7-2011

A Descriptive-Correlational Study Exploring Post-Secondary Student Tracks Chosen by Learners with High Spatial Ability

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A DESCRIPTIVE-CORRELATIONAL STUDY EXPLORING POST-SECONDARY STUDENT TRACKS CHOSEN BY LEARNERS WITH HIGH SPATIAL ABILITY

A Thesis Submitted to the Graduate School in Partial Fulfillment of the Requirements for the Degree of Master of Science

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July 2011

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An Abstract of the Thesis by Robert McGowan

People that process thought using pictures rather than words have difficulty in school. Previous research has shown that characteristics of Spatial Learners, or people that process thought spatially, by thinking in pictures rather than words, have poor spelling, are less likely to graduate high school, have a lower grade average, are likely male, don't read instructions carefully, are late bloomers, have a bedroom that is disorganized, lose track of time and have difficulty memorizing words. Many of history's great problem solvers are believed to be highly spatial people.

It is theorized that the majority of highly spatial learners are not as likely to enter post-secondary education as degree earners but instead as a Career Technical Education (CTE) student because traditional education is not oriented toward their style of learning.

The objective of this research was to see if there is a relationship to spatial learners and the learning track they pursue. A survey was developed asking students in general education classes and CTE classes if they have the traits that have been identified as a person with spatial strengths. The student also completed a spatial test to measure their spatial ability.

The results indicated little relationship between general education vs. technical education and spatial ability. There was also no relationship between spatial ability and the known traits previously associated with highly spatial people. Unfortunately, this leaves the spatial test used in the research questionable and likely not viable. Since little

relationship was measured between any of the data, it suggests that the research should be repeated using a different tool to measure spatial ability; perhaps from the Elliot Spatial Test Collection at the University of Akron.

Previous research indicated relationships between people with high spatial abilities and certain behaviors that could not be duplicated with this survey. If the spatial evaluation tool cannot show a relationship between the known behaviors of highly spatial people, it brings its validity into question. The question of if there are larger groups of highly spatial learners in different learning tracks remains unanswered by this work.

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CHAPTER I

INTRODUCTION

Over the last century, many schools have evolved from a mix of liberal education, vocational, and mechanical education to a preparatory system for college with emphasis on scoring high on academic testing. Secondary schools place much less emphasis on shop classes, vocational or career technical coursework because emphasis is placed on college preparation (Chad, 2006). Many students that traditionally found success in these vocational classes had learning styles that made success difficult in the traditional classroom (Chad, 2006). Shop and vocational education had an inaccurate image of a dumbed-down curriculum with students that could not measure up in regular classes and so shop and vocational classes fell from favor at most schools (Lynch, 2000). Shop and vocational classes were often removed completely or replaced with classes from a satellite location that could only handle a limited number of students. J. Hattok (personal communication, March 20, 2010), an auto tech teacher in Kansas City Kansas, explained that only about 3 students from each high school may attend each off campus Auto Tech class offered. Other local schools that offer these same classes within the high school have around 100 students enrolled in this same subject, from the same school. With this reduced opportunity, most students that would traditionally gain from vocational programs are not able to take the classes.

One group in particular that frequently attended these shop classes were students that lacked audio-sequential ability but had visual-spatial strengths. These students tended to learn better in the holistic learning environment offered by the vocational

technical classes(Lynch, 2000). As some districts eliminated traditional vocational and career programs from the high school, these students were placed back in the classroom, and it is difficult to know how they performed because they were seldom tested for spatial ability any longer. Scholastic Aptitude Test [SAT] and Graduate Record Exam [GRE] do not assess spatial ability (Gohm, 1998). This leaves the question of how Visual-Spatial Learners (VSL) lives were affected by this lost opportunity and what happened to them during and after the high school experience.

J. Stevenson (personal communication, October 2008), a retired director of a vocational school in Kansas City, stated that;

> In the past, we tested students for abstract, spatial and mechanical abilities …the school required all students have credits in vocational classes…we were reaching the students that were not doing well in traditional education. Now we have eliminated almost all of our traditional vocational programs at the secondary level in order to increase the time spent for college preparation… people fail to realize that these classes are a tool to help teach general education to people that learn in other ways, not just prepare them for a specific vocation. We have success in providing general education to students that will not succeed in traditional schools.

Some portion of the students that learn "other ways" include VSL's and students with high spatial abilities or Spatial Learners (SL). A VSL or SL is a student that processes thought primarily with strong visual images rather than words and sequential memorization. They have the ability to build, rotate, manipulate and alter images in their brain (Freed, 1997). Many of the people that did not do well in high school share this visual-spatial learning style (Silverman, 2002). Individuals identified as having spatial gifts or talents are disproportionately undereducated and underemployed relative to their ability level when compared with equally gifted individuals with strengths in mathematical and verbal areas. Individuals with high spatial abilities are more likely to

drop out of school, are working in larger proportions in traditional blue-collar occupations, and hold a smaller proportion of credentials at every educational level beyond high school (Gohm, Humphreys, Lubinski, & Yao, 1993).

Most students that have high VSL strengths also have diminished ability to perform linguistic tasks (Silverman, 2000). While the VSL student has terrific ability to manipulate images in thought and complex problem solving, they tend to be handicapped in the world of words. Unfortunately for the VSL students, schools are primarily worlds of words (Freed, 1997). School systems rely on mostly audio-sequential teaching methods, students with VSL strengths are finding it difficult to learn, and the gap between teacher and pupil widens (Freed, 1997). In the No Child Left Behind era, schools have adopted standardized instruction and assessment that is not conducive to VSL's learning style (Mann, 2006).

