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Using Brain Compatible Assessment to Obtain Higher Test Scores as Compared to Multiple Choice Tests

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Using Brain Compatible Assessment to Obtain Higher Test Scores as Compared to Multiple Choice Tests

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By
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Raena Weimer prepared this research paper under the direction of Dr. John M. Ritz, Graduate Advisor, in OTED 636, Problems in Occupational and Technical Education. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Master of Science.

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My motivation for this study came from the diverse population of students in my Family and Consumer Science classes and the aim for all students to be successful learners. The researcher wishes to acknowledge her deep appreciation for each person's guidance.

Raena Weimer

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Chapter I

Introduction

Within the Technical and Career Education Department of Virginia Beach City Public High Schools, Family and Consumer Sciences, offered a variety of courses to the student body depending on the demographics of the community and the needs and wants of the school body. Courses offered at Frank W. Cox within the discipline of Family and Consumer Science includes Culinary Arts I and II, Resource Management for Independent Living, Child Development, Parenting, and Design I and II. These electives were not a graduation requirement, yet required applicable real-life skills students would employ beyond their high school career. This study focused on Resource Management for Independent Living. Resource Management for Independent Living at Frank W. Cox High School was a one year elective course worth one credit towards graduation. Freshman, sophomores, juniors, and seniors, standard diploma, and special education diploma students enrolled within the class. Students enrolled in the course learned how to use available resources for managing a career, personal finances, families, relationships, and a household. With such a wide variety of information covered and the real life application of the content for each course, long term retention, critical thinking, and varied assessments were significant. Higher order questions and analyzing the content studied was a priority.

Statement of the Problem

The purpose of this study was to determine whether high school students enrolled in Resource Management for Independent Living obtained higher test scores when evaluated using brain-compatible assessments.

Research Hypothesis

To guide a solution to this problem, the following hypothesis was established: $H_{1:}$ Independent Living students would obtain higher test scores using brain-compatible assessments as compared to multiple-choice tests.

Background and Significance

The 1980's revealed a controversy in the American educational system. Media, newspapers, and magazines were filled with attacks about teachers' inefficient assessment strategies and students performing poorly academically (Janesick, 2001). Standardized testing was questioned. Traditional assessment was under scrutiny. Arguments arose concerning if standardized tests in fact tested students understanding of learning or if they tested the students' ability to take a test. "The assessment debate brought about discussions on many different manners: 1. The nature of assessment, 2. The need for displaying how students think, learn, and solve problems, 3. The need to focus on student achievements, and 4. Delineating the concerns and problems with standardized tests" (Janesick, 2001, p. 221). Traditional assessment included multiple choice, matching, and true/false type questions. Multiple choice tests, true/false, and matching test formats required the minimum amount of knowledge from the student and limited the students' response. Mitchell (1999) stated, "…old materials and methods…cater to the test–savvy students (those who know the methods better than the material" (p. 4). For years teachers used traditional forms of testing. Teachers taught to the test and read from the textbook, issuing multiple choice and low level thinking questions. Despite the successes of multiple choice testing for evaluating student

understanding and measuring values added by instruction, there was a growing awareness of the shortcomings of tests that relied exclusively on multiple choice questions, particularly in assessing student's complex thinking skills (Harris, 1997).

Scholars, researchers, and educators began a new movement and coined the term authentic assessment. "In the United States, the systematic use of assessments of different kinds has been proposed to modify teaching and learning. "The result is increased emphasis on performance assessment – judging student performance on complex tasks by real-world standards encountered outside the classroom" (Harris, 1997, p. 122). Testing should measure several dimensions of student performance. "It should provide a benchmark of the stock of knowledge in academic subjects, and it can also provide an assessment of students critical thinking skills" (Harris, 1997, p. 123). According to the Program for International Student Assessment (2000), 15 year olds of the UK were much better than US peers at analytical thinking, which was fundamental to literacy (Jackson, 2006). Educators wanted to provide meaningful and appropriate instruction for each grade level, design authentic assessment tasks, which truly showed what a student could do, what they had learned, and be self-sufficient in the workplace.

