ABSTRACT

Mackie, Russell Keith. Multiple Intelligences and Graphic Design Ability in Five North Carolina Community Colleges. (Under the direction of Theodore J. Branoff and Don C. Locke).

This research study was framed in the theory of Multiple Intelligences developed by Harvard professor Howard Gardner. He theorized that alternative assessment practices that facilitate multiple intelligences could lead to improved student learning outcomes in most school settings. This study was undertaken to investigate the relationship between three of Gardner’s Multiple Intelligences (visual-spatial, linguistic, and logical-mathematical) and graphic design ability. Linguistic and logical-mathematical intelligences were quantified through placement test scores and visual-spatial intelligence was quantified through scores on the Revised Minnesota Paper Form Board Test. Graphic design ability was quantified through a course portfolio.

Due to the open-door policy, the North Carolina Community College System provides placement testing for incoming students in order to gain information regarding students’ academic preparation. Placement test results are used to assess students’ abilities in English, reading, and mathematics. In technical programs, however, students are not required to take specialized assessment tests. Community college attrition rates may be partially due to the lack of information needed to effectively assess and advise incoming technical program students. If additional assessment tools were determined to be effective predictors of student success in specialized technical programs, they may be utilized in addition to the existing instruments to provide a more complete picture of a student’s academic development.

The Revised Minnesota Paper Form Board Test was given to first-year students enrolled in a graphic design course at five North Carolina Community Colleges. Placement
test scores and final course portfolio grades were collected from each college and analyzed to
determine if significant relationships existed. A bivariate correlational analysis was
completed on each of the independent variables (visual-spatial, linguistic, and logical-
mathematical intelligences) and the dependent variable (final course portfolio grade) to
determine if a significant relationship could be found. The results of the analyses indicated
that there was not a significant relationship between visual-spatial intelligence and graphic
design ability. There was also not a significant relationship between logical-mathematical
intelligence and graphic design ability. There was, however, a significant relationship
between linguistic intelligence and graphic design ability.

A multivariate correlational analysis was done to determine the combined strength of the
relationship between all the independent variables and final course portfolio grade. The
results indicated that there was not a significant combined relationship between visual-spatial
intelligence, linguistic intelligence, and logical-mathematical intelligence and final course
portfolio grade.

The results of this study suggest that there is not a significant relationship between
visual-spatial intelligence as measured by the Revised Minnesota Paper Form Board Test and
graphic design ability as indicated by final course portfolio grade. Based on this study, it was
recommended that further research be undertaken to explore the relationship between graphic
design ability and multiple intelligences, specifically visual-spatial and linguistic. It was also
recommended, due to the lack of published research regarding community college graphic
design programs, that additional studies be undertaken in portfolio assessment and grading
practices.
MULTIPLE INTELLIGENCES AND GRAPHIC DESIGN ABILITY IN FIVE NORTH CAROLINA COMMUNITY COLLEGES.

By
Russell Keith Mackie

A dissertation submitted to the Graduate Faculty
of North Carolina State University
in partial fulfillment of the requirements for the
Degree of Doctor of Education

ADULT AND COMMUNITY COLLEGE EDUCATION
Raleigh
2005

Approved by:

___________________________________    __________________________________
Co-Chair of Advisory Committee                   Co-Chair of Advisory Committee
For my wife,
Pamela, for her patience, encouragement, and love.
Biography

Russell Keith Mackie was born and raised in Winston Salem, North Carolina. Mackie earned a bachelor of fine arts degree in 1981 from Western Carolina University in Cullowhee, North Carolina, and a master of arts in technology education in 1997 from Appalachian State University in Boone, North Carolina.

While enrolled at Western Carolina, Mackie received a scholarship from the Piedmont Triad Advertising Federation. The scholarship included a ten-week internship in an advertising agency as a graphic designer. Upon graduation, Mackie was offered a full-time position as an assistant art director. Over the next ten years, he served as art director and production manager for a number of accounts that included the food service, hospitality, sporting goods, and banking industries.

In 1989, Mackie accepted an instructor position in the newly created Advertising Design program at Catawba Valley Community College in Hickory, North Carolina. The position allowed him to impart practical job-required skills to students interested in pursuing a career in the graphics industry. This position included the teaching of courses in graphic arts, typography, prepress file preparation, and webpage construction. Mackie has also served the college as department head and division chairperson.

Currently Mackie is Associate Dean of Business, Graphics, and Public Service at Catawba Valley Community College. The administrative position includes classroom instruction, faculty supervision, student advising, equipment research and acquisition, facilities management, and the maintenance of industry contacts. Mackie has also assisted in the establishment of the Photographic Technology and the Graphic Arts and Imaging Technology programs.
In 1998, Mackie and his brother, Chris, developed Quickball, a baseball-related game that is marketed commercially. In 2003, Quickball joined forces with Ripken Baseball, Incorporated to develop Ripken Quickball as a grassroots sport. Through the Cal Ripken Sr. Foundation, Ripken Quickball is being donated to the Boys and Girls Clubs of America to promote physical fitness through baseball-related activities.

Mackie is a member of the Printing Industries of the Carolinas (PICA), North Carolina Community College Graphics & Design Educators Association, and the Cal Ripken, Sr. Foundation. He has won a number of advertising awards (ADDY) for his design work including 1988 Coastal Advertising Federation Best of Show.

Mackie currently resides in Hickory with his wife Pamela.
Acknowledgements

Through the writing of this dissertation, I have developed a deep appreciation for the support from faculty, colleagues, and family.

I would like to recognize and thank my committee members, Dr. Theodore Branoff, Dr. Thomas Conway, Dr. James Haynie, and Dr. Don C. Locke, for their support and for generously sharing their expertise and guidance. The encouragement and inspiration of Dr. Locke as the Asheville Cohort advisor has been invaluable throughout my tenure at North Carolina State University. I would also like to thank Dr. Robbie Pittman for his assistance with the statistical analyses.

The participation of the community college administrators, faculty, and students was greatly appreciated. They have taken time from their busy schedules to voluntarily participate in this study with the hope that the knowledge gathered will aid in the advisement and placement of graphic design students in the North Carolina community colleges.

I have had a terrific group of classmates in the Asheville cohort. The camaraderie and assistance of Mike Burnette, Gary Davis, and Jeni Wyatt have been critical to the completion of my doctoral studies. Special thanks is extended to David Shockley for his advice and friendship throughout the four years of our doctoral travels.

This research project was undertaken with the continual support of family and friends. My parents, Russell and Syvileen Mackie, to whom I owe so much, have shown encouragement, love, and support throughout my academic pursuits. I would also like to thank my brothers, Chris and Allan, for demonstrating to me the value of creativity, hard work, and determination.
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Chapter 1

Introduction

In his 1983 book, *Frames of Mind: The Theory of Multiple Intelligences*, Howard Gardner proposed the existence of seven intelligences. He identified the seven intelligences as linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal. In a subsequent book, *Intelligence Reframed: Multiple Intelligences for the 21st Century*, Gardner (1999) proposed an eighth intelligence, the naturalist. While Gardner supported the value of traditional intelligence and assessment measures, he also believed that educators should develop means to assess the other intelligences. He theorized that improved assessment practices that facilitate multiple intelligences could lead to improved student learning outcomes in most school settings.

The North Carolina Community College System, which practices an open-door policy, requires students to take reading, writing, and mathematics placement tests to determine scholastic abilities. This process is mandatory unless the student has equivalent coursework or an earned degree from another institution of higher learning. This has become increasingly necessary due to the significant demographic changes the community colleges have experienced over the past two decades (Cohen & Brawer, 2003). These changes include increased enrollment of older students, English-as-a-second-language (ESL) students, and low-ability students (Cohen & Brawer). Placement tests provide data that are used to determine a student’s placement into developmental coursework or college level courses. Placement tests are primarily designed to measure verbal and mathematical skills (North Carolina Department of Public Instruction, 2002). While placement tests are used to predict potential success in general education courses such as mathematics and English, their
predictive value in a community college graphic design program has not been investigated.

The North Carolina Community College System currently has 20 colleges with graphics programs. The programs are designed to provide graduates with technical and artistic skills necessary for employment in the graphics industry and include courses in illustration, graphic design, multimedia, electronic media, and file preparation for print and electronic production. Gardner (1983) theorized that visual art programs not only require college-level language and mathematical skills but also specialized abilities that involve visual-spatial intelligence. While more than half of the required curriculum course hours are graphics-related, there are no placement instruments currently in use to predict student aptitude in the area of visual-spatial ability. If an instrument designed to measure visual-spatial intelligence was related to student competence in a graphic design course, then the test would provide information that may be used to improve the advising and placement process for graphics students.

Statement of the Problem

Historically, students entering college-level graphic design programs had a background in high school art-related coursework such as drawing, painting, and sculpture (Fowler, 1996). With the advent of the computer, however, students began entering community college graphic design programs with minimal art experience or training. In an interview with Brandt (1988), Gardner supported the concept of a working portfolio, or a processfolio, to determine a student’s progress. While university graphic design programs require a student portfolio as an integral aspect of the application process, many community college graphics instructors, such as Dwight Downie, have been unable to enforce such a requirement due to the open-door policy (D. Downie, personal communication, September 23, 2004). Entering
students may have minimal previous design-related experience and may not possess a portfolio. While portfolio methods of evaluation are exercised once students are enrolled in graphic design courses, such a collection of work may not be available before enrollment. The lack of a portfolio increases the difficulty in assessing a student’s visual art ability or experience before entering the curriculum.

Graphic design programs in North Carolina community colleges currently have no methods for assessment and placement of students into graphic design courses other than the existing placement tests. These scores are used for placement in general education courses but are not designed to measure graphic design aptitude. While all students entering these programs have prior educational experience in mathematics and English, it is not known whether they have any formal graphic design training. Technical program attrition, which is approximately 50% in the North Carolina Community College System, may be a result of students entering these programs without proper preparation (North Carolina Community College System, 2004b). In English, mathematics, and reading, community colleges offer developmental coursework, if needed, to prepare students for college-level courses. In the graphic design programs, there is no pre-testing or developmental placement strategy. If a specialized entrance test, such as a visual-spatial test, had predictive value, graphic design instructors may be able to develop additional strategies to support program completion.

There are a limited number of studies assessing the relationship among linguistic, logical-mathematical, and visual-spatial intelligences and final course portfolio grade in a community college graphic design program in North Carolina. Such a study may provide data that indicate a relationship between a visual-spatial test and final course portfolio grade in a graphic design course. Additionally such a study may provide data regarding the
relationship between linguistic and logical-mathematical placement test scores and final course portfolio grade in a graphic design course.

_Purpose of the Study_

The purpose of this study was to investigate the relationship between linguistic, logical-mathematical, and visual-spatial intelligences and graphic design competence as indicated by final course portfolio grade in a North Carolina Community College graphic design course. If a correlation exists, the instrument may have value as an assessment and advising tool for students entering the graphics programs. The researcher has been unable to find research that correlates a visual-spatial intelligence instrument with a community college graphic design course.

_Research Questions_

The purpose of this study was to examine the relationship between linguistic, logical-mathematical, and visual-spatial intelligences and final course portfolio grade in a North Carolina community college graphic design course. The following research questions are posed:

1. Is there a significant correlation between visual-spatial intelligence and final course portfolio grade in a community college graphic design course?
2. Is there a significant correlation between linguistic intelligence and final course portfolio grade in a community college graphic design course?
3. Is there a significant correlation between logical-mathematical intelligence and final course portfolio grade in a community college graphic design course?
4. Is there a significant combined correlation between visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio
grade in a community college graphic design course?

Hypotheses

H₀₁: There is no statistically significant correlation between visual-spatial intelligence and final course portfolio grade in a North Carolina community college graphic design course.

H₀₂: There is no statistically significant correlation between linguistic intelligence and final course portfolio grade in a North Carolina community college graphic design course.

H₀₃: There is no statistically significant correlation between logical-mathematical intelligence and final course portfolio grade in a North Carolina community college graphic design course.

H₀₄: There is no statistically significant combined correlation among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course.

Definitions

For the purposes of this study, the following definitions will apply:

**Accuplacer Computerized Placement Test** is designed and published by The College Board and is a computer-adaptive assessment test designed to provide advisement information for college personnel.

**ASSET** is a testing and advising program published by the American College Testing Program (ACT) for placing students into postsecondary institutions. Test scores are utilized to determine a student’s scholastic ability in the areas of mathematics, reading, and English.

**Common course library** is a menu of North Carolina Community College State Board...
approved courses for use in standard curricula. In order to promote consistency and uniformity throughout the state, all 58 North Carolina community colleges select curriculum courses from the library (North Carolina Community College System, 2004a).

COMPASS is a computerized version of the ASSET placement test that includes an additional ESL component.

Final course portfolio grade refers to the grade that was derived from instructor evaluations of student projects created during a 16-week graphic design course. The final course portfolio grade was based exclusively on student graphic design projects.

Graphic Design II is a first year design course that trains students to effectively use design principles and visual elements. The project content of the course includes creation of various commercially viable designs, such as logos, posters, outdoor advertising, and publication designs. The course emphasizes the understanding and use of visual design elements. (North Carolina Community College System, 2004a).

Linguistic intelligence is the ability to use words and language effectively. Such intelligence may be evident in either written or spoken word. Writers, orators, teachers, and politicians possess increased levels of linguistic intelligence (Gardner, 1983).

Logical-mathematical intelligence “involves the capacity to analyze problems logically, carry out mathematical operations, and investigate issues scientifically. Mathematicians, logicians, and scientists exploit logical-mathematical intelligence” (Gardner, 1999, p. 42).

Multiple Intelligences is the theory developed by Gardner (1999) that divides human cognitive ability into eight separate intelligences: linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, musical, and naturalist.

Open-door policy states that any person, whether a high school graduate, or non-graduate
who is eighteen years old or older will be served by the institution. There may be restrictions on admission to specified curricula (North Carolina Community College System, 2004c).

*Portfolio* is a collection of student work that demonstrates academic understanding and skill development (Lazear, 1994). Graphic design course grades are based on the development of projects that culminate into a course portfolio.

*Revised Minnesota Paper Form Board Test* is an instrument devised by Likert and Quasha (1995) to assess visual-spatial intelligence.

*Visual-spatial intelligence* is the possession of “capacities to perceive the visual world accurately, to perform transformations and modifications upon one’s initial perceptions, and to be able to re-create one’s visual experience, even in the absence of physical stimuli” (Gardner, 1983, p. 173). Visual artists, designers, engineers, architects, and navigators are believed to have enhanced visual-spatial intelligence.

*Assumptions of the Study*

1. Community college students will perform to the best of their ability on the Revised Minnesota Paper Form Board Test.

2. Community college students will perform to the best of their ability on the Accuplacer placement test or the COMPASS placement test.

3. Graphic design faculty will assess student course performance based on the students’ effective usage of graphic design elements, principles, and concepts.

4. Reading, writing, and mathematics placement test scores provided by the community colleges are accurate measures of these abilities.

5. Visual-spatial ability test scores provided by the Revised Minnesota Paper Form Board Test are accurate measures of this ability.
6. First year graphic design courses adhere to the curriculum standards set forth by the North Carolina Community College Common Course Library.

7. Final course portfolio grades will be accurately recorded and an accurate measure of student work.

Limitations of the Study

1. Participants in this study were limited to first year students enrolled in a North Carolina Community College graphic design course. As a result, the findings from this study apply only to students enrolled in a North Carolina Community College graphic design course.

2. Visual-spatial intelligence represents a broad and complex range of human ability (Eliot, 2002). Tests for spatial abilities measure only limited aspects of visual-spatial intelligence, therefore, it is possible that the Revised Minnesota Paper Form Board Test may not measure specific visual-spatial abilities required for success in graphic design.

3. There may be inconsistency in the grading process among the five community colleges. Such inconsistency may affect the statistical analyses required to determine the nature of the relationship between visual-spatial intelligence and graphic design ability.

Significance of the Study

There is currently no assessment method used in the North Carolina Community College System to evaluate incoming student graphic design abilities other than placement tests. The predictive value of these tests may be limited to general education and college-transfer courses and may be less useful for assessing specialized abilities. If a test designed to
assess visual-spatial ability correlates with course grades in community college graphic design courses, then the test may provide an indication of an incoming student’s potential in a graphic design course. Graphic design instructors may create developmental courses in order to facilitate the developmental needs of incoming graphic design students.
In his 1983 book, *Frames of Mind: The Theory of Multiple Intelligences*, Howard Gardner proposed the existence of seven intelligences. He identified the seven intelligences as linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical, interpersonal, and intrapersonal. In a subsequent book, *Intelligence Reframed: Multiple Intelligences for the 21st Century*, Gardner (1999) proposed an eighth intelligence, the naturalist. While Gardner supported the value of traditional intelligence and assessment measures, he also believed that educators should develop means to assess the other intelligences. He theorized that improved assessment practices could lead to improved student learning outcomes.