While everyone has some visual-spatial and audio-sequential abilities, approximately one-third of people share strengths in audio-sequential ability with strengths in rote memorization and word strengths, one-third are visual-spatial and process thoughts in images and pictures rather than utilization of linear organization, and about one-third have abilities that are nearer a balanced mixture of the two. The one-third that rely mostly on visual-spatial ability have difficulty in school because it is designed for audio-sequential success (Silverman, 2002). Men are more likely to be VSL than women. Men tend to test higher in visual-spatial ability, while women test higher in verbal ability (Moir,1991, Silverman, 2002).

One goal in teaching would be to help all students to strengthen the areas of weakness. In order to strengthen a VSL's audio-sequential ability must be taught through their visual spatial strengths (Silverman, 2002).

Nearly half of high school freshmen will not graduate high school in 2008 (NCES, 2007). How many of these dropouts are VSL's is difficult to say because these students have never been assessed as far as learning styles or abilities. As history shows though, some of the most influential inventors and creative thinkers have been identified as VSL's, and they frequently had great difficulties in traditional school. These include Edison, da Vinci, and Einstein (West, 1997).While schools have greatly reduced vocational education, it is realized the value of integration of vocational and academic education is beneficial to the student (Lynch, 2000).

Some students that have difficulty in school are diagnosed with a disorder called Attention Deficit Disorder (ADD). It is estimated that 2 to 3 percent of students actually have ADD yet a much larger percentage is medicated for this disorder. Most all children who are labeled as ADD are right brained or VSL, and have visual learning styles. VSL students tend to do poorly in school because their educators are likely not to be VSL and view the VSL's as flawed (Freed, 1997).

Typically, the educational system is administered by people that were successful students in the college model and are now the architects of educational design. With the best intent, secondary education that once prepared youth for life became instead a preparation for college and thus secondary schools adopted the same goals and teaching styles of the traditional college (Mann, 2006). In this model, subjects are divided into bits that are delivered sequentially much like the chapters in a book, in written and verbal

delivery. If audio-sequential learners are the best performers in this school design, they will find success and become the teachers and designers of education for the next generation (Freed, 1997). As this cycle continues, people that rely on strong visual-spatial reasoning will not be served well and may even be labeled as learning disabled solely because they process thought using right brain dominance while the teacher is left brain dominant (Freed, 1997).

Dixon (2006), stated that:

> Elementary school teachers are often those who themselves experienced comfort and success when they were being introduced in first grade to the memorized intricacies of reading, writing, and arithmetic…It is the rare teacher who has any extensive training in the nature of spatial and mechanical skills or who uses spatially dominant activities as anything but a passing fancy in the classroom. Spatial children have the potential for understanding the interconnected patterns in quantum theory, quasars, path analysis, thermodynamics, matrix algebra, spatial analysis, etc. yet they go undiscovered in our left-brained educational system because some of these same children have trouble deciphering basic rote skills in the classroom. (p. 132)

Problem Statement

There is little formal research that has been conducted about what areas that Visual Spatial learners tend to enroll in post-secondary school. After their high school or high school equivalency, some of these students will move into post-secondary education. This brings about the questions raised in this research. Are people with high visual-spatial abilities that decide to attend post-secondary education more likely to end up in a college program designed for career training or a track designed to achieve a higher degree? Are postsecondary students with high spatial ability more likely to choose a career technical education degree due to this characteristic?

Research Questions/Objectives

1. Describe the demographics respondents including age, sex, high school graduate or GED, and GPA.
2. Determine how did students rate their spatial abilities?
3. Identify what type of learners are currently enrolled in one Composition II class, one College Algebra class, one Auto Tech and one Welding class at Kansas City Kansas Community College (KCKCC)?
4. Based on the respondents self-identified VSL, are they more likely to enroll in a general degree program or enroll in a career based, skills and training program

Hypothesis

Based on previous research, results should indicate relationships between:

1. Age of the students and class type
2. Gender and class type
3. School diploma type and class type
4. High spatial abilities and high school diploma type
5. Gender and spatial ability
6. Spatial strength and age
7. Secondary grade point average and spatial strengths
8. Spatial strengths and desire to read instructions
9. Spatial strengths and ability to spell
10. Spatial strengths and being a late bloomer
11. Spatial strengths and being in legal trouble in past
12. Spatial strengths and keeping bedroom organized

13. Spatial strengths and memorizing lines form a script
14. Likelihood of Spatial learners in Comp II, College Algebra, Welding and Auto tech
15. Number of Highly Spatial Learners in General Education or Tech classes

Definition of Terms

1. Career and technical students - Students that are enrolled in school to learn a vocation or occupation.
2. Degree students - Students who intend to enroll to complete a degree of 2 or more years
3. Spatial ability - Someone who's primary method of thought utilizes manipulation of visual images rather than the sequential memorization of words and thoughts
4. Criminal history - Someone who has committed a crime
5. High school completer - Someone who completes high school or equivalent
6. High school drop-out - Someone who does not complete traditional high school
7. VSL - Visual Spatial Learner. Ability to manipulate images in thought and solve complex problems.
8. SL – Spatial Learner. Highly spatial student.
9. ASL - Audio-Sequential Learner. Ability to process thoughts in linear organization that enables greater linguistic abilities.
10. Right Brained - Loose term for the area of the brain associated with spatial reasoning. Although more complex than simply the right brain, this phrase is often used to represent spatial strength.