Why the need for brain compatible assessments for students to demonstrate an understanding of learning? We were at an exciting time in this era of educational reform. Researchers were making great strides to find how the mind operated. Ronis (2007) had been creating material that aided educators with instruction and assessment methodologies. In Ronis's book titled, *Brain-Compatible Assessments,* she quoted Popham (2001), when saying, "…unreasonable emphasis had been placed on high-stakes test results, forcing teachers to forgo 'meaningful and relevant' instructional

methodologies in favor of a test-prep curriculum" (p. 213). Such high stake achievement tests did not measure the vast amount of curriculum set forth by states and school districts. These tests tended to measure those things that were easy to measure, in an efficient and economical way. This meant that the focus was on lower-order thinking skills, with a sprinkling of higher order skills (Ronis, 2007).

Most measures of cognitive development correlated with age, genetics, and experience. In many measurable aspects of decision making, adolescents were approaching adult levels of competence by age 15. Yet, in real life situations, adolescents showed extremely high rates of "poor" decision making (Dahl, n.d.) Students were entering the work force unarmed with the soft and hard skills necessary for employment. These hard and soft skills were known as Work Place Readiness Skills. Technical and career education teachers in Virginia Beach were responsible for incorporating these skills into the curriculum using practical real world situations. Four of the twelve work place readiness skills (as defined by Virginia Beach City Public Schools) were directly related to the key functions of the adolescent brain: critical thinking, problem solving, communication, and decision making. Three other skills were indirectly related to the cognitive thinking processes of the brain in terms of adolescent brain development because they were associated with the emotional aspect of brain development such as confidence, self esteem, and dealing with peer pressure. Teamwork, leadership, and showing initiative were examples of these workplace readiness skills. Teachers needed to employ worthwhile, significant, and meaningful assessments that focused on the process of the growth of understanding as well as the final product in order for a student to carry these critical skills with them to the workplace.

Brain compatible assessment offered the students an opportunity to create a response rather than choose from a given list, therefore reinforcing the skill of critical thinking and affective creative development. As educators, we need to teach strategies that will allow adolescents to process information, increase their capacity to communicate, to learn from experience, to engage in logical reasoning, to control impulses, and to understand other's reactions. There was an abundance of evidence that indicated students act on impulse and that in group settings they are more often followers than leaders (Steinberg, 2004).

Success is demonstrated in the use of brain compatible assessments in terms of providing assessments that promote self-confidence, leadership, improved communication skills, and critical thinking skills. According to Mitchell (1999), an assistant principal and previous teacher, he stated, …"when I used traditional methods of assessments, most of my students performed poorly. They either did well on the section related to the reading or the sections to the lab, but rarely on both" (p. 4). Open-ended questions ensured students could express what they know about a subject in varied contexts (Jackson, 2006). Instructors wanted all students to perform successfully, and in order to achieve this we must recognize how to effectively assess.

Limitations

This study was based on the following limitations:

1. It was limited to Family and Consumer Sciences, Resource Management for Independent Living high school students.
2. It was limited to Frank W. Cox High School in Virginia Beach.
3. It was limited to a three month period.

4. It was limited to four forms of brain compatible assessments: journal writing, demonstration, observation, and short answer.

Assumptions

The following assumptions have been made to assist in the completion of this study:

1. Multiple choice tests were the primary source of traditional assessment used to evaluate student performance.
2. Special education students performed poorly on traditional assessment methods.
3. The results of this study would be used to enhance classroom instruction.
4. The use of short answer questions gave students the freedom to explain their answers using higher order thinking skills.

Procedures

For this experimental research, three Resource Management for Independent Living classes were tested. Class sizes ranged from 18-21 students and varied in ratio of male to female, age, ethnicity, and readiness level. The units studied and assessed by the high school students were titled apparel construction, preparing food, communication, and child development.

Students enrolled in the course were tested using four forms of brain compatible assessments. The brain compatible assessments employed were short answer questions, demonstrations, observations, and journal writings. Students were tested during a 90 – minute block period. Results from the brain compatible assessments were compared to the results of multiple choice tests (a form of traditional assessment) from last year students during the same units of study. The data were compared using a t-test.

Definition of Terms

The following terms were defined to clarify this study:

Brain-compatible assessment - "this type of assessment requires authentic tasks of students that show what they can do. It assumes feedback and redirection for student growth. It shows what a student can do" (Janesick, 2001, p. 223).