Psychologists and educators have traditionally identified spatial abilities as separate from the traditional hallmarks of linguistic and mathematical intelligence (Gardner, 1983; Sternberg, 1985; Thurstone, 1938). Visual-spatial intelligence, as defined by Gardner, includes the ability to perceive, understand, and communicate through the visual realm. Artists, designers, engineers, navigators, and architects seem to possess increased visual-spatial abilities.

Verbal and mathematical intelligences have been empirically tested since the beginning of the 20th century through intelligence tests, college entrance exams, aptitude assessments, and other traditional educational exercises such as short answer tests, exams, and pop quizzes. Such instruments have been the assessment cornerstones of western academic culture. Students entering institutions of higher education to pursue specialist programs are screened and evaluated on the basis of traditional intelligence-type tests, regardless of the abilities necessary for their chosen fields. While such tests may indicate
potential success in the general education areas, they are less predictive of success in programs that require other abilities – such as visual-spatial, bodily-kinesthetic, or musical intelligence (Gardner, 1983).

Historically, assessment practices in the arts have not followed assessment practices employed in the traditional academic subjects. Evaluation of art in school settings has traditionally been a controversial topic within the art education community. There are those who believe that assessing artwork with empirical measures is as difficult as grading a rainbow (Eisner, 1971). Others argue that assessment is necessary to raise the level of the arts to a serious cognitive field of study (Colwell, 2003). Both critics and supporters of traditional arts assessment, however, agree that pencil and paper short-answer tests are not acceptable assessment tools. The standard assessment process in the visual arts has been evaluation of work collected into a student portfolio. These collections allow faculty to review and evaluate authentic examples of the student’s abilities, ideas, and development. In the early 1990s, portfolios were also adopted as a method of evaluation and assessment in curricula other than the arts. However, critics contend that portfolio assessment is a highly subjective process that lacks reliability and validity (Lubinski & Benbow, 1995; O’Neil, 1992). Advocates, on the other hand, see the portfolio as an evaluative tool that provides a summative assessment of the complexities of student learning (Beattie, 1994; Fowler, 1996; Gardner, 1999).

The purpose of this chapter is to a) research the historical underpinnings and development of Multiple Intelligences theory, b) research the literature pertaining to current assessment methods for Multiple Intelligences theory (specifically linguistic, logical-mathematical, and spatial intelligence), c) research visual art portfolio development, d)
research current applications of portfolio usage in higher education, and e) research the relationship between Multiple Intelligences theory and portfolio development.

Multiple Intelligences

Development of Intelligence Theory

In order to better understand the development of Multiple Intelligences theory, it is necessary to briefly summarize the development of intelligence theory. Intellectually gifted individuals have always been valued by their societies. Aristotle, Plato, and Socrates sought to understand the nature of human intelligence (Gardner, 1983). These early philosophers described intelligence as the ability to solve problems and to learn through logic and geometry. As established by Gardner, this early emphasis on mental powers has dominated the concept of intelligence:

The unending search for an essence of humanity has led, with seeming ineluctability, to a focus upon our species’ quest for knowledge; and those capacities that figure in knowing have been especially valued. Whether it be Plato’s philosopher-king, the Hebrew prophet, the literate scribe in a medieval monastery, or the scientist in a laboratory, the individual capable of using his mental powers has been singled out. Socrates’ “know thyself,” Aristotle’s “All men by Nature desire to know,” and Descartes’ “I think: therefore I am” provide photographs that frame an entire civilization. (pp. 5-6)

Intelligence has historically been viewed as a single measurable commodity that is present at birth. Individuals were believed to possess a predetermined amount of intelligence throughout their lives. Sir Francis Galton (1892) believed that intelligence was physiologically dependent and the result of genetic inheritance. He developed tests to assess
mental and physical abilities that allowed him to study the possible link between genealogy and intelligence. Galton surmised that success was due to superior traits passed on through heredity. In his 1892 book, *Hereditary Genius: An Inquiry Into Its laws and Consequences*, Galton traced the lineage of successful, famous men. He believed that, in addition to intelligence, personality traits were also primarily inherited. Galton’s theories provided the foundation for theorists in the early 20th century who proposed the concept of intelligence as a unitary, inheritable trait.

Early in the 20th century, Alfred Binet and Theodore Simon, at the request of the French Ministry of Education, developed a test to predict school children’s academic potential (Fancher, 1985).

Binet began with largely sensory-based items but soon discovered the superior predictive power of other, more “scholastic” questions. From Binet’s time on, intelligence tests have been heavily weighted toward measuring verbal memory, verbal reasoning, numerical reasoning, appreciation of logical sequences, and ability to state how one would solve problems of daily living. Without fully realizing it, Binet had invented the first tests of intelligence. (Gardner, 1999, p. 12)

Binet’s tests were primarily designed to assess mathematical and verbal skills. Critics of intelligence tests have argued, however, that the tests have been misused and were never designed to be indicators of an individual’s intelligence but rather a measure of how one would do in school (Gardner, 1983; Neisser, 1976; Sternberg, 1985). Binet’s test was initially designed as a one-on-one test for children but was later altered by researchers at Stanford University into a pencil and paper test that could be given to large groups of individuals simultaneously (Fancher).
Charles Spearman (1904) defined intelligence as a single entity that could be measured. The psychometric view of intelligence posited by Spearman theorized that intelligence applied to a wide range of cognitive abilities. This intelligence factor, entitled Spearman factor \( g \), is a numerical measure of general intelligence. Spearman and his followers believed that human intelligence could be measured, and that a single intelligence quotient would provide an assessment of an individual’s general intellectual abilities.

A number of critics have rejected this unitary view of intelligence. They pointed to ethnic and cultural bias, superficiality of test questions, and the potential risk of assessing a person’s intellectual abilities in a brief and limited manner as factors limiting the validity and reliability of unitary measures of intelligence (Gardner, 1999; Sternberg, 1985). Gardner (1983) stated that while IQ scores may well correlate to success in school, \( g \), and its relationship to success in specific fields or life in general, has been more difficult to assess.

Thurstone (1938) rejected the theory of a unitary view of intelligence. He identified seven different vectors of the mind. These included verbal comprehension, word fluency, numerical fluency, spatial visualization, associative memory, perceptual speed, and reasoning. He believed that in order to assess individuals’ abilities in various occupations, it was necessary to separate the essential elements required for successful performance.

Guilford (1967) proposed 150 distinct intelligence factors. According to Guilford, mental tasks involved three factors: an operation, content, and a product. Operations are basic mental processes such as memory and reasoning. Contents are types of mental processes, such as verbal, mathematical, or behavioral. Products are the results of the interaction between operations and contents. Guilford illustrated his theory as a large cube representing the factors. The large cube is divided into smaller cubes, representing the 150 possible mental
combinations. Guilford devised tests to measure many of these factors. While tests were developed to measure these factors independently, they were considered psychologically dependent due to intercorrelatedness.

Sternberg (1985) proposed a triarchic view of intelligence that is concerned with the cognitive processes involved in solving problems and the organization and management of those processes. Sternberg’s theory involved three types of intellectual abilities: creative, analytical, and practical. Creative abilities are demonstrated through the development of ideas and the application of those ideas. Analytical thinking is necessary to solve problems. Practical intelligence is how one functions and solves problems in everyday life. Sternberg believed that knowing when to employ these intellectual processes was equally important. Sternberg also supported the idea that intelligence can be taught.

*Multiple Intelligences Theory*

In *Frames of Mind: The Theory of Multiple Intelligences*, psychologist and Harvard professor Howard Gardner (1983) proposed a multi-faceted view of intelligence similar to that of Thurstone. Gardner, who was influenced by the research of Piaget (1960), Thurstone (1938), and Guilford (1967), defined intelligence as the “the ability to solve problems, or to create products, that are valued within one or more cultural settings” (p. x). Gardner (1993) did not dismiss the Spearman theory of $g$ but believed it to be too narrow a description of human intelligence. He believed that evidence in support of $g$ was derived from intelligence tests that measured mathematical and verbal skills, and because of this, the tests did have predictive value in relation to academic success. Gardner (1983), however, asserted that the same tests did not have predictive value outside of a school setting:

I do not deny that $g$ exists; instead, I question its explanatory importance outside the
relatively narrow environment of formal schooling. For example, evidence for $g$ is
provided almost entirely by tests of linguistic and logical intelligence. Since these
tests measure skills that are valuable in the performance of school-related tasks, they
provide reliable prediction of success or failure in school. So, for that matter, do last
year’s grades. The tests are not nearly as reliable in predicting success outside school
tasks. (p. 39)

Gardner emphasized cultural values in his theory. In a video entitled *MI: Intelligence,
Understanding, and the Mind*, (Into the Classroom Media, 1996) Gardner stated that a
brilliant writer or mathematician, whose intellectual ability is valued in western society, may
find his abilities of little value in other cultures.

Gardner (1983) developed a set of criteria that defined each intelligence. The first of
eight identified signs was derived from Gardner’s research at Boston Veterans
Administration Hospital. As a psychologist, Gardner studied the affects of brain damage on
individuals’ mental and motor abilities. In some cases, a specific ability would be lost due to
damage to or lesions on certain areas of the brain. Gardner observed that while one ability
may be lost, others would remain intact. For example, a lesion in the right temporal lobe
would result in loss of musical ability, but other abilities, such as spatial or linguistic
abilities, remained intact. Gardner believed that the isolation of a specific ability to one area
of the brain supported the concept of a mostly autonomous biological intelligence.

The second sign identified by Gardner (1983), is the existence of individuals with
specific, highly exceptional abilities, such as child prodigies and savants. These individuals
may exhibit above average abilities in one area, such as the skill to play a musical instrument
well or the cognitive power to solve complex mathematical problems, while simultaneously
exhibiting low abilities in other areas of their lives. Savants and prodigies have been identified with exceptional abilities in each of the eight intelligences identified by Gardner (Armstrong, 1994; Gardner).

The third sign is the existence of one or more core operations or set of operations. The core operations are “basic information-processing operations or mechanisms, which can deal with specific kinds of output” (Gardner, 1983, p. 64). Examples of this include the ability to recognize pitch in music or the ability to imitate movement in the bodily-kinesthetic intelligence (Armstrong, 1994; Gardner). Visual-spatial ability may be demonstrated through drawing and building models or through the ability to navigate through unfamiliar surroundings.

The fourth sign is an identifiable developmental history and a definable set of expert states. Each of the intelligences has its own lifetime developmental trajectory, and there are quantifiable levels of ability ranging from beginner to expert. Musical intelligence is one of the first intelligences to develop in childhood, but it remains robust into old age. Conversely, mathematical intelligence peaks early in life and declines in later years. Expert states are demonstrated through the work of exceptional individuals. For example, the masterpieces of Renoir or the symphonies of Mozart demonstrate an expert end-state performance in visual-spatial and musical intelligence respectively (Armstrong, 1994; Gardner, 1983).

The fifth sign is the existence of an evolutionary history and evolutionary plausibility. For example, the cave drawings in Lescaux demonstrate human spatial intelligence and indicate an evolutionary history (Gardner, 1983). Musical intelligence can be traced through the archeological examples of early musical instruments and the songs of birds (Armstrong, 1994; Gardner).
A specific intelligence becomes more plausible to the extent that one can locate its evolutionary antecedents, including capacities (like a bird song or a primate social organization) that are shared with other organisms; one must be on the lookout for specific computational abilities which appear to operate in isolation in other species but have yoked with another in human beings. (For example, discrete aspects of musical intelligence may well appear in other species but are joined only in humans). (Gardner, p. 65)

Support gathered from experimental psychological tasks is the sixth sign. Using methods of the cognitive psychologists, the intelligences can be investigated autonomously. Such experimentation can determine whether intelligences are related. For example, reading ability can be evaluated through psychometric measures and prescriptive steps then taken to improve reading ability without having an impact on mathematical ability. This demonstrates the inability to transfer linguistic intelligence to mathematical intelligence; in other words, improved intelligence in reading does not necessarily equate to improved mathematical abilities.

The seventh sign is the evidence gathered from psychometric findings. While Gardner (1983) was not a proponent of standardized testing, he did believe it supports MI theory. “To the extent that the tasks that purportedly assess one intelligence correlate highly with another, and less highly with those that purportedly assess other intelligences, my formulation enhances its credibility” (Gardner, p. 66). He added that standardized tests do not always measure what they are supposed to measure, and they are ineffective at measuring such things as physical movement or interaction with other individuals. Gardner, however, did believe psychometrics are useful tools for measuring specific abilities.
The eighth and final sign is the susceptibility to encoding in a symbol system. Symbol systems are culturally contrived systems of meaning. The ability to use and recognize symbols separates humans from other species. For example, spatial intelligence uses a range of graphic symbols recognized by designers, architects, and artists. Letterforms are another symbol system that can be constructed and interpreted through linguistic intelligence (Gardner, 1983).

In addition to the aforementioned theoretical underpinnings, Gardner’s Multiple Intelligences theory includes the following assumptions:

1. People possess all eight intelligences but to varying degrees. One intelligence is usually more dominant than others, but some individuals demonstrate advanced abilities in that one intelligence.

2. Intelligences can be developed to an adequate level of competency if given encouragement.

3. Intelligences work together. Their separation is a fiction devised to illustrate and describe MI theory. In actuality, the eight intelligences work together to solve problems. For example, a gymnast relies on bodily-kinesthetic and visual-spatial intelligence to perform a competitive maneuver.

4. There are numerous ways to display ability in the intelligences. An individual who does not display athletic ability may be able to use his hands to cross-stitch an intricate pattern, or a person who is not able to read well may possesses excellent verbal story-telling skills.

Gardner (1999) identified eight intelligences. They are linguistic, musical, logical-mathematical, visual-spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalist.
These intelligences, according to Gardner, meet the criteria outlined above. This paper deals primarily with linguistic, logical-mathematical, and spatial-intelligence, but it is necessary to discuss the other five in order to fully understand MI theory and because all eight work together in varying degrees. The three intelligences of primary concern in this paper will be discussed subsequent to the descriptions of the other five intelligences.

Musical intelligence is the capacity to perform, compose, and appreciate musical patterns. Gardner (1983) closely aligned musical and verbal intelligence. “In my view, musical intelligence is almost parallel structurally to linguistic intelligence, and it makes neither scientific nor logical sense to call one (usually linguistic) an intelligence and the other (usually music) a talent” (Gardner, 1999, p. 42). Musical intelligence is demonstrated through the work of musicians, composers, music critics, and aficionados.

Bodily-kinesthetic intelligence involves the ability to use the body to fashion a product or to perform a physical function. Actors, dancers, and athletes possess this intelligence. The intelligence involves the understanding of the body’s orientation to its surroundings and the ability to perform complex physical maneuvers with precision (Gardner, 1983).

Gardner (1983) grouped interpersonal and intrapersonal intelligences together into personal intelligences. He stated in an interview with Brandt (1988) that the personal intelligences were the most controversial aspect of MI theory. Interpersonal intelligence involves social behavior, including the ability to understand and interpret the facial expressions, gestures, and voices of others and the ability to respond to these in a pragmatic and influential way. Politicians and salespeople often have heightened interpersonal intelligence. Intrapersonal intelligence involves the ability to be introspective and self-
reflective. Self-understanding, self-discipline, and self-esteem are attributes of intrapersonal intelligence.

The following intelligences – visual-spatial, linguistic, and logical-mathematical – are of special interest in this paper; therefore, more detailed definitions and descriptions of these intelligences are presented.

Linguistic and Logical-Mathematical Intelligences

Linguistic and logical-mathematical intelligences are most often associated with scholastic success. Since the development of the Binet intelligence test, measures have been developed to assess students’ academic potential. These abilities are highly valued in western culture, but Gardner (1983) believed that testing exclusively for linguistic and logical-mathematical abilities was narrow and did not fully assess a student’s potential.

Linguistic intelligence is an essential aspect of human behavior. According to Gardner (1983), “linguistic competence is, in fact, the intelligence – the intellectual competence – that seems most widely and most democratically shared across the human species” (p. 78). Linguistic intelligence is the ability to use words and language effectively. Such intelligence may be evident in either written or spoken word. Writers, orators, teachers, and politicians possess increased levels of linguistic intelligence.