11. Left Brained - Loose term for the area of the brain associated with sequential reasoning. Although more complex than simply the left brain, this phrase is often used to represent sequential reasoning.

Delimitations

1. Students in one Composition II class, one College Algebra class, one Auto Tech class and one Welding class were the only students tested.
2. The students from other colleges were not included in this test.
3. Students from outside these groups were not included.
4. Students that did not complete high school were not included in this test.
5. Students that dropped out and did not complete their high school equivalency were not included in this test.
6. Students that completed high school or equivalent but chose not to enroll in post-secondary education were not included in this study.

Limitations

1. Subjects from this study are limited to students that have completed some form of high school and enrolled in post-secondary education at the community college.
2. The population was limited to these two classes and these two skill areas.
3. Students that test high in visual-spatial and audio-sequential will test high on all tests.
4. This study looks at only one geographic area.
5. This study looks at only students at one community college.

6. While this data is gathered in a post-secondary setting, it does not necessarily measure elements about the college itself. Students decided on their program choice before entering the college based on previous experiences and life events.

Assumptions

The following assumptions were made in conducting this study.

1. This study took place at one school and it is assumed that the study can be repeated at other schools with the same result.
2. It is assumed that the student's spatial ability has not changed since their high school experience.
3. Students with the visual spatial learning characteristics are very similar to spatial learners therefore the data can be compared.
4. Subjects are able to read English.

Significance of the Study

Drop-out rates and quality of high school education is a topic that is of great concern. With so many students having such difficulty in their high school experience, all searches for helpful information need to be considered. In the case of the SL, concerning appropriate educational and career alignment and successful degree attainment, further understanding is needed. Every added piece of information could help to understand the problem and suggest solutions that will work. If these students are really slipping through our educational system, then something can be done to help them find success. If one-third of the people are strongly SL as the literature describes and they are not represented in the college equally, educational institutions may not be serving a large portion of

students. Are those that think differently being treated as though they are deficient? Could the ADD epidemic simply be a product of educational design that is based solely on sequential processing leaving the VSL lost in the system?

CHAPTER II

REVIEW OF LITERATURE

What makes someone a visual-spatial learner?

Visual-spatial learners are excellent observers, comprehend holistically,-may have sudden "Aha!" understanding that leaps over steps,-appear to think in images, may need translation time to put their ideas into words, and sometimes have word retrieval problems. Their thinking and emotions are very intertwined (Silverman, 2002).

At school, students with spatial strengths may struggle to master material that is typically considered "easy" and requires rote memorization, yet they thrive when engaged in activities that require higher order thinking skills and creative problem solving (Baum, 1984).

Differences between Visual Spatial Learners and Auditory Sequential Learners

Below is how Silverman (2002) made the comparison between visual spatial learners and auditory sequential learners.

Visual Spatial Learners

- Is right-hemispheric learners
- Think primarily in images
- Relate well to space but not to time
- Whole concept learners
- Read maps well
- Have unique methods of organization
- Learn complex concepts easier than simple skills
- Generates unusual solutions to problems
- Late bloomer

Auditory Sequential Learners

- Is left-hemispheric learners
- Think primarily in words
- Relates well to time
- Follows steps in instruction easily
- Excels at rote learning
- Repetition to reinforce learning
- Is well-organized
- Progresses from easy steps to difficult sequentially
- Early bloomer

Huk (2006) found in a related study utilizing 3D models to teach to students, that while using 3D models did enhance learning to spatial learners, it caused tension to people that learn using other methods. Thus training methods that are good for Visual-Spatial students may not be good for Audio-Sequential students as Audio-Sequential methods may not be good for Visual-Spatial students. The results suggest that each group should be offered the type of experience that matches their learning style.

Sexes and the Visual-Spatial Learner

The effect of VSL's and right or left brain becomes more apparent between the sexes (Moir, 1991). Both the left and right sides of the female brain are involved in verbal and visual abilities. Men's brains are more specialized. The left side of the male brain is almost exclusively set aside for the control of verbal abilities, the right sides for the visual. Men, for example, tend to use the right side of their brain when working on an abstract problem, while women use both sides.

Famous Visual-Spatial Learners

West (1997) speaking about how Einstein described his process of thought stated that:

> It is of no small significance that Einstein's words clearly describe a two-mode process that corresponds closely to the findings of those who have been investigating the roles of the two hemispheres. He first 'plays' with 'images' in the visual right hemisphere, the apparent source of new ideas or perceptions of order, possibly relatively independently of conventional thought, current scientific understanding, and education. He plays until he arrives at the desired result. And then, 'only in a secondary stage' does he have to seek 'laboriously' for the right words and mathematical symbols to express the ideas in terms of the verbal left hemisphere, in the terms of the world, in terms that can be 'communicated to others'.(pg #)

West (1997) speaking of Einstein's sister:

> According to his sister, Einstein never was much good at the 'easy' part of mathematics. To shine, he had to move on to the 'hard' part. In adult life, his mathematical intuition was recognized as extraordinary and he could handle deftly the most difficult tensor calculus, but it appears that arithmetic calculation continued to be an area of comparative weakness. (pg #)

West (1997) quoting Einstein:

> I was summoned by my home-room teacher who expressed the wish that I leave the school. To my remark that I had done nothing amiss he replied only 'your mere presence spoils the respect of the class for me.' I myself, to be sure, wanted to leave school and follow my parents to Italy. But the main reason for me was the dull, mechanized method of teaching. Because of my poor memory for words, this presented me with great difficulties that it seemed senseless for me to overcome. I preferred, therefore, to endure all sorts of punishments rather than learn to gabble by rote. (p.33)