Cognition – the information a student learns, understands, and knows (Ronis, 2007).

Family and Consumer Sciences – field of study once referred to as Home Economics; it is the study of many disciplines such as consumer science, nutrition, cooking, textiles, parenting, human development, and interior design.

Multiple Choice Question Tests – a traditional form of assessment where respondents were asked to pick one or more of the choices from a list. Test makers were often trained in Bloom's taxonomy.

Performance Task – activities that students performed to demonstrate what they know and could do.

Rubric - an assessment tool that described levels of student achievement on performance tasks.

Technical and Career Education – aided with funding from the Carl D. Perkins Act, included courses such as Agricultural Education, Health and Medical Sciences, Marketing, Technology Education, Trade and Industry Education, Engineering, Business and Industry, Career Connections, and Family and Consumer Sciences.

Overview of Chapters

Chapter I introduced the need for brain compatible assessments in the classroom. No longer should teachers feel forced to teach using traditional methods but focused on

the long term effect brain compatible assessments could have on the student's long term retention of the material and applicable uses in the real world. The goals, limitations, assumptions, and procedure of the study were given to provide an understanding of this research.

Chapter II will provide a review of literature that has been written on brain-compatible assessment. This chapter will compare traditional assessments to brain compatible assessments recognizing pioneers of the assessments and applicable uses that have or have not been effective in the classroom environment. This chapter will also provide a foundation for investigating this topic as well as identifying knowledge gaps within this area of educational findings.

Chapter III will discuss the methods and procedures this researcher employed in retrieving the appropriate data and the instrument(s) employed. Chapter IV will present the findings of this study and how they may be interpreted. Finally, Chapter V presents the findings of this study and will summarize the conclusions assessed by this researcher along with recommendations for further and continued research.

Chapter II

Review of Literature

This chapter describes literature relevant to the research purposes of this thesis. It is organized into four sections: (1) Introduction, (2) Brain Development during Adolescence, (3) Traditional Assessments, (4) Brain Compatible Assessments, (5) and Importance and Application of Brain Compatible Assessment in the Family and Consumer Science Classroom. At the end of each section, the relevance of the literature to the research reported in this thesis is discussed.

Introduction

Educational programs such as Family and Consumer Science offer courses which can be assessed using brain compatible assessments. Within the elective class of Resource Management for Independent Living, knowledge was assessed by having students demonstrate their understanding of learning based on how they could best reiterate the information presented. This type of assessment is referred to as brain compatible assessment. For example, students learned skills in financial management, interviewing, employability skills, apparel construction, home buying, insurance, preparing nutritious foods, parenting, child development, and building healthy relationships through positive communication. Each of these units offered activities that could be assessed using one of the many brain compatible assessments.

As with old cooking classes, the clothing classes of the past, which focused on sewing for the family, have also undergone a change. The apparel construction classes of today use high tech equipment such as sergers and embroidery machines to give students

the opportunity of a hands-on approach to learning. Both are examples of brain based assessments that can be implemented to evaluate student performance. Neuroscientists are mapping the pathways between body and brain, providing tangible evidence of the benefits of hands on experiential learning (McGeehan, 2001). Leslie Hart was among the first authors to write about the brain from the perspective of education. He coined the term "brain compatible assessment" in 1983 to refer to education designed to match settings and instruction to the nature of the brain rather than trying to force the brain to comply. Hart argued that such learning environments would logically produce strikingly better outcomes (McGeehan, 2001). Instead of requiring all students to verbalize or identify the parts of the machine, brain compatible assessment evaluates the students differently. Some students may display their understanding by verbalizing, others by demonstrating how to use the machine, yet others writing down the parts of the machine and how they work.

Within some states of America teachers expanded the use of hands-on projects, written term papers, and visual displays that students could choose from to study a lesson or demonstrate their understanding of it. Brain research suggested that students learn better in an enriched environment that taps into an individual's intrinsic interests and motivations (Stover, 2001). Resource Management for Independent Living was an elective that offered teachers the opportunity to apply brain research as part of an evaluative tool.