Basic linguistic skills include understanding the meanings of words, constructing basic sentences, and communicating with others. Complex linguistic tasks include expanded vocabulary, the ability to tell stories, and the ability to tell and understand jokes. High-order linguistic skills include creative writing, the ability to tell complex stories, and the ability to communicate in a range of situations. Gardner (1983) identified the poet as the epitome of linguistic intelligence.
Linguistic intelligence has four primary components (Gardner, 1983). The rhetorical aspect of language involves the ability to convince others of a course of action. The second aspect is the mnemonic potential of language. Mnemonics is the ability to use verbal knowledge to enhance memory. An example would be remembering answers to potential exam questions by recalling the first letters of the answers. The third aspect of linguistic intelligence is its role in explanation. Gardner stated that communication is primarily verbal and is used to teach and learn. Even logical-mathematical information must be explained verbally. The fourth aspect of linguistic intelligence is metalanguage, the ability to use language to talk about language. Linguistic intelligence appears to reside in the left temporal lobe. If there is damage to this area of the brain, language abilities will be affected while other abilities remain intact.

Logical-mathematical intelligence involves the ability to process problems through logical and numerical means. Mathematicians, engineers, and computer programmers display this intelligence, which includes “sensitivity to logical patterns and relationships, statements and propositions (if-then, cause-effect), functions, and other related abstractions” (Armstrong, 1994, p. 2). Logical-mathematical intelligence affects the following abilities: an ability to understand numbers and logical concepts, an ability to perceive numerical and logical patterns, an ability to use highly developed reasoning skills, and an ability to comprehend abstract analysis and functions. “Quite possibly, the most central and least replaceable feature of the mathematician’s gift is the ability to handle skillfully long chains of reasoning” (Gardner, 1983, p. 139).

While Gardner (1983) supported Swiss developmental psychologist Jean Piaget’s (1970) framework of human intellectual growth in relation to logical-mathematical
development, he disagreed that the same progression exists for other intelligences. He also debated Piaget’s theorized lock-step progression of development. He preferred an explanation that involved a more uneven, gradual progression. A child’s logical thought processes develop from interaction on his material surroundings, and early comprehension of numbers is derived from the physical counting of objects, such as toys. The child internalizes these initial understandings and begins to apply the same logical mental processes to abstract thought. Gardner indicated that this progression was not universal, as Piaget had suggested, but applied to Western middle-class development.

Western culture has excelled in logistic-mathematical and linguistic intellectual achievements; therefore, according to Gardner (1993), it is not surprising that these intelligences are considered primary in the United States. These intelligences, he stated, were the significant abilities that traditional intelligence tests measured:

Along with the companion skill of language, logical-mathematical reasoning provides the principal basis for IQ tests. This form of intelligence has been heavily investigated by traditional psychologists, and it is the archetype of “raw intelligence” or the problem-solving faculty that purportedly cuts across domains. It is perhaps ironic, then, that the actual mechanism by which one arrives at a solution to a logical-mathematical problem is not as yet properly understood. (Gardner, p. 20)

Other countries, such as Japan, Germany, and Switzerland, also highly value logical-mathematical ability. In less industrialized societies, logical-mathematical intelligence is demonstrated through social and cultural activities. From activities such as hunting and tracking prey, to games or planning community dwellings, similar logical processes are used by those outside of western culture. It is also believed in other cultures that mathematical
ability can be learned, while in the United States, it is primarily perceived as a natural talent.

Savants have demonstrated the ability to calculate the answers to numerical problems quickly, while simultaneously lacking most other mental capacities. There have also been documented cases of brain-damaged individuals who lost mathematical abilities but maintained their linguistic, as well as other, intelligences. Numerical abilities are found in the left hemisphere of the brain while the understanding of numerical relations is housed in the right hemisphere. Due to interrelatedness, however, problems with language can affect mathematical ability.

*Assessment of Linguistic and Logical-Mathematical Intelligences*

Assessment of linguistic and logical-mathematical intelligences has been the focus of intelligence and scholastic aptitude testing since Binet’s time (Gardner, 1983). Various instruments have been developed to test these intelligences and to assess academic potential. Until the factorial analyses of researchers such as Thurstone (1938), and Gardner’s eventual development of MI theory, tests that actually measured scholastic ability were unquestionably credited with quantifying human intelligence. Gardner surmised that test designers mistakenly believed they were creating instruments that assessed intelligence, while in actuality they were measuring a narrow range of ability.

Today’s instruments are built on the foundation created by these early tests. Test developers, however, contend that the tests have been redesigned to eliminate past flaws. The tests are now defined as measures of ability rather than measures of intelligence, and supporters believe that the tests accurately measure a student’s potential for success in higher education (American College Testing, 2004; College Board, 2004a; Lubinski & Benbow, 1995). Critics of the tests continue to argue that the tests are flawed and do not account for
cultural, economic, and gender biases (Hatch & Gardner, 1996; Perez, 2002). Gardner contended that the tests might eliminate students from academic opportunities because, while they may be gifted in non-academic abilities such as music or art, they may not perform well on a standardized test. Entry into many universities requires the College Board’s SAT or the American College Testing’s (ACT) ACT Assessment test, while entry into community colleges requires placement tests such as ASSET, COMPASS, and Accuplacer or previous college-level coursework. Many community colleges will accept SAT scores in lieu of placement test scores. According to Gardner, these instruments primarily measure linguistic and logical-mathematical intelligence.

The Scholastic Aptitude Test (SAT) was originally developed in 1925 as an intelligence test for college admission. The test was offered to a number of elite colleges in the Northeast to assist in determining suitable applicants for financial aid (Perez, 2002). Today, there are two versions of the SAT, the SAT Reasoning Test (formerly SAT I), and the SAT Subjects Test (SAT II). The College Board defines these two instruments as having different purposes:

The SAT Reasoning Test (formerly SAT I: Reasoning Test), better known as the SAT, is a three-hour test that measures verbal and mathematical reasoning skills students have developed over time and skills they need to be successful academically. The SAT is the best independent, standardized measure of a student's college readiness. Subject Tests (formerly SAT II: Subject Tests) are designed to measure students' knowledge and skills in particular subject areas, as well as their ability to apply that knowledge. Students take the Subject Tests to demonstrate to colleges their mastery of specific subjects like English, history, mathematics, science, and language. The tests are
The SAT tests were revised in March of 2005 and, according to the College Board, the revised versions include new elements to ensure the test reflects current curricula and incorporates additional writing and numerical skills. The changes include a verbal component that requires the writing of an essay. The essay portion requires students to take a position on an issue and to support their position though their writing. Multiple choice questions that measure a student’s ability to identify errors in sentences and to correct the errors have also been added. Additionally, the revised mathematics section includes new topics, such as exponential growth, absolute value, functional notation, and fractional components (College Board, 2004a).

The ACT Assessment test, a competitor of the SAT, is designed to be a measure of student learning rather than an aptitude or intelligence test. “The ACT is curriculum-based. The ACT is not an aptitude or an IQ test. Instead, the questions on the ACT are directly related to what students have learned in high school courses in English, mathematics, and science” (American College Testing, 2004). ACT contends that students are more comfortable with the ACT test than with other tests because it is based on familiar curriculum content. Perez (2002) stated, however, that there is a significant correlation of .84 between the two SAT tests and a correlation of between .89 and .92 between the ACT and the SAT instruments. Perez argued that the high correlations between tests indicate the instruments’ similarity and calls “into question how reliable testmaker claims are that the exams measure something unique” (p. 21).

Placement tests are used in many community colleges to assess students’ academic
levels and to place students in academically appropriate courses. Actual placement instruments vary from state to state. In the North Carolina Community College System (NCCCS), for example, mathematical and linguistic abilities are assessed through the use of three tests: ACT’s ASSET and COMPASS, and the College Board’s Accuplacer. The most significant difference between the ASSET and the COMPASS (both published by ACT) is that the ASSET is a pencil and paper test, while the COMPASS is a computerized test. ACT’s tests are nationally normed instruments designed to “quickly and efficiently gather information about an individual student’s skills, needs, and plans as an important step in the process of assisting the student in developing and implementing a sound program of study that leads to the goals” (American College Testing, 1994, p. 1). The ASSET and COMPASS are composed of tests in the following subject areas: writing skills, reading skills, mathematics, and advanced mathematics skills. By assessing ability levels in these areas, the ASSET/COMPASS placement test will help to determine placement in appropriate writing, mathematics, and reading courses. The Accuplacer is also a nationally normed adaptive placement test that is also designed to measure reading, writing, and mathematical abilities. The computer-based test is delivered online via the internet. The difficulty of the test questions increase or decrease based on a student’s ability to provide correct answers. According to College Board, this feature reduces the effects of repeated practice testing by the students.

Critics of standardized testing believe that the tests are built on a faulty foundation – a foundation slanted toward upper middle class white males (Perez, 2002). Historically, this has led to disadvantages for minorities and women. A correlation between socioeconomic status and test performance has also been established with students from low-income families.
scoring below their wealthier counterparts (Crouse & Trusheim, 1988; White, 1982). Additionally, the timed aspects of the tests provide an apparent disadvantage for women and English as a second language (ESL) students. The timed, short answer format of the tests caters to a particular test-taking style (Perez). Opponents of standardized testing have also questioned their effectiveness. Research has shown that other factors, such as high school grade point average (GPA), class rank, and difficulty level of high school courses are more accurate predictors of college success. Citing many of these problems, Gardner (1999) recommended that other factors, such as project portfolios, should be considered in addition to standardized testing.

**Visual-Spatial Intelligence**

Visual-spatial intelligence is the ability to perceive the visual world accurately. This intelligence “features the potential to recognize and manipulate the patterns of wide space (those used, for instance, by navigators and pilots) as well as the patterns of more confined areas (such as those of importance to sculptors, surgeons, chess players, graphic designers, or architects)” (Gardner, 1999, p. 42). Visual-spatial intelligence involves sensitivity to space, color, line, shape, texture, and the relationship between these elements. Individuals with visual-spatial intelligence have the ability to visualize and to graphically represent ideas (Armstrong, 1994). Gardner (1983) defined visual-spatial intelligence as the ability to describe and interpret one’s surroundings:

Central to spatial intelligence are the capacities to perceive the visual world accurately, to perform transformations and modifications upon one’s initial perceptions, and to be able to re-create aspects of one’s visual experience, even in the absence of relevant physical stimuli. (p. 173)
Visual-spatial intelligence theory, however, did not begin with Gardner’s development of Multiple Intelligences theory. Spatial intelligence studies can be traced back to the early 20th century when a unitary view of intelligence was prominent. To some, Spearman’s theory of \( g \) proved too confining to explain the full range of cognitive ability; therefore, a number of studies were undertaken to measure mechanical and practical aptitude (Smith, 1964).

El-Kousy (1935) defined spatial intelligence as the ability to obtain, understand, and use visual-spatial imagery. El-Kousy theorized that spatial ability, identified as \( k \), was separate from Spearman’s \( g \). While he concurred with El-Kousy, Kelly (1928) was the first to theorize that spatial ability also involved the capacity to manipulate spatial relationships. Based on the belief that spatial ability was separate from \( g \), researchers began developing paper and pencil tests for the measurement of the ability.

Through the use of factor analysis, Thurstone (1938) identified seven primary mental abilities that included verbal comprehension, word fluency, number facility, spatial visualization, associative memory, perceptual speed, and reasoning. Thurstone described three aspects of spatial ability: (a) recognizing an object when viewed from various angles, (b) imagining the internal movement of parts, and (c) visualizing one's body in imagery and placing themselves within the object for the purpose of viewing the object from any perspective. Guilford (1967) posited a three dimensional structure of intellect that included 150 intellectual dimensions. The materials dimension of his theory included figural and symbolic aspects. Guilford’s structure of intellect model included 30 distinct spatial abilities within the figural component. Other researchers developed similar categorizations of spatial abilities.
Guilford, Fruchter, and Zimmerman (1952) organized spatial abilities into two major categories: spatial orientation and spatial visualization. Spatial orientation has been described as an awareness of one’s physical orientation in the environment and the ability to remain unconfused due to change or alteration of one’s orientation. Spatial visualization involves the ability to mentally manipulate pictorial information by a process that involves recognizing, retaining, and recalling configurations in which there is movement of a figure or parts of a figure.

McGee (1979) organized spatial processes into two separate categories, spatial visualization and spatial orientation. Spatial visualization refers to the mental rotation of two and three-dimensional objects. Spatial orientation involves the ability to understand an arrangement of elements in complex patterns and the ability to remain unconfused by an object’s orientation.

Lohman (1979) defined spatial ability as the ability to “generate, retain, and manipulate abstract visual images” (p. 188). He believed that there are several spatial abilities, and he prioritized the abilities based on significance. The three primary spatial abilities are: visualization, the ability to manipulate visual patterns; spatial orientation, the ability to view objects from different perspectives and to recognize horizontal and vertical angles; and speeded rotation, the ability to determine rotational properties.

Eliot and Smith (1983) stated that several identifying terms have been advocated in an effort to specify spatial ability. These include visualization, spatial relations, and spatial orientation. The authors organized these terms and varying definitions into two categories: the ability to recognize spatial relationships and the ability to manipulate spatial relationships. Eliot (2002) stated that this myriad of terms related to spatial intelligence is a
testament to its “pervasiveness and its complexity” (p. 480). Eliot also drew a clear distinction between spatial abilities and spatial intelligence, identifying the former as an aspect of the latter. While spatial ability is related to the broader concept of human spatial intelligence, tests for spatial abilities measure only limited aspects of spatial intelligence.

Linn and Peterson (1985) defined spatial ability as the “skill in representing, transforming, generating, and recalling symbolic, nonlinguistic information” (p. 1482). They described three categories of spatial intelligence: spatial perception, spatial visualization, and mental rotation. Spatial perception includes the ability to locate vertical and horizontal axes, and spatial visualization includes the ability to manipulate complex spatial information, usually through a multi-step process. Mental rotation includes the ability to mentally rotate three-dimensional objects and to represent the rotated object in its new orientation. Halpern (1992), who supported Linn and Peterson’s categorizations, described spatial ability as the ability to “imagine what an irregular figure would look like if it were rotated in space or the ability to discern the relationship amongst shapes and objects” (p. 68).

In 1983, Gardner included spatial intelligence as one of his core intelligences. He suggested identifying this intelligence as visual-spatial. The reason for this consideration is the inclusiveness of the term. Gardner surmised that visual-spatial intelligence included a family of independent abilities that worked in coordination to comprehend visual experiences. He described spatial intelligence as:

A number of loosely related capacities: the ability to recognize instances of the same element; the ability to transform or to recognize a transformation of one element into another; the capacity to conjure up mental imagery and then to transform that imagery; the capacity to produce a graphic likeness of spatial information, and the like. Indeed they
work as a family and use of each operation may well reinforce use of the others. (p. 176)

In addition to the aforementioned aspects of spatial intelligence, Gardner added two other factors to the existing definitions of spatial intelligence. The first is sensitivity to the issues of tension, balance, and composition that are found in the arts and in natural structures. “These facets, which contribute to the power of a display, occupy the attention of arts and viewers of arts” (Gardner, p. 176). The second aspect is the ability to employ metaphoric imagery to recognize the similarities of two disparate forms – utilizing mental pictures to connect unrelated concepts. Gardner indicated that visual-spatial intelligence, while not as apparent in some professions, was immediately obvious in the visual arts.

Some type of imagery and visual interpretation is essential to thought, and visualization is essential for graphical representation (Damasio, 1994; Miller & Bertoline, 1991). Arnheim (1969) stated that all thinking requires mental imagery. Albert Einstein, as well as Pablo Picasso, stated that he thought in images (Newbold, 1999). Gardner (1999) theorized that individuals use different strategies to solve problems, and when confronted with test questions, they usually solve the problems through linguistic or spatial thought processes.

Sex differences are more prominent in visual-spatial intelligence than in the other intelligences. These results have been well documented (Burin, Delgado, & Prieto, 2000; Deno, 1995; Jones, 1994; Stumpf & Eliot, 1995; Voyer, Voyer, & Bryden, 1995). Gardner (1983) posited that this difference is due to evolutionary influences – males were the primary hunters and explorers, and males with low levels of visual-spatial intelligence were more likely to face an early death. However, in specific cultures where spatial skills are valued and essential to survival, visual-spatial intelligence is high in both males and females. Gardner stated that 60% of Eskimo children scored as high as the top 10% of Caucasian children on
tests of visual-spatial intelligence. Miller and Bertoline (1991) stated that individuals who rank in the top 10% in visual-spatial intelligence are primarily employed as engineers, draftsmen, scientists, and designers.

