participate in the study. Also, time constraints during the focus groups limited the depth of questioning allowed. High school students are enmeshed in mandatory school attendance which requires a significant amount of their time for attendance and outside study. Consequently, it was difficult to draw answers from them that reflected other than school situations and examples. Since students enrolled in concurrent enrollment are participating in college level courses it was assumed that the majority of participants had the reading skills to understand the instructions and scenarios presented in the survey. Every effort was made to answer questions.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Adult Learning Theories

Adult life is filled with transitions such as leaving home for the first time, marriage, having children, finding or changing careers, retiring and a myriad of other life transitions. Each of these transitions requires a person to learn a new set of behaviors, attitudes and values in order to cope with the change. The transition from adolescence to becoming a young adult is just the first of many transitions. Hudson (1991) discussed life transitions and states the following about the young adult transition, "The adult years begin when adolescents break out of their family of origin and stake out the adult territory of love, work, and play. The primary goals are identity, intimacy, role mastery, and individuation" (p. 136).

Merriam and Caffarella (1991) have classified numerous adult learning theories into three categories. They include theories based on an adult's life situation, those based on changes in consciousness, and those based on adult characteristics. The category based on an adult's life situation includes adult learning theorists such as McClusky (1971), Knox (1980), and Jarvis (1983) who believe that

adult learning can be explained by understanding the life situation an adult is in. McClusky (1971) proposed what is called the "theory of margin." This theory maintains that "Margin" is keeping one's ability to deal with life (power) a little ahead of the problems (load). Depending on the life situation of a person, education will assist one in creating a margin of power for the attainment and conservation of well-being.

Knox's (1977) proficiency theory puts an emphasis on the ability of a person to perform satisfactorily. He states, "learning that results in competent and satisfactory performance entails the integration of new and changed knowledge, skills, and attitudes" (Knox, 1977, p. 406). Another aspect of proficiency theory is that an individual is expected to be proficient in major life roles and this is the goal of learning. Knox (1986) wrote, "proficiency-oriented continuing education emphasizes achievement of optimal standards of proficiency related to adult life roles" (p. 16).

At the heart of Jarvis's (1983) theory is experience. Any experience that requires more than a reflexive and unthinking response precipitates learning. He also emphasizes the importance of the social environment in learning. Jarvis (1983) wrote,

> Thus it may be argued that given specific social situations every adult is a learner, whereas in familiar experiences the knowledge gained merely reinforces that which the individual already has. Yet there is a sense in which this argument suggests that the motivating force for learning is a discordant experience between the self and the sociocultural environment, but I would be unwise to suggest that this is the only reason for undertaking such an activity. (p. 60)

The category based on changes in consciousness includes adult learning theorists such as Mezirow and Schon who argue that adult learning is a reflective and transformative process. Daloz (1986) defined transformative learning as growth which "can be understood as a series of transformations in our ways of making meaning" (p. 137). Mezirow (1978) viewed learning as "perspective transformation". Further, adults "learn to become critically aware of the cultural and psychological assumptions that have influenced the way we see ourselves and our relationships and the way we pattern our lives" (p. 101).

Schon (1987) applied his "reflection-in-action" model toward training professionals. He referred to knowing-in-action as "the sorts of know-how we reveal in our intelligent action-publicly observable, physical performances like riding a bicycle and private operations like instant analysis of a balance sheet. We reveal it by our spontaneous, skillful execution of the performance; and

we are characteristically unable to make it verbally explicit' (p. 25). Schon stated that this reflection can occur after the action is performed or reflection can occur while we are performing the action. Schon (1987) stated, "Alternatively, we may reflect in the midst of action without interrupting it. In an *action-present*--a period of time, variable with the context, during which we can still make a difference to the situation at hand--our thinking serves to reshape what we are doing while we are doing it. I shall say, in cases like this, that we reflect-*in*-action" (p. 26).

The category based on adult characteristics includes adult learning theorists such as Cross and Knowles who believed that adult learning emanates from the characteristics of adults.

Historically, adult educators have seen adult learners as different from children (Cross, 1981; Kidd, 1973; Knowles, 1980; Merriam & Caffarella, 1991; Mezirow, 1981;). Cross (1981) called her theory CAL--Characteristics of Adults as Learners. Her model divided the differences between adults and children into two classes. First are personal characteristics such as physical, psychological and the stage of one's life cycle. Cross (1981) placed some of the andragogical principles of Knowles (1980) into this

portion of her theoretical framework. For instance she stated,

> The advantage of placing andragogical assumptions, such as readiness and self-concept, on CAL continua is that we can now account for the low level of self-direction on the part of some adults. The andragogical assumption that calls for treating adults as though they are self-directing while children are not-or at least treating adults as though they are *more* self-directing than children-flies in the face of the experience of many teachers who have worked with dependent adults and independent children. The CAL model calls for considering self-concept a function of developmental growth rather than a matter of childhood versus adulthood. Similarly, the assumption of readiness, interpreted as motivation for learning tasks associated with the life cycle, is placed on a sociocultural continuum which is related to age or at least to societal expectations regarding age appropriate behaviors. (p. 238-239)

Second, Cross (1981) outlined the situational variables as adults being, "typically part-time learners, and they are usually volunteers" (p.235).

Malcolm Knowles (1980) developed a number of principles of how to teach adults. Many of these principles came from practitioners who were teaching adults differently from the accepted pedagogy. However, during the transition from adolescence to adulthood many adult learning principles apply. Malcolm Knowles (1980) surmised that,

> The differences between children and adults are not so much real differences , I believe, as differences in assumptions about them that are made in traditional pedagogy. Actually, in my observation (and retrospection), the children

> start fairly early to see themselves as being self-directing in broadening areas of their lives; they start preparing for social roles (such as through part-time jobs) and therefore experiencing adult like readinesses to learn; and they encounter life problems for which they would like some learnings for immediate application. Therefore, many of the principles of andragogy have direct relevance to the education of children and youth. (p.58)

Knowles (1978) in discussing Lindeman stated, "It is interesting to note that Lindeman did not dichotomize adult versus youth education, but rather adult versus 'conventional' education, thus implying that youth might learn better, too, when their needs and interests, life situations, experience, self-concepts, and individual differences are taken into account" (p. 31). Knowles (1980) further wrote,

> Originally I defined andragogy as the art and science of helping adults learn, in contrast to pedagogy as the art and science of teaching children. Then an increasing number of teachers in elementary and secondary schools (and a few colleges) began reporting to me that they were experimenting with applying the concepts of andragogy to the education of youth and finding that in certain situations they were producing superior learning. So I am at the point now of seeing that andragogy is simply another model of assumptions about learners to be used alongside the pedagogical model of assumptions, thereby providing two alternatives models for testing out the assumptions as to their "fit" with particular situations. (p. 43)

Another model of assumptions for teaching youth was developed by Parnell (1994). He called for reform in schools by outlining seven principles of "Logo-Learning" to

make education more meaningful for high school students. He stated that learning should have a purpose, that new knowledge should be built on prior knowledge, that new knowledge should be practical, that learners should be active--not passive--to solve problems, students should learn teamwork and cooperation; learners should be guided toward discovering new knowledge. Many of these principles are similar to principles of adult learning as out lined by Knowles (1980). Refer to Table 1 for a comparison of Knowles' and Parnell's assumptions and principles. Given the importance of lifelong learning in today's rapidly changing technological, economic, demographic and cultural environment, it is proper for educators to explore new ways to promote lifelong learning at a younger age. High school students may use a variety of learning strategies in order to acquire the skills necessary to be successful in their concurrent enrollment courses. Darkenwald and Knox (1984)

TABLE 1: Comparison of the Assumptions of: Pedagogy, Andragogy, and Logo-Learning

Concept of the learner:

> Pedagogy: The role of the learner is, by definition, a dependent one. The teacher is expected by society to take full responsibility for determining what is to be learned, when it is to be learned, how it is to be learned, and if it has been learned.
>
> Andragogy: It is a normal aspect of the process of maturation for a person to move from dependency toward

increasing self-directedness, but at different rates for different people and in different dimensions of life. Teachers have a responsibility to encourage and nurture this movement. Adults have a deep psychological need to be generally self-directing, although they may be dependent in particular temporary situations.

Logo-learning: The purpose principle: teachers help students understand the purpose of any study unit, not only what they should learn, but why! The problem-solving principle: Students are encouraged to become active (rather than passive) learners by using new knowledge and skills to solve problems.

Role of learner's experience

Pedagogy: The experience learners bring to a learning situation is of little worth. It may be used as a starting point, but the experience from which learners will gain the most is that of the teacher, the textbook writer, the audiovisual aid producer, and other experts. Accordingly, the primary techniques in education are transmittal techniques--lecture, assigned reading, AV presentations.

Andragogy: As people grow and develop they accumulate an increasing reservoir of experience that becomes an increasingly rich resource for learning--for themselves and for others. Furthermore, people attach more meaning to learnings they gain from experience than those they acquire passively. Accordingly, the primary techniques in education are experiential techniques--laboratory experiments, discussion, problem-solving cases, simulation exercises, field experience, and the like.

Logo-learning: The building principle: New knowledge and new units of study are deliberately and specifically connected with student's prior knowledge or past learning so that the new learning builds on prior experience.

Readiness to learn

Pedagogy: People are ready to learn whatever society (especially the school) says they ought to learn, provided the pressures on them (like fear of failure) are great enough. Most people of the same age are

ready to learn the same things. Therefore, learning should be organized into fairly standardized curriculum, with a uniform step-by-step progression for all learners.

Andragogy: People become ready to learn something when they experience a need to learn it in order to cope more satisfyingly with real-life tasks or problems. The educator has a responsibility to create conditions and provide tools and procedures for helping learners discover their "needs to know." And, learning programs should be organized around life-application categories and sequences according to the learners' readiness to learn.

Logo-learning: The application principle: new knowledge is specifically related to its practical, real-life application-especially how it relates to student's future roles as citizens, consumers, workers, family members, lifelong learners, healthy individuals, and participants in cultural and leisure activities.

Orientation to learning

Pedagogy: Learners see education as a process of acquiring subject-matter content, most of which they understand will be useful only at a later time in life. Accordingly, the curriculum should be organized into subject-matter units (e.g., courses) which follow the logic of the subject (e.g., from ancient to modern history, from simple to complex mathematics or science). People are subject-centered in their orientation to learning.

Andragogy: Learners see education as a process of developing increased competence to achieve their full potential in life. They want to be able to apply whatever knowledge and skill they gain today to living more effectively tomorrow. Accordingly, learning experiences should be organized around competency-development categories. People are performance-centered in their orientation to learning.

Logo-learning: The discovery principle: The classroom slogan is "try it!" Students are guided toward discovering new knowledge rather than having the answers (or multiple answers, as is often the case) handed to them. Teachers help students explore, test, and seek their own answers, often with the help of

	learning partners, i.e., cooperative learning.
	The connection principle: Teachers help students see the connections between context and content, knowledge and application, one discipline and another. Divisions between traditional disciplines are minimized.
	The teamwork principle: students learn teamwork and cooperation by working together to solve problems.

Table adapted from Parnell (1994) and Knowles (1980).

studied young adults in terms of Houle's (1961) types of adult learners. They found, "Young adults, both men and women, are overwhelmingly goal oriented; education is seen as instrumental to the achievement of specific competencies for performance in the adult roles related mainly to work and family life" (Darkenwald and Knox, 1984, p. 19). Much of this learning is performed with the intent of solving problems in real-life situations. Thus, learning strategies are the approaches used by young adults to solve real-life problems (Conti & Fellenz, 1991).

Learning Strategies

Psychologists have long recognized the importance of learning strategies to the concept of learning. Dense and Hails (1967) in discussing the importance of strategies in concept learning stated, "Even more to the point, there is the matter of strategies. The use of strategies clearly lifts concept learning out of the domain of simple discrimination learning" (p. 422). They go on to report the

findings of a study conducted by Brunei, Good now, and Austin (1956 as reported by Dense and Hails, 1967). They presented subjects with various forms that varied in shape, color and number of borders. The subjects were asked to "learn various concepts by making successive choices of stimuli as instances of the concept in question" (p. 423). The researchers noted several strategies used by the subjects to arrive at the correct concept. The first strategy they reported was what Brunei, Good now, and Austin called "conservative focusing." This strategy involves sticking with one attribute at a time until the subject had eliminated the choices to a single unique combination that was correct.

Another strategy they found was the "focus gambling" strategy. In this technique the subject changes two of the attributes at a time. This strategy was found to be less effective but is used during trials with time or number of trial constraints. Still other less effective strategies were demonstrated by some subjects. However, the importance of their findings relates directly to the use of strategies to learn new material.

Fellenz (1994) stated that learning strategies are "the techniques or skills that an individual elects to use in order to accomplish a learning task" (p. 3). In contrasting

learning strategies from learning styles Fellenz (1994) wrote,

> Learning strategies differ from "learning styles" in that style connotes a rather stable characteristic of an individual. As Keefe (1982) states "learning styles are cognitive, affective and physiological traits that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (p.44). Strategies are more a matter of preference; they are developed throughout life and vary by task. While the effectiveness of a particular style relates to the individual, the success of strategies depends more on the situation. (p. 3)

Learning strategies are also different than learning skills. Conti and Fellenz (1991) have stated that,

> While learning strategies have grown out of the tradition of study skills, they differ significantly from that tradition, "What is new with the current interest in learning strategies is that it can be based on an emerging cognitive theory of human learning and memory' (Mayer, 1988, p. 12). Rather than skills in note taking, outlining, and test passing, learning strategies tend to focus on solving real problems involving metacognitive, memory, motivational, and critical thinking strategies. (p. 64)

Researchers have recognized the importance of researching learning strategies in areas of classroom achievement, learning outside institutional settings, and real-life learning. (Fellenz, 1988; Hays, 1995; Hill, 1992; Kolody, 1997; Mayer, 1988; McKeachie, 1989; Weinstein, 1988). Conti and Fellenz (1991) have stressed the importance of learning strategies to learning in real life situations. In their review of Sternberg (1990) they pointed out

differences between academic problem solving and real life problem solving in areas such as identification, context, structure, resources, and feedback. It seems academic problems are well outlined with relevant sources and timely feedback. However, real life situations do not have instructor involvement, are seldom well structured and may not provide all relevant information (p.65). In their study of learning in real life situations Conti and Fellenz (1991) have developed the Self-Knowledge Inventory of Lifelong Learning Strategies (SKILLS). This instrument assumes that five learning areas are employed when adults engaged in real life learning activities. These include metacognition, metamotivation, memory, critical thinking, and resource management. Each of these five constructs consists of three learning strategies (Conti & Fellenz, 1991; Fellenz and Conti, 1989).

Metacognition Strategies

Metacognition is the knowledge and control over one's thinking and learning (Brown, 1988). Yussen (1985) stated that "metacognition is that mental activity for which other mental states or processes become the object of reflection...metacognition is sometimes referred to as thoughts about cognition, or thinking about thinking" (p. 253). Metacognition can be separated into three broad

categories. The first is the autobiographical information one gathers about one's own cognitions. Second, is the monitoring of one's own cognitions during problem solving and reality monitoring, along with planning, adjusting, or calibrating. Finally, there is the control of cognitions which includes activities such as budgeting time for study, and selecting and controlling certain memory functions (Leahey & Harris, 1993, p. 236). This learning area is reflected in nature and involves the analysis, management and calibration of learning activities. Consistent with Leahey & Harris (1993), the three learning strategies involved in the area of metacognition in the SKILLS instrument are planning, monitoring, and adjusting.

Planning. Planning is a learning strategy in which a person focuses on the learning task at hand and determines how to organize and identify the steps essential to the learning process (Kolody, 1997; Yabui, 1993; Yussen, 1985). Counter and Fellenz (1994) stated that, "important elements of the learning situations are noted and strategies are previewed to determine how to proceed with the situation" (p. 7). Examples of ways to implement planning include: skimming, conducting an overview of the task, determining purpose or focus, and planning.

Monitoring. While participating in a learning task many situations may occur that could require one to change the original learning plan. At this point, monitoring and assessing how one is proceeding through a learning project becomes paramount. Strategies used include reviewing plans, checking to ensure one is on task, comparing progress to an accepted standard or model, checking new resources and receiving feedback (Counter & Fellenz, 1994, p.8).

Adjusting. This metacognitive strategy refers to the person's modifying and making corrections or changes as one is evaluating the progress made during the learning task. Effective learning often requires the learner to modify and "fine-tune" to meet the changing learning situations. Some of the strategies used to direct and improve one's learning processes include revising plans, changing strategies, restructuring the learning task to coincide with one's knowledge level and adjusting the techniques one uses to meet individual learning characteristics (Counter & Fellenz, 1994).

Metamotivation Strategies

There are two important considerations with regard to motivation. In the SKILLS Manual, Fellenz (1994) pointed out that energization and direction are essential to

understanding motivation (Deci and Ryan, 1985, p.3). Energization is a response to needs while direction is what gives focus to the response. Metamotivation is at the next level of motivation control. Kuhl & Kraska (1989) defined metamotivation as the "knowledge regarding one's own motivational functioning (e.g., what thoughts produce an increase or decrease in motivation, what environments contain effective personal incentives, etc.)" (p.343). They also explained that as a person matures from childhood to adulthood one becomes better able to control and self direct one's behavior through the metamotivational process. Conti and Fellenz (1991) explained that "the word metamotivation was used to emphasize the learner control of motivational strategies. This was also done to distinguish the traditional juncture of motivation and participation in the field of adult education from the individual's metamotivational energizing and direction given to personal learning" (p. 68). In developing the SKILLS model for metamotivation Keller's (1987) ARCS model provided useful categories for metamotivational strategies. His categories were attention, relevance, confidence, and satisfaction.

The SKILLS metamotivation strategies developed by Fellenz (1994) and those used in this study were attention, reward, and confidence.

Attention. Entails the directional aspect of motivation to focus the learner's learning abilities on the material to be learned. Kuhl and Kraska (1989) included the strategy of "attention control" in their theory of action control. They defined attention control as the "cognitive preference for working and inhibits the cognitive representation of playing by channeling attentional resources accordingly" (p. 351). Kidd (1973) emphasized the importance of a high level of attention, which he called engagement, to the learning process. McKeachie (1980) stated that one is going to learn more if one pays attention. Keller (1987) pointed out that attention arouses interest, invokes an attitude of inquiry, and maintains interest. Attention can be influenced by factors such as curiosity, interest from previous experience, or recognition of a need to learn (Fellenz, 1994, p.12). Some specific strategies a learner may use include setting aside time for learning, developing a resolve to learn, and avoiding distractions.

Reward/Enjoyment. The second metamotivational strategy is reward or enjoyment. This is "anticipating or recognizing the value to one's self of learning specific material" (Fellenz, 1994, p.13). In the action control

model of Kuhl and Kraska (1989), they defined motivation control as that

> Which enhances the activation of the emotional preference for working and reduces the emotional attractiveness of playing. This can be achieved by focusing on positive incentives of being able to maintain an intention in general or of being able to enjoy the good feeling of having finished one's work. (p. 351)

As can be seen from this definition, the affective domain is a dominant factor in learning with this strategy. In real-life learning, enjoyment "appears to be a more important motivational factor in real-life learning than in formal learning situations where external motivators such as grades or certificates often dominate" (Fellenz, 1994, p. 13). Kolody, (1997) gave the following examples of specific rewarding strategies, "personal growth, increase in self-esteem, helping others, working as part of a team for a worthwhile project, feeling good about accomplishments, or pride in the results of an activity" (p.41).