Brain Development during Adolescence

Brain development was a lifelong process. "Growth and differentiation of the brain proceeded at a particularly rapid pace during the prenatal and early postnatal periods, yet the brain continued to develop into adolescence" (Spear, 2007, p. 362). Research has shown the brain developed over time with a significant amount of brain growth before the age of 6. Byrnes (2001) stated that the brain was 90% of its adult volume before the age of 6.

The human brain was composed of gray and white matter. The gray matter was the thinking part, the white matter were wire-like fibers that establish neurons' long distance connections between brain regions which thicken progressively from birth. Neurons (cells) and synapses (connections between brain cells) were highly productive during early ages. Pruning (period which the brain looses gray matter) increased during early adolescence (Giedd, 2004). Pruning was a necessary process that allowed for older knowledge to be 'pruned' out and new knowledge to be stored. Giedd referred to this principle as 'use or loose it' (Spinks, n.d.). Another factor to consider when researching adolescent brain development is the formation of myelin. Myelin enveloped nerve fibers making them more efficient, similar to insulation around electric wires. Myelin is improving the productivity of the neurons. According to research, increased myelination in the adult frontal cortex is likely related to the maturation of cognitive processing and executive functions.

Byrnes (2001) pointed out that processes of the brain have either an open or fixed timetable. Fixed timetables most likely started and stopped at specific ages whereas open

time tables started early and continued into adulthood (Byrnes, 2001; Nelson & Luciana, 2001). From childhood, to adolescence, myelination of cortical fibers proceeded from the back of the head to the front (Byrnes, 2001). Coch (2007) believed, the frontal region was involved in abilities such as planning, working memory, organization, adjusting mood and inhibition.

> Geidd was quoted as saying that as the prefrontal cortex matures, teenagers could reason better, developed more control over impulses and make better judgments (Spinks, n.d.). In the corpus callosum, myelination of connecting fibers between the hemispheres proceeded from the frontal to the posterior regions. This latter change meant that during adolescence, regions of the temporal and parietal lobes became more capable of communicating and working together to process language, mathematics, and spatial problems more quickly. In addition, improvements in long term memory were expected (Byrnes, 2007, p. 36).

Armed with this knowledge educators could create assessments that would benefit higher order thinking skills in Family and Consumer Science classes. By providing experiences that would connect new knowledge to previous experiences for long term retention, methodologies should shift to recall, retrieval and long term storage. Understanding how the brain worked could aid educators in developing assessments to complement their learners.

Traditional Assessment

Traditional assessment referred to forced-choice measures of multiple choice tests, fill-in-the-blanks, true-false, and matching (Mueller, 2006). Students typically selected an answer or recalled information to complete the assessment. These tests were standardized or teacher created. They were administered locally or statewide.

Tests were used widely and for several purposes. Traditional testing was provided in many formats and provided evidence to the students, teachers and public concerning the learning inside the classroom. Legislation required high stakes tests to validate that learning was taking place inside the classroom, yet, how did the federal government measure learning? Janesick (2001) posed the question, "Do traditional tests administered to children actually test for the information the children learned in school?" (p. 16). The answer in many cases was a resounding "No" (Janesick, 2001).

Traditional pencil-and-paper tests asked students to read or listen to a selection and then answer questions about it. Such tests were helpful as measures of students' knowledge of language, their listening and reading comprehension ability (NCLRC, 2004).

Instructors also needed to be careful about what pencil-and-paper tests were actually testing. Language instructors encountered students who did well on pencil-and-paper tests of grammar and sentence structure, but made mistakes when using the same forms in oral interaction. In such cases, the test indicated what students knew *about* the

language, but did not provide an accurate measure of what they were able to actually *do* with it (NCLRC, 2004, para 4).

Brain Compatible Assessment

Byrnes (2001) stated that brain research should guide instructional decision-making. Lessons needed to be developed and methods implemented to enhance cognitive thought processes. The specific classroom practices that were most compatible with adolescent brain processes included project-based and authentic learning opportunities, simulations and role plays, debates and learner-centered instruction that gave students choices of topics, ways of learning, and modes of expression. "Likewise, sensori-motor-hands on activities, movement, and learning labs – built and nurtured curiosity during early adolescence and promoted the formation of complex neural connections in the brain. These practices helped adolescents learn instructional routines, expanded learning, and strengthened neural connections" (Caskey & Ruben, 2003, p. 38).