Assessment of Visual-Spatial Intelligence

Due to the complex and varied nature of visual-spatial intelligence, there have been a number of research perspectives. According to Linn and Peterson (1985) there are four research perspectives in relation to spatial intelligence. This number of research approaches is due to the complexity of identifying and measuring spatial intelligence. These four approaches are the differential perspective, the psychometric perspective, the cognitive perspective, and the strategic perspective. The differential perspective involves examining the differences between groups, such as between males and females, or differences between ethnic groups. The psychometric perspective involves the comparison of correlations between spatial tasks to define factors in spatial ability. This is possibly the most common approach and grew out of the factorial analyses of Thurstone (1938) and others (Guilford, 1967). The cognitive perspective involves “the identification of processes used universally to solve a particular spatial ability task, albeit with quantitatively different efficiency” (Linn & Peterson, p. 1480). The strategic perspective examines qualitatively various strategies used to solve spatial tasks.

There are a number of spatial tests available (Eliot, 2002). This may be due to the complexity of assessing spatial intelligence (Eliot). Each test is designed to measure specific spatial abilities. Sjolinder (1998) categorized spatial tests based on the three areas of spatial ability described by Linn and Peterson (1985): spatial perception, mental rotation, and spatial visualization. Tests designed to measure spatial perception include, but are not limited to, the
following: Rod and Frame Test (Witkin & Asch, 1948), and the Water Level Test (Piaget & Inhelder, 1967). These tests measure the participant’s abilities to “determine spatial relationships with respect to the orientation of their own bodies” (Linn & Peterson, p. 1482). Mental rotation tests include the Cards Rotations Test (Ekstrom, French, & Harman, 1976), the Generic Mental Rotations Test (Voyer, Voyer, & Bryden, 1995) and the Mental Rotations Test (Vandenberg & Kuse, 1978). These tests measure the participant’s ability to rotate a two or three-dimensional image quickly and accurately (Shepard & Metzler, 1971). Spatial visualization tests include the Revised Minnesota Paper Form Board Test (RMPFBT) (Likert & Quasha, 1995), the Identical Blocks Test (Stafford, 1961), the Paper Folding Test (Ekstrom, French, & Harman), and the Differential Aptitude Test (Bennett, Seashore, & Wesman, 1981). Spatial visualization tests require multi-step, analytical thinking. Successful performance on the instruments involves the ability to select the optimal solution strategies.

The Revised Minnesota Paper Form Board Test (Likert & Quasha, 1995) is a test designed to measure spatial visualization. This test is of interest to this review of literature because it has been correlated to the spatial abilities of artists and designers (Likert & Quasha). Sjolinder (1998) stated that the RMPFBT, categorized as a spatial-visualization test, is designed to assess the “ability to manipulate complex spatial information when several stages are needed to produce the correct solution” (p. 48). Sjolinder notes, however, the RMPFBT does also include a mental rotation component. Likert and Quasha described the RMPFBT as useful in determining “those aspects of ability requiring the capacity to visualize and manipulate objects in space” (p. 8). The test was originally developed in the 1920s and was revised in 1934, 1970, and again in 1995. The test uses geometric shapes to assess the candidate's mechanical-spatial abilities. The 64 two-dimensional shapes are drawn in
separate pieces. The examinee visualizes the pieces as a complete geometric shape and then selects the correct answer. The test has been identified as a valid indicator of visual-spatial abilities for students in graphic-oriented fields such as art, design, mechanical drafting, and engineering.

Criticisms of Multiple Intelligences Theory

There are critics of Gardner’s Multiple Intelligences theory. Lubinski and Benbow (1995) questioned the validity of Gardner’s theory. The authors indicated that the theory was not new but rather the restructuring of existing theories. A primary concern among critics is the lack of support from empirical testing. Lubinski and Benbow state:

But to say that Gardner’s ideas have not adequately met meaningful scientific criteria, over the same period, would be too generous. Based on our reading of the present volume and published work in the most prestigious scientific outlets for educational research (e.g., Gardner & Hatch), we, like others, find little empirical support for or against the unique features of Gardner’s ideas. Before MI theory can be taken seriously by the scientific community and policy makers, Gardner’s (1983) bold theoretical skeleton is in need of empirical flesh. (p. 937)

These authors also point to the lack of validity and reliability in the assessment practices proposed by Gardner. Suggested assessment practices, such as portfolio reviews, have reliability issues. “Without reliability, we cannot have validity in the real world or anywhere else” (Lubinski & Benbow, p. 936). They believed that the foundation of Multiple Intelligences is based on intuition and assumptions rather than empirical evidence. Lubinski and Benbow indicated that the empirical research published by Gardner was minimal, and the research that had been published suffered from inadequate sample sizes. Sternberg (1994)
also criticized Gardner’s theory due to lack of empirical data. He stated that there have been interventions in a wide range of schools but there has been minimal empirical evidence to indicate the potential outcomes of these interventions. He warned of the potential negative effects of implementing a theory without empirical evidence supporting such implementation.

There has also been discussion regarding whether Gardner’s identified intelligences are actually intelligences. Critics of Gardner’s theory ascertain that the abilities he identified in *Frames of Mind: The Theory of Multiple Intelligences* may actually be talents, skills, or learning styles that have been previously identified (Morgan, 1996; Sternberg, 1994). Morgan asserted that Gardner’s intelligences were a reframing of cognitive styles developed in the 1950s. Sternberg referred to Gardner’s Multiple Intelligences as multiple talents. He also criticized the theory for lack of meaningful constructs to explain student behaviors. Sternberg indicated that the scores on MI instruments correlate with measures of general intelligence (g), therefore, traditional intelligence measures are effective predictive instruments. Klein (1997) believed that the theory presented a static view of student abilities and was too generalized to be useful in practice. He described this duality as being on the “horns of a dilemma” (Klein, p. 377): “A weak version of Multiple Intelligences theory would be uninteresting, whereas a strong version is not adequately supported by the evidence Gardner presents” (p. 377). Traub (1998) voiced concerns regarding the implementation of MI theory in the classroom because educators have embraced the theory of MI and applied its concepts in class without evidence of its efficacy. He believed that MI theory, while it may raise self-esteem of non-academically proficient students, could cause a weakening of educational expectations.
Current Implementation of Multiple Intelligences Theory

Regardless of the criticism, MI theory has had a dramatic impact on education and its practices (Shearer, 2004). There are a number of studies related to MI theory at all educational levels. The studies included here are related specifically to higher education visual-spatial, mathematical, and linguistic intelligences.

Current spatial intelligence research has been primarily focused on the areas of 3D computer graphics, engineering graphics, and computer programming, specifically in the areas of spatial visualization and spatial orientation (Baartmans & Sorby, 1996; Smith & Strong, 2001). The researcher has been unable to find any studies related to spatial intelligence and graphic design, however, recent research has been conducted related to visual intelligence and art ability.

Khoza (2003) investigated the relationship between learning styles and spatial abilities of apparel design students. The study included 88 American students and 97 Swazi students. A multivariate analysis of variance indicated that spatial ability was impacted by learning styles and culture. Khoza recommended that instructors integrate flexible teaching methods and use culturally sensitive learning tools to enhance learning across culturally diverse student populations.

Swanson (1997) investigated the relationship between student spatial visualization ability and achievement in technical drawing. He concluded that the correlation between spatial ability and technical drawing achievement was not significant. There was, however, a significant correlation between reading ability and technical drawing achievement. Further research to explore the relationship between spatial, reading, and technical drawing abilities was recommended.
Moirs (1996) investigated the relationship between spatial ability and drawing ability among art students. Two drawing instructional methods were implemented – The Edwards method of inverted drawing and the Copying method. Pre-instruction and post-instruction drawings were compared for differing levels of spatial visualization ability, verbal fluency ability, and closure speed ability. Spatial ability correlated significantly with drawing skills, but there was no significant difference in drawing ability based on instructional method.

Orde (1996) investigated the correlation between drawing ability and spatial ability. The Clark’s Drawing Ability Test and the Test for Visual-Perceptual Ability were given to 94 sixth and eighth grade students. The results of the data analysis showed no correlation between spatial ability and drawing ability. No differences were noted between males and females, but there was a positive correlation between age and spatial ability. A negative correlation was noted between age and drawing ability.

Ksicinski (2000) investigated Multiple Intelligences among 81 community college remedial students to determine if there were differences with regard to gender, ethnicity, or age. Another purpose of the study was to determine if there were differences between teachers and students in the preferred learning domains. The researcher used the Multiple Intelligences Development Assessment Scale (MIDAS), a 119 question, self-report, Likert scale instrument to measure students’ perceptions regarding their MI. Ksicinski found that while there were significant differences based on sex, there were no significant differences based on ethnicity. There was also a significant difference between teachers and students, with the teachers rating themselves highest in verbal-linguistic, and the students rating themselves highest in interpersonal. The study suggested that the remedial population has a distinct profile that favored the personal intelligences. It was also suggested that teachers
should consider various approaches to the delivery of course material, because remedial students may not be verbally or analytically oriented.

Malm (2001) used the MIDAS to assess the distribution of MI among faculty and students enrolled in various associate degree, college-transfer, and career/occupational programs at a community college to determine if there were differences and if the differences found were program specific. He was also interested in determining if there were dominant intelligences of students in the programs. The data indicated that the intelligences were evenly distributed among students in each program, and there were no significant differences in intelligences among students in each program. There were, however, significant differences between students in different programs. Additionally, there were no significant differences between faculty and students within the same programs. Malm asserted that the self-reported high scores in interpersonal and intrapersonal intelligence provide important educational information related to adult students.

Berkemeier (2002) researched students at Ozarks Technical Community College for the following purposes: to study student learning through the theory of Multiple Intelligences, to investigate differences in self-reported multiple intelligences based on age and gender, to investigate the differences between perceived and tested multiple intelligences in regards to non-science and science majors, and to determine which teaching style would be most effective for science majors. Relationships between MI and science majors and non-science majors, gender, and age were identified. There was a difference in students’ tested MI and perceived MI. There also was a change in the perception of study methods among the experimental group. Older students preferred lecture-style instruction while the younger students preferred a variety of methods. The results suggested that curriculum reform should
begin with changing student attitudes toward study methods rather than instructional content.

Woods (2004) investigated the efficacy of web-based instruction in relation to technology, the integration of technologies, the principles of good practice, and the accommodation of multiple intelligences. The purpose of the study was to formulate recommendations for the improvement of web-based course design by accommodating diverse student learning styles. The data indicated that intrapersonal, interpersonal, spatial, and verbal intelligences were rated higher than logical-mathematical, musical, bodily-kinesthetic, and naturalist intelligences. Recommendations were made for the accommodation of multiple intelligences in distance learning course design.

Shore (2001) investigated the use of MI in a university ESL classroom. The correlation between MI and student self-efficacy was examined. There was a significant correlation among students’ reading self-efficacy and logical-mathematical and interpersonal intelligences. Correlations were also found between writing self-efficacy and interpersonal, intrapersonal, bodily-kinesthetic, and linguistic intelligences. It was also found that 90% of the instructors emphasized logical-mathematical, linguistic, and interpersonal intelligences. The researcher indicated that integrating MI practice into the classroom and understanding the importance of the personal intelligences would have a positive effect on self-efficacy in the ESL courses.

Graphic Design Portfolio Development and Assessment

A portfolio is a collection of work assembled in order to demonstrate abilities and typically includes a collection of a student’s best work. This work demonstrates academic understanding and skill development (Lazear, 1994). Krueger and Wallace (1996) assert that a portfolio is constructed for an explicit purpose. It is important to consider whether the
purpose is to display the student’s best work or whether it is for developmental purposes. Grady (1992), in *The Portfolio Approach to Assessment*, stated:

> The portfolio represents a range of efforts and tangible achievements; it presents learning in history. In a well-designed portfolio system, the student selects the pieces of work to be included in the portfolio. The student has the chance to revise it, perfect it, evaluate it, and explain it. It is different from work completed just to fulfill an assignment or written only for the teacher’s eyes; a piece created for the portfolio bears a piece of the student’s identity. It represents the student in a concrete and authentic way that a stanine score cannot do. (p. 12)

Research indicates that the use of portfolios in educational settings has the potential to bridge the gap between teacher-directed learning and student-centered learning (Dietz & Wolf, 1998).

Interest in portfolios as an indication of learning is increasing in disciplines other than the arts. A review of the literature indicates that portfolio-style assessment is occurring in English, science, and mathematics. This has been due to educators’ interest in authentic assessment. Interest in assessment in public education increased in the 1980s following the release of *A Nation at Risk* (Fowler, 1996). Schools investigated different learning assessment methods and became increasingly focused on learning instead of teaching. The concept of determining student learning from short-answer instruments was questioned. Did these instruments provide an accurate assessment of learning or merely an account of students’ abilities to memorize facts? Gardner (1999) believed that the memorization of facts did not equate to meaningful learning and that students needed to participate in production-oriented experiences in order to assimilate new information.
Portfolio development is certainly not a new concept in the arts. Artists have traditionally followed the apprenticeship model – young artists would work with masters, in whatever manner the master deemed appropriate, and in exchange, the master would teach the apprentice essential techniques and processes. This method of learning has existed for centuries. The apprenticeship model is still in place in many trades. For example, the printing and publishing industries have long followed an apprentice approach to learning the printing trade. As apprentices produced work, they would display the finished product to demonstrate their skill. As their skill levels increased, they would alter and update their collection of work, or portfolio. Artists, both fine and commercial, have displayed their work in order to secure business. Fine artists have traditionally displayed their work in galleries, exhibits, and collections. Commercial artists, or graphic designers, maintain a portfolio of their work. The portfolio is used as a résumé in order to secure new clientele (Madeja, 2004). Gardner (1993) indicated that it is ironic that the traditional academic subjects, such as mathematics and the sciences, which have historically been considered academically superior to the arts, have in recent years looked to the arts for guidance in assessment practices.

Graphic design curricula grew out of the fine art tradition. During the 1950s, universities began offering commercial art programs as a practical alternative to fine art. Graphic design curricula combined the aesthetics and creativity of the fine art programs with the mechanical knowledge of technical programs. Graduates used their artistic ability, usually drawing and painting, to develop images for commercial application. As the work was developed, it was collected into a portfolio to display creative and technical abilities for the purpose of marketing. These example works would be targeted to a specific market (Madeja, 2004). Typically, the portfolio included finished samples only. In a classroom
setting, the portfolio may be described somewhat differently. These bodies of work may be limited to a specific course or a specific problem and may include work in various stages of completion.

The mini-portfolio espoused by Beattie (1994) describes a “small cohesive body of work limited to a time period of no longer than six weeks” (p. 14). The process included formative and summative evaluation. Formative evaluation information may be provided to teachers and students during a course of study. Summative evaluation information may be provided through expansion of the portfolio construction process to include comprehensive program assessment (Beattie). The process emphasizes conceptual development, working methods, and final product. The mini-portfolio collection stresses depth of ideas and production skills. Suggested rules of the mini-portfolio process include: 1) a designated time period for completion of the portfolio; 2) completion of the work during class time, allowing for observation of the student’s work methods by the teacher; and 3) a specified theme. The major difference between the mini-portfolio and the other portfolio development and evaluation processes is the presence of a single theme. For example, in the Arts PROPEL model, projects are varied and may include a number of themes. On the other hand, the mini-portfolio method includes one theme evident throughout the collection. Beattie asserted that the unitary thematic approach encourages “research, development and growth, whereby a well-organized and comprehensive mode of inquiry in art production is made manifest in the portfolio” (p. 16).

Other types of arts-related portfolios exist as well (Kárpáti, Zempléni, Verheist, Velduijzen, & Schönau, 1998). The journal portfolio is used primarily in college writing and literature classes. It provides a sense of the students’ writing styles and also provides insight
into students’ conceptual development. A teacher portfolio is a collection of work that the teacher maintains regarding individual students. The portfolio can contain different artifacts of student learning and provides the teacher with a record of student progress. A controlled task portfolio is constructed around a theme and is assembled within a specific time frame. For example, students may draw a specific subject from the same vantage point a number of times at the beginning of the course and then again at the end of the course. The instructor would then use the drawings to determine the student’s progress.

Portfolio assessment models have been implemented at the secondary education level. These include Arts PROPEL, International Baccalaureate, and Advanced Placement. International Baccalaureate and Advanced Placement programs are intended to determine college-level credit for high school students. Arts PROPEL has been employed most often at the primary and secondary school levels but has also been implemented in a university setting (Fowler, 1996). This overview of the following assessment practices provides a basis for current portfolio practices in visual art programs.