Confidence. The third metamotivational strategy is confidence in one's ability to learn or believing that one can complete the learning task successfully. Confidence in one's ability to learn is one of the essential elements in motivation (Keller, 1987). Wlodkowski (1985) explained the relationship between confidence, competence and learning by stating that,

> The relationship between competence and self-confidence is mutually advantageous. Competence allows confidence to develop, which leads to emotional support for effort to master new skills and knowledge. Competent achievement of this new learning further buttresses confidence, which can now again support and motivate more extensive learning. (p. 56)

"Belief that one can complete the learning task successfully is an important factor in motivation to learn" (Fellenz, 1994, p.13).

Memory Strategies

People can learn to do a number of things from reading a book to performing in a concert. All of this learning would be useless though if we could not remember. Long (1983) stated:

> The process of learning and memory are so closely related and interdependent that it is often difficult to determine whether we are concerned with one phenomenon or two...one who does not learn has nothing to remember, and without memory there is no evidence of learning. (p. 58)

Memory has been described as a three step process that includes acquisition, storage, and retrieval or alternatively, registration, retention and recall (Higbee, 1977; Salthouse, 1982). Paul and Fellenz (1994) referred to these processes as memory processes and emphasized that they are important in understanding real-life learning.

Researchers have identified two possible mechanisms, short-term and long term memory, that function in the memory

process (Best, 1986, Higbee, 1977). Differences exist between the two processes and include:

> (1) The nerve changes that take place in the brain may be different for short-term memory and long-term memory. (2) Short-term memory is an active, ongoing process that is easily disrupted by other activities; long-term memory is not as easily disrupted. (3) Short-term memory has a limited capacity; the capacity of long-term memory is virtually unlimited. (4) Retrieval from short-term memory is an automatic, dumping-out process; retrieval problems come in long-term memory. (Higbee, 1977, p. 13-14)

According to Best (1986), the information-processing theory of memory, stated that rehearsal is the control process that permits transfer of information between short-term and long-term memory. Paul and Fellenz (1994) called the processes, memory structures. They are "concerned with the form and nature of information storage as a product of the memory process" (p.16). Finally, Paul and Fellenz (1994) suggested that mediating or influencing factors are used to form relationships among items in the memory. They submit that "a major property of memory is the forming of relationships among items. Such relationships allow the person to integrate different experiences in order to discover similarities among them and to use the past as a basis for interpreting the present (p. 17). They also identified schema and scripts as an organized body of knowledge that has rules for the use of that knowledge while scripts are rules for ritual knowledge (p. 17-18). The memory

strategies used in the SKILLS model include Organization, External Aids, and Memory Application.

Organization. Organization is the structuring or processing information so that material will be better stored, retained, and retrieved. Organizing information not only assists the learner in recalling information but information is stored in such a way as to fit into the existing framework of knowledge and relationships (Higbee, 1977; James, 1918; Norman, 1982). William James (1918) pointed out,

> The more other facts a fact is associated with in the mind, the better possession of it our memory retains. Each of its associates becomes a hook to which it hangs, a means to fish it up by when sunk beneath the surface. Together, they form a network of attachments by which it is woven into the entire tissue of our thought. The "secret of a good memory" is thus the secret of forming diverse and multiple association with every fact we care to retain.... (p. 662)

Organization strategies used in the SKILLS model include chunking, mnemonics, visualization, imagery and the forming of associations and connections (Higbee, 1977; Paul & Fellenz, 1994: Zechmeister & Nyberg, 1982).

External Aids. This strategy involves using external aids to reinforce memory. Examples of these include writing information down in a notebook or in a list reviewing material (Higbee, 1977; Zechmeister & Nyberg, 1982), and

asking others to provide reminders. All of these strategies help the learner to correlate mental interaction with cues in the surrounding environment (Yabui, 1993).

Memory Application. Memory application involves using remembrances, mental images, or other memories to facilitate planning or problem-solving. Using mental images and remembrances and other internal strategies are effective in real life learning situations involving planning, completing and evaluating learning (Kolody, 1997; Yabui, 1993). In adult real-life learning memory application is used to avoid mistakes, to know and anticipate what to expect, to select methods, to acquire some new physical skills, to solve puzzles, to provide background information and to acquire skills necessary for effective community involvement (Paul & Fellenz, 1994).

Critical Thinking Strategies

Fellenz (1994) reviewed Sternberg's (1985) classification of critical thinking definitions. They include philosophical, psychological and educational definitions. Philosophers emphasize formal logical systems of thought. Psychological definitions focus on identifying components involved in critical thinking. Educators reflect a taxonomical approach as found in Bloom (1956). Adult educators have underscored the importance of the

relationship between critical thinking and the social environment and transformative learning (Mezirow, 1990).

Brookfield (1987) constructed a model of critical thinking that contains four components. First, he suggested that one must identify and challenge the "assumptions that underlie the ideas, beliefs, values and actions that we (and others) take for granted" (p. 7). Second, he believed one should challenge the contexts of our perceptions, understandings, and interpretations thus, "Critical thinkers are contextually aware" (p. 8). Third, he stated that a critical thinker tries "to imagine and explore alternatives to existing ways of thinking and living" (p.8). Finally, by imagining and exploring alternatives one is led to reflective skepticism. He wrote, "when we realize that alternatives to supposedly fixed belief systems, habitual behaviors, and entrenched social structures always exist, we become skeptical of claims to universal truth or to ultimate explanations" (p. 9). The SKILLS Critical Thinking strategies are based on the model proposed by Brookfield (1987). They include testing assumptions, generating alternatives, and conditional acceptance of general knowledge.

Testing Assumptions. This strategy refers to the process of recognizing and evaluating assumptions in

relation to a learning situation. "The process of challenging assumptions presumes the ability to identify these assumptions and the willingness to examine them. Because they have often been taken for granted over long periods of time, their limitations are not readily noticed" (Fellenz, 1994, p. 26). To measure challenging assumptions in real-life learning, the SKILLS model uses activities such as taking opportunities to examine the accuracy of assumptions, identifying relationships, spotting inconsistencies, or questioning value sets (p. 26).

Generating Alternatives. The strategy refers to the adult learner's ability to conceive of alternatives or to hypothesize. Fellenz (1994) pointed out that "the value and importance of exploring alternatives when engaged in critical thinking or problem solving is recognized throughout the literature on learning" (p. 26). The SKILLS instrument uses a number of specific actions to measure this strategy and such as brainstorming or envisioning the future, hypothesizing, and rank ordering alternatives or identifying alterative solutions (p. 27).

Conditional Acceptance. While the pure skeptic may summarily dismiss any and all claims to truth, "reflective skepticism, on the other hand, applies a cautious intelligence to grandiose claims regarding 'ultimate' truth

or 'final' solutions" (Brookfield, 1987, p. 21). With conditional acceptance the adult learner is cautious and reflects on a solution to ascertain if alterations are needed before accepting the solution. The questioning of simplistic answers, predicting results, reflective and tentative maintenance of principles along with monitoring and evaluating results are evidence of critical thinking and are used by the SKILLS model to measure Conditional Acceptance (Fellenz, 1994, p. 27).

Resource Management Strategies

Houle, (1996) defined a learning resource as "any object, person, or other aspect of the environment that can be used for support or help in an educational activity...because resources are so important in conveying content, they have often been considered the heart of the educational format" (p. 196-197). Resource management is the process a learner uses to identify evaluate and use resources relevant to a learning task. It refers to how a learner manages learning resources.

Shaaden and Raiford (1984) found that older adults are not prepared to cope with information delivery systems such as computers, Internet over TV, countless magazines and the invisible university of courses available over Internet. Shirk (1983) found that less than 25% of American adults use

the library with regularity. Houle states that "the growth of such resources has brought about both quantitative and qualitative differences in education" (p.199). Hill (1992) found environmental factors such as time availability, accessibility of resources and a learner's ability to differentiate good sources of information important for managing resources.

While for some adults scarcity of resources may be a problem, for others the problem is one of choice. A learner must not only decide which resources are best to achieve a learning goal but must also decide which goals are best among those possible with so many resources available (Houle, 1996).

Three critical aspects of resource management include one's ability to identify appropriate resources, the critical use of resources, and the use of human resources (Fellenz, 1994).

Identification. This strategy refers to the knowledge of or knowing how to locate the most appropriate resources for a learning activity. The best possible resources should include a variety such as modern information sources, print sources, people or models, professionals and agencies (Fellenz, 1994). Kolody (1997) suggested that "a concern of

the learner at this point can include the learner's willingness to use a particular source" (p. 51).

Critical Use. Critical Use as a Resource Strategy involves using appropriate rather than available resources while recognizing their limitations. The adult learner uses "insightful decisions in the selection of materials to use in a learning project" (Yabui, 1993). Factors to consider when critically using a resource include timeliness of material, reliability of the resource, using sources that worked in the past but may not work in the present and the possible bias of a resource (Fellenz, 1994, p. 30). Some of the strategies a learner may use are contacting an expert or outsider, checking a second source, and personal observation.

Human Resources. This strategy involves integrating others into the social and political process of knowing. This integration involves more than just using information from another but involves a dialogue or debate and discussion (Fellenz, 1994). This strategy was included "to acknowledge the powerful impact of people and the social environment on learning" (p. 30). "This support and networking are strategies considered important in the measurement of a learner's preference in incorporating the

use of human resources in their learning process" (Kolody, 1997, p. 52).

COMPASS

The Computer-Adaptive Placement Assessment and Support System (COMPASS) is an adaptive assessment designed to place students into ability groups. Adaptive testing is designed to either determine a person's proficiency or classify the person into one of several categories. UVSC uses the COMPASS to place students into one of several placement categories. Test items are varied and testing stops when the student is classified at the 90 % level of accuracy (The American College Testing Program, 1994, pp.1-5).

Utah Valley State College uses two of the assessment's three subject tests. The first subject test is the mathematics test. The test consists of problems in the areas of prealgebra, algebra, college algebra, geometry and trigonometry. Each area has a pool of 200 questions that were selected by expert panels and is designed to test at three levels of complexity: basic skills, application, and analysis. Problems are presented to the students on the computer screen and students are required to select the correct choice from several possible answers (The American College Testing Program, 1994, pp.7 & 20).

The second area test is the writing skills assessment. This test is designed to measure a student's ability to do college level writing. The student is presented with a sample of writing and his or her task is to find and correct errors in grammar, usage and style. To correct an error, the student selects the correct passage from five possibilities. With the information provided by these tests, the student is counseled on course placement.

Students are not kept out of any class by reason of low COMPASS scores. They can sign a waiver releasing the college of responsibility and may register for any class for which they have the prerequisites.

Degrees of Reading Power

The Degrees of Reading Power (DRP) is a criterion-referenced assessment that measures a person's ability to make sense of "real life' reading material. The test materials consist of nonfictional reading materials that were drawn from topics in the *Encyclopaedia Britannica* as representative samples of all possible prose. The test items are arranged in increasing order of difficulty with the length of each passage being approximately 325 words. Within the test item there are seven sentences that contain a blank and the student is to choose the correct word from a

list of five possibilities (Touchstone Applied Science Association, 1986, p. 1). The DRP uses the concept of readability to measure the difficulty of a passage of written text. The less difficult a passage is, the more readable it is. Many factors contribute to the readability of text and include the reader's background, level of complexity of the text, amount of common words used, the number of short words, and the length of the sentences. This readability is measured by the assessment in DRP units. The assessment uses the Bormuth mean cloze readability to calculate the difficulty level of a given test sample. This formula has a validity of R= .92 in providing an absolute range of DRP units (Touchstone Applied Science Association, 1986, pp. 5-8).

Utah Valley State college uses the DRP to assess a new student's reading ability. Test Forms E and F are used and DRP units are reported in readability levels. The level reported in this study is the P=80 level. That is, the level where a student can read with an 80% probability of success (Touchstone Applied Science Association, 1986, p. 9). With this information the student is counseled about appropriate course placement. Again, students are not kept out of any class by reason of low DRP scores. They can sign a waiver releasing the college of responsibility and may

register for any class for which they have the appropriate prerequisites.

CHAPTER 3

METHODS AND PROCEDURES

Introduction

In order to address the research questions posed in Chapter 1, this research project was conducted in two steps. The study design is causal-comparative. To study the relationship of learning strategies to various demographic variables the causal-comparative format "attempts to determine the cause, or reason, for existing differences in the behavior or status of groups of individuals" (Gay, 1992, p.284). In this research design, the data was evaluated using the multivariate statistical technique of discriminant analysis. This technique was used to determine if individual variable differences occurred in the groups and from these differences attempts were made to identify the major factors that created the difference. This type of research is also referred to as "ex post facto" since the researcher studies the effect and presumable cause after the event has occurred (Gay, 1992).

The second portion of the study involved using cluster analysis to identify groups of learners that existed in the sample. Once identified by their learning strategy characteristics' focus groups were conducted with learners

from each cluster to discuss their learning preferences. Finally, a discriminant analysis of the clusters was conducted to determine the process that separates the groups (Conti, 1996, p.71).

Population

According to the Alpine School District statistical report, (Alpine School District, 1997) 9,870 students were enrolled during the 1996-1997 school year. The gender percentages for the tenth grade were 50.7% male and 49.3 % female; for the eleventh grade 51.2% male and 48.8% female; and for the twelfth grade 51.1% male and 48,9% female. Total enrollment at each school was as follows:

Lehi High School	944
American Fork High School	2031
Mountain View High School	1693
Orem High School	1635
Timpanogos High School	1212
Pleasant Grove High School	1536
Alpine Life and Learning Center	810

Alpine Life and Learning Center does not register its concurrent enrollment students until year-end; thus, no students from the school were included in the study. The enrollment included students in grades 10, 11, and 12. Ages normally range from 15 to 19 years. The six high schools in

the study are located in seven communities, approximately 30 to 50 miles south of Salt Lake City, providing both rural and urban settings. From this population there were 1,284 students enrolled in the concurrent enrollment program through Utah Valley State College. Students from each of the three grade levels are enrolled in the program so ages again ranged from 15 to 19 years old.

Sampling

The sample consisted of the students enrolled in the Utah Valley State College concurrent enrollment program from Alpine School District. The district included six high schools that were participating in the program. A report of student enrollment during the year was obtained on December 10, 1996, to ensure current data. The numbers of students enrolled in concurrent enrollment at each high school were as follows:

High School	Number
Lehi High School	185
American Fork High School	141
Mountain View High School	464
Orem High School	160
Timpanogos High School	36
Pleasant Grove High School	149
Total	1284

Permission was granted first from the district testing and evaluation office and second from each of the high school principals. Permission was granted only if the researcher used complete classes and not individuals randomly selected. Thus, a cluster sample was used to select classes containing concurrent enrollment students at each school. Gay (1992) stated that cluster sampling is "sampling in which groups, not individuals, are randomly selected" (p.132). This type of sampling was appropriate for a large population and when administrative constraints dictate. The sample size was projected to be approximately 300. Krejcie and Morgan (1970) suggested the sample size be 297 for a population of 1300. Roscoe (1975) recommended that if using a multivariate statistical technique "the sample size should be several times (preferably 10 or more times) as large as the numbers of variables" (p. 184). This study contained 28 variables therefore a required sample size would be 280. The sample size of 279 was only 18 less than Krejcie and Morgan suggested and only one less than required by Roscoe.

Instruments

SKILLS

The Self-Knowledge Inventory of Lifelong Learning Strategies (SKILLS) measures learning strategies used in

daily life. This instrument has documented reliability and validity developed by faculty and graduate students at the Center for Adult Learning Research, Montana State University--Bozeman (Conti & Fellenz, 1991). The SKILLS instrument was developed to measure important parts of the adult learning process as it occurs in an adult's practical learning needs. These strategies are categorized into the five areas of metacognition, metamotivation, memory, critical thinking, and resource management (Conti & Fellenz, 1991).

The instrument consists of different scenarios representing real-life learning situations which require various types and levels of knowledge and skill acquisition. Following each scenario are 15 questions intended to evaluate which learning skills or techniques (learning strategies) an individual would use to resolve a particular learning task. The 15 questions of SKILLS are used to distinguish specific applications of the 15 learning strategies of the SKILLS instrument.

When responding to the SKILLS instrument, a participant is first asked to select four of the six available scenarios in which the individual is interested. The participant is then asked to assess from the list of 15 associated learning strategies the 5 he or she would Definitely Use, the 5 he or

she would Possibly Use, and the 5 he or she would Not Likely Use in the various learning strategies. Respondents enter the appropriate corresponding numbers on a score sheet to be tabulated and evaluated later. The general score determines which strategies participants generally prefer in the selected learning situations.

Recent research using the SKILLS instrument suggest modifying the instrument to specific real-life learning scenarios and situations. McKenna (1991) compared the influence of personal and professional learning situations on real-life learning strategy utilization by school administrators in Wyoming. He required that his participants choose two of the original scenarios along with two professional ones that he created. Further research revealed that the validity and reliability of this approach remained intact. McKenna, Conti, and Fellenz (1994) noted that "researchers may either use the existing form of SKILLS or create specific scenarios using the established form of SKILLS as a model. Such a choice can allow researchers to tailor their learning strategies instrument to fit their distinctive need" (p. 263). Yabui (1993) and Moretti (1994) modified the SKILLS instrument in their respective studies on reflective judgment and metacognition of learning strategies and learning strategies of CEOs of volunteer nonprofit organizations. Likewise, Strakal (1995) modified

SKILLS in his study on learning strategies in personal and career development situations of students in post-secondary vocational educational settings. Strakal further recommended that researchers using SKILLS "modify the instrument as part of the research design...modify or develop scenarios that are distinctly related to their studies and the data they are attempting to gather" (p. 186). As long as the statements are written and "constructed using similar statements from matched scenarios from the original SKILLS scenarios, validity and reliability will remain intact" (McKenna, Conti & Fellenz, 1994, pp. 261-263). The SKILLS scenarios used in this study were not modified and were judged appropriate by the researcher and the Alpine School District assessment coordinator.

Validity and Reliability

The degree to which an instrument measures what it is actually supposed to measure is called the validity of the instrument (Gay, 1992, p. 155). SKILLS has two relevant types of validity--construct and content. Construct validity "is the degree to which a test measures an intended hypothetical construct...Content validity is the degree to which a test measures an intended content area" (Gay, 1992, pp. 156-157).

Construct validity for SKILLS was established through a literature review which documented the source of the concepts in SKILLS. In addition, an assessment on the constructs was obtained from a group of adult education and educational psychology professors. Robert Sternberg assessed the SKILLS instrument, and Wilbert McKeachie reviewed the constructs and accompanying strategies at a summer institute at the Center for Adult Learning Research (Conti & Fellenz, 1991, p.69). McKeachie (1988) provided an independent review of SKILLS, and the group of adult educators performed a critique of the instrument in small groups. They found the consensus among the group to be, "that the instrument indeed addressed the five theoretical constructs of metacognition, metamotivation, memory, critical thinking, and resource management" (p.70).

"Content validity is the degree to which the sample of test items represents the content that the test is designed to measure" (Borg & Gall, 1989, p.250). Additionally content validity "requires both item validity and sampling validity" (Gay, 1992, p.139). Content validity of the SKILLS instrument was field tested in numerous settings including adult basic education programs, undergraduate and graduate university courses, museums, health-care provider programs, continuing education programs, and elder hostel programs (Conti & Fellenz, 1991). In the field test, a

sample set of 253 participant responses confirmed the assessment of the group of adult educators previously mentioned above that the items in SKILLS adequately represented the five conceptual areas of the instrument (Conti & Fellenz, 1991, p.70). Sternberg, McKeachie, and the group of adult educators also confirmed the content validity of SKILLS by using a similar assessment procedure to the one used in assessing construct validity.