Brain compatible assessment was a form of authentic assessment. It was "...using engaging and worthy problems or questions of importance, in which students used knowledge to fashion performances effectively and creatively. The tasks were either replicas of or analogous to the kinds of problems faced by adult citizens and consumers or professionals in the field" (Wiggins, 1993, p. 229). Brain compatible assessment was a tool used to evaluate learning in settings closely related to the real world. Students provided reasons for their answers.

They provided evidence that they fully understood concepts. It allowed for active learning to take place. Multiple indicators were used to show that students understood

the content of their unit. Students had to use judgment and powers of reason. At the same time, they explained and evaluated their work and responded to the problems; they had to demonstrate what they learned (Janesick, 2001, p. 6).

Another aspect considered when developing brain compatible assessments was the time of day adolescents were tested. Research has shown that adolescents performed better later in the day than in the early morning (Spear, 2007). As stated earlier, Spear agreed with Byrnes concerning cognitive abilities included inhibitory control, working memory, abstract reasoning, decision making, insensitive to future consequences, processing of affective stimuli and regulations of emotions.

Importance and Application of Brain Compatible Assessment in the Family and Consumer Science Classroom

Taking the above into consideration assessments were developed that would cater to the adolescent mind. Brain compatible assessments took more time to complete and grade than traditional testing methods. Block scheduling was developed in some secondary schools around the country to accommodate the learning patterns of adolescents which also complemented the time requirements needed for brain compatible assessments. Benefits of block scheduling included less fragmentation to the school day, more time to delve into concepts and allowed for transfer to occur and more time to develop hands-on activities, such as projects to use as a form of assessment. It also allowed for more performance-based assessments of student learning, reducing the reliance on paper-and-pencil tests. Lessons would be planned in 20 minute segments, so down time was reduced to 10 minutes when the instructional block was 90 minutes in

length. Down-time was used to engage students in discussions about their new learning or by using brain breaks. "Block-scheduling allowed for teaching within and across the subject areas by collaborating with other teachers. It also allowed for the incorporation of multisensory activities and variations in assessment technique" (Sousa, 2006, pp. 123 – 124).

The use of brain compatible assessment within the Virginia Beach Schools became more important with the adoption of the new curriculum writing process, Understanding by Design (UbD). UbD concept was to begin teaching the curriculum with the end in mind. The instructor knew what the students should have accomplished by the end of the lesson, and therefore planned the objectives and instructional activities around the assessment. Brain compatible assessment supported this curriculum design.

> Assessment focused on gathering information about student achievement that can then be used to make instructional decisions. Formative assessments provided opportunities for students to practice, take mental risks, learn from mistakes, and revise their work. They enabled a teacher to analyze student performance to date and provided targeted feedback for improvement (Tomlinson & McTighe, 2006, p. 131).

Teachers needed to assess how the knowledge could be applied rather than how it could be regurgitated. "Synthesis of knowledge, an ability that was rarely tested, could not be assessed using multiple-choice tests because the demonstration of such synthesis required the production of an original response that is unique to each student" (Ronis, 2007, p. 19).

From a brain–compatible perspective, assessment was viewed as an ongoing activity in which teachers gathered information about student learning in multiple ways. Progress of the students was just as important as the product. Helping students learn and grow became easier when day to day assessment was well integrated within the instruction process. Methods included listening, observing, talking with students, posing questions and examining students' written work (Ronis, 2007).

Another reason to use brain compatible assessments with UbD was because with brain compatible assessments teachers determined the tasks students performed to demonstrate mastery and then a curriculum was developed that enabled students to perform these tasks well. Family and Consumer Science teachers practiced this each day with the curriculum. They taught the skills required to perform well; they did not assess students by giving them multiple choice to see if they could sew a pair of pants or communicate well on a job interview. Students were placed in a sewing activity or demonstrated their interview skills and asked to perform. Teachers taught the students how to do the task, not just know it. To assess what the students learned, students were asked to perform tasks that replicated challenges they would encounter outside the school environment (Mueller, 2006).