Arts PROPEL

Gardner and Nelson Goodman founded Project Zero in 1967 at the Harvard Graduate School. Project Zero is a research institute that has collaborated with artists and teachers in order to learn how students communicate with symbols. The organization’s mission is “to understand and enhance learning, thinking, and creativity in the arts, as well as in humanistic and scientific disciplines, at individual and institutional levels” (Project Zero, 2002, para. 1). Goodman’s interest was in improving the arts. He believed that the arts should be studied as a serious cognitive activity and approached the aspect of symbol comprehension from a cognitive viewpoint. This viewpoint was counter to the long-held notion that art was more
emotional than logical and that cognitive psychology was concerned with the sciences, mathematics, and language (Gardner, 1999).

Arts PROPEL was developed from the research of Project Zero. The name of the project is an acronym for production, perception, reflection, and learning. Research at the secondary school level was aimed at examining student learning in relation to the arts and developing assessment procedures for artistic production. Gardner (1993) asserted that in order for students to reflect and learn about art, they must have direct, productive experiences with the chosen medium. He further contended that the making of art, while involving visual-spatial intelligence, involved all of the intelligences.

Based on the work of Project Zero and Arts PROPEL, Gardner (1993) proposed a processfolio approach to art instruction. This process represents a continuum of learning: the concern is not only with the final form of the art product but also on the process required to produce that product as well. This is an exception to the process that many design schools follow. The concept of domain projects was developed through the work of Arts PROPEL. Domain projects are a set of exercises that reflect the student’s understanding throughout the production, perception, and reflection phases of artwork creation. The processfolio includes elements that document the development of the student’s understanding of the domain. It includes the final piece but may also include a sketchbook, a diary, papers related to the domain, thumbnail sketches, student notes, instructor notes, drafts, diagrams, and other materials related to the student’s course experience. Gardner (1993) asserted that such a collection of work allows the instructor to determine the student’s level of understanding. He also believed that the processfolio encourages students to use their multiple intelligences.

Portfolio assessment in an Arts PROPEL program involves production, perception, and
reflection. Production involves the aspect of craft – the student understands and can perform the principles of the domain. Evidence of production lies in the work itself. Production can be scored by the instructor or scored by someone from the outside; however, the reflection and perception phases can be scored by the instructor only. Reflection is assessed from student journals and notebooks and from observations of student activities in class. Perception is evidenced through student journal entries and from student comments in critiques. The approach to work is also evaluated through observations of student classroom interactions and from written journal entries (Gardner, 1993).

Portfolio development has also been supported by Sternberg’s (1985) triarchic theory of intelligence. He theorized that humans are born with a genetic proclivity towards one of three intelligences: the executive, preferring to be told what to do; the legislative, preferring to create and invent new ideas and ways of completing work; or the judicial, preferring to compare, contrast, and evaluate. Samples (1992) also believed that students should not be bound by traditional academic methods of learning when they may be better able to learn by other means. He believed that learning through visual-spatial, kinesthetic, and auditory methods was a more humanistic approach.

*Advanced Placement*

College Board’s Advanced Placement Program (AP) was developed in 1955 for the purpose of granting students college-level credit for coursework completed while still in high school. The program is a collaborative effort between secondary schools, colleges, and universities. There are AP credit-granting institutions in 21 countries with over 60% of the high schools in the United States offering AP courses, and over 900,000 students took an AP course in 2002 (College Board, 2004c). “Over 90 percent of the nation's colleges and
universities have an AP policy granting incoming students credit, placement, or both, for qualifying AP Exam grades” (p. 2). In 2001, AP readers evaluated in excess of 1.4 million examinations (Willis, 2004). There are number of courses offered through the AP program. These include biology, chemistry, economics, computer science, English, French, German, Spanish, history, geography, music theory, physics, psychology, and art. The courses are taught at participating high schools by high school faculty trained in AP methodology.

There are programs in art history and studio art as well. The studio arts include drawing, 2-D design, and 3-D design. The College Board program provides the only national standard for performance in the visual arts that earns college-level credit while in high school. The instructional goals of the AP program in studio art are to:

a) encourage creative as well as systematic investigation of formal and conceptual issues, b) emphasize making art as an ongoing process that involves the student in informed and critical decision-making, c) develop technical skills and familiarize students with the functions of visual elements, d) encourage students to become independent thinkers who will contribute inventively and critically to their culture through the making of art. (College Board, 2004b, p. 4)

The AP Studio Art program is based on portfolio review in lieu of written tests. The focus of the assessment is on the finished portfolio – sketches and notes are not considered. Students do, however, submit a short, written commentary regarding their work. The AP program materials stressed that the program was not a set curriculum and that teachers developed the course structure at the participating high school. A set curriculum would be too restrictive by not allowing for the diversity of college and high school art courses. The focus of the program, rather than on mandated courses, is on the finished portfolio. In addition to
students enrolled in art courses at the high school, the College Board offers an independent study section also. This provides access to the program through self-study.

*The Advanced Placement Program Course Description Guide: Studio Art* (College Board, 2004b) described three portfolio options: Drawing, 2-D Design, and 3-D Design. The portfolios are constructed to emphasize concentration, breadth, and depth. These areas were designed to uncover the student’s understanding and application of visual media and to demonstrate conceptual abilities. The portfolio development and evaluation process was designed to reflect the emphasis found in post-secondary art and design courses. These emphases, according to AP, include: 1) the quality of the finished work, 2) the student’s visual interest, and 3) the breadth of the student’s understanding of the technical, formal, and expressive means of the art form. In order to evaluate the student’s portfolio, AP developed a 3-section instrument that requires scoring of quality, concentration, and breadth. The concentration section requires a depth of understanding that is demonstrated through a series of works related to a compelling visual theme. In the breadth section, the student is asked to demonstrate a serious grounding in visual principles and material production. The quality section permits the student to self-select works that best exhibit a synthesis of form, technique, and content (College Board).

Unlike the Arts PROPEL evaluation method, the completed portfolios are not assessed by the students’ instructors, but rather, by readers – design industry professionals and college faculty. This prevents any biases that local instructors may have toward the student. Readers are trained in the use of a scoring rubric, and discussions and questions regarding the instrument are allowed during the evaluation process to clarify problems or discrepancies. The rubric provides a standardized scoring framework for the readers. The readers evaluate
and score the work based on concentration (12 pieces), quality (6 pieces), and breadth (12 pieces). The reliability of the rubric has been estimated by Chronbach’s Alpha at .90 for the 2-D design portfolio. Validity has been substantiated through the course grades of students entering sophomore-level college courses. Students with AP exam qualifying grades of 3 or higher earned higher grades than native students who took the prerequisite college course.

*The International Baccalaureate Organization Diploma Program*

The International Baccalaureate Organization (IBO) was founded in Geneva in 1968 to create quality educational opportunities for the children of diplomats and military personnel (Gazda-Grace, 2002). The comprehensive two-year program is offered internationally in English, French, and Spanish. The disciplines required for the International Baccalaureate (IB) diploma include literature (termed Language A), a second world language, social sciences and humanities (termed Individuals and Societies), experimental sciences, and mathematics. There is also an option for a sixth subject, which includes the visual arts. In addition to traditional academic disciplines, the IB Diploma program includes the Theory of Knowledge (TOK), an interdisciplinary requirement that links coursework to life experience; Creativity, Action, and Service, a social consciousness component that encourages involvement in community; and, a special interest essay (4000 words) that is intended to prepare the student for college writing coursework. The program emphasizes an international, multicultural perspective. Criterion-based assessment methods are used throughout the program.

The programme has earned a reputation for rigorous assessment, giving IB diploma holders access to the world’s leading universities. The DP’s (diploma program) grading system is criterion-referenced, which means that each student’s performance
is measured against well-defined levels of achievement. These are consistent from one examination session to the next and are applied equally to all schools.

(International Baccalaureate Organization, 2002, p. 3)

The IBO visual arts program includes coursework in the fine arts, as well as design. Program emphasis is placed on “practical production by the student and exploration of a range of creative works in a global context” (p. 11). The program uses a number of assessment strategies such as portfolios, workbooks, and interviews. Assessment is performed regionally by trained examiners who are recruited from institutions other than that of the student being reviewed. The visual art portfolios, which are evaluated by visiting artists or museum curators, account for 70% of the final grade. There is also a research workbook that includes cultural, historical, and critical art-related studies. This portfolio includes finished artwork, as well as working samples, sketches, notes, and concepts. The student is present during the evaluation, and the student may opt to have his/her teacher present during the examination. Additionally, examiners are required to indicate to IBO if the student’s teacher agreed with the assessment, thereby providing for input from the classroom teacher. Such an overview of the student’s portfolio allows the examiner to assess the work based on finished art products, student conceptual development indicated through sketches, and the ability to self-assess (Kárpáti, et al., 1998). Additionally, the examiner, to gain increased understanding of the student’s work and to determine the student’s understanding of the portfolio, conducts an interview with the student. According to IBO, this process provides further insight into the student’s intentions and goals regarding the work. The examiner reaches an overall determination as to the student’s skill level and recommends a score, from one to seven, to the student’s institution. A score of four or above represents a passing grade. The portfolios
are graded on the following criteria: creativity, technical skills, media control, understanding of design fundamentals, research methods, and the ability to self-assess.

**Current Implementation of Visual Design Portfolio Assessment**

There has been some debate over whether the arts can be accurately assessed. Traditionally, critics of assessment have defined art as a vehicle for self-expression, and therefore, impossible to be assessed by others (Eisner, 1971). Assignment of grades to artwork was seen as counterproductive. Hamblen (1988) indicated that art is a unique curriculum that might be threatened by assessment practices. Supporters of assessment believed that all work can be evaluated and that assessment happens whether in a formal or informal way (Metzger & Bryant, 1993). In some states, public schools systems have implemented art program assessment practices:

> Effective evaluation of student learning in art is…complex. Art educators are challenged to develop evaluation methods that measure the full range of student artistic knowledge, skill, response and expression. Evaluation must extend beyond paper and pencil and standardized tests, both of which focus on narrow outcomes. (Iowa State Department of Public Instruction, 1996, p. 50)

The difficulty specific to artistic assessment is consistency in scoring. Inter-rater reliability is difficult to ensure. Gardner (1993) indicates that the instructor is critical to the scoring process.

There have been a minimal number of studies regarding portfolio assessment at the post-secondary level in the visual arts. A review of the literature provided a number of studies regarding portfolio development in higher education, but only three studies related to visual arts and portfolio development. One study was related to music (Heisler, 1998). A
number of studies were found related to college English and writing courses (Broad, 1994; Clayton, 1998; Jones, 1994; Nelson, 1994; Willard, 1998). Studies were also found related to other disciplines (business administration, professional development, English-as-a-second-language) and the use of portfolio development and evaluation (Bolender, 1996; Gelinas, 1998; Howard, 1999; Smith, 1994).

Turner (2003) examined the use of a scoring rubric for assessment of commercial art student portfolios. The assessment system included a) 12 commercial art projects aligned with curriculum objectives, b) 15 commercial art students, c) a validity committee that monitored rater consistency, d) ten graphic design professionals who rated student portfolios, and e) a statistical framework for analysis. Professional graphic designers evaluated the portfolios using the scoring rubric. The scores were then evaluated using the Many-Faceted Rasch Measurement model (MFRM). The scores were adjusted for rater reliability using the MFRM. The researcher concluded that the MFRM provided measures of student abilities that were free of subjective judgments.

Tomhave (1999) compared two portfolio construction and assessment methods. The control group received the Advanced Placement Studio Art (AP) course of study and the experimental group received the International Baccalaureate Art/Design (IB) course of study. The portfolios were sent to AP external examiners for review and assessment. The ratings from AP and IB portfolios were compared to longitudinal data collected during the course of the 1997 and 1998 school year to determine if differences existed between the two instructional methods. Three results were reported: First, teachers should not be concerned that the implementation of a discipline-based approach to art will diminish the quality of student portfolios. The quality and quantity of the portfolio work was not adversely affected
by the time spent on the study of art history, aesthetics, or criticism involved in the IB program. Secondly, the five-point rubric used for assessment insured convergence of rating on each of the six criteria. Thirdly, there was no correlation between course grade and the outside examiner’s rating of the student’s portfolio.

Fowler (1996) examined the process of portfolio assessment and development using the Arts PROPEL model in a university visual arts course. The study investigated student and faculty perceptions of the portfolio process and student learning associated with the portfolio development. The study involved seven students enrolled in a Graphic Design 3 course at Middle Tennessee State University. Through the course of the semester, the students worked through four graphic design problems. The work processes included thumbnail sketches, rough sketches, and finished comprehensives. Projects were critiqued in class, and students had the opportunity to reflect on their learning experiences. The researcher concluded that the Arts PROPEL portfolio process enhanced student learning and understanding.

Yen (1995) stated that there is a lack of information regarding graphic design assessment. The researcher compared structured and unstructured evaluation methods used for graphic design projects. The purpose of the study was to investigate if rating differences existed between the two types of evaluation methods. Two instruments were developed. A simple evaluation form was used for the unstructured method while an evaluation matrix was used for the structured method. Graphic design faculty, professional graphic designers, graduate students, and undergraduate students evaluated 10 posters. The results of the study indicated that there was a significant difference between structured and unstructured graphic design evaluation methods with higher scores resulting from the unstructured method. There was a higher standard deviation for the structured method. Additionally, the researcher found
that professional evaluators’ ratings were higher than student evaluators’ ratings when the 
unstructured method was used; however, the scores of both professional evaluators and 
student evaluators were highly correlated when the structured method was used. Yen 
concluded that the structured method should be employed for more consistent graphic design 
project evaluation. She also stated that the structured evaluation method provided guidance 
for inexperienced instructors and enhanced students’ abilities to judge the quality of artwork.

At the secondary level, Blaikie (1992) evaluated four portfolio assessment programs: 
Arts PROPEL, the General Certificate in Secondary Education (GCSE), the International 
Baccalaureate, and the Advanced Placement program. These programs are used to determine 
college credit for high school students in high school art programs. The problems of visual 
arts assessment outlined by the author include the subjectivity of artwork, the varied purposes 
and meanings of art creation, and the difficulty with methods of evaluation. The four 
programs have somewhat different approaches while sharing some practice and concepts. All 
four approaches focus on both process and product, and all four processes provide effective 
and useful methods for assessing student portfolio work.

Visual-Spatial Intelligence and Portfolio Development

The researcher has been unable to locate any research related to visual-spatial 
intelligence assessment and graphic design portfolio assessment. Some assert that empirical 
evaluation mechanisms by which to assess the visual arts are minimal. In 1993, Metzger and 
Bryant stated that there was a scarcity of empirical evidence related to portfolio development 
and assessment. Colwell (2003) likens research in the arts as the “fig leaf” to cover the 
“nakedness” of the arts in relation to the dearth of empirical research:

Our present and past efforts at assessing the current literature on arts assessment, and
actions by professional organizations are a series of fig leaves adopted to hide our nakedness: In the arts, we find ourselves without substantial clothing and appropriate tools necessary to detail what constitutes valid assessment of teaching and learning. An inspection of the research journals in music, visual arts, theatre, and dance, as well as the doctoral dissertations in these fields during the last decades, uncovers our nakedness in developing and testing assessment procedures and instruments that are the result of serious argument and discussion concerning objectives, standards, sequencing, or experiences of worth. (p. 12)

A number of studies have been carried out in regard to visual-spatial intelligence and other disciplines, such as mathematics, engineering, and geography. It is curious that there appears to be few studies related to visual arts and visual-spatial intelligence. This is especially unusual because of Gardner’s (1999) belief that the connection between visual-spatial intelligence and the visual arts is obvious.

While many of the studies have been related to technically oriented programs, there appears to be no research related to visual-spatial intelligence and graphic design – a discipline that combines visual aesthetics with technical problem-solving skills. Investigating the link between visual-spatial intelligence and graphic design ability would better inform instructors and students and possibly facilitate improved learning.
Chapter 3
Methodology

The purpose of this study was to examine the relationship among linguistic, logical-mathematical, and visual-spatial intelligence, and final course portfolio grade in a North Carolina community college graphic design course. The purpose of this chapter is to describe different aspects of this research project, including the participants, the test instruments, the data collection procedures, and the statistical analysis.

Research Design

A nonexperimental correlational analysis was employed to determine if there was a significant relationship among linguistic, logical-mathematical, and visual-spatial intelligence and final course portfolio grade in a North Carolina community college graphic design course. Gall, Borg, & Gall (1996) indicated that multivariate correlational statistics allow researchers to study the relationships among various combinations of variables.