"Reliability may be defined as the level of internal consistency or stability of the measuring device over time" (Borg & Gall, 1989, p. 257). Reliability for the SKILLS instrument was addressed by calculating a coefficient based on two equivalent forms administered to the same group. "Equivalent-forms reliability is the most commonly used estimate of reliability for most tests used in research" (Gay, 1992, p. 147). The Cronbach alpha coefficient of the scores was .71. The split-half test of reliability was computed using the Guttman method with a resulting .83 correlation. Another .83 correlation was obtained by applying the Spearman-Brown formula. After statistical analysis was completed, it was determined that all correlations were in the acceptable range and that SKILLS is "a reliable instrument for assessing adult learning strategies in real-life situations" (Conti & Fellenz, 1991).

COMPASS Validity and Reliability

Items for the math portion of the COMPASS were pulled from the ACT's "general item pool." There was no new item development needed for this portion of the assessment. For the writing portion of the test, each item was reviewed by the ACT staff. Once an item was accepted and revised to meet ACT requirements, the items were reviewed by consultants for "soundness." Focus groups were formed to review each item for "fairness" (The American College Testing Program, 1994, pp.2-3 to 2-6). The purpose of the COMPASS at UVSC is to place students into appropriate courses, as a result, "placement validity indices" are used to measure the validity of the COMPASS. Colleges participating in the initial analysis of the COMPASS used logistic regression models to determine the probabilities of success in a particular course. The technical manual (The American College Testing Program, 1994) reports that evidence of validity can be seen from,

> Five institutions, each with an English Composition class, tested at least 40 students each with the COMPASS Writing Skills Placement Test. Cutoff scores ranged from 62-80 with a median optimal cutoff score of 64. This optimal cut score is defined as the score that corresponds to a .50 probability that a student will get a grade of B or higher in the standard course (English Composition). Using the optimal cutoff score, a median of 58% of students were placed in the developmental course. The median/accuracy rate, consisting of the percent of students appropriately

> placed in either the entry-level or the developmental English course, was 60%. This represents a 13% increase in appropriate placement over using no placement test. (p. 4-8)

Since the COMPASS assessment is an adaptive measurement, the internal consistency reliability is measured using the marginal reliability. Students are measured with a different reliability because each is given a slightly different version of the test. These variations are averaged across individuals giving a comparable conventional reliability. On the writing assessment a second reliability measuring the accuracy of placement is given. The reliability estimates obtained were found through "simulation studies." The artificial data allows one to see the "true" abilities and compare them to the simulation results. The marginal and classification reliability estimates for the COMPASS tests are located in Table 2.

TABLE 2: COMPASS Marginal Reliability Estimates

Subject Test	Marginal Reliability	Classification Reliability
Mathematics	.87	
Writing	.96	.88

Source: (The American College Testing Program, 1994, p. 3 - 14).

DRP Validity and Reliability

The DRP is designed to measure the "process" of how one reads for comprehension. The manual emphasizes that, "outside knowledge of the content is not important; a functional knowledge of vocabulary, syntax, and other linguistic conventions is sufficient for performance on DRP tests" (Touchstone Applied Science Association, 1986, p. 42). Research in which two passages of different levels of difficulty on the same topic demonstrated that the only difference between the two were because of reading difficulty and not any other factors. Validity is also demonstrated because test results agree with the expectations of reading experts (Touchstone Applied Science Association, 1986, p. 43).

The content validity is assured by taking test passages from the *Encyclopaedia Britannica* and comparing test passages with course material found in schools. To demonstrate criterion-related validity the DRP and *California Achievement Test* were compared in their ability to rank students reading ability. Correlations between the two tests ranged from r=.77 for third graders to r=.84 for ninth graders. Internal-consistency reliability studies were conducted using the same and alternate forms of the

DPR. The Kuder-Richardson reliability coefficients range from .94 to .96.

Studies using alternate forms show reliability coefficients ranging from r=.86 to r=.91. The high coefficients indicate that the DRP is a highly valid and reliable measure of reading comprehension (Touchstone Applied Science Association, 1986, pp. 44-45).

Procedures for Data Collection

Data were collected by administering SKILLS to a representative sample at each of the six high schools participating in the study. Permission from the six high school principals and concurrent enrollment teachers was obtained to conduct the survey with randomly selected classes. However, not every teacher gave permission and some were conducting other studies from other universities. Once the classes were selected the researcher visited the classroom and explained why the researcher was interested in their participation. The students were then given a copy of the SKILLS and allowed to review the instructions for completing the survey which were located at the top of the answer sheet. The researcher at this point explained how to complete the survey, read the instructions, and answered any questions that arose.

Six preselected personal learning scenarios, three from each of the two developed sets from the SKILLS instrument were used. These scenarios were selected on the basis of interest to high school students and reading level as judged by the researcher and the Alpine district assessment supervisor. The six scenarios used were Auto Insurance, Pet Care, Job Regulations, Putting a Bike Together, Dental Care and Letter to the Editor. Information related to age, gender, ethnicity, year in high school, and high school GPA was gathered on a separate form prior to completing the SKILLS instrument. The researchers gave all participants assurances that the surveys and demographic information would be kept confidential. The demographic and educational information solicited were, student identification number, age, gender, and high school GPA. The identification number was used to access the student's testing records.

Data Analysis Overview

Following the initial survey data collection, the data was evaluated in two ways. First through discriminant analysis and then cluster analysis. The data collected from SKILLS and the other test results were entered into dBase III plus, a data management software program used for data organization and manipulation. The Statistical Package for

Social Sciences (SPSS/PC+) computer statistics program was used to run the statistical analysis of the data.

The first analysis to be run was a Discriminant analysis. Discriminant analysis is "a statistical technique which allows the investigation of the differences between two or more groups in relationship to several variables simultaneously" (Klecka, 1980, p.7). Thus multiple variables can be considered. This technique is useful when known and distinct groups exist (Gay, 1992). Conti (1993) highly recommended this technique because it:

> Is concerned with the grouping of people and with analyzing the interrelationship of multiple variables to determine if they can explain a person's placement in a specific group. Unlike univariate analyses which examine individual variables separately and allow them to be disassociated from the total person who is a synergistic composition of these various variables, discriminant analysis examines people on a set of variables to determine if any of them interact in a combination that can explains the person's placement in the group. (p. 91)

The second analysis the study used was Cluster analysis to determine if distinct groups can be found based upon the participants' selection of SKILLS learning strategies (Conti, 1996; Hays, 1995; Strakal, 1995; Yabui, 1993). Analysis of variance is another tool to help determine which variables are related to each cluster and for determining how the variables are associated with the cluster (Conti, 1996). Means for each of the 15 learning strategies were

calculated for each cluster and then a one-way analysis of variance was run for each of the 15 variables to determine if significant differences existed among the clusters (Hays, 1995; Kolody, 1997; Yabui, 1993). Those variables on which the clusters varied significantly were used to name the groups. At this point, a discriminant analysis was run with the clusters used as the grouping variable to ascertain the process that distinguished the clusters from each other.

From the cluster analysis, focus groups with five members from each cluster were used to provide a qualitative perspective to the quantitative data collected though cluster analysis. Strakal (1995) recommended that information from the quantitative analysis be used to guide and narrow the focus for the interview session. This technique was used and the qualitative data gathered was used in combination with quantitative data to provide a more complete description of the clusters.

CHAPTER 4

QUANTITATIVE FINDINGS

To understand the creation of knowledge, one must begin by looking at the thought process. Ernest Nagel(1974) outlined John Mill's philosophy on thought and reasoning. John Mill divided the thought and reasoning process into two operations. He stated:

> Although, therefore, all processes of thought in which the ultimate premises are particulars, whether we conclude from particulars to a general formula, or from particulars to other particulars according to that formula, are equally induction, we shall yet, conformably to usage, consider the name induction as more peculiarly belonging to the process of establishing the general proposition, and the remaining operation, which is substantially that of interpreting the general proposition, we shall call by its usual name deduction. (p. 135)

From this definition by Mill we see that logical reasoning can take a deductive approach, an inductive approach, or a combination of the two. Inductive reasoning is forming generalizations based on observations. Deductive reasoning is processing a generalization down into a specific application. Selectively using only inductive or deductive logic has limited value. Whitehead (1968) illuminated this relationship when he stated:

> A more important question is the relation of induction, based on observation, to deductive

> logic. There is a tradition of opposition between adherents of induction and of deduction. In my view, it would be just as sensible for the two ends of a worm to quarrel. Both observation and deduction are necessary for any knowledge worth having. We cannot get at an inductive law without having recourse to a propositional function. (p. 116)

Gay (1992) pointed out that the phenomena studied in education are so complex and variables so numerous that to exercise control over an experiment is daunting. Researchers (Conti, 1996; Kolody, 1997) have argued that using both inductive and deductive methods is a powerful method for studying educational phenomena. Conti wrote:

> With the deductive approach, researchers impose sense on the data by asking questions of the data that are meaningful to the researcher and which the researchers bring to the study based upon their knowledge, experience, and intuition. Multivariate statistical procedures such as discriminant analysis (Conti, 1993; Klecka, 1980) allow the researcher to function in the psychological mode by dividing learners into predetermined groups to examine if this categorization produces the differences which were hypothesized. With the inductive approach, researchers function more in a sociological mode. Here the issue is how to tease sense out of the data. Rather than imposing sense upon the data, the goal is to have meaning and understanding emanate from the data, itself. (Conti, 1996, p. 67)

Both methods of inquiry were used in this study. By using discriminant analysis and cluster analysis learners were divided into groups. Through focus groups meaning and understanding were brought to the groups.

Statistical Profile of the Learners

The cluster sample for the study included students from each of the six high schools in Alpine School District with concurrently enrolled students. All students participating in the study were in the Utah Valley State College Concurrent Enrollment program.

A total of 279 high school students participated in this study. The group ranged in ages 15 to 19 with a mean age of 16.9 (see Table 3). The gender distribution in this study was 146 (52.5%) females and 132 (47.5) males.

Table 3. Age Frequency of Participants

Age Groupings	Frequency	Percent	Cumulative Percent
15	14	5	5
16	74	27	32
17	109	39	71
18	77	28	28
19	3	1	100

The overall grade point average on a four-point scale for the group ranged from 1.5 to 4.0 with a mean of 3.51 (see Table 4). As in Hill's study (1992), the least successful students were those grouped in the lower 15 percentile and the most successful students were those grouped in the highest 15 percentile. This criteria was used for the discriminant analysis described later.

Table 4. Distribution of Grade Point Averages

Value	Frequency	Percent	Cumulative Percent
1.5 - 3.3	82	29.4	29.4
3.4 - 3.8	118	42.3	71.7
3.8 - 4.0	79	28.3	100

Aptitude Tests

There were 218 students who completed the Student Degrees of Reading Power (DRP). Student performance on the DRP ranged from 39 (a placement recommendation requiring students to receive individual assistance from the Academic Technology Assistance Center) to 99 with a mean score of 78.9 which permits a student to enroll in all entry level courses (see Table 5). The average concurrent enrollment student taking the DRP has reading skills that are adequate for most entry level college courses.

There were 218 students who completed the COMPASS Writing Skills. Student performance on the COMPASS Writing Skills ranged from 1 (a placement recommendation requiring students to receive individual assistance from the Learning Enrichment Center) to 99 with a mean score of 65.5 (see Table 6). The average concurrent enrollment student taking the COMPASS writing assessment has writing skills that need remediation with college prep grammar and writing.

Table 5. Distribution of Degrees of Reading Power (DRP) Scores

Value	Frequency	Percent	Cumulative Percent
39 - 66	35	16	16
67 - 91	146	67	83
92 - 99	37	17	100

Table 6. Distribution of COMPASS Writing Skills Scores

Value	Frequency	Percent	Cumulative Percent
1 - 31	35	16.1	12.5
32 - 93	147	67.4	86.7
94 - 99	36	16.5	100

There were 130 students who completed the COMPASS Prealgebra math portion of the assessment. Student performance on the Prealgebra test ranged from 17 (a placement recommendation requiring students to receive individual assistance from the Learning Enrichment Center) to 99 with a mean score of 40.8. The average student taking the COMPASS Prealgebra assessment are at the high school Algebra 1 level (a placement recommendation for Foundations Algebra) (see Table 7).

Table 7. Distribution of COMPASS Prealgebra Scores

Value	Frequency	Percent	Cumulative Percent
1 - 21	23	17.7	17.7
22 - 55	82	63.1	80.8
56 - 99	25	19.2	100

One-hundred ninety-six students completed the COMPASS Algebra math portion of the assessment. Student performance on the Algebra test ranged from 16 to 99 with a mean score of 37.4. The average concurrent enrollment student taking the COMPASS Algebra test has algebra skills at the high school Algebra 2 level (a placement recommendation for Introductory Algebra) (see Table 8).

Table 8. Distribution of COMPASS Algebra Scores

Value	Frequency	Percent	Cumulative Percent
1 - 18	31	16	16
19 - 57	132	67	83
58 - 99	33	17	100

Only eleven students completed the COMPASS College Algebra portion of the assessment and no students attempted the Trigonometry or Geometry portions; therefore, no statistical analysis was completed for these COMPASS subtests.

Seventy-nine students completed the ACT English test. Student performance on the English test ranged from 14 to 34 with a mean score of 22.3 (see Table 9). The average student taking the ACT test has skills allowing one to take freshman English.

Seventy-eight students finished the ACT Math test. Student scores on the Math test ranged from 14 to 29 with a mean score of 22 (see Table 10). The average concurrent enrollment student taking the ACT Math test scored well enough to take College Algebra for non-science majors.

Table 9. Distribution of ACT English Scores

Value	Frequency	Percent	Cumulative Percent
14 - 16	11	14	14
17 - 27	57	72	86
28 - 34	11	14	100

Table 10. Distribution of ACT Math Scores

Value	Frequency	Percent	Cumulative Percent
14 - 17	17	22	22
18 - 25	43	55	77
26 - 29	18	23	100

Seventy-eight students completed the ACT Reading test. Student performance on the Math test ranged from 8 to 36 with a mean score of 23.5 (see Table 11). The average concurrent enrollment student taking the ACT Reading has reading skills sufficient to take any college course.

Table 11. Distribution of ACT Reading Scores

Value	Frequency	Percent	Cumulative Percent
8 - 18	14	18	18
19 - 26	43	55	73
27 - 36	21	27	100

Seventy-eight students completed the ACT Science test. Student performance on the Science test ranged from 12 to 40 with a mean score of 23 (see Table 12). This score is not used for course placement recommendations.

Table 12. Distribution of ACT Science Scores

Value	Frequency	Percent	Cumulative Percent
12 - 18	14	18	18
19 - 26	46	59	77
27 - 40	18	23	100

Seventy-nine students had ACT Composite scores. Student scores on the Composite ranged from 12 to 30 with a mean score of 22.8 (see Table 13). The average concurrent enrollment student scored well enough on this scale to enroll in any college course.

Table 13. Distribution of ACT Composite Scores

Value	Frequency	Percent	Cumulative Percent
12 - 18	12	15	15
19 - 25	44	56	71
26 - 30	23	29	100

It appears that the students who are taking the ACT scales are on the average scoring above the level required by UVSC to enroll in entry level college courses.

Learning Strategies

In scoring SKILLS, the respondent receives three points for each item that he or she would "Definitely Use", two points for one that they might "Possibly Use", and one point for an item that they would "Not Likely Use". Two types of scores were computed for SKILLS. First, scores for the five strategy areas of Metacognition, Metamotivation, Memory, Critical Thinking, and Resource Management were calculated. Similarly, there are three learning strategies in each learning strategy area, giving a range of possible scores for the learning strategies areas from 12 to 36 with a middle score of 24. All the group means were within the range of 23.57 for the least used strategy of Metamotivation to 24.54 for the most used Resource Management(see Table 14).

Table 14. Means of Learning Strategies Areas of SKILLS Used by Participants

Areas	Mean	SD	Range
Resource Management	24.54	2.97	16 - 33
Memory	24.10	2.92	14 - 31
Critical Thinking	23.77	2.96	17 - 32
Metacognition	23.77	2.82	16 - 33
Metamotivation	23.57	2.96	13 - 31

Secondly, scores were computed for each of the 15 learning strategies within the instrument. The five learning strategies subscales each contain three learning strategies.

With four scenarios, each with one learning strategy item, the range of the total possible score for each learning strategy is 4 to 12.

The distribution of scores revealed that Attention which is a Metamotivation learning strategy, and Use of External Aids, which is a Memory learning strategy, were the two learning strategies most commonly preferred by the participants (see Table 15). The Metamotivation learning

Table 15. Means of Individual Learning Strategies of SKILLS Used by Participants

Learning Strategies	Mean	SD	Range
Attention	8.90	1.67	4 - 12
External Aids	8.53	1.71	4 - 12
Testing Assumptions	8.49	1.81	4 - 12
Human Resources	8.49	1.69	4 - 12
Organization	8.39	1.60	4 - 12
Resource Identification	8.24	1.64	4 - 12
Planning	8.20	1.82	4 - 12
Monitoring	8.00	1.60	4 - 12
Critical Use	7.81	1.69	4 - 12
Confidence	7.72	1.82	4 - 12
Conditional Acceptance	7.71	1.64	4 - 12
Adjusting	7.59	1.70	4 - 12
Generating Alternatives	7.57	1.55	4 - 12
Memory Application	7.18	1.73	4 - 12
Reward/Enjoyment	6.95	1.67	4 - 12

strategy of Reward/Enjoyment was the strategy least relied upon by the students. Although some individuals scored at the extremes of the strategies, the overall group means were near the middle of the group. With a possible range of 8, the divergence between the highest and the lowest mean was 1.95; this represents 24.4% of the possible range. Thus, by

analyzing the distribution of the SKILLS scores to investigate research question 1, which asks what learning strategies are employed by high school concurrent enrollment students, these scores show little divergence in learning strategies when the participants are viewed as a group.

Discriminant Analysis

In conducting research in the natural environment, it is reasonable to assume that the researcher will be investigating several variables and their interaction. Discriminant analysis is a multivariate statistical technique which allows the researcher to investigate the differences between two or more groups in relationship to several variables simultaneously (Klecka, 1980, p. 7). Kachigan (1986) stated that

> Discriminant analysis is a procedure for identifying boundaries between groups of objects, the boundaries being defined in terms of those variable characteristics which distinguish or discriminate the objects in the respective criterion groups. (p. 357)

In discriminant analysis as with other multivariate techniques, the emphasis is upon analysing the variables together rather than singly; the purpose of multivariate procedures is to examine the interaction of the multiple variables (Conti, 1993). "Discriminant analysis requires

the researcher to make meaningful decisions about the data and to impose sense upon it" (p. 90).

Discriminant analysis can be used either to describe the way groups differ or to predict membership in a group. In this study, discriminant analysis was used to examine if learning strategies could be used to identify the ways groups differed. For these analyses, the 279 participants were grouped according factors that predicted possible success in concurrent enrollment college courses as measured by grade point average, gender, age, COMPASS scores and ACT scores. In addition, discriminant analysis was used to identify the process that separated the clusters which were found in the cluster analysis (Conti, 1996, p. 71).