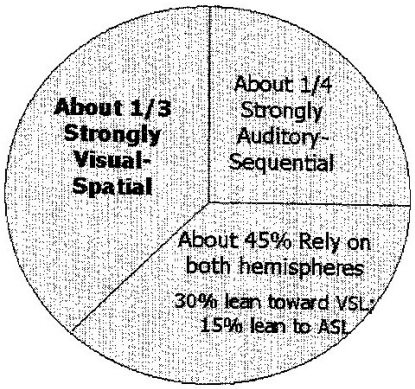
Einstein clearly had issues with remembering words, simple math problems, and a hatred for rote memorization, all classic signs of the VSL.

West (1997) on Leonardo da Vinci:

> Leonardo relied heavily on mental rotation and the recognition of mirror-image similarities in triangles and polygons. His strengths are well known. Leonardo's spelling has been described by various authors as being 'by ear,' 'bizarre,' 'inconsistent.' His errors are characterized by consonant doubling, letter substitutions, additions, blending, and word splitting. He made misspellings when copying from other texts, a rare form of error…Leonardo was clearly aware of his own language problems…'you should prefer a good scientist without literary abilities than a literate without scientific skills'. (pg #)

How many people are Visual-Spatial Learners?

Many studies have been done to identify people that have this ability and it appears that everyone has spatial ability to some degree. About 45% of people rely on both hemispheres utilizing visual spatial and auditory sequential methods to process thought, 25% are strongly auditory sequential, and 33% are strongly visual spatial (Silverman, 2002). This group of one-third of strong visual spatial people is the focus of this study.



Relationship to ADD

Most gifted and virtually all children diagnosed with ADD/ADHD share the same learning style. Simply put, they are highly visual, non-sequential processors who learn by remembering the way things look and by taking words and turning them into mental pictures. The teaching techniques that work so well for gifted, right –brained students also work for children with ADD. Educators tend to be left-brained and too often spatial learners are only recognized and only regarded as a problem. Many students are incorrectly diagnosed with ADD because their inability to fit into a left brained, sequential order that exists in most public schools (Freed, 1997).

Issues a Visual Learner Face

Students that have visual-spatial strengths face difficulties in school because school is designed and taught for people that have strengths in audio-sequential methods of reasoning. Teachers, because they are a product of the school they teach, are likely to possess strengths in audio-sequential processing and therefore are going to view students who process thoughts differently as learning disabled (Mann, 2002). The

underemployment and under education of gifted students with spatial strengths is of concern because they are ideal candidates to become America's future engineers, scientists, and innovators (Mann, 2002).

Teaching Students with high visual-spatial ability

Rather than insisting that basic skills be mastered prior to engaging in higher level activities, educators should give the gifted spatial learner opportunities to work with complex material that requires creativity and higher order thinking skills (Baum & Owen, 1988). Students with high spatial abilities have a holistic approach to learning and benefit from interdisciplinary activities that illustrate how changes in one subject area influence other domains. As a result of their whole-to-part processing style, these students appear to be slow processing when in reality, they are taking in the new information and considering the significance of it while interpreting how this new piece of knowledge fits into the larger system (Mann, 2005).

Studies conducted by the Bill and Malinda Gates Foundation show that when surveyed, students that drop out of school do not see the purpose of their lessons. While these studies did not address the student's method of thought, it did show that the main reason for dropping out was that youth did not see how the lessons of school related to them and why they needed to learn these subjects (Bridgeland, J., Dilulio, J., Morison, K. 2006). A visual-spatial student needs to know where the lesson is going and where it is coming from. Rationalization comes from seeing the subjects holistically with the lessons. Opportunities for authentic and experiential learning are necessary for students to find value in the tasks in which they are asked to perform (Mann, 2006) .

Career Track of Visual Spatial Learners

Many students that drop out will often complete a high school equivalency, and then decide to join other high school graduates and pursue post-secondary education in the form of a community college. Of those that enter the community college, some will pursue a degree track with the intention of completing a degree, while others will pursue training specifically to gain skills to become employed in an occupation. It would be helpful to understand which track the VSL most likely take and why.

A Summary of Visual Spatial Learners and Learner Characteristics

1. SL's are much more likely to be male.
2. Students with high spatial learning often drop out of school.
3. As reviewed above, we know that students are more likely to seek holistic learning environments than the traditional classroom.
4. SL's do not fit well into the sequential classroom.
5. Integration of vocational and academic education is a solution to deal with students with specialized needs and all students that enjoy the application of theory to understand its worth.

CHAPTER III

METHODOLOGY

Type of Study

This is a descriptive-correlational study which looked at students enrolled in Kansas City Kansas Community College. Students were given a survey and a brief test to determine spatial abilities and collect situational and demographic information. The results were compared to known VSL traits to identify students that have high spatial abilities. The number of VSL's in each class will be compared to see if there is a significant difference between classes; those enrolled in the academic track and those enrolled in the CTE track. .

Population

The students selected for the survey and test will are from four classes at KCKCC. Two classes will be representative of courses that would typically be taken by students enrolled in a two year Associate of Applied Science (AAS), but not typically taken in a CTE course of study. These classes will be Composition II and College Algebra. The other two classes will be a typical career training class that a student would take to learn a skill or trade to go to work. These classes will be Automotive Technology and Welding Technology.