Participants

The population in this study consisted of a convenience sample of 113 students enrolled in a first-year graphic design course in a North Carolina Community College. Student participation was voluntary. Faculty from the following colleges volunteered their institutions to participate in the study: Catawba Valley Community College (CVCC) located in the foothills, Central Piedmont Community College (CPCC) located in the southern Piedmont, Guilford Technical Community College (GTCC) located in the Piedmont, Lenoir Community College (LCC) located in the eastern region of the state, and Southwestern Community College (SCC) located in mountains. These particular colleges were selected to provide diverse geographic representation. Of the 113 students, 49 students did not have
placement test scores. North Carolina Community Colleges may waive placement testing based on previous coursework. For example, transfer students, due to the transferring of credits, may be exempt from placement testing. Forty-eight students had COMPASS scores, 10 had Accuplacer scores, and 6 had SAT scores. The SAT and Accuplacer scores, due to the low sample number, were not included in the initial multiple regression data analyses. In order to include the Accuplacer results, a subsequent regression analysis was completed by equating Accuplacer scores to COMPASS scores through the use of concordance tables.

**Instruments**

There are several tests available for assessing visual-spatial intelligence. According to Sjolinder (1998), spatial tests can be divided into three categories: spatial perception, mental rotation, and spatial visualization. She stated that the Revised Minnesota Paper Form Board Test (RMPFBT) is categorized in the latter grouping. This grouping, spatial-visualization, is defined as the “ability to manipulate complex spatial information when several stages are needed to produce the correct solution” (p. 48). Sjolinder noted, however, the RMPFBT also includes a mental rotation component. Sjolinder indicated that there is less gender difference on the RMPFBT than on many other visual-spatial intelligence tests. There are also no ethnic biases reported. Likert and Quasha (1995) described the RMPFBT as useful in determining “those aspects of ability requiring the capacity to visualize and manipulate objects in space” (p. 7). The test was developed in the 1920s and was revised in 1934, 1970, and again in 1995.

The timed test (20 minutes) uses geometric shapes to assess the candidate's mechanical-spatial abilities. The 64 two-dimensional shapes are drawn in separate pieces; the examinee visualizes the pieces as a complete geometric shape and then selects the correct
answer (Appendix D). The test has been identified as a valid indicator of visual-spatial abilities for students in graphic-oriented fields such as mechanical drafting and engineering. Construct validity was evidenced by differences in scores between groups that would be expected to have different visual-spatial abilities. Pearson (2001) also stated that the manual’s discussion of criterion-related validity included studies that relate to artistic ability and technical drawing. “The reliability measures of the instrument are adequate. Internal consistency coefficients are .93 and .95 for split half and .86 and .91 for alternate forms. Test-retest reliability was .71 for delayed readministration and .85 for immediate readministration” (para. 4). Roszkowski (2001) stated that the “the reliability of the Revised Minnesota Paper Form Board Test is strong and the validity of the test as a measure of spatial ability is without question” (para.16).

The North Carolina Community College System uses three tests for placement purposes: the ACT ASSET, the ACT COMPASS, and the College Board Accuplacer. The community colleges in this study use the COMPASS and Accuplacer tests. The ACT COMPASS is a nationally normed instrument “designed to assist institutions in placing students into appropriate college-credit courses or developmental or preparation courses” (American College Testing, 2003, p.2). The COMPASS is composed of tests in the following subject areas: writing skills, reading skills, mathematics, and advanced mathematics skills. By assessing ability levels in these areas, the COMPASS placement test will help to determine placement in appropriate writing, mathematics, and reading courses. Reliability measures are high for the COMPASS. Test-Retest correlation ranged between .76 and .90. Equivalent forms reliability correlation was between .73 and .88. ACT correlates placement test scores to final course grades to determine placement validity. Placement validity refers to
the success rates of students placed into courses based on the placement test score. The success rates ranged from 67% to 87% for students placed in course levels based on their placement test scores.

The Accuplacer Computerized Placement Test is designed and published by The College Board and is a computer-adaptive assessment test designed to provide advisement information for college personnel. The information is used for placement into college level courses. The Accuplacer is composed of tests in the following subject areas: sentence skills, reading skills, mathematics, and advanced mathematics skills. By assessing ability levels in these areas, the Accuplacer Computerized Placement Test, like the COMPASS, will help to determine placement in appropriate writing, mathematics, and reading courses. Test-Retest correlation ranged between .73 and .96. Reliability measures are high for the Accuplacer – ranging from .91 to .96. Fisher (1998) indicated that the content and predictive validity were adequate and that the Accuplacer “appears to be an excellent system for providing CPT evaluation and placement of students in appropriate courses” (para.16).

Portfolio Evaluation

Students completed several commercially appropriate, graphic-related works, and faculty evaluated the project portfolio using their regular evaluation procedures based on standards established in their programs. The final course portfolio grade provided for this study was based on visual design work only and did not include grades from exams, reports, quizzes, or other academic coursework.

Procedures

Approval to administer the tests was obtained from the North Carolina State University Institutional Review Board (IRB) (Appendix A). In January of 2005, the
researcher submitted research study information to the participating colleges. Once approvals were received, test scheduling took place with the department chair at each site. In February 2005, the researcher visited each site, except Lenoir Community College, to administer the RMPFBT (Form AA) to the participants. At LCC, in order to maintain consistency, the test facilitator used a script to administer the test under the same conditions as the other sites. The script was identical to the script read at the other four sites (Appendix C). The students were told that participation was voluntary and that the results of their test scores and placement test scores would be confidential and anonymous. The RMPFBT was given during the students’ regularly scheduled classes. Course instructors remained in the classrooms but were not involved in the testing process. The purpose of the tests was explained to the participants before testing began. Once testing was completed, the researcher collected and scored the tests.

Placement test scores were obtained for each participant from the academic records division of the respective colleges. In May 2005, final course portfolio grades were acquired from the participating colleges, and the appropriate statistical analyses were performed in order to answer the following research questions:

1. Is there a significant correlation between visual-spatial intelligence and final course portfolio grade in a community college graphic design course?
2. Is there a significant correlation between linguistic intelligence and final course portfolio grade in a community college graphic design course?
3. Is there a significant correlation between logical-mathematical intelligence and final course portfolio grade in a community college graphic design course?
4. Is there a significant combined correlation among visual-spatial intelligence,
linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course?

**Data Analyses**

The purpose of this study was to examine the relationship among linguistic, logical-mathematical, and visual-spatial intelligence and final course portfolio grade in a North Carolina community college graphic design course. All data collected were interval data and the significance level was set at .05 ($p < .05$). The data analyses included descriptive statistics, Pearson Product-Moment Coefficient of Correlation ($r$), and multivariate correlational analyses ($R^2$). Multiple regression analysis was used to test the hypotheses. Gall, Borg, & Gall (1996) stated that multiple regression analysis “allow researchers to measure and study the relationship among various combinations of these variables” (pp. 432-433).
Chapter 4

Analysis of Data

Overview of the Study

This purpose of this study was to investigate the relationship among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and graphic design ability as indicated by final course portfolio grade in a North Carolina community college graphic design course. Data were collected from students enrolled in a first-year graphic design course at five North Carolina community colleges. The independent variables were scores from the Revised Minnesota Paper Form Board Test (RMPFBT) (visual-spatial intelligence), COMPASS Reading Placement Test (CRPT) and the COMPASS Writing Placement Tests (CWPT) (linguistic intelligence), and the COMPASS Mathematics Placement Test (CMPT) (logical-mathematical intelligence), and the dependent variable was graphic design ability as indicated by final course portfolio grade in a North Carolina community college graphic design course. The final course portfolio grade was based on a portfolio of student work completed during the semester and evaluated at each site by the course instructor. The independent variables, the RMPFBT and placement test scores, were regressed with the dependent variable, final course portfolio grade, in order to investigate the relationship among visual-spatial, linguistic, and logical-mathematical intelligence, and graphic design ability. This chapter presents an overview of the study, the results of the data analyses, findings of the study based on the research questions, and a summary of the findings.
The Research Sites

The North Carolina Community College System is comprised of 58 institutions. The colleges offer a comprehensive range of technical, vocational, and college transfer programs. The offerings range from one-semester certificate programs to one-year diploma programs to 2-year associate degree programs. According to the North Carolina Community College System (2005), “most of the programs offered at the Community College System are designed to prepare individuals for entry-level technical positions in business and industry with an associate of applied science degree” (p. 6).

There are currently 20 community colleges in North Carolina that have graphics programs, and this study was conducted at five of these institutions. The colleges included in the study were Catawba Valley Community College (CVCC), Central Piedmont Community College (CPCC), Guilford Technical Community College (GTCC), Lenoir Community College (LCC), and Southwestern Community College (SCC). These colleges are comprehensive institutions that offer a range of degree, diploma, and certificate programs that include college transfer, technical, and vocational degree options. The five colleges were selected to provide statewide geographic representation.

The Target Population

In 2003-2004, 179,124 (63%) of the students enrolled in a community college were enrolled in an associate degree program. Twenty-two percent of the students were enrolled in a degree-seeking program on a full-time basis. Thirty percent of the community college students were employed full-time, 31% were employed part-time, and 39% were unemployed. The mean age of North Carolina community college students is 30 years with the modal age being between 20 and 24 years of age. Ninety-five percent of the students are
attending North Carolina community colleges as state residents (North Carolina Community College System, 2005).

The convenience sample used in this study consisted of 113 first-year community college students enrolled in a graphic design course in a North Carolina community college. This study examined students who were enrolled in GRD142 Graphic Design II, a face-to-face graphic design course. This course is a first-year required course that emphasizes the understanding and use of visual design elements through the commercial application of graphic design theories and practices. The project content of the course includes the creation of various commercially viable designs, such as logos, posters, outdoor advertising, and publication designs. (North Carolina Community College System, 2004a). This course requires that students complete a collection of projects that is similar in composition to the final portfolio required for graduation.

Assumptions of the Study

1. Community college students will perform to the best of their ability on the Revised Minnesota Paper Form Board Test.
2. Community college students will perform to the best of their ability on the Accuplacer Placement test or the COMPASS placement test.
3. Graphic design faculty will assess student course performance based on the students’ effective usage of graphic design elements, principles, and concepts.
4. Reading, writing, and mathematics placement test scores provided by the community colleges are accurate measures of these abilities.
5. Visual-spatial ability test scores provided by the Revised Minnesota Paper Form Board Test are accurate measures of this ability.
6. First year graphic design courses adhere to the curriculum standards set forth by the North Carolina Community College Common Course Library.

7. Final course portfolio grades will be accurately recorded and an accurate measure of student work.

Preliminary Statistical Analysis

**Descriptive Statistics**

Descriptive statistics (Table 1) explained the means and standard deviations of the data collected through the RMPFBT, the placement test scores, and final course portfolio grades.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMPFBT</td>
<td>113</td>
<td>44.89</td>
<td>0 - 64</td>
<td>9.94</td>
</tr>
<tr>
<td>Final course portfolio grade</td>
<td>107</td>
<td>89.26</td>
<td>0 - 100</td>
<td>9.76</td>
</tr>
<tr>
<td>COMPASS Reading</td>
<td>47</td>
<td>72.51</td>
<td>0 - 100</td>
<td>18.06</td>
</tr>
<tr>
<td>COMPASS Writing</td>
<td>48</td>
<td>65.98</td>
<td>0 - 100</td>
<td>26.35</td>
</tr>
<tr>
<td>COMPASS Mathematics</td>
<td>48</td>
<td>38.47</td>
<td>0 - 100</td>
<td>18.62</td>
</tr>
<tr>
<td>SAT Mathematics</td>
<td>5</td>
<td>512.00</td>
<td>200 - 800</td>
<td>67.60</td>
</tr>
<tr>
<td>SAT Verbal</td>
<td>6</td>
<td>530.00</td>
<td>200 - 800</td>
<td>80.00</td>
</tr>
<tr>
<td>Accuplacer Reading</td>
<td>10</td>
<td>79.65</td>
<td>0 - 120</td>
<td>14.18</td>
</tr>
<tr>
<td>Accuplacer Sentence</td>
<td>10</td>
<td>89.48</td>
<td>0 - 120</td>
<td>15.32</td>
</tr>
<tr>
<td>Accuplacer Mathematics</td>
<td>10</td>
<td>49.0</td>
<td>0 - 120</td>
<td>27.66</td>
</tr>
</tbody>
</table>

For the study sample, the mean for the Revised Minnesota Paper Form Board Test (RMPFBT) ($n = 113$) was 44.89, and the standard deviation was 9.94. Likert and Quasha
(1995) reported that the mean for college freshmen \((n = 510)\), male and female, was 44.5, and the standard deviation was 9.4 for males and 12.4 for females. For the study sample, the mean for the COMPASS Reading Placement Test \((n = 47)\) was 72.51, and the standard deviation was 18.06. The mean for the COMPASS Reading Placement Test for students enrolled in two-year colleges \((n = 177845)\), as reported by ACT, was 79.4, and the standard deviation was 15.6. For the study sample, the mean for the COMPASS Writing Placement Test \((n = 48)\) was 65.98, and the standard deviation was 26.35. ACT reports the mean for the COMPASS Writing Placement Test for students enrolled in two-year colleges \((n = 177845)\) was 59.5, and the standard deviation was 28.7. For the study sample, the mean for the COMPASS Mathematics Placement Test (numerical/prealgebra) was 38.47, and the standard deviation was 18.62. ACT reports the mean for the COMPASS Mathematics Placement Test (numerical/prealgebra) placement test for students enrolled in two-year colleges \((n = 162259)\) was 43.4, and the standard deviation was 20.2. The Accuplacer Placement Tests and the SAT placement test descriptive statistics are reported in Table 1, but the SAT scores were not included in the multiple regression statistical analysis due to the small sample size. The Accuplacer scores were equated to COMPASS scores through the use of concordance tables and a subsequent multiple regression analysis was conducted (Table 4).

**Correlational Analyses**

Table 2 indicates the correlations between the variables. The data collected through the RMPFBT and the CPT scores were compared to the final course portfolio grade to determine if there was a relationship between the variables.
Table 2
Correlations Between Final Course Portfolio Grade and the Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>r</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMPFBT</td>
<td>107</td>
<td>.117</td>
<td>.229</td>
</tr>
<tr>
<td>COMPASS Reading</td>
<td>43</td>
<td>.300</td>
<td>.050*</td>
</tr>
<tr>
<td>COMPASS Writing</td>
<td>45</td>
<td>.365</td>
<td>.014*</td>
</tr>
<tr>
<td>COMPASS Mathematics</td>
<td>44</td>
<td>.045</td>
<td>.384</td>
</tr>
</tbody>
</table>

Correlation is significant at the .05 level (2-tailed).

For the variables final course portfolio grade and the RMPFBT ($n = 107$), the correlation coefficient ($r$) is .117 and the $p$-value is .229. This indicates that the relationship between final course portfolio grade and the RMPFBT is not significant. For the variables final course portfolio grade and CRPT ($n = 43$), the correlation coefficient ($r$) is .300 and the $p$-value is .05. This indicates that the relationship between reading ability and final course portfolio grade is significant at the .05 level. The correlation coefficient ($r$) is .365 and the $p$-value of .014 for the variables CWPT and final course portfolio grade ($n = 45$). This correlation is significant at the .05 level. For the COMPASS mathematics (CMPT) test and final course portfolio grade ($n = 44$), the correlation coefficient ($r$) is .045 and the $p$-value is .384, indicating a relationship that is not significant at the .05 level.

Due to the low number of students that were included in the sample, the analyses for the Accuplacer placement tests and the SAT placement tests were considered unreliable. It is possible that the small sample size may not represent the population. Gall, Borg, and Gall (1996) state that “in correlational research, it is traditional to use a minimum of 30 subjects” (p. 229). For the data included in Table 4, the Accuplacer scores were equated to Compass
scores through the use of concordance tables.

Multiple Regression Analyses

Two regression analyses were completed in order to analyze the data. The first analysis included the final course portfolio grade, the RMPFBT, and the COMPASS Placement Test scores. These results are included in Table 3. A subsequent regression analysis was completed that included concordant Accuplacer scores. These results are included in Table 4. This was necessary due to the small sample of Accuplacer scores ($n = 10$). The Accuplacer scores were equated to COMPASS scores, and a secondary multiple regression analysis was completed. ACT (2001) reported that concordance tables can be used appropriately in cases where “evidence exists that the specific inferences to be made using concordant scores (Y) will not be too different from the inferences made using X” (p. 16).