In this study, discriminant analysis was used to determine which variables contributed most to identifying participants with low or high academic scores and if it was possible to discriminate between age and gender. In the process of doing the discriminant analysis, a discriminant function is produced regardless of the meaning or the statistical significance of the function. Therefore, the researcher has to have established criteria for determining if the function can be "judged as good and useful" (Conti, 1993, p. 93; Kolody, 1997, p. 85). Two criteria were used to determine if the discriminant analysis truly could discriminate between groups. First, by using the stepwise

selection method for two groups the discriminant function produced by the analysis had to be describable using the structure coefficients with a value of .3 or greater (Conti, 1993, p. 93). The analysis produces a structure matrix which shows the correlation between the individual discriminating variables and the total discriminant function (Klecka, 1980, p. 31). Hill (1992) has pointed out that if several variables do not have a coefficient of at least .3 or if a large number of variables correlate then it is not possible to derive meaning from the function. Second, the discriminant function had to correctly classify at least one-half of the cases beyond the chance placement that might occur in the group. "The percentage of cases classified correctly is often taken as an index of the effectiveness of the discriminant function. When evaluating this measure it is important to compare the observed misclassification rate to that expected by chance alone" (Norusis, 1988, p. B-13). For this study, in order for the discriminant function to be judged as useful, it had to correctly classify not only those possible by chance but also an additional 50% of that number. For example, in a two-group analysis, the discriminant function had to correctly classify 75% of the cases; this represents the 50% due to chance placement and an additional 25%.

By using these two criteria one can distinguish between those functions which are clearly descriptive and highly accurate and those that are not. The functions which are descriptive and accurate provide useful information and descriptions for the groups involved.

Grades

Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their grade point average (GPA) based on a 4.0 scale. To analyze this variable the 279 respondents were placed in three groups (see Table 4). One group of 82 contained individuals who had a GPA lower than 3.3. The other group of 79 was made up of those students with a GPA higher than 3.8. Those students whose GPA fell between the range of 3.3 to 3.8 were placed in the middle group. This group totaled 118 cases and was not used in the analysis. As pointed out in Hill's (1992) study, this process of dividing groups into those composed of the approximately 15% with the highest and lowest grades results in students who are approximately one standard deviation from the mean. By looking at groups that are distinctly different from the classification variable and by having a

buffer zone between them, chances of finding meaningful differences are increased (Yabui, 1993).

The set of discriminating variables used to predict placement in these groups consisted of the learning strategies found in SKILLS. The 15 separate variables in this set were as follows: Metacognition--Planning, Monitoring, and Adjusting; Metamotivation--Attention, Reward/Enjoyment, and Confidence; Memory--Organization, Using External Aids, and Memory Application; Critical Thinking--Testing Assumptions, Generating Alternatives, and Conditional Acceptance; and Resource Management--Resource Identification, Critical Use, and Human Resource.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups of either most successful or least successful learners. The pooled within-groups correlation matrix of discriminating variables was examined because interdependencies among variables are important in most multivariate analyses. That is, in order for multiple variables to be included in an analysis, they should not share variance; a high correlation indicates that variables indeed account for the same variance. The within-groups matrix reveals how the discriminant function is related to the variables within each group in the analysis. The examination of the 105 coefficients in this analysis showed

that all were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at the .4 level, 2 were at the .3 level, 10 coefficients were at the .2 level; the remaining 92 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently did not share a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the most successful and the least successful learners. Stepwise procedures produce an optimal set of discriminating variables. Although there are various methods of selecting variables for inclusion in the discriminant analysis, Wilks' lambda was chosen for this analysis because it takes into consideration both the differences between the groups and the cohesiveness within the groups. Cohesiveness refers to the degree which discriminant variables cluster near their group centroid (Klecka, 1980, p. 54). Because of its approach to variable selection, Wilks' lambda is commonly used in discriminant analysis studies in educational research. As a result of this stepwise procedure, five variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.95; Monitoring--.96; External Aids--.96; Test Assumptions--.99;

and Resource Identification--.98. The other 10 variables included in the analysis did not account for enough variance to be included in the discriminant function.

Standardized discriminant function coefficients are used to determine which variables contribute most to the discrimination between the groups. By examining the standardized coefficients, the relative importance of each variable to the overall discriminant function can be determined. The standardized coefficients for this function which discriminated the most successful from the least successful learners were as follows: External Aids (-.62); Monitoring (.42); Planning (.40); Testing Assumptions (-.35); and Resource Identification (.35). External Aids contributed the most with Monitoring, Planning, Testing Assumptions and Resource Identification contributing essentially equally in discriminating between most successful and least successful learners.

The percentage of cases correctly classified shows how accurate the discriminant function was in grouping the respondents. This discriminant function was 65.2% accurate in classifying cases. It correctly placed 53 (64.6%) in the least successful learning group and 52 (65.8%) in the most successful learning group. This discriminant function is a 15.2% improvement over chance in predicting group placement. Consequently, it demonstrates that least successful and most

successful learners cannot be distinguished on the basis of their preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .29 (Planning) + .27 (Monitoring) - .37 (External Aids) - .19 (Assumptions) + .21 (Resource Identification) - .76.

The group centroid for the least successful learning group was .371, and it was -.386 for the least successful group. The canonical correlation is a measure of the degree of association between the discriminant scores and the groups and was .36 for this study. When this is squared, it indicates that the groups explain only 12% of the variation in the discriminant function.

The structure matrix contains the coefficients which show the similarity between each individual variable and the total discriminate function. The variables with the highest coefficients have the strongest relationship to the discriminant function. These coefficients are used to name the discriminant function because they show how closely the variable and the overall discriminant function are related. In a study such as this in which the discriminant analysis is used for descriptive purposes, this is the most important information related to discriminant functions which satisfy the acceptance criteria. This elevated importance stems from the fact that interpreting the structure matrix results

in naming the process that distinguishes the groups from each other. Since the overall purpose of discriminant analysis is to describe the phenomenon that discriminates the groups from each other, this logical process of giving meaning to the discriminant function by interpreting the structure matrix is central and critical to the whole process. In this interpreting process, variables with coefficients of approximately .3 and above are generally included in the interpretation.

Three variables had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were Planning (.61), External Aids (-.57), Monitoring (.52) and Resource Identification (.36). However, because of the low percentage of variance explained by the discriminant function and because of its lack of accuracy in placing people into the correct group, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question 2 that it was possible to use a variety of variables related to learning strategies to discriminate between most successful and least successful learners enrolled in concurrent enrollment. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function,

it was determined that it is not possible to use learning strategies to discriminate between groups categorized by grade point average.

Gender

For purposes of this discriminant analysis, the respondents were grouped according to gender. The set of discriminating variables used to predict placement in these groups consisted of the fifteen learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups of either gender. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that no strong correlation existed within the groups of discriminating variables. The highest correlation was -.29. Therefore, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the genders. As a result of this Wilks' lambda stepwise procedure, five variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected:

Organization--.92; External Aids--.95; Memory Application--.92; Conditional Acceptance--.96; Critical Use of Resources--.94. The other 10 variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the genders were as follows: External Aids (.65); Critical Use of Resources (.58); Conditional Acceptance (-.49); Memory Application (-.32); and Organization (-.24). Therefore, External Aids, Critical Use of Resources and Conditional Acceptance, contributed about twice as much as Memory Application and Organization in discriminating between genders.

The percentage of cases correctly classified was 61.2%. The classification correctly placed 78 (59.1%) in the male group and 92 (63%) in the female group. Thus, the discriminant function is a 11.2% improvement over chance in predicting group placement. Consequently, it demonstrates that gender cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = -.15 (Organization) + .39 (External Aids) - .18 (Memory Application) - .29 (Conditional Acceptance) + .35 (Human Resources) - 1.23.

The group centroid for the male group was -.314, and it was

.84 for the female group. The canonical correlation was .29 for this study. When this is squared, it indicates that the groups explain only 8% of the variation in the discriminant function.

Three variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows: Critical Use of Resources (.55), External Aids (.54), and Conditional Acceptance (.43). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question that it was possible to use a variety of variables related to learning strategies to discriminate between genders. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not possible to use learning strategies to discriminate between groups categorized by gender.

Age

For purposes of the discriminant analysis, the respondents were divided according to age (see Table 3).

The following age groupings were used since the average age was 16.9: Groups of students under the age of 17 and those 18 through 19 years of age. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups of students under the age of 17 and those 18 through 19 years of age. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only one coefficient was at the .3 level. Six coefficients were at the .2 level; and the remaining 98 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the three age groups. As a result of this Wilks' lambda stepwise procedure, Five variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Monitoring--.98; Testing Assumptions--.998; Resource Identification--.99; Human Resources--.99; and Critical Use

of Resources--.996; The other ten variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the age were as follows: Monitoring (.73); Critical Use of Resources (.54); Human Resources (-.48); Resource Identification (-.40); and Testing Assumptions (.38). Accordingly, Monitoring contributed the most with Critical Use of Resources, Human Resources, Resource Identification, and Testing Assumptions contributing less but approximately equally in discriminating between age.

The percentage of cases correctly classified was 58.5%. The classification correctly placed 116 (58.9%) in under 17 group and 46 (50%) in the 18 and over group. Thus, the discriminant function is an 8.5% improvement over chance in predicting group placement. Consequently, it demonstrates that age cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .45 (Monitoring) + .21 (Testing Assumptions) - .25 (Resource Identification) + .32 (Critical Use of Resources) - .28(Human Resources) - 3.53.

The group centroid for the 17 and under group was -.134, and it was -.330 for the 18 and over group. The canonical

correlation was .21 for this study. When this is squared, it indicates that the groups explain only 4% of the variation in the discriminant function.

Three variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows: Monitoring (.59), Human Resources (-.43), and Resource Identification (-.36). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question that it was possible to use a variety of variables related to learning strategies to discriminate between age groups. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not possible to use learning strategies to discriminate between groups categorized by age.

Degrees of Reading Power

For purposes of the discriminant analysis, the respondents were divided according to scores on the Degrees

of Reading Power. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the Degrees of Reading Power. Thus, for purposes of analysis, 218 respondents were placed in three groups (see Table 5). One group of 35 contained individuals who had a DRP lower than 66. The other group of 37 was made up of those students with a DRP higher than 91. Those students whose DRP fell between the range of 67 to 91 were placed in the middle group. This group totaled 146 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 4 coefficients were at the .3 level, 14 were at the .2 level ,and the remaining 87 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the DRP groups. As a result of this Wilks' lambda stepwise procedure, three variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.91; Confidence--.86; and Memory Application--.85. The other 12 variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Planning (.83); Confidence (.68); and Memory Application (.35). Consequently, Planning and Confidence contributed almost twice as much as Memory Application in discriminating between programs.

The percentage of cases correctly classified was 68.06%. The classification correctly placed 24 (68.6%) in the below 67 group and 25 (67.6%) in the above 91 group. Thus, the discriminant function is an 18.06% improvement over chance in predicting group placement. Consequently, it demonstrates that the DRP scores cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .47 (Planning) + .36 (Confidence) + .19 (Memory Application) - 7.92.

The group centroid for the below 67 group was .430, and it was -.407 for the above 91 group. The canonical correlation was .39 for this study. When this is squared, it indicates that the groups explain only 15% of the variation in the discriminant function.

Four variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows: Planning (.72); Confidence (.53); Human Resources (-.32); and Critical Use of Resources (-.30). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was conducted to investigate the research question that it was possible to use a variety of variables related to learning strategies to discriminate between performance on the Degrees of Reading Power. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not

possible to use learning strategies to discriminate between groups categorized by DRP scores.

COMPASS Writing Skills

For purposes of the discriminant analysis, the respondents were divided according to scores on the COMPASS writing skills assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the writing skills assessment. Thus, for purposes of analysis, 218 respondents were placed in three groups (see Table 6). One group of 35 contained individuals who had a COMPASS writing lower than 32. The other group of 36 was made up of those students with a COMPASS writing higher than 93. Those students whose writing assessment fell between the range of 32 to 93 were placed in the middle group. This group totaled 151 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis

showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 4 coefficients were at the .3 level, 15 were at the .2 level ,and the remaining 86 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the COMPASS writing groups. As a result of this Wilks' lambda stepwise procedure, three variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Monitoring--.93; Reward/Enjoyment--.97; and Conditional Acceptance--.94. The other 12 variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Monitoring (.70); Conditional Acceptance (-.49); and Reward/Enjoyment (.45). Therefore, Monitoring contributed more than both Conditional Acceptance and Reward/Enjoyment which contributed equally in discriminating between groups with high writing scores and those with low scores.

The percentage of cases correctly classified was 67.61%. The classification correctly placed 24 (68.6%) in

the below 32 group and 24 (66.7%) in the above 93 group. Thus, the discriminant function is a 17.61% improvement over chance in predicting group placement. Consequently, it demonstrates that the COMPASS writing scores cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .48 (Monitoring) + .25 (Reward/Enjoyment) - .30 (Acceptance) - 3.15.

The group centroid for the below 32 group was .402, and it was -.391 for the above 93 group. The canonical correlation was .37 for this study. When this is squared, it indicates that the groups explain only 14% of the variation in the discriminant function.

Three variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows: Monitoring (.67); Conditional Acceptance (-.63); and Reward/Acceptance (.47). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question that it was possible to

use a variety of variables related to learning strategies to discriminate between performance on the COMPASS writing skills assessment. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not possible to use learning strategies to discriminate between groups categorized by writing skills scores.

COMPASS Prealgebra Assessment

For purposes of the discriminant analysis, the respondents were divided according to scores on the COMPASS Prealgebra assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the Prealgebra test. Thus, for purposes of analysis, 130 respondents were placed in three groups (see Table 7). One group of 23 contained individuals who had a Prealgebra score less than 22. The other group of 25 was made up of those students with a Prealgebra score higher than 55. Those students whose Prealgebra assessment fell between the range of 22 to 55 were placed in the middle group. This group totaled 82 cases and was not used in this analysis. The set of discriminating variables used to predict placement in

these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 4 coefficients were at the .3 level, 15 were at the .2 level ,and the remaining 86 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the COMPASS Prealgebra groups. As a result of this Wilks' lambda stepwise procedure, seven variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.96; Adjusting--.86; Attention--.97; Confidence--.91; Testing Assumptions--.95; Generating Alternatives--.99; and Resource Identification--.93. The other eight variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Resource Identification (.75); Confidence (.71); Generating Alternatives (.67); Attention (.52); Adjusting (-.50); Testing Assumptions (.47); and Planning (.37). Thus, Resource Identification and Confidence contributed almost twice as much as Planning in discriminating between programs. Generating Alternatives, Attention, and Testing Assumptions contributed a moderate and approximately equal amount in discriminating between programs.

The percentage of cases correctly classified shows how accurate the discrimination function was on grouping the respondents. This discrimination function was 83.33% accurate in classifying cases. It correctly placed 17 (73.9%) in the group with the low Prealgebra scores and 23 (92.0%) in the group with the high Prealgebra scores. Since there were two groups, a 50% chance probability existed for placement in the correct group. Thus, the discriminant function is a 33.33% improvement over chance in predicting group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest Prealgebra scores and those with the lowest scores.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .48 (Resource Identification) + .39 (Confidence) + .41 (Generating Alternatives) + .30 (Attention) - .34 (Adjusting) + .28 (Testing Assumptions) + .19 (Planning) - 14.23

The group centroid for the below 22 group was .941, and it was -.866 for the above 55 group. The canonical correlation was .68 for this study. When this is squared, it indicates that the groups explain 46% of the variation in the discriminant function.

Two variables in the structure matrix had sufficient coefficients to be included in this interpretation of the meaning of the discriminant function. They were Adjusting (-.43) and Confidence (.33)). The coefficients of the variables of Adjusting are equal to that of Confidence. In addition, these learning strategies are opposing traits; when one is used, the other is not. The means for the group with the high Prealgebra scores were 7.88 on Adjusting and 7.32 on Confidence. The means for the group with the low Prealgebra scores were 6.74 for Adjusting and 8.43 for Confidence.

Based upon the structure matrix, this function was named Metacognitive Consciousness. Neither variable is dominant in this function. Confidence is a Metamotivational strategy which involves believing that one can be successful in a learning task. This confidence is modified by Metacognitive Adjusting which focuses on making changes in

the learning process to improve learning. This interaction however, is in the negative direction. The confidence that one will be successful is not controlled by a sense of concern for making changes to improve the learning. Those who get the lowest scores in the group engage in Metacognitive Consciousness. Those who get the highest scores in the group refrain from it. Consequently, the process that distinguishes the most successful from the least successful students is the degree to which they engage in Metacognitive Consciousness. Since the learning task being evaluated in the COMPASS Prealgebra test is oriented to basic math skills, Metacognitive Consciousness is related to a specific math learning task.

Thus, a discriminant analysis was calculated to investigate if it was possible to use SKILLS scores to discriminate between Concurrent Enrollment students with high and low COMPASS Prealgebra scores. Based on the high percentage of variance explained by the function discriminating between the groups and on the high percentage of prediction accuracy by the discriminant function, it was determined that it is possible to use learning strategies to discriminate between groups categorized by Prealgebra scores. The process that distinguishes these groups is Metacognitive Consciousness.

COMPASS Algebra Skills

For purposes of the discriminant analysis, the respondents were divided according to scores on the COMPASS algebra assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the algebra skills assessment. Hence, for purposes of analysis, 196 respondents were placed in three groups (see Table 8). One group of 31 contained individuals who had an algebra score lower than 19. The other group of 33 was made up of those students with a algebra higher than 57. Those students whose algebra assessment fell between the range of 19 to 57 were placed in the middle group. This group totaled 132 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at

the .4 level, 5 were at the .3 level, 14 were at the .2 level, and the remaining 85 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the COMPASS Algebra groups. As a result of this Wilks' lambda stepwise procedure, four variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.97; Confidence--.97; Memory Application--.96; and Critical Use of Resources--.99. The other 11 variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Confidence (.78); Planning (.56); Critical Use of Resources (.48); and Memory Application (.44). Confidence provided the most to being able to discriminate between groups on the algebra assessment. Planning, Critical Use of Resources, and Memory Application were moderate and approximately equal in discriminating between the groups.

The percentage of cases correctly classified was 60.94%. The classification correctly placed 19 (61.3%) in the below 19 group and 20 (60.6%) in the above 57 group. Thus, the discriminant function is a 10.94% improvement over chance in predicting group placement. Consequently, it demonstrates that the COMPASS algebra scores cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .33 (Planning) + .44 (Confidence) - .22 (Memory Application) + .28 (Critical Use of Resources) - 6.52.

The group centroid for the below 19 group was .386, and it was -.363 for the above 57 group. The canonical correlation was .36 for this study. When this is squared, it indicates that the groups explain only 13% of the variation in the discriminant function.

Four variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows: Memory Application (-.55); Planning (.49); Confidence (.49); and Adjusting (.35). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question that it was possible to use a variety of variables related to learning strategies to discriminate between performance on the COMPASS algebra assessment. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not possible to use learning strategies to discriminate between groups categorized by algebra scores.

ACT English

For purposes of the discriminant analysis, the respondents were divided according to scores on the ACT English assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the ACT English assessment. Thus, for purposes of analysis, 79 respondents were placed in three groups (see Table 9). One group of 11 contained individuals who had an English score lower than 17. The other group of 11 was made up of those students with a score higher than 27. Those students whose scores fell between the range of 17 to 27 were placed in the middle group. This group totaled 57 cases and was not used

in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 2 coefficients were at the .5 level, 5 were at the .4 level, 19 were at the .3 level, 15 were at the .2 level and the remaining 64 were all below the .2 level. While two variables were at the .5 level, they were not related to more than one other variable and were subsequently retained for analysis. Also, the remaining variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the ACT English groups. As a result of this Wilks' lambda stepwise procedure, four variables were included in the discriminant function. The following discriminating variable and the corresponding Wilks' lambda value was selected: Adjusting--.76. The other 14 variables included in the analysis did

not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Adjusting (1.0). Therefore, it appears that Adjusting was the only variable contributing anything to being able to discriminate between groups on the ACT English test.