Brain compatible assessments, in summary, were designed authentically to reflect real life situations. They gave students the option of being assessed not only by the product, but the process of getting to the product. They were meaningful to the student because the student owned the project, and students were motivated because they received credit for what they knew instead of being penalized for what they did not know.

Finally, brain compatible assessments required reflection by the student which in turn encouraged metacognitive growth as well as higher cognitive levels of thinking such as analysis, synthesis, application and evaluation (Ronis, 2007). Success through brain compatible assessment was demonstrated to prove students increased retention of knowledge.

Summary

There were many research studies supporting both traditional and brain compatible assessments. Each form of assessment offered unique attributes to learning. It was inconclusive as the effectiveness of either brain compatible assessment or traditional assessment. This chapter analyzed opinions and findings from other studies and teaching experiences from educators nationwide. Education was a timeless process and was continuously undergoing changes and improvements to benefit student learning. The following chapter will discuss and explain the methods and procedures used for data collection.

Chapter III

Method and Procedures

This study was done using experimental research methods to compare whether high school students enrolled in Resource Management for Independent Living obtained higher test scores when evaluated using brain-compatible assessments such as journal writings, observations, demonstrations and short answer questions rather than students taking multiple choice tests. The steps taken to gather and analyze the data are discussed in this chapter. This chapter will discuss the population, research variables, instrument design, data collection, methods of data collection, and statistical analysis.

Population

The population for this study was comprised of ninth, tenth, eleventh, and twelfth grade students enrolled in six Resource Management for Independent Living classes during the school year of 2006-2007 and 2007-2008. During the 2006-2007 school year sixty-three students were enrolled in Independent Living. During the 2007-2008 school year sixty-five students were enrolled in Independent Living. All the students attended Frank W. Cox High School in Virginia Beach. The population was chosen based on the population of students the researcher taught. The research was conducted in a general education classroom at Frank W. Cox High School in Virginia Beach, Virginia. Class size ranged from 18 – 22 students. Block scheduling was used at the high school, allowing ninety minutes of assessment time every other day for each class. Students sat at large rectangular tables, with groups of three to four students.

Research Variables

The independent variable was the multiple choice assessment and the brain compatible assessments used in the study. Students during the 2006-2007 school year were tested using multiple choice tests and students during the 2007-2008 school year were tested using observation, journal writing, demonstration or short answer question assessments, each an example of a brain compatible assessment. The dependent variable was the score each student received from the assessment taken. Scores were gathered from three units of study, Communication, Apparel Construction, and Child Development, for both the traditional assessments and the brain compatible assessments. Each student was given as much time as needed to complete the assessment.

Instrument Design

During the 2006-2007 school year students took traditional assessment tests in the form of multiple choice tests that were teacher and textbook publisher created. The traditional assessment questions included multiple-choice questions, true-false, and matching. The scoring for each test was out of 100 points. During the 2007-2008 school year students were assessed using teacher created brain compatible assessments. The brain compatible assessments employed included observation, demonstration, journal writings and short answer. For both school years, data were collected from the same units of study. The units included Communications, Apparel Construction, and Child Development. During each unit the same four brain compatible assessments were employed during the four week period that each unit lasted. Each assessment was scored out of 100 points. Refer to Appendix A to see a sampling of brain compatible assessments used for each unit of study

Methods of Data Collection

The data were collected by the scores the students received from each form of assessment for the years 2006-2007 and 2007-2008 of all students who took the assessments. The test scores were compiled on Excel spreadsheets to report any significance of higher tests scores for each student depending on the form of assessment used. The students' names were omitted from the study to protect the confidentiality of each student.

Statistical Analysis

The t-test was used to determine if there was a significant difference between the means of the two samples. The means were calculated using the mean of the scores from the multiple choice tests from the communication, apparel construction and child development unit and the mean of the scores from the brain compatible assessments of journal writing, demonstration, observation, and short answer. The t-test compared the experimental group (brain compatible assessments) with the control group (traditional assessment). Sixty-one scores, from three units of study, from both school years were used to calculate the data.

Summary

This chapter explained and presented the methods and procedures used to collect data relevant to the hypothesis. This chapter also described the instrument used for data collection. The Resource Management for Independent Living students scores were gathered and reported in tables for use in calculating the t-test. The data collected from the traditional assessments and brain compatible assessments is presented in Chapter IV, Findings.