Table 3
Multiple Regression Results Predicting Final Course Portfolio Grade from the Study Variables

<table>
<thead>
<tr>
<th>Criterion Variable</th>
<th>Predictor Variable</th>
<th>$N$</th>
<th>$B$</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio Grade</td>
<td>RMPFBT</td>
<td>40</td>
<td>.187</td>
<td>.214</td>
<td>1.260</td>
<td>.216</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td>40</td>
<td>.014</td>
<td>.022</td>
<td>.098</td>
<td>.922</td>
</tr>
<tr>
<td></td>
<td>Writing</td>
<td>40</td>
<td>.169</td>
<td>.411</td>
<td>1.816</td>
<td>.078</td>
</tr>
<tr>
<td></td>
<td>Mathematics</td>
<td>40</td>
<td>-.135</td>
<td>-.228</td>
<td>-1.223</td>
<td>.230</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th></th>
<th>$df$</th>
<th>$SS$</th>
<th>$MS$</th>
<th>$F$</th>
<th>$Sig. F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4</td>
<td>868.410</td>
<td>217.103</td>
<td>2.048</td>
<td>.109</td>
</tr>
<tr>
<td>Residual</td>
<td>35</td>
<td>3710.535</td>
<td>106.015</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CORRELATION

<table>
<thead>
<tr>
<th></th>
<th>Multiple $R$</th>
<th>$R^2$</th>
<th>Adjusted $R^2$</th>
<th>$SE$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.435</td>
<td>.190</td>
<td>.097</td>
<td>10.296</td>
</tr>
</tbody>
</table>
As seen in Table 3, the multiple $R^2$ of .190 and the standard error of measurement of 10.296 indicate that 19% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. Final course portfolio grade could be predicted within an average of 10.3 points of the actual course grade. The regression significance level of .109 indicates that the regression is not statistically significant. The independent variable CWPT has a standardized coefficient ($Beta$) of .411. Therefore, the independent variable CWPT contributes most to the independent prediction of final course portfolio grade.

Table 3 presents multiple regression data necessary to formulate a prediction equation relative to the dependent variable final course portfolio grade and the independent variables, the scores from the RMPFBT and the reading, writing, and mathematics placement tests. The following prediction equation was developed from the regression analysis:

\[
\text{final course portfolio grade} = 0.169(\text{writing}) + 0.187(\text{RMPFBT}) + 0.014(\text{reading}) + 0.135(\text{mathematics}) + 73.63. 
\]

The equation accurately explains 19% of the data therefore the equation should not be used without the collection of additional data and further analysis.

*Multiple Regression Analysis Using Concordance Tables*

Due to the small sample of students who had taken the Accuplacer Placement Tests, their scores were not included in Table 3. This excluded, however, two colleges from the regression analysis. Concordance tables relating Accuplacer placement test scores to COMPASS placement test scores, developed by Aims Community College (1999) for the purposes of student placement, were used to convert Accuplacer scores to COMPASS scores. Including the concordant scores increased the regression sample size from 40 ($n = 40$) to a sample size of 50 ($n = 50$). The results of this analysis are included in Table 4.
As seen in Table 4, the multiple R² of .154 and the standard error of measurement of 10.621 indicate that 15.4% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. Final course portfolio grade could be predicted within an average of 10.6 points of the actual course grade. The regression significance level of .105 indicates that the regression is not statistically significant. The independent variable CWPT has a standardized coefficient (Beta) of .431. Therefore, the independent variable CWPT contributes most to the independent prediction of final course portfolio grade.

Table 4 presents multiple regression data necessary to formulate a prediction equation relative to the dependent variable final course portfolio grade and the independent variables,
the scores from the RMPFBT and the reading, writing and mathematics placement tests. The following prediction equation was developed from the regression analysis:

\[
\text{final course portfolio grade} = 0.186(\text{writing}) + 0.136(\text{RMPFBT}) - 0.035(\text{reading}) - 0.125(\text{mathematics}) + 77.386.
\]

Only 15% of the variance in final course portfolio grades can be explained by the combined influence of the three independent variables, therefore the equation should not be used without the collection of additional data and further analysis.

**Hypotheses Testing**

*Research Question One*

Research Question One investigated the relationship between visual-spatial intelligence and final course portfolio grade in a community college graphic design course. The null hypothesis (\(H_{01}\)) states that there is not a statistically significant correlation between visual-spatial intelligence and final course portfolio grade in a North Carolina community college graphic design course. In the preliminary analysis, the correlation coefficient between visual-spatial intelligence and final course portfolio grade was \(r = 0.117\) and the \(p\)-value was 0.229. Therefore, the null hypothesis was retained.

*Research Question Two*

Research Question Two investigated the relationship between linguistic intelligence and final course portfolio grade in a community college graphic design course. The null hypothesis (\(H_{02}\)) states that there is not a statistically significant correlation between linguistic intelligence and final course portfolio grade in a North Carolina community college graphic design course. In the preliminary analysis, the correlation coefficient between linguistic ability as indicated by reading placement test scores and final course portfolio grade was \(r = 0.30\) and the \(p\)-value was 0.05 indicating a moderate relationship between reading
ability and graphic design ability as indicated by final course portfolio grade. The correlation coefficient between linguistic intelligence as indicated by writing placement test scores and final course portfolio grade was .365 ($r = .365$) and the level of significance of .014 was below the required level of significance ($p < .05$). Therefore, the null hypothesis was rejected. There was a statistically significant relationship between linguistic intelligence and final course portfolio grade.

*Research Question Three*

Research Question Three investigated the relationship between logical-mathematical intelligence and final course portfolio grade in a community college graphic design course. The null hypothesis ($H_{03}$) states that there is not a statistically significant correlation between logical-mathematical intelligence and final course portfolio grade in a North Carolina community college graphic design course. In the preliminary analysis, the correlation coefficient between logical-mathematical intelligence and final course portfolio grade was $r = .045$ and the $p$-value was .384. There was not a significant relationship between logical-mathematical intelligence and final course portfolio grade in a community college graphic design course. Therefore, the null hypothesis was retained.

*Research Question Four*

Research Question Four investigated the combined correlation among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course. The null hypothesis ($H_{04}$) states that there is not a combined significant correlation among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course. In the preliminary analysis, the multiple $R^2$ of .190
and the standard error of measurement of 10.296 indicate that 19% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. In 19% of cases, final course portfolio grade could be predicted within an average of 10.3 points of the actual course grade. The regression significance level of .109 indicates that the regression is not statistically significant. Including the concordant scores increased the regression sample size from 40 ($n = 40$) to a sample size of 50 ($n = 50$). With the concordant scores added, the multiple $R^2$ of .154 and the standard error of measurement of 10.621 indicate that 15.4% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. Final course portfolio grade could be predicted within an average of 10.6 points of the actual course grade for 15% of cases. The regression significance level of .105 indicates that the regression is not statistically significant. Therefore, the null hypothesis ($H_{0\alpha}$) was retained in both regression analyses.

**Summary of the Findings**

The data gathered from the convenience sample of 113 graphic design students were presented and analyzed based on the results of the RMPFBT and placement test scores. Due to the low number of participants with SAT and Accuplacer placement test scores, these scores were not included in the initial multiple regression analysis. A second multiple regression was completed that included concordant scores. The data were presented in tables illustrating the bivariate and multivariate relationships between final course portfolio grades and visual-spatial intelligence, linguistic intelligence, and logical-mathematical intelligence.

The bivariate correlational analyses were done using the Pearson Product-Moment Coefficient of Correlation ($r$) to determine the strength of the relationship among the students’ final course portfolio grades and their visual-spatial intelligences, linguistic
intelligences, and logical-mathematical intelligences. In the multivariate correlational analyses, the multiple correlation coefficient \((R)\) and multiple coefficient of determination \((R^2)\) were used to determine the strength of the relationships between students’ final course portfolio grades and visual-spatial abilities, linguistic abilities, and logical-mathematical abilities.

As a result of the correlational analysis \((r)\) for the dependent variable of final course portfolio grade and the independent variable visual-spatial intelligence, as measured by the RMPFBT, hypothesis one \((H_{01})\) was retained on the grounds that visual-spatial intelligence did not have a significant relationship to final course portfolio grade. The correlation coefficient \((r)\) was .117, and the \(p\)-value was .229. There was not a significant relationship between visual-spatial intelligence and final course portfolio grade.

As a result of the correlational analysis \((r)\) for the dependent variable of final course portfolio grade and the independent variable linguistic intelligence, as indicated by reading and writing placement test scores, hypothesis two \((H_{02})\) was rejected on the grounds that linguistic intelligence did have a significant relationship to final course portfolio grade. The correlation coefficient \((r)\) for reading was .300, and the \(p\)-value was .050, and the correlation coefficient \((r)\) for writing was .365, and the \(p\)-value was .014. There was a significant relationship between linguistic intelligence and final course portfolio grade.

As a result of the correlational analysis \((r)\) for the dependent variable of final course portfolio grade and the independent variable logical-mathematical intelligence, hypothesis three \((H_{03})\) was retained because logical-mathematical intelligence as measured by CMPT, did not have a significant relationship to final course portfolio grade. The correlation coefficient \((r)\) was .023 and the \(p\)-value was .881. There was not a significant relationship
between logical-mathematical intelligence and final course portfolio grade.

In addition to the correlation analyses, two multiple regression analyses were completed to determine the combined correlation the independent variables have on the dependent variable. The first analysis included the COMPASS Placement Test scores, and the second analysis used concordance tables to equate the Accuplacer scores to COMPASS scores. Using the resulting values, prediction equations were developed.

Findings were discussed in regards to each data table presented. While there was not a significant relationship between visual-spatial ability or logical-mathematical intelligence and graphic design ability reported, there was a significant relationship between linguistic intelligence and graphic design ability. The study findings will be discussed in the following chapter.
Chapter 5

Summary, Conclusions, and Recommendations

Introduction

This research study was undertaken to investigate the relationship among three of Howard Gardner’s Multiple Intelligences – visual-spatial, linguistic, and logical-mathematical – and graphic design ability. Due to the open-door policy, the North Carolina Community College System provides placement testing for incoming students in order to gain information regarding students’ academic preparation. Placement test results are used to place students in appropriate English, reading, and mathematics courses. In specialized technical programs, students are not required to take additional assessment tests. In the community colleges, high attrition rates may be partially due to the lack of information needed to do effective advising and placement for such programs. Therefore, if additional assessment tools were determined to be effective predictors of ability in specialized technical programs, they may be utilized in addition to the existing instruments to provide a more complete picture of a student’s preparedness.

The purpose of this study was to investigate the relationship among linguistic, logical-mathematical, and visual-spatial intelligence, and graphic design competence as indicated by final course portfolio grade in a North Carolina community college graphic design course. If a correlation exists, additional assessment instruments may have value as a placement and advising tool for students entering the graphic design program.

Overview of the Study, Research Questions, and Hypotheses

Overview of the Study

The purpose of this study was to determine if a relationship existed among linguistic,
logical-mathematical, and visual-spatial intelligence, and graphic design ability as indicated by final course portfolio grade in a North Carolina community college graphic design course. Four research questions were posed, and data were collected in order to address the corresponding hypotheses.

Research Question One

Is there a significant correlation between visual-spatial intelligence and final course portfolio grade in a community college graphic design course?

H₀₁: There is no statistically significant correlation between visual-spatial intelligence and final course portfolio grade in a North Carolina community college graphic design course.

Research question one investigated the relationship between visual-spatial intelligence and final course portfolio grade in a community college graphic design course. In the preliminary analysis, the correlation coefficient between visual-spatial intelligence and final course portfolio grade was $r = .117$, and the $p$-value was .229. Therefore the null hypothesis was retained.

Research Question Two

Is there a significant correlation between linguistic intelligence and final course portfolio grade in a community college graphic design course?

H₀₂: There is no statistically significant correlation between linguistic intelligence and final course portfolio grade in a North Carolina community college graphic design course.

Research question two investigated the relationship between linguistic intelligence and final course portfolio grade in a community college graphic design course. The correlation
coefficient between linguistic ability as indicated by reading placement test scores and final course portfolio grade was $r = .30$, and the $p$-value was .05, therefore, indicating a moderate relationship between reading ability and graphic design ability as indicated by final course portfolio grade. The correlation coefficient between linguistic intelligence as indicated by writing placement test scores and final course portfolio grade was .365 ($r = .365$), and the level of significance of .014 was below the required level of significance ($p < .05$). Therefore the null hypothesis was rejected. There was a significant relationship between linguistic intelligence and final course portfolio grade.

*Research Question Three*

Is there a significant correlation between logical-mathematical intelligence and final course portfolio grade in a community college graphic design course?

$H_{03}$: There is no statistically significant correlation between logical-mathematical intelligence and final course portfolio grade in a North Carolina community college graphic design course.

Research question three investigated the relationship between mathematical intelligence and final course portfolio grade in a community college graphic design course. The correlation coefficient between logical-mathematical intelligence and final course portfolio grade was $r = .045$ and the $p$-value was .384. There was not a significant relationship between mathematical intelligence and final course portfolio grade, therefore the null hypothesis was retained.

*Research Question Four*

Is there a significant combined correlation among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a
community college graphic design course?

$H_{04}$: There is no statistically significant combined correlation among visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course?

Research question four investigated the combined correlation between visual-spatial intelligence, linguistic intelligence, logical-mathematical intelligence, and final course portfolio grade in a community college graphic design course. In the preliminary analysis, the multiple $R^2$ of .190 and the standard error of measurement of 10.296 indicate that 19% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. In 19% of cases, final course portfolio grade could be predicted within an average of 10.3 points of the actual course grade. The regression significance level of .109 indicates that the relationship was not statistically significant. With the concordant scores added, the multiple $R^2$ of .154 and the standard error of measurement of 10.621 indicated that 15.4% of the variance in final course portfolio grade can be explained by the combined influence of the three independent variables. Final course portfolio grade could be predicted within an average of 10.6 points of the actual course grade for 15% of cases. The regression significance level of .105 indicates that the relationship was not statistically significant. Therefore, the null hypothesis ($H_{04}$) was retained in both regression analyses.

Key Findings and Conclusions

The purpose of this study was to examine the relationships among visual-spatial intelligence, linguistic intelligence, and logical-mathematical intelligence, and graphic design ability. The study was framed in the theory of Multiples Intelligences. Howard Gardner (1999) believed that individuals have eight separate, but connected intelligences. His theory
was in contrast to the long-held theory of \( g \), or general intelligence. Traditionally, formal education has emphasized reading, writing, and mathematics abilities over other disciplines, such as art and music. Gardner questioned this narrow approach to education and believed that educators should develop means to assess and promote other abilities.

Following Gardner’s theory, it would be reasonable to assume that a student who demonstrates ability in graphic design would have increased visual-spatial intelligence. If this theory held true, then students interested in graphic design could be assessed through the use of a visual-spatial abilities test, and the results could provide additional information for advising and placement. In most graphic design courses, ability is demonstrated through hands-on production activities. The products of these activities are used to construct a collection of work, or portfolio, and instructors evaluate these portfolios to determine aesthetic and technical skill development. Many students entering community colleges do not have portfolios, and it is unclear as to the predictive value of the current reading, writing, and mathematics placement test measures. A significant correlation between portfolio assessment and a visual-spatial assessment instrument may indicate that the instrument is a valid predictor of graphic design ability.

The results of this study indicated that there was not a significant correlation between visual-spatial intelligence and graphic design ability. This conclusion is based on 107 first year students enrolled in a graphic design course. While this was a convenience sample, it represented a substantial number of North Carolina community college graphic design students. For example, in 2003-2004, a total of 192 community college students graduated from graphics programs across the state (North Carolina Community College System, 2005). Since the study employed a convenience sample, however, its generalizability is limited.
In addition to visual-spatial intelligence, this study explored the relationship between graphic design ability and linguistic intelligence and logical-mathematical intelligence. These intelligences were examined through the relationship between college placement test scores and final course portfolio grade. Students who have advanced skill in these areas should place higher on the mathematical and verbal placement tests. The results of this study indicated that there was not a significant correlation between logical-mathematical intelligence and graphic design ability. There was a correlation between linguistic intelligence and graphic design ability.