The percentage of cases correctly classified was 63.6%. The classification correctly placed 7 (63.6%) in the below 17 group and 7 (63.6%) in the above 27 group. Thus, the discriminant function is a 13.6% improvement over chance in predicting group placement. Consequently, it demonstrates that the ACT English scores cannot be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .786 (Adjusting) - 6.18.

The group centroid for the below 17 group was -.535, and it was .535 for the above 27 group. The canonical correlation was .49 for this study. When this is squared, it indicates that the groups explain only 24% of the variation in the discriminant function.

Three variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the discriminant function. They were as follows:

Adjusting (1.00); Confidence (-.42); Testing Assumptions (-.31); and External Aids (.30). Because of the low percentage of variance explained by the discriminant function and the lack of accuracy in classification, the discriminant function was not named.

Thus, a discriminant analysis was calculated to investigate the research question that it was possible to use a variety of variables related to learning strategies to discriminate between performance on the ACT English assessment. Based on the low percentage of variance explained by the discriminant function between groups and the low percentage of accuracy of prediction into the groups by the discriminant function, it was determined that it is not possible to use learning strategies to discriminate between groups categorized by English scores.

ACT Math

For purposes of the discriminant analysis, the respondents were divided according to scores on the ACT Math assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the math assessment. Thus, for purposes of analysis, 79 respondents were placed in three groups (see Table 10). One group of 17

contained individuals who had a math score lower than 18. The other group of 18 was made up of those students with a score higher than 25. Those students whose scores fell between the range of 18 to 25 were placed in the middle group. This group totaled 44 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that most were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at the .7 level, 1 coefficient was at the .5 level, 3 were at the .4 level, 17 were at the .3 level, 15 were at the .2 level and the remaining 68 were all below the .2 level. While one variable was at the .7 level and two variables were at the .5 level, they were not related to more than one other variable and were subsequently retained for analysis. Also, the remaining variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the ACT

Math groups. As a result of this Wilks' lambda stepwise procedure, ten variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.88, Monitoring--.89, Adjusting--.99, Attention--.99, Confidence--.98, Organizing--.99, External Aids--.99, Memory Application--.97, Resource Identification--.99, and Critical Use of Resources--.99. The other five variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Critical Use of Resources (1.68), Confidence (1.47), Adjusting (1.26), Monitoring (1.16), Planning (1.01), Attention (-.67), Memory Application (-.59), Organizing (.54), Resource Identification (.49), and External Aids (-.41). Thus, Critical Use of Resources, Confidence, Adjusting, Monitoring, and Planning contributed almost twice as much as Attention, Memory Application, Organizing, Resource Identification, and External Aids in discriminating between groups.

The percentage of cases correctly classified was 82.9%. The classification correctly placed 15 (88.2%) in the below 17 group and 14 (77.8) in the above 27 group. Thus, the discriminant function is a 32.9% improvement over chance in

predicting group placement. Consequently, it demonstrates that the ACT Math scores can be distinguished on the basis of learners' preference for learning strategies.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .950 Critical Use of Resources + .928 Confidence + .783 Adjusting + .762 Monitoring + .601 Planning - .487 Attention -.380 Memory Application + 3.44 Organizing + .305 Resource Identification - .248 External Aids - 27.529.

The group centroid for the below 18 group was 1.135, and it was -1.072 for the above 25 group. The canonical correlation was .75 for this study. When this is squared, it indicates that the groups explain only 56% of the variation in the discriminant function.

Two variables in the structure matrix had sufficient coefficients to be included in this interpretation of the meaning of the discriminant function. They were Planning (.32) and Monitoring (.30). The coefficients of the variables Planning and Monitoring are equal. The means for the group with the high ACT math scores were 7.56 on Planning and 7.27 on Monitoring. The means for the group with the low math scores were 8.76 for Planning and 8.29 for Monitoring.

Based upon the structure matrix, this function was named Calibrating. Neither variable is dominant in this

function. Planning and Monitoring are both Metacognitive strategies. Planning consists of analysing the best way to proceed with a specific learning task. Monitoring interacts with planning by reviewing how one's plans are proceeding and comparing progress to the accepted standard. The planning that one does is controlled by a sense of concern and he or she continues to assess how they are doing. Since the learning task being evaluated in the ACT Math scale is oriented to higher level math skills than the COMPASS Prealgebra test, Calibrating is related to specific higher math learning tasks. Those who get the lowest scores in the group engage in Calibrating. Those who get the highest scores in the group refrain from it. Consequently, the process that distinguishes the most successful from the least successful students is the degree to which they engage in Calibrating.

Thus, a discriminant analysis was calculated to investigate if it was possible to use SKILLS scores to discriminate between Concurrent Enrollment students with high and low ACT Math scores. Based on the high percentage of variance explained by the function discriminating between the groups and on the high percentage of accuracy of prediction by the discriminant function, it was determined that it is possible to use learning strategies to discriminate between groups categorized by their math

scores. The process that distinguishes these groups is Calibrating.

ACT Reading

For purposes of the discriminant analysis, the respondents were divided according to scores on the COMPASS Reading assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the reading test. Thus, for purposes of analysis, 78 respondents were placed in three groups (see Table 11). One group of 14 contained individuals who had a reading score less than 19. The other group of 21 was made up of those students with a reading score higher than 26. Those students whose reading assessment fell between the range of 19 to 26 were placed in the middle group. This group totaled 43 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis

showed that most variables were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at the .6 level, 2 were at the .5 level, 4 were at the .4 level, 10 were at the .3 level, 14 were at the .2 level, and the remaining 74 were all below the .2 level. While one variable was at the .6 level and two variables were at the .5 level, they were not related to more than one other variable and were subsequently retained for analysis.

Stepwise selection was used to determine which variables added most to the discrimination between the ACT Reading groups. As a result of this Wilks' lambda stepwise procedure, seven variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Adjusting--.93; Attention--.99; Reward/Enjoyment--.91; Memory Application--.95; Conditional Acceptance--.93; Resource Identification--.99; and Critical Use of Resources--.99. The other eight variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Memory Application (.97); Reward/Enjoyment (.78); Conditional Acceptance (.75); Attention (.56); Resource Identification (.49); Critical Use of Resources (-.41); and Adjusting

(.38). Accordingly, Memory Application, Reward/Enjoyment, and Conditional Acceptance contributed almost twice as much as Attention, Resource Identification, Critical Use of Resources and Adjusting.

The percentage of cases correctly classified shows how accurate the discrimination function was on grouping the respondents. This discrimination function was 82.86% accurate in classifying cases. It correctly placed 12 (85.7%) in the group with the low reading scores and 17 (81.0%) in the group with the high reading scores. Since there were two groups, a 50% chance probability existed for placement in the correct group. Thus, the discriminant function is a 32.86% improvement over chance in predicting group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest ACT Reading scores and those with the lowest scores.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .30 (Resource Identification) + .34 (Attention) + .25 (Adjusting) + .53 (Reward/Enjoyment) + .63 (Memory Application) + .43 (Conditional Acceptance) - .24 (Critical Use of Resources) - 16.90

The group centroid for the below 19 group was -1.063, and it was .709 for the above 26 group. The canonical correlation was .67 for this study. When this is squared, indicates

that the groups explain 45% of the variation in the discriminant function.

Five variables in the structure matrix had sufficient coefficients to be included in this interpretation of the meaning of the discriminant function. They were Reward/Enjoyment (.35), Monitoring (-.35), Human Resources (-.32), Conditional Acceptance (.32), and Adjusting (.31). The coefficients of the variables are equal. In addition, Reward/Enjoyment, Conditional Acceptance and Adjusting are opposing traits to Monitoring and Human Resources; when one is used highly, the other is low. The means for the group with the high reading scores were 7.19 Reward/Enjoyment, 7.76 Monitoring, 8.52, Human Resources, 8.33 Conditional Acceptance, and 7.71 Adjusting. The means for the group with the low reading scores were 6.29 Reward/Enjoyment, 8.43 Monitoring, 9.29 Human Resources, 7.36 Conditional Acceptance, and 6.86 Adjusting.

Based upon the structure matrix, this function was named Feedback Detachment. This process involves the internal strategies of adjusting, monitoring, and reward/enjoyment. These internal strategies are balanced by the strategies of Conditional Acceptance and Human Resources. However, the Monitoring and Human Resource strategies are opposite the other three strategies. This interaction creates a process where the learner is not

monitoring their learning or using human resources to learn. They are internally focused on adjusting, feeling motivated and critically looking at their assumptions about learning. They are motivated but cautious about their learning but, are cut off from monitoring what is happening and they are not receiving feedback from others. Since the learning task being evaluated in the ACT Reading scale is oriented to reading skills, Feedback Detachment is related to the specific task of reading. Those who get the lowest scores in the group engage in Feedback Detachment. Those who get the highest scores in the group refrain from it. Thus the process that distinguishes the most successful from the least successful students is the degree to which they engage in Feedback Detachment.

Thus, a discriminant analysis was calculated to investigate if it was possible to use SKILLS scores to discriminate between Concurrent Enrollment students with high and low ACT Reading scores. Based on the high percentage of variance explained by the function discriminating between the groups and on the high percentage of accuracy prediction by the discriminant function, it was determined that it is possible to use learning strategies to discriminate between groups categorized by reading scores. The process that distinguishes these groups is Feedback Detachment.

ACT Science

For purposes of the discriminant analysis, the respondents were divided according to scores on the ACT Science assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the science test. Thus, for purposes of analysis, 78 respondents were placed in three groups (see Table 12). One group of 14 contained individuals who had a science score less than 19. The other group of 18 was made up of those students with a science score higher than 26. Those students whose science assessment fell between the range of 19 to 26 were placed in the middle group. This group totaled 46 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that most were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at

the .7 level, 1 was the .5 level, 5 were at the .4 level, 14 were at the .3 level, 17 were at the .2 level, and the remaining 67 were all below the .2 level. While one variable was at the .7 level and one variable was at the .5 level, they were not related to more than one other variable and were subsequently retained for analysis. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the ACT Science groups. As a result of this Wilks' lambda stepwise procedure, six variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.84; Confidence--.99; External Aids--.96; Testing Assumptions--.96; Resource Identification--.96; and Critical Use of Resources--.92. The other nine variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: External Aids (-1.26); Testing Assumptions (-1.19); Planning (.99); Resource Identification (.84); Critical Use of Resources(.57); and Confidence (.50). Thus, External Aids,

Testing Assumptions, Planning, and Resource Identification contributed almost twice as much as Critical Use of Resources and Confidence in discriminating between programs.

The percentage of cases correctly classified shows how accurate the discrimination function was on grouping the respondents. This discrimination function was 93.75% accurate in classifying cases. It correctly placed 13 (92,9%) in the group with the low science scores and 17 (94.4%) in the group with the high science scores. Since there were two groups, a 50% chance probability existed for placement in the correct group. Thus, the discriminant function is a 43.75% improvement over chance in predicting group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest ACT science scores and those with the lowest scores.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .56 (Planning) + .29 (Confidence) - .77 (External Aids) - .62 (Testing Assumptions) + .54 (Resource Identification) .31 (Critical Use of Resources) - 1.56

The group centroid for the below 19 group was 1.398, and it was -1.088 for the above 26 group. The canonical correlation was .79 for this study. When this is squared,

it indicates that the groups explain 62% of the variation in the discriminant function.

Two variables in the structure matrix had sufficient coefficients to be included in this interpretation of the meaning of the discriminant function. They were Planning (.34) and Adjusting (.31). The coefficients of the variables Planning and Adjusting are equal. The means for the group with the high science scores were 7.22 Planning, and 7.94 Adjusting. The means for the group with the low science scores were 8.71 Planning, and 7.29 Adjusting.

Based upon the structure matrix, this function was named Metacognitive Adaptation. Planning, a Metacognitive strategy, involves analysing the best way to proceed with a specific learning task. Adjusting, also a Metacognitive strategy, involves evaluating, directing and making changes in the learning process to improve learning. Since the learning task being evaluated in the ACT Science scale is oriented to science skills, Metacognitive Adaption is related to the specific task of science learning. Those who get the lowest scores in the group engage in Metacognitive Adaptation. Those who get the highest scores in the group refrain from it. Thus, the process that distinguishes the most successful from the least successful students is the degree to which they engage in Metacognitive Adapting.

Thus, a discriminant analysis was calculated to investigate if it was possible to use SKILLS scores to discriminate between Concurrent Enrollment students with high and low ACT Science scores. Based on the high percentage of variance explained by the function discriminating between the groups and on the high percentage of accuracy prediction by the discriminant function, it was determined that it is possible to use learning strategies to discriminate between groups categorized by science scores. The process that distinguishes these groups is Metacognitive Adaptation.

ACT Composite

For purposes of the discriminant analysis, the respondents were divided according to scores on the ACT Composite assessment. Discriminant analysis was used to describe the combination of variables that could be used to distinguish the most successful learners from the least successful learners as determined by their scores on the composite test. Thus, for purposes of analysis, 79 respondents were placed in three groups (see Table 13). One group of 12 contained individuals who had a composite score less than 19. The other group of 23 was made up of those students with a composite score higher than 25. Those students whose composite assessment fell between the range

of 19 to 25 were placed in the middle group. This group totaled 44 cases and was not used in this analysis. The set of discriminating variables used to predict placement in these groups consisted of the 15 learning strategies found in SKILLS.

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their groups. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only 1 coefficient was at the .6 level, 1 was the .5 level, 2 were at the .4 level, 13 were at the .3 level, 18 were at the .2 level, and the remaining 70 were all below the .2 level. Thus, the variables in this discriminant analysis were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the ACT Composite groups. As a result of this Wilks' lambda stepwise procedure, ten variables were included in the discriminant function. The following discriminating variables and their corresponding Wilks' lambda values were selected: Planning--.91; Confidence--.93; Monitoring--.99; Testing Assumptions--.99; Resource Identification--.98;

Critical Use of Resources--.97; Adjusting--.92; Organization--.99; Generating Alternatives--.99; and Human Resources--.98. The other five variables included in the analysis did not account for enough variance to be included in the discriminant function.

The standardized coefficients for this function which discriminated between the programs were as follows: Critical Use of Resources (1.59); Confidence (1.56); Generating Alternatives (1.41); Adjusting (1.39); Monitoring (1.36); Organization (1.15); Planning (1.05); Human Resources (.94); Testing Assumptions (.58); and Resource Identification (.54). Thus, Critical Use of Resources, Confidence, Generating Alternatives, Adjusting, and Monitoring dominate and contribute almost one third as much as Organization, Planning, Human Resources, Testing Assumptions, and Resource Identification in discriminating between programs.

The percentage of cases correctly classified shows how accurate the discrimination function was on grouping the respondents. This discrimination function was 82.86% accurate in classifying cases. It correctly placed 9 (92.9%) in the group with the low composite scores and 20 (87.0%) in the group with the high composite scores. Since there were two groups, a 50% chance probability existed for placement in the correct group. Thus, the discriminant function is a 32.86% improvement over chance in predicting

group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest ACT Composite scores and those with the lowest scores.

The discriminant function which was used to classify the cases into these groups was as follows:

D = .65 (Planning) + 1.05 (Confidence) +.89 (Monitoring) +.31 (Testing Assumptions) + .34 (Resource Identification) + .90 (Critical Use of Resources) + .90 (Adjusting) + .74 (Organization) + .88 (Generating Alternatives) + .66 (Human Resources) - 58.27

The group centroid for the below 19 group was 1.615, and it was -.843 for the above 25 group. The canonical correlation was .77 for this study. When this is squared, it indicates that the groups explain 59% of the variation in the discriminant function.

Two variables in the structure matrix had sufficient coefficients to be included in this interpretation of the meaning of the discriminant function. They were Conditional Acceptance (.42) and Reward/Enjoyment (.36). The coefficients of the variables Conditional Acceptance and Reward/Enjoyment are approximately equal. The means for the group with the high composite scores were 8.30 for Conditional Acceptance and 7.00 for Reward/Enjoyment. The means for the group with the low composite scores were 7.25 for Conditional Acceptance and 6.50 for Reward/Enjoyment.

Based upon the structure matrix, this function was named Critical Differentiating. Conditional Acceptance, a Critical Thinking strategy, involves a reflective and tentative review of a solution to determine if adjustments are needed before acceptance. Reward/Enjoyment, a Metamotivational strategy, involves recognizing the value of learning. The reflection on accepting a solution is controlled by a sense of enjoyment and value. Since the learning tasks being evaluated by the ACT Composite scale are drawn from the other scales, Critical Differentiating is related to generalized learning in reading, English, math, and science learning. Those who get the lowest scores in the group refrain from Critical Differentiating. Those who get the highest scores in the group engage in it. Thus the process that distinguishes the most successful from the least successful students is the degree to which they engage in Critical Differentiating.

Therefore, a discriminant analysis was conducted to investigate if it was possible to use SKILLS scores to discriminate between Concurrent Enrollment students with high and low ACT composite scores. Based on the high percentage of variance explained by the function discriminating between the groups and on the high percentage of accuracy prediction by the discriminant function, it was determined that it is possible to use learning strategies to

discriminate between groups categorized by composite scores. The process that distinguishes these groups is Critical Differentiating.

Summary

In this study, discriminant analysis was used to analyze the relationship between learning strategies and various demographic and educational variables. Using the deductive approach of inquiry, groupings believed to have an influence upon how people used learning strategies were imposed upon the data. Only weak differences were found when the learners were grouped by grades, gender, and age. Additionally, only weak differences were found on the Degrees of Reading Power, COMPASS writing, COMPASS algebra and ACT English assessments. Likewise, each of these analyses explained only about 10% to 20% of the variance that could be explained beyond mere chance. However, learning strategies as measured by SKILLS were useful in discriminating similar groups of learners on the COMPASS Prealgebra (the Metacognitive Consciousness process), ACT Math (the Calibrating process), Reading (the Feedback Detachment process), Science (the Metacognitive Adaptation process) and Composite (the Critical Differentiating process). Each of these analyses explained as much as 33%

to 44% of the variance that could be explained beyond mere chance.

CHAPTER 5

IDENTIFYING GROUPS OF LEARNERS

Cluster Analysis

Cluster analysis was used to determine if groups of learners could be identified based on SKILLS learning strategies. This part of the investigation involved the use of cluster analysis, one-way analysis of variance, and interviewing techniques to help describe the clusters (Aldenderfer & Blashfield, 1984, Chap 1; Kaufman & Rousseeuw, 1990, p. 1; Norusis, 1988b, p. B-71). Cluster analysis is a multivariate statistical procedure that is used "to discover structure in data that is not readily apparent by visual inspection or by appeal to other authority" (Aldenderfer & Blashfield, 1984, p. 16). Cluster analysis procedures empirically form clusters or groups that have similar characteristics. By using this inductive approach to naturalistic inquiry, "researchers function more in a sociological mode. Here the issue is how to tease sense out of the data. Rather than imposing sense upon the data, the goal is to have meaning and understanding emanate from the data itself" (Conti, 1996, p. 67).

There are several methods for determining how cases will be combined into clusters (Kaufman & Rousseeuw , 1990).

The Ward's method (Ward, 1963) has been widely used in the social sciences and was chosen in this study because it is designed to optimize the minimum variance within clusters, it tends to create clusters of equal size (Aldenderfer & Blashfield, 1984), and "it appears that this method is suitable for many situations and possesses a certain robustness with respect to slight distortions" (Kaufman & Rousseeuw , 1990, p. 243).

Five clusters of adult learners were identified and named Physical Response Learners, Matrix Learners, Strategic Learners, Sequential Learners, and Creative Learners. The participants were distributed fairly equally among the clusters (see Table 16). The names for the clusters were derived from both a statistical profile of each group based on the 15 variables in SKILLS, academic variables, and from follow-up analysis of interviews with participants from the various groups.