This sample contained a typical mix of students from diverse backgrounds that should only share the choice of class they decided to take. KCKCC was used for this research and has both traditional vocational programs and 2 year degree programs. If the theories of the visual-spatial are supported by the data, then there should be able to find

more SL's which have gravitated to the career technical programs instead of the degree core classes.

Instrumentation

A copy of the survey is included in the appendix titled; Survey Instrument A. The first portion of this survey includes questions about the subject while the second part of the survey is a tool developed by PsychTests AIM Inc., to measure spatial ability. The spatial test is proprietary and a copy of it and a summary explaining validity and reliability can be obtained by contacting the author or PsychTests AIM Inc., 9001 boul. de l'Acadie, Suite 802 Montréal, QC H4N 3H5.

The survey asked respondents for:

Age

Sex

Complete high school or GED or equivalent

GPA in high school

Class in which survey was taken

In addition, the survey includes questions that indicate spatial tendencies. These include:

Do not read instructions

Poor spelling

Late bloomer

Had legal trouble as youth

Disorganized bedroom

Poor memorization of lines from play

Lose track of time

Thinks in pictures rather than words

Procedures

The questionnaires were be presented to the class with written instructions that were be read to the class. The instruments were then collected and placed in an envelope. Every caution was taken to assure consistency between the survey sessions. The students received the test in their own classroom.

The classes were Welding Technology, Automotive Technology, Composition II, and College Algebra. A copy of the survey and spatial test is in the appendix of this document. The student will be told that it takes approximately 20 minutes to take the test and survey. No minors or secondary students were be allowed to participate.

Data Analysis

Results were compared for correlations between visual-spatial students and type of program that they are enrolled into and other values. In addition, to see if a higher proportion of students with visual-spatial strengths were male or female, have been in legal trouble, completed a high school equivalency rather than a diploma, and if they have shared lower GPA's.

CHAPTER IV.

RESULTS

Table 1. Age of respondents

		Frequency	Percent
Valid	18	7	13.5
	19	9	17.3
	20	4	7.7
	21	6	11.5
	22	2	3.8
	23	3	5.8
	24	3	5.8
	26	2	3.8
	27	1	1.9
	30	2	3.8
	32	2	3.8
	33	2	3.8
	36	1	1.9
	39	4	7.7
	40	1	1.9
	45	1	1.9
	49	1	1.9
	63	1	1.9
	Total	52	100.0
		Mean 25.88 Standard Deviation = 9.587	

As can be seen in table one, over one-half of the respondents were below the age of 23. The average age was 25.88 with a standard deviation of 9.587

Table 2. Gender of Respondents

		Frequency	Percent
Valid	Male	35	67.3
	Female	17	32.7
	Total	52	100.0

Slightly more than two thirds of the students were male (67.3%) as seen in table 2

Table 3. Diploma Type

		Frequency	Percent
Valid	GED	6	11.5
	Diploma	46	88.5
	Total	52	100.0

Most all students had earned a high school diploma (88.5%)

Table 4. Grade Average in High School

		Frequency	Percent
Valid	D	2	3.8
	C	15	28.8
	B	24	46.2
	A	10	19.2
	Total	51	98.1
Missing	99	1	1.9
Total		52	100.0

The average grade was 2.82 or just under a C on a 4 point scale.

Hypothesis: When testing the relationship of student age, grade or type of high school certificate received when compared to class type taken the following correlations were used: Cramer's V, Phi, and Kendall's Tau.

Table 5. Relationship between Age and Class Type

		Class Gen ed or Tech				
		Welding	Comp 2	Auto Tech	College Algebra	Total
Age	18	2	0	3	2	7
	19	1	2	2	4	9
	20	0	0	1	3	4
	21	1	3	2	0	6
	22	0	1	1	0	2
	23	1	1	1	0	3
	24	0	2	1	0	3
	26	1	0	1	0	2
	27	0	0	0	1	1
	30	1	0	1	0	2
	32	0	2	0	0	2
	33	0	1	1	0	2
	36	0	0	1	0	1
	39	0	1	1	2	4
	40	0	0	0	1	1
	45	0	1	0	0	1
	49	0	0	0	1	1
	63	0	0	1	0	1
Total		7	14	17	14	52

Cramer's V = .558, Probability =.574

Ho: There is no relationship between age of student and class type.

The probability (.574) calculated with test statistic (Cramer's V = .558) is greater than alpha (.05), so we accept the Ho. There is no correlation between the age of students and class types.

Table 6. Relationship between Gender and Class Type

		Class Gen ed or Tech				
		Welding	Comp 2	Auto Tech	College Algebra	Total
Gender	Male	7	6	16	6	35
	Female	0	8	1	8	17
Total		7	14	17	14	52

Cramer's V = .564, Probability .001

Ho: There is no relationship between gender and class type.

The probability (.001) calculated with test statistic (Cramer's V = .564) is less than alpha (.05), so we reject the Ho according to the Davis Conventions there is a substantial association between gender and class type. Females traditionally do not tend to take welding and auto tech courses because it is associated as a traditionally male role.

Table 7. Relationship between High School Diploma Type and Class Type

		gen or tech		
		welding or auto tech	comp algebra	Total
High School or GED	GED	5	1	6
	Diploma	19	27	46
Total		24	28	52

Phi = .269, Probability = .052

Ho: There is no relationship between high school diploma type and class type.

The probability (.052) calculated with test statistic (Phi = .269) is more than alpha (.05), so we accept the Ho. There is a no correlation between diploma type and class type.