If graphic design ability is related more to linguistic and mathematical ability than to visual-spatial ability, then this offers stronger support for the theory of \(g\) than for the theory of Multiple Intelligences. It would be reasonable that traditional academic tests, such as COMPASS, Accuplacer, and the SAT, can provide accurate placement guidance for a specialized technical program such as graphic design. Gardner (1993) did not dismiss the Spearman theory of \(g\) but believed it to be too narrow a description of human intelligence. He believed traditional assessment approaches were valuable and he also believed that standardized testing supports the theory of Multiple Intelligences. “To the extent that the tasks that purportedly assess one intelligence correlates highly with another, and less highly with those that purportedly assess other intelligences, my formulation enhances its credibility” (Gardner, 1983, p. 66). He did also stress the importance of alternative assessment measures such as portfolios to evaluate student ability. Continued exploration of instruments that correlate with successful portfolio development may be necessary before visual-spatial testing could take place.
Recommendations for Future Research

1. It is recommended that a longitudinal study be conducted with a larger sample of students. Testing would take place upon entrance into the graphics program, and test scores would be correlated with graduate portfolio assessment and final GPA.

2. It is recommended that further study be conducted to explore the use of other standardized assessment instruments that measure visual-spatial ability. The exploration of other assessment tools to measure ability in the graphic arts may provide additional information and guidance for student advisement and placement.

3. It is recommended that more research be conducted regarding the process of portfolio evaluation in a community college graphic design program. While various models of portfolio assessment were discussed in the Chapter 2, there was limited research regarding portfolio evaluation in North Carolina community college graphic design programs.

4. It is recommended that more research be conducted regarding higher education graphic design programs and multiple intelligences. Conducting this research project in the area of graphic design uncovered the paucity of research concerning graphic design programs and the arts in general. Others have noted the scarcity of arts-related empirical studies as well (Colwell, 2003; Metzger & Bryant, 1993). Further research into graphic design ability and multiple intelligences may provide further insight into learning strategies in visual arts programs.

Implications for Practice

The researcher was unable to find any studies related specifically to graphic design and visual-spatial ability, but research was uncovered that explored visual-spatial ability and
drawing. This study’s findings affirm similar research by Swanson (1997) and Orde (1996), who found no significant relationship between visual-spatial ability and drawing ability. Additionally, Swanson found a significant correlation between drawing ability and reading ability. In contrast, Moirs (1996) found that visual-spatial ability and drawing was significantly correlated. It is possible that the RMPFBT measured an aspect of visual-spatial intelligence that is not critical for success in a community college graphic design course. Eliot (2002) indicated that spatial ability is related to the broader concept of human intelligence and that tests for spatial ability only measure limited aspects of visual-spatial intelligence. Additional study may be necessary to determine the relationship between visual-spatial ability, graphic design ability, and instruments that measure these abilities.

In this study, a significant relationship between visual-spatial intelligence and graphic design ability was not found. There was also not a significant relationship between logical-mathematical intelligence and graphic design ability. There was, however, a significant relationship between linguistic intelligence and graphic design ability. This is not unexpected, since graphic design coursework does require the ability to read, write, and to communicate with others. Students who are unable to understand written assignments or verbal instructions may have difficulty completing their projects in an effective and timely manner. Graphic design is visual communication – successful concepts employ elements such as illustration, photography, graphic symbols, and typography to convey a client’s message in a clear and concise way. Additionally, students are required to verbalize their assessment of classmates’ work through oral and written critiques. Much of the verbal feedback from instructors during such critiques is intended to improve student work. Increased linguistic intelligence would benefit students in a graphic design program. The
researcher was unable to find studies concerning the correlation of reading and writing tests and graphic design ability but this study may provide some evidence of the usefulness of the current placement test instruments in regards to graphics programs.

Gardner indicted that while he theoretically separated human intelligences into eight specific areas, in reality, the intelligences are not separable. The intelligences work together to solve problems. For instance, a gymnast uses bodily-kinesthetic and visual-spatial ability to accomplish complex maneuvers. This interconnectedness was the purpose for the multiple regression in Chapter Four – to explore influences from the three intelligences upon graphic design ability. Course performance can be affected by other factors, such as interpersonal interactions with the instructor, the ability to interact effectively with classmates, or difficulty in translating a concept to a finished piece of commercial art via the computer or by hand.

Exploration of other intelligences and their role in a graphic design course may be helpful in understanding factors that impact portfolio development.

Not all of the colleges in this study used a formal evaluation instrument. This may have affected grading consistency. The subjectivity of visual design work and the variation in grading procedures may have contributed to the outcomes. Research has demonstrated that instructors who used formal assessment instruments graded more consistently, and their evaluations were more closely aligned with those of industry professionals (Tomhave, 1999; Turner, 2003; & Yen, 1995). Even though the final course portfolio grade was limited to visual design projects only, other factors, such as late or missed projects could have affected final course portfolio grades. Further exploration of graphic design portfolio evaluation in North Carolina community college graphic design programs may provide insight into existing assessment methods that could be used to improve consistency and accuracy.
Summary

This study explored the relationship among three of eight multiple intelligences identified by Gardner – visual-spatial, linguistic, and mathematical intelligences, and graphic design ability. If a test designed to assess visual-spatial ability correlated with course portfolio grades in community college graphic design courses, then the test may provide an indication of an incoming student’s potential in a graphic design course. The null hypothesis regarding visual-spatial intelligence and mathematical intelligence was retained, however, indicating that a significant relationship did not exist. The null hypothesis concerning linguistic intelligence and graphic design ability was rejected indicating that the existence of a significant relationship.

The results of this study indicate that there is not a significant correlation between visual-spatial ability and graphic design ability. However, this finding is counterintuitive and may be due to the broad and complex nature of visual-spatial intelligence. The ability to recognize and understand shape, form, and space is essential to the visual arts, particularly graphic design. Designers work with the organization and structure of complex shapes to create visually communicative pieces of work. In light of these findings, additional exploration of other visual-spatial tests may be warranted. Investigation of portfolio assessment may also provide insights into the evaluation processes of community college graphic design instructors. An interesting finding of this study is the correlation between linguistic intelligence and graphic design ability. Until further research is conducted regarding the relationship between visual-spatial intelligence and graphic design ability, reading and writing placement test scores may prove valuable in the assessment and placement of students into community college graphic design programs.
References


(UMI No. AAI9705687)


Hamblen, K. (1988). If it is to be tested, it will be taught: A rationale worthy of examination. *Art Education, 22*(1), 57–62.


Into the Classroom Media (Producer). (1996). *MI: Intelligence, understanding, and the mind* [video]. (Available from Into the Classroom Media, 10573 W. Pico Boulevard, Los Angeles, CA 90064)


Appendices
Appendix A

Permission Statement from

North Carolina State University

Institutional Review Board for the Use of Human Subjects in Research
From: Debra A. Paxton, IRB Administrator  
North Carolina State University  
Institutional Review Board  

Date: January 26, 2005  

Project Title: Multiple Intelligences and Graphic Design Ability in Four North Carolina Community Colleges  
IRB#: 021-05-1  

Dear Mr. Mackie:  

The project listed above has been reviewed in accordance with expedited review procedures under Addendum 46 FR8392 of 45 CFR 46 and is approved for one year. This protocol expires on January, 26, 2006, and will need continuing review before that date.  

NOTE:  
1. This board complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU the Assurance Number is: FWA00003429; the IRB Number is: IRB00000330.  
2. The IRB must be notified of any changes that are made to this study.  
3. Your approval for this study lasts for one year from the review date. If your study extends beyond that time, including data analysis, you must obtain continuing review from the IRB.  

Please provide your faculty sponsor with a copy of this letter. Thank you.  

Sincerely,  

[Signature]  
Debra Paxton  
NCSU IRB
Appendix B

North Carolina State University

Informed Consent Form for Research
North Carolina State University
INFORMED CONSENT FORM for RESEARCH

Multiple Intelligences and Graphic Design Ability in Five North Carolina Community Colleges
Keith Mackie (principal researcher)  Dr. Ted Branoff (Faculty Advisor)

We are asking you to participate in a research study:
The purpose of this study is to investigate the relationship between linguistic, logical-mathematical, and visual-spatial intelligence and graphic design competence as indicated by course grade in a North Carolina Community College graphic design course. Participants will complete a visual-spatial abilities test and a statistical test will later be conducted to determine if a relationship exists between the visual-spatial test score, mathematical and verbal placement test scores, and final course portfolio grade in a first-year graphic design course. If a correlation exists, the visual-spatial test may have value as an assessment and advising tool for students entering the graphic design program. Participation is voluntary.

INFORMATION
If you agree to participate in this study, you will be asked to:
1) Complete the Revised Minnesota Paper Form Board Test to the best of your ability. The test will take approximately 30 minutes. The Revised Minnesota Paper Form Board Test is a multiple choice, paper and pencil test.
2) Grant permission for the obtainment of placement test scores from your college.
3) Grant permission for the obtainment of your final course portfolio grade from the college.

RISKS
There are no risks associated with the study.

BENEFITS
There is no assessment method used in the North Carolina Community College System to evaluate incoming student graphic design abilities other than placement tests. The predictive value of these tests may be limited to general education and college-transfer courses and may be less useful for assessing specialized abilities. If a test designed to assess visual-spatial ability correlates with course grades in community college graphic design courses, then the test may provide an indication of an incoming student’s potential in a graphic design course. North Carolina Community College graphic design instructors may create developmental courses in order to facilitate the developmental needs of incoming graphic design students.

CONFIDENTIALITY
The information in the study records will be kept strictly confidential. Data will be stored securely in key researcher’s office. No reference will be made in oral or written reports which could link you to the study.

CONTACT
If you have questions at any time about the study or the procedures, you may contact the researcher, Keith Mackie, at 4729 Crystal Falls Avenue, Hickory, NC 28601, or 828-313-9971. If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. Matthew Zingraff, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/513-1834) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148)

PARTICIPATION
Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed your data will be returned to you or destroyed at your request.

CONSENT
“I have read and understand the above information. I have received a copy of this form. I agree to participate in this study with the understanding that I may withdraw at any time.”

Subject's signature __________________________ Date __________________
Investigator's signature __________________________ Date __________________
Appendix C

Revised Minnesota Paper Form Board Test

Facilitation Script
Research Study Script

RESEARCHER:

We are asking you to participate in a research study and the purpose of this study is to investigate the relationship between linguistic, logical-mathematical, and visual-spatial intelligence and graphic design competence as indicated by course grade in a North Carolina Community College graphic design course. The study may provide information that will be helpful for advising incoming graphic design students.

Participation in the study is voluntary. There are no risks associated with this study and your test results will be kept confidential. Participating will not affect your grade in this course in any way. If you agree to participate in this study, you will be asked to do the following 4 things:

- Complete the Revised Minnesota Paper Form Board Test to the best of your ability. The test will take approximately 20 minutes.

- Grant permission to the researcher to obtain your placement test scores from your college.

- Grant permission to the researcher to obtain your final course portfolio grade from the college.

- Sign a consent form.

Any questions?

How many would like to participate?

Please read and sign the consent form if you want to participate in the study and we will begin.
Open your test booklets and I will read the instructions aloud to you:

Look at the problems on the right side of this page. You will notice that there are eight of them, numbered from 1 to 8. Notice that the problems go DOWN the page. First look at Problem 1. There are two parts in the upper left-hand corner. Now look at the five figures labeled A, B, C, D, E. You are to decide which figure shows how these parts can fit together. Let us first look at Figure A. You will notice that Figure A does not look like the parts in the upper left-hand corner would look when fitted together. Neither do Figures B, C, or D. Figure E does look like the parts in the upper left-hand corner would look when fitted together, so E is PRINTED in the square above 1 at the top of the page.

Now look at Problem 2. Decide which is the correct answer. As you will notice, Figure A is the correct answer, so A is printed in the square above 2 at the top of the page. The answer to Problem 3 is B, so B is printed in the square above 3 at the top of the page. In Problem 4, D is the correct answer, so D is printed in the square above 4 at the top of the page. Now do Problems 5, 6, 7, and 8.

PRINT the letter of the correct answer in the square above the number of the example at the top of the page. DO THESE PROBLEMS NOW. If your answers are not the same as those which the examiner reads to you, RAISE YOUR HAND. DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

Some of the problems on the inside of this booklet are more difficult than those which you have already done, but the idea is exactly the same. In each problem you are to decide which figure shows the parts correctly fitted together. Sometimes the parts have to be turned around, and sometimes they have to be turned over in order to make them fit. In the square
above 1 write the correct answer to Problem 1; in the square above 2 write the correct answer to Problem 2 and so on with the rest of the test. Start with Problem 1, and go DOWN the page. After you have finished one column, go right on with the next. Be careful not to go so fast that you make mistakes. Do not spend too much time on anyone problem. PRINT WITH CAPITAL LETTERS ONLY. MAKE THEM SO THAT ANYONE CAN READ THEM. DO NOT TURN THE PAGE BEFORE YOU ARE TOLD TO DO SO. YOU WILL HAVE EXACTLY 20 MINUTES TO DO THE WHOLE TEST. Any questions? Please begin.
Appendix D

Revised Minnesota Paper Form Board Test

Instructions and Sample Problems
DIRECTIONS AND PRACTICE PROBLEMS

READ THE FOLLOWING DIRECTIONS VERY CAREFULLY WHILE THE EXAMINER READS THEM ALOUD

Look at the problems on the right side of this page. You will notice that there are eight of them, numbered from 1 to 8.
Notice that the problems go DOWN the page. First look at Problem 1. There are two parts in the upper left-hand corner. Now look at the five figures labelled A, B, C, D, E. You are to decide which figure shows how these parts can fit together. Let us first look at Figure A. You will notice that Figure A does not look like the parts in the upper left-hand corner would look when fitted together. Neither do Figures B, C, or D. Figure E does look like the parts in the upper left-hand corner would look when fitted together, so E is PRINTED in the square above 1 at the top of the page.
Now look at Problem 2. Decide which is the correct answer. As you will notice, Figure A is the correct answer, so A is printed in the square above 2 at the top of the page. The answer to Problem 3 is B, so B is printed in the square above 3 at the top of the page.
In Problem 4, D is the correct answer, so D is printed in the square above 4 at the top of the page.
Now do Problems 5, 6, 7, and 8.
PRINT the letter of the correct answer in the square above the number of the example at the top of the page.
DO THESE PROBLEMS NOW.
If your answers are not the same as those which the examiner reads to you, RAISE YOUR HAND.
DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.
Some of the problems on the inside of this booklet are more difficult than those which you have already done, but the idea is exactly the same. In each problem you are to decide which figure shows the parts correctly fitted together. Sometimes the parts have to be turned around, and sometimes they have to be turned over in order to make them fit. In the square above 1 write the correct answer to Problem 1; in the square above 2 write the correct answer to Problem 2 and so on with the rest of the test. Start with Problem 1, and go DOWN the page. After you have finished one column, go right on with the next. Be careful not to go so fast that you make mistakes. Do not spend too much time on any one problem.
PRINT WITH CAPITAL LETTERS ONLY.
MAKE THEM SO THAT ANYONE CAN READ THEM.
DO NOT TURN THE PAGE BEFORE YOU ARE TOLD TO DO SO.
YOU WILL HAVE EXACTLY 20 MINUTES TO DO THE WHOLE TEST.
Appendix E

Graphic Design Project Evaluation Sheet
Advertising Design Program Project Evaluation Sheet

This grading guide sheet is divided into 10 categories, and in most cases, all of the items listed will be evaluated when grading the project even though all may not be an integral part of the project.

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept, Creativity, Innovative thinking on basic idea direction and solution.</td>
</tr>
<tr>
<td>Layout, Design, overall simplicity of visual presentation.</td>
</tr>
<tr>
<td>Copywriting effectiveness, Headline, and the accompanying Body Copy.</td>
</tr>
<tr>
<td>Typography, selection of appropriate faces, kerning, spacing, alignment, legibility, etc.</td>
</tr>
<tr>
<td>Comprehensive Layout qualities; balance, alignment, contrast, repetition, etc.</td>
</tr>
<tr>
<td>Cleanliness, Accuracy, Overall appearance of the mounted project in terms of detailing.</td>
</tr>
<tr>
<td>Correct Spelling and Punctuation in all areas of copy; head, subhead, text, address, etc.</td>
</tr>
<tr>
<td>Verbal Presentation, confidence, poise, ability to communicate clearly, etc.</td>
</tr>
<tr>
<td>Mounting, arrangement, flapping, gluing, matting, trimming, etc.</td>
</tr>
<tr>
<td>Project completed within the assigned time-frame, no excuses, not late, ready to present.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th>Grade</th>
</tr>
</thead>
</table>

Overall Critique Comments:

__________________________________________________________________________
__________________________________________________________________________
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__________________________________________________________________________
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