ANOVA of the Clusters

After the five cluster solutions were chosen, a one-way analysis of variance was performed on each SKILLS score, demographic variable and educational variable to determine if there were any significant differences among the five

Table 16. Cluster Frequency Distribution

Cluster Name	Frequency	Percentage
Physical Response Learners	70	25.1
Matrix Learners	44	15.8
Strategic Learners	59	21.1
Sequential Learners	64	22.9
Creative Learners	42	15.1

clusters (Hays, 1995; Strakal, 1995; Yabui, 1993). Conti (1996) suggested that, "analysis of variance is a useful tool for determining which variables are related to each cluster and for determining how the variables are associated with the cluster (p.70). Means for each of the 15 learning strategies in SKILLS were calculated for each of the five cluster groups. Significant differences existed in 14 of the 15 learning strategies (see Table 17).

Table 17. ANOVA of Significantly Different Learning Strategies In Clusters

Strategy	df	SS	MS	F	p
Planning					
Between	4	354.65	88.66	42.66	.0001
Within	274	569.50	2.08		
Monitoring					
Between	4	40.68	10.17	4.14	.0028
Within	274	672.28	2.45		
Adjusting					
Between	4	4.22	1.06	.3633	.8347
Within	274	797.37	2.91		
Attention					
Between	4	120.23	30.06	12.56	.0001
Within	274	655.76	2.39		
Reward					
Between	4	36.45	9.11	3.38	.0101
Within	274	737.74	2.69		
Confidence					
Between	4	223.01	55.75	21.92	.0001

Within	274	696.74	2.54		
Organization					
Between	4	36.37	9.09	3.70	.0060
Within	274	673.82	2.46		
External Aids					
Between	4	102.76	25.69	9.93	.0001
Within	274	708.67	2.59		
Memory Application					
Between	4	130.00	32.50	12.62	.0001
Within	274	705.68	2.57		
Testing Assumptions					
Between	4	281.24	70.31	30.27	.0001
Within	274	636.50	2.32		
Generating Alternatives					
Between	4	66.57	16.64	7.57	.0001
Within	274	601.95	2.20		
Conditional Acceptance					
Between	4	125.35	31.34	12.52	.0001
Within	274	685.71	2.50		
Resource Identification					
Between	4	54.57	13.64	5.39	.0003
Within	274	692.86	2.53		
Critical Use of Res.					
Between	4	182.35	45.59	20.50	.0001
Within	274	609.20	2.22		
Human Resources					
Between	4	212.45	53.11	25.21	.0001
Within	274	577.27	2.11		

Adjusting was the only variable that was not significantly different, and therefore, it was left out of the analysis to characterize and assist in naming the groups. A one-way analysis of variance was also conducted on each of the 13 demographic variables to determine if there were significant differences among the five cluster groups (see Table 18). There existed a significant difference only for the demographic variable of GPA. Consequently, this significant variable was retained to assist in analysing and naming the groups. The one-way

analysis also determined that there were no significant differences among the clusters regarding the 12 other demographic variables. Since these variables showed no significant differences, they were not considered characteristic of any of the clusters and were not

Table 18. ANOVA of Demographic Variables Among Clusters

Variable	df	SS	MS	F	p
Variables with Significant Difference					
GPA					
Between	4	1.81	.45	2.56	.0393
Within	259	40.23	.15		
Variables With No Significant Difference					
DRP					
Between	4	1072.12	268.05	.34	.8506
Within	242	190642.50	787.78		
COMPASS Writing					
Between	4	2766.77	691.69	.65	.6300
Within	241	257933.08	1070.26		
Age					
Between	4	11.02	2.75	.97	.4299
Within	274	775.91	2.83		
COMPASS Prealgebra					
Between	4	4891.38	1222.84	2.04	.0905
Within	188	112702.57	599.48		
COMPASS Algebra					
Between	4	136.95	34.24	.07	.9917
Within	222	113145.84	509.67		
ACT English					
Between	4	518.96	129.74	.95	.4348
Within	158	21496.75	136.05		
ACT Math					
Between	4	450.36	112.59	.86	.4882
Within	159	20766.03	130.60		
ACT Reading					
Between	4	576.50	144.12	.93	.4471
Within	157	24283.50	154.67		
ACT Science					

Between	4	645.56	161.39	1.12	.3473
Within	157	22544.86	143.60		
ACT Composite					
Between	4	486.21	121.55	.87	.4804
Within	158	21948.64	138.91		
COMPASS College Algebra					
Between	4	485.85	121.46	.41	.7986
Within	7	3054.33	436.33		
Gender					
Between	4	2.28	.57	2.32	.0569
Within	273	67.04	.25		

used in classifying and naming the five groups determined in the cluster analysis.

The means of the 14 learning strategies along with the significant demographic variables for each cluster were used to help identify the important characteristics of each group. Following the one-way analysis of variance, Tukey post hoc tests were also used to identify the groupings for each of the significant variables. The means for the significant learning strategies and demographic variables are displayed in Table 19. Five clear and distinct clusters of learners were determined from the multivariate technique of cluster analysis. Hence, this analysis, which investigated research question number four related to clusters of learners existing in the data, demonstrated that it was possible to identify distinct clusters of learners in concurrent enrollment students based on student responses on 15 learning strategies of SKILLS.

Interview Data

In this phase of the study, focus groups were used as a supplement to the quantitative analysis to assist in naming and describing each group. The focus group interviews were conducted with representative learners from each cluster. Focus group one contained only members of cluster one and focus group two contained only members from cluster two and so on. Strakal (1995) recommended using the information from the quantitative data to serve as a discussion guide for the focus groups. The quantitative data together with the quantitative information when combined provide a more comprehensive and accurate description of the clusters (Conti, 1996, p. 71).

This triangulation process of gathering qualitative data and using qualitative data to verify the quantitative data has evolved from a series of learning strategies studies in Montana (Conti & Kolody, 1995; Hays, 1995; Kolody & Conti, 1996; Lockwood, 1997; Strakal, 1995; Yabui, 1993) and is highly recommended by Conti (1996, p. 70).

Interviews were scheduled at the high schools, which presented some logistical problems. Some teachers were in the middle of important lessons at the scheduled time so they delayed the students from coming on time. Some teachers wanted their students back promptly. This resulted

Table 19. Means of Cluster Groupings on Learning Strategies and Demographic Variables

Variable	PRL	StL	SqL	Matrix	Creative
Planning	8.3	9.1	9.3	7.2	6.1
Monitoring	8.3	8.3	7.3	8.1	7.9
Adjusting	-	-	-	-	-
Attention	8.2	9.6	9.6	8.0	8.9
Reward	7.5	6.7	6.6	6.9	6.8
Confidence	8.5	7.9	6.4	8.8	7.0
Organization	8.3	9.0	7.9	8.4	8.4
External Aids	8.5	9.1	7.6	8.4	9.3
Application	8.0	6.4	6.5	7.8	7.2
Test Assumptions	8.8	7.3	9.7	7.1	9.1
Gen. Alternatives	7.6	7.3	7.6	6.8	8.5
Conditional Acceptance	6.7	8.4	7.4	8.4	8.1
Resource Identification	8.2	8.3	8.9	7.5	7.9
Use of Resources	6.7	7.3	8.5	8.3	8.7
Using Human Resources	8.1	7.4	9.0	10.1	8.1
GPA	3.7	3.7	3.4	3.3	3.5

in some interviews being short and lacking in depth. Also, before 9:00 A.M. is not a good time to interview students, as often they are less alert and less talkative. Twenty five students participated in the interviewing process (see Table 20).

Table 20. Participants of Qualitative Interviews

Clusters	Focus Group Participants
Physical Response Learner	5
Matrix Learner	5
Strategic Learner	5
Sequential Learner	5
Creative Learner	5
Total	25

Previous researchers (Hays, 1995; Kolody, 1997; Yabui, 1993) have conducted similar studies and found five clusters of learners. Hays (1995, Chap 4) described the characteristics of students with learning disabilities which she called the Assisted Learners, the Hands-On Learners, the Sensitive Learners, the Persistent Learners and the Balanced Learners. Yabui (1993, Chap 4) described learning characteristics of subjects demonstrating various level of reflective judgement and named them the Veteran Status Quo Learner, the Active Learner, the Reactive Learner, the Analytical Learner, and the Insecure Learner. By far the most extensive study was conducted by Kolody (1997, Chap 5) using 1,143 students located at five two year colleges located in the province of Alberta, Canada. She found a five cluster group of learners that she described as Navigators, Engagers, Critical Thinkers, Monitors and Networkers. In each of these studies, the clusters were described using the results from the SKILLS and qualitative information from interviews. Thus, through quantitative and

qualitative means, five distinct groups of learners were identified and described. The combination of these techniques allowed research questions three and four which asked about the description of these groups to be answered. The following descriptions of the five groups of learners are the results of the cluster analysis, the analysis of variance of each group, and comments from learners within each cluster which was collected during focus group interviews.

Physical Response Learner

Physical Response Learners love to read or learn new things in their spare time. They are most interested in meaningful applications of general subjects. The Physical Response Learner does not want to know just the basics but wants a more in-depth perspective and desires to understand how that knowledge is most applicable to the real world. They use mental images and other memories to help solve problems and are good at changing to the teacher's needs when it comes to giving the right answer on tests and evaluations. Most would prefer a more hands-on approach to learning and feel that tests do not fully measure true knowledge or ability. During the focus group, one student made the following comments concerning learning material to pass a test,

> I don't think tests show your knowledge. I don't think they (teachers) prepare you for them. They skim over so much information but then they don't deal with the important stuff that you need to know for the tests.

Physical Response Learners rely on the strategies of Reward/Enjoyment, Monitoring, and Memory Application. This was the largest group of the five types of learners (see Table 20). The Physical Response Learner scored high in the metamotivational learning strategy of Reward/Enjoyment, which is anticipating or recognizing the value, to one's self, of learning specific material and having fun or experiencing satisfaction with the learning activity (Fellenz & Conti, 1989). One student stated emphatically that "I learn best by doing things over and over again. My best teachers stay after school for a while and let me catch up on my school work I didn't finish in class."

Not only do Physical Response Learners have the internal reward and enjoyment for learning, they react positively to those around them who also enjoy learning. One focus group member mentioned that "I learn better when the teacher is enthusiastic." The Physical Response Learner resents the teacher who "just gives homework and just dumps it into your head."

The Physical Response Learner's metamotivational reward and enjoyment for learning is combined with cognitive processes. In addition to reflecting on the enjoyment of

learning, they engage in monitoring and reviewing learning plans to check if they are on task and to compare their progress with accepted standards or models. However, this is tempered by their love of learning in depth. One group member complained that "I hate deadlines, I would like to have more time to learn a subject than to skim over it."

Memory Application is another learning strategy in which Physical Response Learners scored high. They enjoy applying memory skills to not only academic situations but also to life learning situations. One high school senior was preparing to go on a mission for his church. He enthusiastically stated "at church we have a class where we learn to teach people and I have been memorizing [lessons]."

Physical Response Learners along with the Strategic Learners have the highest grade point average of all the groups. Physical Response Learners have excellent reading skills. The reading and Memory Application skills may account for their good grades. Although Physical Response Learners want more than just basal levels of skills and knowledge, they tend to internalize the content, which they must find personally rewarding or enjoyable; they succeed best with teachers who focus on learning rather than on formal evaluation and who encourage hands-on learning projects. They prosper under the care of a teacher who

displays a personal interest in them and with whom they can develop an emotional affinity.

Matrix Learner

The Matrix Learner loves groups, group activities, group study, and group projects. This learner relishes verbally examining problems, being quizzed and quizzing others in the group. This learner does not mind working on his or her own but when given the choice, prefers to work in a group setting. High personal interaction is a necessity for this learner. The Matrix Learners scored high on the Human Resources strategy. Fellenz describes this strategy

> That involves listening to people with different opinions or insights into issues is suggested as well as the use of discussion to think through or study problems. In some situations, the support provided by human resources may be as important as the information they contribute. (Fellenz, 1994, p. 37)

Learning comes easier for the Matrix Learners when they are in a group. "I like [it] when I work with others, talk to others, and I talk things out. Then I can learn easier and kind of talk out what I'm thinking." These learners use the group setting to work on and solve problems. One group member pointed this aspect out by saying, "I usually get in groups, like a good friend, and we quiz each other where we're having problems and work them out or mostly in groups. I'd rather study in groups than by myself."

Matrix Learners use the group format to seek out the kind of information they need to be successful. "In my Biology class I would get together with others and study because I didn't know all the information and they help me to talk to people who did know."

Learning from others is supported by confidence in one's ability to learn. This metamotivational strategy is an essential element for motivating the Matrix Learner. Other strategies that are moderately strong include Organizing, Memory Application and Reward/Enjoyment. These strategies help the Matrix Learner to interact with others. "I learn best [as I] watch and learn, like having things shown to me. Then I go practice it. Sometimes it's easy to talk with people and get done a lot faster and I pick it up a little better." Having fun with the learning activity, the enjoyment, is also important to the Matrix Learner. One student laughed as she related that, "Sometimes (in class) we'll have a paper fight. We'll move all our desks together and throw paper at each other--it's fun."

The Matrix Learner focuses on the group interaction while learning. Teachers who use group activities and discussion techniques facilitate the learning of these students. These learners do not do well on formal evaluations in or out of class. Their GPA's are the lowest of all the clusters.

Strategic Learner

The Strategic Learner thrives on monitoring the progress of one's learning. This learner figures out how to take the tests or figures out what the teacher expects of him or her and "delivers" to get a good grade. The Strategic Learner likes specific directions on how to get things done and then does them. Often, this student does not even study much, only when it is absolutely necessary. "I don't like to study--I'm not a very good studier. I study when I have to but if I don't have to, if I can get by without doing it, I don't."

The Strategic Learners recognize their learning progress and closely monitor their learning. This group of learners has along with the Physical Response Learners the highest GPA. The metacognitive strategy of monitoring is important to these learners. They review plans, check to see if they are on task, and compare their progress to accepted standards or models.

> Operationally, comprehension monitoring involves establishing learning goals, assessing the degree to which these goals are being met, and, if necessary, modifying the strategies being used to facilitate goal attainment. (Weinstein, 1988, p. 294)

Strategic Learners express interest, have an attitude of inquiry, and are able to maintain an interest in learning activities. They make an effort to avoid distractions while

learning. One interviewee in commenting on his study habits stated "It's got to be quiet. I [do it] usually in my room. I'll clean an area, sit down and read (the assignment), then write it and hopefully remember it." Strategic Learners use visualization, imagery and the forming of connections to aid the learning process. One student noted,

> The good teachers are the ones [who] write on the board or draw pictures like in science; sometimes, they draw the plate tectonics and explain it while they're drawing it. Then it makes sense to me.

Another student commented, "I can't study for a test. It's too hard for me. Mostly what I learn is by watching the teacher do something. Then it'll just stay with me. That's how I pass my tests."

Strategic Learners tend to be cautious. They like to reflect on solutions before accepting them. These learners learn best by observation. It is important for this type of learner to see a procedure modeled before he or she tries. In commenting on what a good teacher does to help them learn one student replied, "the ones who will actually sit down and show me what's going on, not tell me, but show me."

Teachers should provide visual models and demonstrations along with clear expectations of outcomes. This allows Strategic Learners to measure their present level of learning in comparison to the final objective.

Sequential Learner

The Sequential Learner likes things specific and detailed and is very organized. This type of learner loves deadlines and a fixed schedule. They rely on planning and organization. These learners know "how to elicit purpose from both themselves and the situations and how to organize and identify the steps essential to the learning process" (Yussen, 1985, p. 280). The Sequential learner is independent and generally dislikes group projects. He or she is mainly concerned with what needs to be learned to succeed in class. These learners focus on the learning task and ascertain how to organize and determine the steps basic to the learning task. One student from this group commented,

> [When] I have to read the book, I go over my notes and I write my notes; it's organized. I like detailed things. I don't really like cheesy lessons that are object lessons. They're OK but I don't really learn from them. I just like the hard core stuff.

These learners feel frustrated with a learning situation that is not well planned and organized. They like teachers who get to the point and move on. "I like lectures. A planned lecture that gives good information--what I need to know and then stop. I just like to get the information and get out."

Sequential Learners like Strategic Learners express interest, have an attitude of inquiry, and are able to

maintain an interest in learning activities. However, Sequential learners focus their learning abilities more directly on the material to be learned. In describing what a teacher does to help them learn, one student said, "A good teacher will usually have a good lesson prepared for that day. They will have you do things like labs or they have lectures but, not too long, just dealing with what we need to learn."

Sequential Learners are able to recognize and evaluate assumptions in relation to a learning situation. One student mentioned "the teacher needs to be up there to give the facts and to help you think." These learners also are good at using the resource management strategy of identifying or knowing how to locate the most appropriate resources for a learning activity.

The Sequential Learner does not like group work and finds it difficult to participate in this kind of learning. One person emphatically stated, "In my English class, we're doing group projects and I hate having to depend on other people for my grade." Another student stated, "if you're going to get ready to do a test and the teacher does a test review by saying 'OK now everybody get into your little study groups and go over what you've learned'--[I think] No! I have my notes. Leave me alone and I can just do it myself."

These learners indicated a preference for teachers who are direct and use lectures or other structured learning activities.

Creative Learners

Creative learners use a reflective thinking process which utilizes higher order thinking skills (Brookfield, 1987). They become frustrated with teachers who want only one correct answer or insist the students learn the material in only one way. One student expressed this frustration with teachers by saying. "I don't like the teachers who are set in their ways and think their's is the only way. The way the teacher does it is right; if you either do it this way, you'll pass, or this way, you'll fail. I think there is more leeway than some teachers give." These learners study in various ways, to learn the material. Creative Learners do not necessarily dislike planning, but they cannot seem to get into the regiment of planning. Creative Learners demonstrate critical thinking skills and an ability to conceive alternatives and to hypothesize. Brookfield (1989) explained:

> Central to critical thinking is the capacity to imagine and explore alternatives to existing ways of thinking and living. Realizing that so many ideas and actions spring from assumptions that might be inappropriate for their lives, critical thinkers are continually exploring new ways of thinking about aspects of their lives. (p. 8)

Although not as dominating as their ability to generate alternatives, Creative Learners are adept at the learning strategies of testing assumptions to evaluate the specifics and generalization within a learning situation; they are open to conditional acceptance of learning outcomes while keeping an open mind to other learning possibilities. One student commented that, "It depends on the teacher too. If the teacher's test is going to be multiple choice--it happened on this date and this date and this date--learning about the battles and who's who and what's what, will help you as much as just memorizing the dates."

Creative Learners are also adept at critically deciding on appropriate resources for their learning projects. "I don't really think it does me any good to read the chapter again the night before a test. If I want to read some other source of text or information, a different book or a different movie just to get the idea in my head is better."

Creative Learners make customary use of external aids to assist them in remembering. Using aids such as lists and appointment books help the Creative Learner to correlate the mental activity going on inside with cues in the surrounding environment (Yabui, 1993). When teaching these learners it is important to keep in mind that no set method works for every Creative Learner.

Discriminant Analysis on Clusters

Discriminant analysis was conducted on the five learning clusters as a confirmatory measure to gain insight into the process that separates the groups of learners. The set of discriminating variables used to predict placement in the five clusters consisted of the 15 learning strategies found in SKILLS. Here the discriminant analysis was used as a:

> Tool for identifying the process that separates the clusters and therefore for helping to describe the clusters. By using the various clusters as the groups and by using the variables from the cluster analysis as the set of discriminating variables, an analysis can be generated which produces a structure matrix which describes the process that separates the various clusters into distinct groups and which yields a discriminant function that is a formula that can be used for predicting placement in the various clusters. (Conti, 1996, p. 71)

The pooled within-groups correlations are the correlations for the variables with the respondents placed in their clusters. The examination of the 105 coefficients in the pooled within-groups correlations in this analysis showed that all were at a sufficiently weak level to retain the variables in the analysis. Only three coefficients were at the .2 level, and the remaining 102 were all below the .2 level. Thus, the variables in this discriminant analysis

were not related to each other and consequently were not sharing a common variance.