Table 8. Relationship between Grade Average and Grade Type

		gen or tech		
		welding or auto tech	comp algebra	Total
Grade Average	D	2	0	2
	C	8	7	15
	B	8	16	24
	A	6	4	10
Total		24	27	51

Phi = .312, Probability .174

Ho: There is not a relationship between grade average in high school and class type

The probability (.174) calculated with test statistic (Phi = .312) is more than alpha (.05), so we accept the Ho. There is a no correlation between grade average in high school and class type.

Table 9. Relationship between Spatial Abilities and Diploma Type

		High School or GED		
		GED	Diploma	Total
Spatial Ability	Below	1	25	26
	Average	3	16	19
	Slightly Above	1	4	5
	Well Above	1	1	2
Total		6	46	52

Cramer's V = .313, Probability = .165

Ho: There is no relationship between people with high spatial abilities and their high school diploma type.

The probability (.165) calculated with test statistic (Cramer's V = .313) is greater than alpha (.05), so we accept the Ho. There is no relationship between spatial ability and GED versus HS diploma students.

Table 10. Relationship between Gender and Spatial Ability

		Gender		
		Male	Female	Total
Spatial Ability	Below	14	12	26
	Average	16	3	19
	Slightly Above	3	2	5
	Well Above	2	0	2
Total		35	17	52

Cramer's V = .331, Probability = .127

Ho: There is no relationship between spatial ability and gender.

The probability (.127) calculated with test statistics (Cramer's V = 331) is greater than alpha (.05), so we accept the Ho. There is no relationship between spatial strength and gender.

Table 11. Relationship between Age and Spatial Strength

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Age	18	4	2	1	0	7
	19	5	2	2	0	9
	20	2	2	0	0	4
	21	3	2	0	1	6
	22	0	2	0	0	2
	23	1	1	0	1	3
	24	1	1	1	0	3
	26	0	2	0	0	2
	27	0	1	0	0	1
	30	1	1	0	0	2
	32	2	0	0	0	2
	33	1	1	0	0	2
	36	1	0	0	0	1
	39	2	2	0	0	4
	40	1	0	0	0	1
	45	1	0	0	0	1
	49	1	0	0	0	1
	63	0	0	1	0	1
Total		26	19	5	2	52

Kendall Tau C = -034, Probability .772

Ho: There is no relationship between spatial strength and age.

The probability (.772) calculated with test statistic (Kendall Tau C = -.034) is greater than alpha (.05), so we accept the Ho. There is no relationship between spatial strength and age.

Table 12. Relationship between Spatial Strengths and Grade Average In High School

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Grade Average	D	0	2	0	0	2
	C	9	4	0	2	15
	B	10	11	3	0	24
	A	6	2	2	0	10
Total		25	19	5	2	51

Kendal Tau = .017, Probability .896

Ho: There is not a relationship between spatial strengths and grade average in high school.

The probability (.896) calculated with test statistic (Kendal Tau = .017) is greater than alpha (.05), so we accept the Ho. There is no relationship between spatial ability and grade average in high school.

Table 13. Relationship between Students with Spatial Strengths and Reading Instructions Carefully

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Do You Read Instructions Carefully	Yes	12	11	4	0	27
	Somewhat Yes	10	8	1	2	21
	Somewhat No	4	0	0	0	4
Total		26	19	5	2	52

Kendall Tau = -.147, Probability .256

Ho: There is no relationship between students with spatial strengths and reading instructions carefully.

The probability (.256) calculated with test statistic (Kendall Tau = -.147), is greater than alpha (.05), so we accept the Ho. There is no relationship between students with spatial strengths and reading instructions carefully.

Table 14. Relationship between Students with Spatial Strengths and Good Spelling

		Good Speller				
		Yes	Somewhat Yes	Somewhat No	No	Total
Spatial Ability	Below	9	10	4	3	26
	Average	9	7	3	0	19
	Slightly Above	2	2	1	0	5
	Well Above	0	2	0	0	2
Total		20	21	8	3	52

Cramer's V = .204, Probability .690

Ho: There is no relationship between students with spatial strengths and good spelling.

The probability (.690) calculated with test statistics (Cramer's V = .204), is greater than the alpha (.05), so we accept the Ho. There is no relationship between students with spatial strengths and good spelling.

Table 15. Relationship between Students with Spatial Strengths and Being A Late Bloomer.

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Late Bloomer	Yes	4	1	0	1	6
	Somewhat Yes	2	5	2	0	9
	Somewhat No	6	6	1	1	14
	No	14	7	2	0	23
Total		26	19	5	2	52

Kendall Tau =-262, Probability .212

Ho: There is no relationship between students with spatial strengths and being a late bloomer.

The probability (.212) calculated with test statistic (Kendall Tau = -.262) is greater than alpha (.05), so we accept the Ho. There is no relationship between students with spatial strengths and being a late bloomer.

Table 16. Relationship between Students with Spatial Strengths and Being In Legal Trouble Before

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Been in Trouble	Yes	5	4	2	0	11
	Somewhat Yes	2	4	0	1	7
	Somewhat No	4	2	0	0	6
	No	15	9	3	1	28
Total		26	19	5	2	52

Kendall Tau =-.078, Probability .539

Ho: There is no relationship between students with spatial strengths and being in legal trouble before.

The probability (.539) calculated with test statistics (Kendall Tau = -.078) is greater than alpha (.05), so we accept the Ho. There is no relationship between students with spatial strengths and legal trouble in past.