Chapter IV

Findings

The purpose of this study was to determine whether high school students enrolled in Resource Management for Independent Living obtained higher test scores when evaluated using brain-compatible assessments as compared to students who took multiple choice tests. Assessments from both the 2006-2007 and 2007-2008 school years were assessed from the same unit areas: Apparel Construction, Communication and Child Development. This chapter presented all the relevant data that were collected and will provide a statistical analysis comparing the sample means in order to test the hypothesis.

Study Participants

Of the 128 students enrolled in Resource Management for Independent Living, 122 scores were used in the data. Sixty-one multiple choice test scores were taken from the school year 2006-2007 and sixty-one brain compatible assessment scores were taken from the school year 2007-2008.

Comparison of Data

The sample means of sixty-one students from the 2006-2007 school year and sixty-one students from the 2007-2008 school year were collected and calculated using a one-tailed t-test to determine statistical significance. The three final test scores received from the traditional assessments were averaged and used in the t-test calculation as data group one. The three final test scores received from the brain compatible assessments were averaged and used in the t-test calculation as data group two. The t-test calculation was used to determine if there was a statistical significance between traditional assessment and brain compatible assessments. The average grade calculated from the

traditional assessment in 2006-2007 was seventy-seven. The average grade calculated from the brain compatible assessments in the 2007-2008 was eighty-six. The test is a one-tailed test because it has a predicted hypothesis. The t-value was 3.143. The degree of freedom was 120. The value for a degree of freedom of 120 on the critical values of t was at the .05 $p > 1.658$ and at the .01 level $p > 2.358$.

Summary

This chapter presented the collected data and calculated results in order to determine if there was a difference between students' scores on brain compatible assessment and students' scores on multiple choice tests from two different school years. The sample means were compared and subjected to a t-test in order to determine statistical significance. In Chapter V, conclusions will be given based on statistical analysis of the findings and recommendation for the future will be offered.

Chapter V

Summary, Conclusions and Recommendations

The purpose of this experimental study was to determine if there was a significant difference in students obtaining higher test scores when taking brain compatible assessments as compared to students taking multiple choice tests. This chapter summarizes the study, draws a conclusion based on findings and offers recommendations for further studies.

Summary

The problem of this study was to determine if students enrolled in Resource Management for Independent Living scored higher when taking brain compatible assessments versus traditional assessments. According to literature reviewed for this study, each form of assessment offered unique attributes to learning. Students learned differently and have strengths in certain areas of academic development. Some students excelled at memorization while others excelled with hands on learning. The adolescent brain worked with teaching methodologies that focused on critical thinking, problem solving and communication and decision making. Therefore, the brain compatible assessments employed during this study supported the theory of teaching adolescents through worthwhile, significant and meaningful assessments that focused on the process of the growth of understanding as well as the final product. The instruments designed for this research assessed students based on how they learned and determined if there was a significant difference between the types of tests and the scores received by the students. During 2006-2007 school year students were assessed using multiple choice tests for three units of study. These scores were compared to brain compatible assessments taken

by students in the 2007-2008 school year for the same units. In order to determine if there was a significant difference in the effectiveness of the type of assessment used, the final test scores, from three units of study were compared. The test scores were collected and subjected to a t-test in order to compare the sample for significant difference.

Conclusion

This study was based on the following hypothesis:

$H_{1:}$ Independent Living students would obtain higher test scores using brain-compatible assessments as compared to multiple-choice tests.

The test is a one-tailed test because it has a predicted hypothesis. The t-value was 3.143. The degree of freedom was 120. The value for a degree of freedom of 120 on the critical values of t at the .01 level $p > 2.358$, therefore a significant difference was shown. As a result of the obtained t-value being greater than the critical value the hypothesis was accepted. The statistical analysis indicated that the students taking brain compatible assessments obtained higher test scores than those students who took multiple choice tests.

Recommendations

Due to the fact that students in Family and Consumer Science classes had varying abilities, interests, and motivations it is expected that providing students the opportunity to be assessed based on how they learn will play an important role in a teacher's choice of assessment in future education. Although teaching styles and learning styles must be altered slightly to accommodate different abilities of classroom students, the results of this study indicated that using brain compatible assessments to evaluate an adolescence achievement positively influenced test scores.