Stepwise selection was used to determine which variables added most to the discrimination between the programs. As a result of this Wilks' lambda stepwise procedure, 13 variables were included in the discriminant function and with their Wilks' lambda values are as follows: Confidence--.76, External Memory Aids--.87, Memory Application--.84, Attention--.84, Organization--.95, Critical Resources--.77, Planning--.62, Conditional Acceptance--.84, Resource Identification--.93, Testing Assumptions--.69, Human Resources--.73, Generating Alternatives--.90, and Monitoring--.94.

Four canonical discriminant functions were identified in the analysis and two functions were determined to be relevant descriptors of the discrimination process.

Function 1

The standardized coefficients for the first function which discriminated between clusters were as follows: Confidence (.62), Planning (-.56), Testing Assumptions (-.39), Memory Application (.38), Monitoring (.30), Attention (-.26), Resource Identification (-.20), Conditional Acceptance (.17) External Aids (.09), Critical use of Resources (.04), Human Resources (.04), Organization (.03),

and Generating Alternatives (.01). Accordingly, the two strategies of Confidence and Planning contributed most to this function. The two strategies of Testing assumptions and Memory Application contributed about two thirds as much as Confidence. The other strategies made weaker contributions to discriminating between the clusters.

The discriminant function which was used to classify the cases and which can serve as a guide for predicting future placement of respondents into these groups was as follows:

D = -.39 (Planning) +.19 (Monitoring) - .17 (Attention) + .39 (Confidence) + .19 (Organization) + .56 (External Aids) + .24 (Application) - .25 (Testing Assumptions) + .66 (Generating Alternatives) +.11 (Conditional Acceptance) - .12 (Resource Identification) + .28 (Critical use of Resources) + .88 (Human Resources) - .801.

The group centroid of this first function for the clusters were as follows: Cluster 1 (.42), Cluster 2 (1.76), Cluster 3 (-.28), Cluster 4 (-1.74) and Cluster 5 (.50). The canonical correlation was .75 for this function. When this is squared, it indicates that the groups explain 56% of the variation in the discriminant function.

Four variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the first discriminant function. They were: Confidence (.41), Attention (-.31), Planning (-.50) and

Testing Assumptions (-.37). The first discriminant function was named Convergent Taxonomy of Learning.

The process that discriminated the groups from each other in the first function is a two part process. First, was the focusing function of both Attention and Planning. Attention focuses a learner's motivation while Planning focuses the learner towards identifying the steps in the learning activity. The second part of the process is the identification function of both Planning and Testing Assumptions. Planning identifies the steps in the learning activity and Testing Assumptions identifies assumptions to be challenged in relation to a learning situation. This process is reinforced by the confidence or belief that one can be successful at learning. While some learners emphasized identification of their learning assumptions and learning steps, others used their focusing ability in learning.

Function 2

The standardized coefficients for the second function which discriminated between clusters were as follows: Critical use of Resources (.54), Testing Assumptions (.52), Planning (-.45), Human Resources (.36), Organization (-.19), Memory Application (.17), Confidence (-.15), Conditional Acceptance (-.08), , External Aids (-.08), Monitoring (.04),

Generating Alternatives (.08), Resource Identification (-.05), and Attention (-.02). Thus, the three learning strategies which contributed most to determining the scores on the function were Critical Use of Resources, Testing Assumptions, and Planning. Human Resources contributed almost two thirds as much with the other strategies contributing very little to determining the scores.

The discriminant function which was used to classify the cases and which can serve as a guide for predicting future placement of respondents into these groups was as follows:

D = -.31 (Planning)+ .23 (Monitoring) - .15 (Attention) - .93 (Confidence) - .12 (Organization) - .50 (External Aids) + .11 (Memory Application) + .39 (Testing Assumptions) + .53 (Generating Alternatives) - .50 (Critical Acceptance) - .31 (Resource Identification) + .36 (Critical use of Resources) + .25 (Human Resources) - 3.69.

The group centroid for this second function for the clusters were as follows: Cluster 1 (-.306), Cluster 2 (.374), Cluster 3 (-1.386), Cluster 4 (.601) and Cluster 5 (1.150). The canonical correlation was .65 for this function. When this is squared, it indicates that the groups explain 42% of the variation in the discriminant function.

Four variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the second discriminant function. They were:

Planning (-.52), Critical Use of Resources (.48), Testing Assumptions (.44), and Human Resources (.42). The second discriminant function was named Focus of Learning.

The second function used to describe a second process to discriminate the groups from each other paired Testing Assumptions and Planning by focusing on the identifying of learning assumptions to be challenged and identifying the best way to learn. Opposite to this pair were the Resource Management strategies of Critical Use of Resources and Human Resources. Hence, this process distinguishes between those with a need to identify learning steps and assumptions with what resources are needed to learn.

Function 3

The standardized coefficients for the third function which discriminated between clusters were as follows: Conditional Acceptance (.67), Attention (.52), Critical use of Resources (.46), External Aids (.30), Memory Application (-.29), Organization (.26), Testing Assumptions (-.21), Planning (-.18), Human Resources (-.13), Monitoring (.08), Confidence (-.08), Generating Alternatives (.07), and Resource Identification (-.05). Accordingly, Conditional Acceptance and Attention dominated in contributing to the scores for this function. While other learning strategies

contributed about half as much as Conditional Acceptance, most others made little contribution.

The discriminant function which was used to classify the cases and which can serve as guide for predicting future placement of respondents into these groups was as follows:

> D = -.12 (Planning) + .49 (Monitoring) + .33 (Attention) - .52 Confidence + .16 (Organization) + .19 (External Aids) - .18 (Memory Application) - .14 (Testing Assumptions) + .50 (Generating Alternatives) + .43 (Conditional Acceptance) - .32 (Resource Identification) + .31 (Critical use of Resources) - .88 (Human Resources - 7.52.

The group centroid for this third function for the clusters were as follows: Cluster 1 (-1.21), Cluster 2 (.148), Cluster 3 (.825), Cluster 4 (-.156) and Cluster 5 (.936). The canonical correlation was .6312 for this function. When this is squared, it indicates that the groups explain 39.8% of the variation in the discriminant function.

Four variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the third discriminant function. They were as follows: Critical use of Resources (.37), Testing Assumptions (-.30), Conditional Acceptance (.48), and Memory Application (-.35). Because of an eigenvalue (.63) of less than one and because the amount of variance accounted for by this function was much less than accounted for by the first two functions, this discriminant function was not named.

Function 4

The standardized coefficients for the fourth function which discriminated between clusters were: Human Resources (.67), Planning (.40), Generating Alternatives (-.36) Testing Assumptions (-.32), External Aids (-.31), Acceptance (.25), Monitoring (-.17), Confidence (.11), Resource Identification (.06), Memory Application (.04), Attention (.005), and Organization (.0006). Thus, Human Resources was by far the most significant learning strategy in contributing to determining the scores for this function. While Planning also was an important element in determining the scores, the other learning strategies were far less influential.

The discriminant function which was used to classify the cases and which can serve as a guide for predicting future placement of respondents into these groups was as follows:

D = .28 (Planning) - .11 (Monitoring) + .32 (Attention) + .66 Confidence + .42 (Organization) - .19 (External Aids) + .27 (Memory Application) - .21 (Testing Assumptions) - .24 (Generating Alternatives) + .16 (Conditional Acceptance) + .35 (Resource Identification) + .15 (Critical use of Resources) + .46 (Human Resources) - 3.42.

The group centroid for this fourth function for the clusters were as follows: Cluster 1 (-.506), Cluster 2 (1.197), Cluster 3 (-.045), Cluster 4 (.496) and Cluster 5 (-1.104). The canonical correlation was .59 for this function. When

this is squared, it indicates that the groups explain 34.8% of the variation in the discriminant function.

Five variables in the structure matrix had sufficient coefficients to be included in the interpretation of the meaning of the fourth discriminant function. They were as follows: Planning (.33), Human Resources (.62), Testing Assumptions (-.31), External Aids (-.31), and Generating Alternatives (-.37). Because of an eigenvalue (.54) of less than one and because the amount of variance accounted for by this function was much less than accounted for by the first two functions, this discriminant function was not named.

The percentage of cases correctly classified was 81.36%. The classification correctly placed 49 (70%) in Cluster 1, 39 (88.6%) in Cluster 2, 46 (78%) in Cluster 3, 58 (90.6%) in Cluster 4, and 42 (83.3%) in Cluster 5. Thus, the discriminant function is a 31.36% improvement over chance in predicting group placement. Consequently, it demonstrates that clusters can be distinguished on the basis of learners' preference for learning strategies.

The discriminant analysis was calculated to investigate the final research question concerning what process differentiates and how to describe one cluster from another. Because the discriminant analysis was being performed on clusters that had been produced by a cluster analysis, it was anticipated that the amount of variance accounted for by

the functions and the correct classification rate would be high; the results from both of these were very high indicating that the discriminant functions were good and useful for describing the process that separates the clusters from each other. Therefore, five distinct groups of learners exist and the processes that distinguish them from each other are Convergent Taxonomy of Learning and Focus of Learning.

CHAPTER 6

CONCLUSIONS & RECOMMENDATIONS

Summary

Secondary educators are continually researching new ways to teach their students. The concept of learning strategies offers a new approach to viewing high school students and identifying how these young adults learn. By using the Self-Knowledge Inventory of Lifelong Learning Strategies researchers have found that learners can be characterized by the learning strategies they use. Most of these studies have focused on the "adult" learner, high school students are in the transition into adulthood and information concerning their learning strategies could provide a key to their success.

Therefore, the purpose of this study was to first determine the learning strategies high school concurrent enrollment students use. The second purpose was to investigate if different learning strategies are used by students depending on their age, gender, performance on writing, math and reading achievement. The third purpose was to determine if distinct groups of learners exist. The final purpose was to describe the groups through quantitative and qualitative measures.

The participants in this study consisted of 279 representative concurrent enrollment students. The group ranged in age from 15 to 19. The gender distribution in this study was 146 (52.5%) females and 132 (47.5) males.

Each research question was answered by the study. Research Question 1: What learning strategies are employed by high school concurrent enrollment students as measured by the Self-Knowledge Inventory of Lifelong Learning Strategies which measures 15 learning strategies? Data concerning the student's learning strategies was gathered using the SKILLS. The distribution of scores revealed that Attention which is a Metamotivation learning strategy, and External Aids, which is a Memory learning strategy, were the two learning strategies most commonly preferred by the participants. The Metamotivation learning strategy of Reward/Enjoyment was the strategy least used by the students. The range of scores for the learning strategies areas are from 12 to 36. All area means were within the range of 23.57 for the least used strategy of Metamotivation to 24.54 for the most used Resource Management.

Research Question 2: When comparing groups of learners, do high school concurrent enrollment students use different learning strategies based on demographics such as age and gender, performance on the Computerized-Adaptive Placement Assessment and Support System test, ACT, Degrees of Reading

Power test, and academic achievement measured by high school GPA? Data concerning the student's achievement was gathered using ACT test scores, COMPASS test scores and a demographic questionnaire. Discriminant analysis was used to determine if differences in learning strategies between learners grouped according to age, gender, GPA, or achievement test scores existed. These analyses produced several functions that described differences in learners.

Grades

Students were grouped according to highest GPA and lowest GPA. The percentage of cases correctly classified shows how accurate the discriminant function was in grouping the respondents. The discriminant function was 65.2% accurate in classifying cases. Therefore, this discriminant function was only a 15.2% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on learning strategies.

Gender

This grouping resulted in correctly classifying 61.2% of the students. This was only a 11.2% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on gender.

Age

The percentage of cases correctly classified for this group was 58.5% only and 8.5% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on age.

DRP

The percentage of cases correctly classified was 68.06% only a 18.06% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on the Degrees of Reading Power.

COMPASS Writing

The percentage of cases correctly classified was 67.61% only a 17.61% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on the COMPASS Writing.

COMPASS Prealgebra

This discrimination function was 83.33% accurate in classifying cases. Thus, the discriminant function was a 33.33% improvement over chance in predicting group placement. Since this was above the 75% correct placement

criterion, this function was judged useful for discriminating between those with the highest Prealgebra scores and those with the lowest scores. Two variables had sufficient power to be included in this interpretation of the meaning of the discriminant function. They were Adjusting and Confidence. In addition, these learning strategies are opposing traits; when one is used, the other is not. Based upon the structure matrix, this function was named Metacognitive Consciousness. Confidence is a Metamotivational strategy in which one believes that he or she can be successful in a learning task. This confidence is modified by Metacognitive Adjusting which focuses on making changes in the learning process to improve learning. This interaction however, is in the negative direction. Those who get the lowest scores in the group engage in Metacognitive Consciousness. Those who get the highest grades in the group refrain from it.

COMPASS Algebra

The percentage of cases correctly classified was 60.94% only a 10.94% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on the COMPASS Algebra.

ACT English

The percentage of cases correctly classified was 63.6% only a 13.6% improvement over chance in predicting group placement. This slight improvement was insufficient to accurately discriminate between the groups based on the ACT English.

ACT Math

The percentage of cases correctly classified was 82.9%. Thus, the discriminant function is a 32.9% improvement over chance in predicting groups. Since this was above the 75% correct placement criterion, this function was judged useful for discriminating between those with the highest Prealgebra scores and those with the lowest scores. Two variables had sufficient power to be included in this interpretation of the meaning of the discriminant function. They were Planning and Monitoring.

Based upon the structure matrix, this function was named Calibrating. Planning and Monitoring are both Metacognitive strategies. Planning consists of analysing the best way to proceed with a specific learning task. Monitoring interacts with planning by reviewing how one's plans are proceeding and comparing progress to the accepted standard. The planning that one does is controlled by a sense of concern and continues assessment of how one is

doing. Those who get the lowest scores in the group engage in Calibrating. Those who get the highest grades in the group refrain from it.

ACT Reading

This discrimination function was 82.86% accurate in classifying cases. Thus, the discriminant function is a 32.86% improvement over chance in predicting group placement. This function was judged useful for discriminating between those with the highest ACT reading scores and those with the lowest scores.

Five variables had sufficient power to be included in this interpretation of the meaning of the discriminant function. They were Reward/Enjoyment, Monitoring, Human Resources, Conditional Acceptance, and Adjusting. In addition, Reward/Enjoyment, Conditional Acceptance and Adjusting are opposing traits to Monitoring and Human Resources; when one is used highly, the other is low.

Based upon the structure matrix, this function was named Feedback Detachment. There is no dominating strategy among those selected. This process involves the internal strategies of adjusting, monitoring, and reward/enjoyment. These internal strategies are balanced by the strategies of Conditional Acceptance and Human Resources. This interaction creates a process where the learner is not

monitoring their learning or using human resources to learn. They are internally focused on adjusting, feeling motivated and critically looking at their assumptions about learning. Those who get the lowest scores in the group engage in Feedback Detachment. Those who get the highest scores in the group refrain from it.

ACT Science

This discrimination function was 93.75% accurate in classifying cases. Thus, the discriminant function is a 43.75% improvement over chance in predicting group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest ACT science scores and those with the lowest scores. Two variables had sufficient power to be included in this interpretation of the meaning of the discriminant function. They were Planning and Adjusting. Based upon the structure matrix, this function was named Metacognitive Adaption. Planning, a Metacognitive strategy, involves analyzing the best way to proceed with a specific learning task. Adjusting, also a Metacognitive strategy involves evaluating, directing and making changes in the learning process to improve learning. Those who get the lowest scores in the group engage in Metacognitive Adaption.

Those who get the highest grades in the group refrain from it.

ACT Composite

This discrimination function was 82.86% accurate in classifying cases. Thus, the discriminant function is a 32.86% improvement over chance in predicting group placement. Since this was above the 75% correct placement criterion, this function is judged useful for discriminating between those with the highest ACT composite scores and those with the lowest scores. Two variables had sufficient power to be included in this interpretation of the meaning of the discriminant function. They were Conditional Acceptance and Reward/Enjoyment. Based upon the structure matrix, this function was named Critical Differentiating. Conditional Acceptance, a Critical Thinking strategy, involves a reflective and tentative review of a solution to determine if adjustments are needed before acceptance. Reward/Enjoyment, a Metamotivational strategy involves recognizing the value of learning. The reflection on accepting a solution is controlled by a sense of enjoyment and value. Those who get the lowest scores in the group refrain from Critical Differentiating. Those who get the highest grades in the group engage in it.

Research Question 3 and Research Question 4: Are there distinct clusters of concurrent enrollment students? And If distinct clusters exist among concurrently enrolled students, by using focus groups that will investigate factors that discriminate among the groups, what are their characteristics? The cluster analysis technique produced a solution with five specific learner groups. Focus groups were held with members of each cluster to provide qualitative data to provide additional information in naming and describing the clusters. The Physical Response Learner does not want to know just the basics, but wants a more in-depth perspective and desires to understand how that knowledge is most applicable to the real world. The Matrix Learner loves groups, group activities, group study and group projects. The Strategic Learner likes specific directions on how to get things done and then does them. The Sequential Learner likes things specific and detailed and is very organized. Creative Learners feel there is more than one way to learn and more than only one correct answer. The discriminant functions calculated to describe the processes that distinguish these five clusters were named Convergent Taxonomy of Learning and Focus of Learning.

Conclusions

Three prominent conclusions have been derived from this study. These three discoveries highlight the differences among adult learners, identify the relationship between content delivery and adult learning, and classifies learning processes specific to academic areas.

The major conclusion of this study is that there were five distinguishable learning groups identified in the general young adult population of concurrent enrollment students in Alpine School District, Utah. Each group had distinctive characteristics and preferences for learning strategies. The Physical Response Learner is interested in meaningful and in-depth learning. They use monitoring in their learning tasks. The Matrix Learner learns best in group settings and prefers using human resources. The Strategic Learner likes to be given a direction then follows it strictly. The Sequential Learner is able to organize his or her learning and focuses on details. The Creative Learners use higher order thinking skills to approach their learning and is good at generating alternatives.

This study focused on young adults from 15 to 19 years old. It is significant to note that similar clusters appear as those found in other learning strategy studies (Conti, Kolody, & Schneider, 1997; Kolody, 1997; Korinek, 1997; and

Lockwood, 1997). "The differences between children and adults are not so much real differences, I believe, as differences in assumptions about them that are made in traditional pedagogy" (Knowles, 1980, p. 58). Parnell (1994) calls for reform in the way high school students are taught. This finding is consistent with these ideas. Young adults from the age of 15 demonstrate preferences in their approach and use of strategies similar to adults. The use of learning strategies from young adults through all ages of adulthood is shown to occur in this and other studies (Kolody, 1997; Lockwood, 1997; Bighorn, 1997).

Another meaningful finding is that demographics such as age, gender, GPA and academic assessment have no effect on the learner's placement into one of these groups. This indicates that the variance caused by demographics is evenly distributed across the various learning strategies. This is understandable since if you have a normally distributed population then these groups of learners will also be normally distributed in the sample.

A number of recent studies using SKILLS to measure learning strategies have surveyed other diverse populations and have found similar groups of learners. Kolody reviewed several recent learning studies using SKILLS and concluded that "each of these studies is congruent with the major conclusion of this study in that distinct groups of learners

exist in both formal and informal settings based on the learning strategies utilized by the adult learner" (p. 170). This was because "each study found distinct groups of learners, and these groups, which were elicited from smaller and more specific samples than used in this study, can be viewed as subsets of the five groups in this study" (p. 170).