Table 17. Relationship between Students with Spatial Strengths and Keeping A Bedroom Neat And Organized.

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Are You Organized	Yes	13	4	2	0	19
	Somewhat Yes	7	9	2	0	18
	Somewhat No	5	2	0	0	7
	No	1	4	1	2	8
Total		26	19	5	2	52

Kendall Tau .261, Probability of .036

Ho: There is no relationship between students with spatial strengths and keeping a bedroom neat and organized.

The probability of (.036) calculated with test statistic (Kendall Tau = .261) is less than the alpha (.05), so we reject the Ho.

There is a relationship between students with spatial strengths and bedroom organization.

According to the Davis conventions, there is a low relationship between students with spatial strengths and bedroom organization. The more organized someone is, the lower their spatial ability.

Table 18. Relationship between Students with Spatial Strengths and Being Good At Memorizing Lines from a Script

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Good at Memorizing Speech	Yes	5	1	1	1	8
	Somewhat Yes	13	7	3	0	23
	Somewhat No	4	8	1	1	14
	No	4	3	0	0	7
Total		26	19	5	2	52

Kendall Tau b = .065, Probability .610

Ho: There is no relationship between students with spatial strengths and being good at memorizing lines from a script.

The probability (.610) calculated with test statistics (Kendall Tau b = .065) is greater than alpha (.05), so we accept the Ho. There is no relationship between spatial strength and memorization.

Table 19. Relationship between Students with Spatial Strengths and Loosing Track Of Time.

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Keep on Time	Yes	2	1	0	0	3
	Somewhat Yes	6	7	1	0	14
	Somewhat No	8	5	1	1	15
	No	10	6	3	1	20
Total		26	19	5	2	52

Kendall Tau b = .046, Probability .705

Ho: There is no relation between students with spatial strengths and loosing track of time.

The probability (.705) calculated with test statistic (Kendall Tau b = .046) is greater than alpha (.05), so we accept the Ho. There is no relationship between high spatial strength and loss of time.

Table 20. Relationship between Students with High Spatial Ability and Thinking Mainly in Pictures.

		Spatial Ability				
		Below	Average	Slightly Above	Well Above	Total
Think in Pictures	Yes	6	4	0	0	10
	Somewhat Yes	14	7	3	2	26
	Somewhat No	4	5	1	0	10
	No	2	3	1	0	6
Total		26	19	5	2	52

Kendall Tau b = .145, Probability .914

Ho: There is no relationship between students with high spatial ability and thinking mainly in pictures.

The probability (.914) calculated with test statistics (Kendall Tau b = .145) is greater than alpha (.05), so we accept the Ho. There is no relationship between thinking in pictures and high spatial ability.

Table 21. Relationship between Spatial Learners and Composition II Class, One College Algebra Class, One Auto Tech Class and One Welding Class At KCKCC?

		Class Gen ed or Tech				
		Welding	Comp 2	Auto Tech	College Algebra	Total
Spatial Ability	Below	3	10	6	7	26
	Average	3	2	7	7	19
	Slightly Above	1	1	3	0	5
	Well Above	0	1	1	0	2
Total		7	14	17	14	52

Cramer's V = .416, Probability .439

Ho: There is no relationship between spatial learners and composition II class, one college algebra class, one auto tech and on welding class at a local community college. The probability (.439) calculated with test statistic (Cramer's V = .416) is more than alpha (.05), so we accept the Ho. There is no correlation between spatial learners and Composition II class, one College Algebra class, one Auto Tech and on Welding class at a local community college.

Table 22. Relationship between Highly Spatial Students and General Education Or Tech Classes.

		General Ed or Tech		
		General Ed	Tech	Total
Spatial Ability	Below	17	9	26
	Average	9	10	19
	Slightly Above	1	4	5
	Well Above	1	1	2
Total		28	24	52

Phi = .278, Probability .258

Ho: There is no relationship between highly spatial students and general education or tech classes.

The probability (.258) calculated with test statistic (Phi = .278) is more than alpha (.05), so we accept the Ho. There is no correlation between VSL and General Education or Tech classes.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

As educational institutions in the United States have evolved over the last hundred years they have encompassed many different philosophies that have served the needs of the student and society. As these needs have changed, so have the approaches to education. Some educators have suggested that some types of students have methods of reasoning that allow them to process information in a linear method while other students think more in using spatial reasoning while others are more balanced in spatial and liner or read/write strengths. The review of literature reinforces these theories, and goes further to suggest that modern secondary schools are managed by people with strengths in read write and a combination of read write and spatial reasoning and therefore have produced instructional institutions that are difficult for someone of spatial strengths to find success in. It is further suggested that many of the estimated 1/3 of the student population with spatial strengths are more likely to drop out of school and end up in jobs where their abilities will not be realized. Furthermore, it was suggested that in the past people who were spatial were often educated using other methods such as mentoring or internship that taught skills and life skills from the prospective of doing such as vocational technical programs in high school. The review of literature suggests that many of history's most famous visionaries had spatial strengths and difficulty in read write learning, and that men were much more likely to be spatial than women.

Based on the review of literature, it was decided to collect data from students at a community college to determine if differences in the respondent groups were enrolled in more typical of either general education or classes more typical of vocational and technical education. A third party test to attempt to measure spatial ability was used to identify if the respondent had spatial strengths and in what path of post-secondary education they chose, academic or CTE. The survey was developed to assess traits that the review of literature suggested would be present in people with spatial strengths.