Based on these findings, when considering using brain compatible assessments, teachers need to be aware of how the assessment will be evaluated since brain compatible assessments are more subjective than multiple choice assessments. Evaluating a multiple choice test can be as simple as running a Scantron through a machine, whereas brain compatible assessments took into account the adolescent's thinking process and how they arrived to an answer or solution for the problem. The brain compatible assessments used in this study were observation, journal writing, demonstration and short answer. These types of brain compatible assessments brought emotion, varying view points, physical labor and debates into the learning environment. With more complex thinking, the evaluation process was more frequent and took more time than traditional assessments. Therefore, a concrete evaluation system such as a rubric should be used to keep scoring methods consistent, fair and explainable. Also, time management needs to be carefully planned to allow sufficient time for assessing throughout the unit and at the end of the unit. Based on the findings, the researcher would recommend brain compatible assessments as an evaluative part of classroom instruction. The brain compatible assessments used would need to be varied depending on the unit being studied and the adolescents being taught.

Future recommendations for research based upon this study could include the benefits of coupling brain compatible activities with brain compatible assessments, comparing adolescent retention of information over long periods of time when using brain compatible learning activities and assessment as well as the benefits of brain compatible assessments for students with disabilities. Adolescents who scored high on brain compatible assessments may not necessarily store the information long term for

future use. In a Resource Management for Independent Living class, underclassmen need to store information long term for future retrieval. For example, one unit of study, Buying and Financing a Home, a student may not use this information for several years. Therefore, developing an understanding for the material is critical for future retrieval. Since it has been theorized that brain based research was used to make learning authentic, it would be interesting to determine if by using brain compatible assessments to support brain based learning increased the brain's ability to make connections and retain new information.

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Appendix A
Brain Compatible Assessments

Communication Unit, Apparel Construction Unit, Child Development Unit
Brain Compatible Assessments – Journal Writing, Demonstration, Observation and Short Answer

For each unit, lasting four weeks (three months total time), students completed 5 journal entries, a demonstration activity, and short answer questions. Students were evaluated on observation throughout the unit. A sampling of each of the above assessments is described below and the method of evaluation is described for each type of brain compatible assessment.

Journal entries were each worth 5 points. Students wrote their responses at the beginning of class followed by a class discussion. After listening to other students' perspectives, students were given a chance to add content knowledge to their journal during class time to incorporate information learned during the day's lesson.

Here is a sampling of four journal entries:

Journal Entry #1 – What does effective communication mean to you?

Journal Entry #2 – Identify 5 strengths and 5 weaknesses you have regarding your speaking skills? What are methods to improve your area of weakness(es)?

Journal Entry #3 – Identify 5 strengths and 5 weaknesses you have regarding your listening skills? What are methods to improve your area of weakness(es)?

Journal Entry #4 – How does the activity 'Barrier Games' relate to real life situations you may encounter with friends, family, the public and coworkers? Give an example for each.

Evaluation Tool for students' journal entries:

Have the students demonstrated building on previous knowledge with the new knowledge being presented?

Have the students demonstrated what they have learned can be extended beyond the confines of this lesson, applicable to other subject areas or areas in life?

Do students write with organized thoughts, correct grammar, and spelling?

Did the student answer the question?

Brain Compatible Assessment – Demonstration and Observation

For the Apparel Construction Unit portion of demonstration and observation, students had to demonstrate basic sewing skills by completing one of the following projects: boxer shorts, pajama pants, purse or a to-sew activity kit. The projects were worth 50 points. Observation throughout the demonstration portion totaled 15 points.

Assessment questions used to evaluate students:

Observation Checklist

- How are the students internally processing the information?
- How are the students demonstrating an understanding of the content?
- How are the students interacting with each other?

10-15 minute observation of individual or group activity

Content to Observe:

- topic content
- social dynamics
- needed help

Observation Rubric

Focus Items	Observations
Concepts:	
Technique:	
Problem-solving, reasoning	
Communication and collaboration	

Brain Compatible Assessment – Short answer

Students had to complete short answer questions used as a culminating assessment for the project. Questions formed to answer statements about content, reflection, problem solving, decision making and critical thinking skills.