A second conclusion of this study is that by using the concept of the five groups of learners one can identify the relationship between content delivery and adult learning. Each of the five groups have a preference for a particular strategy as found in the discriminant analysis. Also, during the interview process, it was clear that each individual had a preference for specific instructional methods. Some enjoyed lectures while others enjoyed group discussions. Each felt that they learned best when their preferred strategy matched the preferred instructional method which they experienced. Many expressed an enjoyment for learning when the teacher taught the way they learned best.

Within a general population of learners each group is equally represented. However, in groups with a narrower purpose only some of the groups may be present. Never-the-less as a teacher instructs a class his or her method of teaching will only match with a portion of the learners in

the class. This gives the instructor an opportunity to teach learning strategies to the learners.

> Current research has demonstrated that one way to influence the manner in which students process new information and acquire new skills is to instruct them in the use of learning strategies. (Weinstein, 1988, p. 25)

Kolody (1997) also suggests that another approach to addressing the diversity of learners within the classroom is to vary the teaching strategies.

The final conclusion is that there were five distinguishable learning processes identified by the SKILLS interview scale. Each of the processes had distinctive characteristics and were used during specific learning situations. Sternberg (1988) argues that to understand intelligence one must understand the mental processes that underlie intelligence. He states "What I'd like to argue is that for practical as well as theoretical reasons, you really ought to understand how the person went about solving the problems" (p. 2). Sternberg uses this idea of understanding the process of how one solves a problem to outline three types of intelligences. The Alice-Type Learner is one who does very well at analysing and remembering but not at synthesizing or creating. This type of learner does well in traditional school like activities. The Barbara-Type Learner is very inciteful, creative and inventive. This type of learner does not do well in

traditional school like activities. Finally there is the Celia-Type Learner who does well in real world situations. These learners are also very good with interpersonal communications. This type of learner does well but not great in traditional school like activities (pp. 3 - 11). By looking at the processes underlying success in academic tasks one can gain a deeper understanding of the learning process. There were five significant processes identified. The Metacognitive Consciousness process involves learners having confidence in their ability to learn. This confidence is modified by the unwillingness or indifference to make changes in the learning process to improve learning. If learners engage in this process, they do not perform well on simple prealgebra tasks. The Calibrating process involves a person who plans and analyzes the best way to proceed with a specific learning task. These learners also monitor their learning by reviewing how one's plans are proceeding and comparing this to their progress. If the learners engage in this process, they perform well on more complicated algebraic tasks. The Feedback Detachment process is a complex interaction of many learning strategies. Feedback Detachment is a process in which learners are not monitoring their learning or using human resources to learn. They are internally focused on adjusting, feeling motivated, and looking critically at

their assumptions about learning. They are motivated but cautious about their learning. They do not monitor their learning and do not receive feedback from others. Those who engage in this process do not perform well on reading tasks. The Metacognitive Adaption process involves analyzing the best way to proceed with a specific learning task and then evaluating, directing and making changes in the learning process to improve learning. Those who engage in this process do not do well on complicated science oriented tasks. The Critical Differentiating process involves a reflective and tentative review of a solution to determine if adjustments are needed before acceptance and also recognizing the value of learning. The reflection on accepting a solution is controlled by a sense of enjoyment and value. Those who engage in this process do well on a wide variety of simple to complex learning tasks.

These five learning processes identified by the SKILLS instrument enable one to understand the process a learner uses in specific academic learning tasks.

Recommendations

Recommendation 1. At the 38th Annual Adult Education Research Conference in Stillwater, Oklahoma, several persons commented on the need to begin applying these findings to real world situations. Information gathered from focus

groups indicated that learning is enhanced when teaching methods and strategies are compatible with preferred learning strategies. There are certain inherent recommendations for teachers when considering the group of learners to be taught. The Physical Response Learners succeed best when teachers focus on learning rather than on formal evaluation. Teachers need to encourage hands-on learning projects. Students prosper under the care of a teacher who displays a personal interest in them and with whom the student can develop an emotional affinity. The Matrix Learners learn best with teachers who use group activities and discussion techniques to facilitate learning. Teachers must understand that these students do not do well on formal evaluations and should look for other ways to evaluate these students. The Strategic Learner needs a teacher who will provide visual models and demonstrations to clarify a topic. Teachers should provide clear expectations of outcomes to allow these students to measure their present level of learning as compared to the expectations. The Sequential Learner prefers a teacher who is direct and uses lectures to convey information. They learn best with structured learning activities. These learners do not like group work and do not like teachers who use this technique often. The Creative Learner prefer teachers who use no set method for teaching or evaluating. They need teachers to

provide external memory aids to help them remember assignments and due dates. They do not prosper under teachers who are rigid in their thinking.

Recommendation 2. High school counselors are struggling with how to counsel and advise students on their future. In Utah every high school counselor is mandated to meet with the students they have responsibility for at least three times a year to discussion career planning. The use of SKILLS is recommended for giving useful feedback to students. Combined with an assessment of academic skills, the inclusion of results from the SKILLS assessment will give a student valuable insight into how he or she learns and what they could do to improve.

Recommendation 3. Recent studies using SKILLS to measure learning strategies have been conducted that confirm these findings. Populations studied have included medical, corporate, military and tribal settings (Lockwood, 1997; Bighorn, 1997). Each study found distinct groups of learners consistent with the major findings of this study. These consistent results are being disseminated at conferences in the United States for experts in the Adult Education field to recognize and review (Conti & Fellenz, 1995; Conti & Kolody, 1995; Kolody & Conti, 1996). It is

recommended that this information be used to further the field.

Recommendation 4. Previous researchers (Hays, 1995; Kolody, 1997; Yabui, 1993) have conducted similar studies and found five clusters of learners. Hays (1995, Chap 4) described the characteristics of students with learning disabilities which she called the Assisted Learners, the Hands-On Learners, the Sensitive Learners, the Persistent Learners and the Balanced Learners. Yabui (1993, Chap 4) described learning characteristics of subjects demonstrating various level of reflective judgement and named them the Veteran Status Quo Learner, the Active Learner, the Reactive Learner, the Analytical Learner, and the Insecure Learner. By far the most extensive study was conducted by Kolody (1997, Chap 5) using 1,143 students located at five two year colleges located in the province of Alberta, Canada. She found a five cluster group of learners that she described as Navigators, Engagers, Critical Thinkers, Monitors and Networkers. There is a need to pull the consistent results of the many studies together and develop a formal body of knowledge. It is recommended that the findings of these studies be published in book format to allow critical review and comment on this important body of knowledge.

Recommendation 5. The results of this study have shown that young adults use the same learning strategies as adults. Further research is needed to determine at what age these preferences begin to form. This could provide valuable insight into how to teach strategies and when it would be appropriate to begin. Further research is needed in determining how to apply the results of learning strategy research. This would provide the much needed bridge between research and practical application.

REFERENCES CITED

Alpine School District. (1997). Alpine School District statistical report, Author.

Aldenderfer, M., & Blashfield, R. (1984). Cluster analysis. Beverley Hills, CA: Sage Publications.

Best, J. B. (1986). Cognitive psychology. St. Paul: West Publishing Company.

Bighorn. R. (1997). Learning strategies of Fort Peck Community College and community agencies learners. Unpublished doctoral dissertation, Montana State University.

Bloom, B. S. (Ed.) (1956). Taxonomy of educational objectives. New York: David McCoy Company.

Borg, W .R., & Gall, M. D. (1989). Educational research. (5th Ed.). White Plains, NY: Longman.

Brookfield, Stephen D. (1987). Developing critical thinkers. San Francisco, CA: Jossey-Bass Publishers.

Brown, A. L. (1988). Learning and development: The problems of compatibility, access, and induction. Human Development, 5 (25), pp. 89 - 115.

Colorado Postsecondary Enrollment Options Act, Article 35, Section 22-35-102 (1990).

Colwell, Lynn H. (1995). Two degrees for the price of one. Community College Journal. Jun/Jul., pp. 8 - 9.

Conti, G. J. (1993). Using discriminant analysis in adult education. Proceedings of the 34th Annual Adult Education Research Conference. University Park, PA: University of Pennsylvania.

Conti, G. J. (1996). Using cluster analysis in adult education. Proceedings of the 37th Annual Adult Education Research Conference. Tampa, FL: University of South Florida.

Conti, G. J., & Fellenz, R. A. (1991). Assessing adult learning strategies. Proceedings 32nd Annual Adult Education Research Conference. Compiled by Michael Langenbach, The University of Oklahoma, Norman, OK, p.64 - 73.

Conti, Gary J., & Kolody, Rita C. (1995). The use of learning strategies: An international perspective. Proceedings of the 36th Adult Education Research Conference (pp. 77 - 89). Edmonton, University of Alberta.

Cross, K. Patricia, (1981). Adults as learners: Increasing participation and facilitating learning. San Francisco: Jossey-Bass Publishers.

Daloz, Laurent A., (1986). Effective teaching and mentoring. San Francisco: Jossey-Bass Publishers.

Darkenwald, Gordon G., Knox, Alan B. (Eds.)(1984). Meeting educational needs of young adults. Paperback Sourcebooks in The Jossey-Bass Higher Education Series Number 21. San Francisco: Jossey-Bass, March.

Deci, Edward L., & Ryan, Richard M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum Press.

Deese, J., Hülse, S. H., (1967). The Psychology of Learning. (3 ed.). New York: McGraw-Hill Book Company.

Fellenz, R. A. (1988). Cognition and the adult learner. Bozeman, MT: Montana State University Kellogg Center of Adult Learning Research

Fellenz, R. A. (1994). Self-Knowledge Inventory of Lifelong Learning Strategies (SKILLS): Manual. Bozeman, MT: Center for Adult Learning Research.

Fellenz, R. A., & Conti, G. J. (1989, April). Using individual differences to design a typology of learning styles. Paper presented at the Adult Education Research Conference, University of Wisconsin, Madison.

Florida Administrative Code. Rule 6A 10.241. (1983). Author.

Gay, L. R. (1992). Educational research: Competencies for analysis and application. (4 ed.). New York: Macmillan Publishing Company.

Greenberg, Arthur R. (1989). Concurrent enrollment programs: College credit for high school students. Bloomington, IN: Phi Delta Kappa Educational Foundation. (ERIC Document Reproduction Service No. ED313936).

Greenberg, Arthur R. (1991). High school-college partnerships conceptual models, programs and issues. ERIC Digest. Mar. (ERIC Document Reproduction Service No. 347956).

Hays, P. A. (1995). Learning strategies and the learning-disabled adult. Unpublished doctoral dissertation, Montana State University, Bozeman.

Higbee, K. L. (1977). Your memory: How it works and how to improve it. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Hill, M. (1992). Learning strategies used in real life to the achievement of Native American tribal college students. Unpublished doctoral dissertation, Montana State University, Bozeman.

Houle, C. O. (1961). The inquiring mind. Madison: University of Wisconsin Press.

Houle, C. O. (1996). The design of education. San Francisco: Jossey-Bass Publishers.

Hudson, Frederic M. (1991). The adult years: Mastering the art of self renewal. San Francisco: Jossey-Bass Publishers.

James, W. (1918). The principles of psychology. Vol 1. New York,: Dover Publications.

Jarvis, Peter (1983). Adult and continuing education: Theory and practice. New York: Nichols Publishing Company.

Kachigan, S.K. (1986). Statistical analysis: An interdisciplinary introduction to univariate and multivariate methods. New York: Radius Press.

Karson, Marvin J. (1982). Multivariate Statistical Methods. Ames, IA: The Iowa State University Press.

Kaufman, L. & Rousseeuw, P. J. (1990). Finding groups in data: An introduction to cluster analysis. New York: John Wiley & Sons, Inc.

Keefe, James W. (1982). Learning style profile: Examiner's manual. Reston, VA. National Association of Secondary School Principals.

Keller, John M. (1987). Strategies for stimulating the motivation to learn. Performance & Instruction, 26,8, pp. 1 - 7.

Kidd, J. R. (1973). How Adults Learn. New York: Association Press.

Klecka, W. R. (1990). Discriminant analysis. Newbury Park, CA: Sage.

Knowles, Malcolm S. (1978). The adult learner: A neglected species. (2 ed.). Houston: Gulf Publishing Co.

Knowles, Malcolm S. (1980). The modern practice of adult education: From pedagogy to andragogy. New York: Cambridge.

Knowles, Malcolm S. (1986). Using learning contracts. San Francisco: Jossey-Bass.

Knox, Alan B. (1977). Adult development and learning. San Francisco: Jossey-Bass Publishers.

Knox, Alan B. (1986). Helping adults learn: A guide to planning implementing, and conducting programs. San Francisco: Jossey-Bass Publishers.

Kolody, Rita C. (1997). Learning strategies of Alberta college students. Unpublished doctoral dissertation, Montana State University, Bozeman

Kolody, Rita C., & Conti, J. (1996). The use of learning strategies: Do distinctive groups of learners exist? Proceedings of the 37th Annual Adult Education Research Conference (pp. 199 - 204). Tampa, Florida: University of South Florida.

Krejcie, R. V., & Morgan, D. (1970). Small-sample technique. Educational and Psychological Measurement, 30, (3).

Kuhl, J., & Kraska, K. (1989). Self-regulation and metamotivation: Computational mechanisms, development, and assessment. In R. Kanfer, P. L. Ackerman, & R. Cudeck (Eds.) Abilities, motivation and methodology. Hillsdale, NJ: Lawrence Erlbaum Associates.

Leahey, Thomas H., & Harris, Richard J. (1993). Learning and cognition. Englewood Cliffs, NJ: Prentice-Hall.

Lockwood, Suzanne (1997). An investigation of learning strategies utilized by nursing students in Montana. Unpublished doctoral dissertation, Montana State University, Bozeman.

Long, H. (1983). Adult learning: Research and practice. New York: Cambridge.

Mayer, R. E. (1988). Learning strategies: An overview. In C. Weinstein, E. Goetz, & P. Alexander (Eds.) Learning and study strategies. San Diego, CA: Academic Press.

McClusky, H. Y. (1971). Education: Background. Report prepared for the 1971 Whitehouse Conference on Aging. Washington, D.C.

McKeachie, W. J. (1980). Learning, cognition, and college teaching (New Directions for Teaching and Learning, Number 2). San Francisco: Jossey-Bass.

McKeachie, W. J. (1988). Psychology and adult cognition. In R. A. Fellenz (Ed.). Cognition and the adult learner. Bozeman MT: Kellogg Center for Adult Learning Research.

McKenna R. J. (1991). The influence of personal and professional learning situations on real-life learning strategy utilization by school administrators in Wyoming. Unpublished doctoral dissertation, Montana State University.

McKenna, R. J., Conti, G. J., & Fellenz, R. A. (1994). Learning in personal and professional situations. Proceedings: Adult Education Research Conference 1994. Knoxville, TN: University of Tennessee.

Merriam, S. B. & Caffarella, R. S. (1991). Learning in adulthood. San Francisco: Jossey-Bass.

Mezirow, J. (1978). Perspective transformation. Adult Education. 28,(2), pp.100 - 110.

Mezirow, J. (1981). A critical theory of adult learning and education. Adult Education. 32, (1), 3 - 27.

Mezirow, J. (1990). Fostering critical reflection in adulthood. San Francisco: Jossey-Bass.

Moretti, R. J. (1994). Executive level decision styles and learning strategies of volunteer leaders. Unpublished doctoral dissertation, Montana State University, Bozeman.

Nagel, E. (1974). Mill: Philosophy of scientific method. New York: Hafner Press.

Norman, D. (1982). Learning and Memory. San Francisco: W.H. Freeman and Company.

Norusis, M. J. (1988a). SPSS/PC+ V2.0 basic manual. Chicago: SPSS Inc

Norusis, M. J. (1988b). SPSS/PC+ advanced statistics V2.0. Chicago: SPSS Inc

Parnell, Dale (1990). Dateline 2000: The new higher education agenda. Washington D.C.: Community College Press.

Parnell, Dale (1994). LogoLearning: Searching for meaning in education. Waco: Center for Occupational Research and Development.

Paul, L. & Fellenz, R. A. (1994). Memory. In R. Fellenz (Ed.). Self-Knowledge Inventory of Lifelong Learning Strategies (SKILLS): Manual. Bozeman, MT: Center for Adult Learning Research.

Randall, R. (1986). Options are changing the face of education in Minnesota. The School Administrator. May.

Roscoe, J. T. (1975). Fundamental research statistics for the behavioral sciences. (2 ed.). New York: Holt, Reinhart and Winston.

Salthouse, T. A. (1982). Adult cognition: An experimental psychology of human aging. New York: Springer-Verlag.

Schon, D. A. (1987). Educating the reflective practitioner. San Francisco: Jossey-Bass Publishers.

Shaaden, B. B., & Raiford, C. A. (1984). The communication of older persons: Prior training and utilization of information sources. Educational Gerontology, 10 (1 - 2), pp. 83 - 97.

Shirk, J. C. (1983). Relevance attributed to urban public libraries by adult learners: A case study and content analysis of 81 interviews. Unpublished doctoral dissertation, Texas A & M University.

Smith, R. M., & Haverkamp, K. K. (1977). Toward a theory of learning how to learn. Adult Education. 28, (1), p.3 - 21.

Sternberg, R. J. (1985). Critical thinking: Its nature, measurement, and improvement. In F. R. Link, Essays on the Intellect. Alexandria, VA: Association for Supervision and Curriculum Development.

Sternberg, R. J. (1990). Understanding adult intelligence. In R. Fellenz, & G. Conti (Eds.). Intelligence and adult learning. Bozeman, MT: Center for Adult Learning Research, Montana State University.

Strakal, D. J. (1995). The use of real-life learning strategies in personal and career development situations by students at Eastern Idaho Technical College. Unpublished doctoral dissertation, Montana State University, Bozeman.

The American College Testing Program. (1994). COMPASS technical manual. Iowa City, Iowa: Author

The American College Testing Program. (1994). COMPASS user's guide. Iowa City, Iowa: Author.

Touchstone Applied Science Association (TASA). (1986). DRP handbook. The College Entrance Examination Board. New York, NY.

Utah Code 53A-17a-120. Weighted pupil units for accelerated learning programs. (1997).

Vernon, Christie (1979). Concurrent enrollment of high school students in college: A status report. Paper presented at the Annual Conference of the American Association of Community and Junior Colleges, Atlanta, Georgia. (ERIC Document Reproduction Service No. ED176 815).

Ward, J. H. Jr. (1963). Hierarchical grouping to optimize an objective function. Journal of the American Statistical Association. 58. pp. 236 - 244.

Weinstein, C. E. (1988). Assessment and training of student learning strategies. In R. R. Schmeck (Ed.). Learning strategies and learning styles. New York: Plenum Press.

Whitehead, Alfred N. (1968). Modes of thought. New York: The Free Press.

Wlodkowski, Raymond J. (1985). Enhancing adult motivation to learn. San Francisco: Jossey-Bass Publishers.

Yabui, A. E. (1993). Reflective judgement and the adult learner's use of metacognitive learning strategies. Unpublished doctoral dissertation, Montana State University, Bozeman.

Yussen, S. R. (1985). The role of metacognition in contemporary theories of cognitive development. In D.L. Forrest-Pressley, G. E. MacKinnon, & T. G. Waller (Eds.). Metacognition, cognition and human performance. Orlando: Academic Press.

Zechmeister, E. & Nyberg, S. (1982). Human memory: An introduction to research and theory. Monterey, CA: Brooks/Cole Publishing Company.

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