The test tool and surveys were distributed to a welding class, an auto tech class, a composition II class and a college algebra class. The results showed that there were more women than men in the general education classes than CTE, students with higher spatial ability kept their room more organized. Other survey questions yielded little difference in the groups. It was hoped that the test and survey would reveal if students with highly spatial strengths might be more likely to attend a CTE program or attend coursework in general education degrees.

CONCLUSIONS

The statistical results showed little relationship between the number of students with high spatial ability in academic and CTE classes. The results did not show relationships between high spatial learners and known traits such as gender, secondary grade point average, diploma type and good spelling. The results indicate that general education students and technical education students have equal numbers of students with high spatial ability. These results do not support the review of literature. Previous research indicates that students within technical education courses have higher spatial ability.

Many of the survey results conflicted with previous research. The results showed no relationship between students with high spatial reasoning and being male or female, having a diploma or equivalency, age difference, grade point average, reading instructions carefully, good spelling, having been in legal trouble before, memorizing lines from a script, loosing track of time and thinking mainly in pictures. The results did show some relationship between being highly spatial and keeping a bedroom clean and that males were dominate in these technical education classes. Although these results suggest there is no difference in spatial strengths in each program, it may suggest errors in the research that might exist.

The data provided in this study may be in-conclusive. It is possible that while these traits were dominant in secondary education, students begin learning more holistically as they move into other learning environments. This could explain why the results of this research do not agree with previous studies showing divisions in students with spatial strengths at a younger age. It is odd that the results showed that students with spatial strengths had no relationship to students that thought in pictures. This too suggests that errors in this research may be present.

RECOMMENDATIONS

Previous research suggests that identification of students with spatial strengths could lead to specialized instruction and reduce the large amount of spatial students that will likely live well below their potential. The importance of understanding which groups of students are under achieving dictates that further research is vital to solving these problems. The results of this study are not completely supported by previous

research and therefore more work needs to be done to make sure we understand these issues.

This research needs to be repeated. Perhaps it would be more effective if groups of students were utilized that had recently completed or dropped out of high school. The difference in age would offer more accurate results and fit better with past data collected from other efforts with this research.

While the spatial evaluation tool chosen for this test came highly recommended, perhaps using it for this particular test is ineffective. This test may not be valid used in this manner. Retesting with another instrument would be advised to make sure. Because inferential statistics have some effect based on size of the population, it is recommended that this research be repeated with a larger sample size and additional courses (both academic and career and technical education).

The research cited in this article shows relationships between people with high spatial abilities and certain behaviors that could not be duplicated with this survey. If the spatial evaluation tool cannot show a relationship between these known behaviors of highly spatial people, it brings its reliability into question. While this tool clearly shows no relationship between quantity of highly spatial learners and the type of class they are in, but clearly does not duplicate work from other research. The question of if there are larger groups of highly spatial learners in different learning tracks remains unanswered by this work as this test may not have clearly measured spatial ability but something else.

This research indicates that it needs to be duplicated with a different tool to measure spatial ability, and in hindsight, it would also be good to measure linear abilities of reason to enable separation of learners into three groups instead of two. Those groups

should be highly spatial learners, highly linear thinkers and people that use both linear and spatial abilities. This research needs to be concentrated to each of group to better differentiate the result.

Recent studies have uncovered more appropriate tests for use in this research. In future research, the Eliot Spatial Test Collection at the University of Akron should be consulted as it represents a treasure trove of spatial testing for specific uses. While the research and statistical results show no relationship between the number of students with high spatial ability and whether they are enrolled in a general education class or technical/career class, the results also did not show relationships between high spatial learners and known traits of high spatial learners.

It would be hoped that this is the beginning of further tests and that this paper will generate questions that need to be answered. The researcher's inexperience may also have contributed to errors in this research project. If this work can be recreated and improved, the results could be beneficial to not only secondary education but teaching and learning in general.

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APPENDIX

Survey Instrument

Dear Student,

Thank you for taking the 20 minutes to finish this survey. The information you will provide will be used as part of a graduate research thesis to better understand students and the choices they make and allow us to better serve the needs of each student.

All information that you provide will remain anonymous and will be used only with group data. Raw data collected will be secured by Bob McGowan and destroyed in 6 months time.
Participation in this survey is voluntary and you may discontinue at any time.
Please answer each question carefully to help us get the most accurate information possible.

A summary of this report will be made available to your instructor for distribution to you, the taker.
No minors or secondary students may take this test! No risks have been indicated by participating in this research.

Thank You for making a difference!

For inquiries contact
Bob McGowan
rmcgowan@kckcc.edu
Graduate Student
Pittsburg State University

Please do not put your name on this paper!

Please answer the following

1. What is your age? _____
2. I am Male Female
3. Did you receive a diploma from high school? Yes No
4. Did you receive a high school equivalency? Yes No
5. My grade average in high school was A B C D

Please answer

1=Yes 2=Somewhat Yes 3=Somewhat No or 4= No

7. I read instructions carefully	1	2	3	4
8. I am a good speller	1	2	3	4
9. I am a late bloomer	1	2	3	4
10. I have been in legal trouble before	1	2	3	4
11. My bedroom is neat and organized	1	2	3	4
12. I am good at memorizing lines from a script	1	2	3	4
13. I often lose track of time	1	2	3	4
14. I think mainly in pictures	1	2	3	4

The Spatial Evaluation Tool can be obtained by contacting Bob McGowan or PsychTests AIM Inc., 9001 boul. de l'Acadie, Suite 802 Montréal, QC H4N 3H5.