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ABSTRACT

This research was conducted in an eastern Tennessee 8th grade science classroom with 99 students participating. The action research project attempted to examine an adolescent science student's integration of science concepts within a project-based setting using the multiple intelligence theory. In an effort to address the national science standards, in particular the "science for all" equity principle, a project-based assignment was designed that incorporated each student's natural or innate multiple intelligence. At the conclusion of each project-base unit, students were given an opportunity to express their integration of project material in one of eight ways based on an intelligence menu. The focus of this research as to study how middle school students integrate conceptual information in the area of science, and its relationship to unique diversity and multiple intelligence. The project-based approach allowed students to learn in personally diverse modalities using a linear or nonlinear fashion based on personal choice. A student's natural multiple intelligence, based on results from a Multiple Intelligence Developmental Assessment Scale (MIDAS) test, did not show evidence of better integration skills. However, upon analysis of results, significantly more students chose the spatial intelligence to represent integration. (Author)

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ABSTRACT

THE EFFECTS OF STUDENT MULTIPLE INTELLIGENCE PREFERENCE ON INTEGRATION OF EARTH SCIENCE CONCEPTS AND KNOWLEDGE WITHIN A MIDDLE GRADES SCIENCE CLASSROOM

ED 479 329

An Action Research Project

Presented to

The Department of Teacher Education

of Johnson Bible College

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In Partial Fulfillment

of the Requirement for the Degree

Master of Arts in Holistic Education

by

Lisa Christine Cutshall

July 2003

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APPROVAL PAGE

This action research project by Lisa Cutshall is accepted in its present form by the Department of Teacher Education at Johnson Bible College as satisfying the action research project requirements for the degree Master of Arts in Holistic Education.

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INTRODUCTION OF RESEARCH PROBLEM

Significance of the Problem

In 1996, the National Research Council presented a vision for science education in the *National Science Education Standards (NSES)*. These standards stated an idealistic and ambiguous view of teaching science for science educators with little to no practical application or foundation. "Goals and standards for science education have been established; the big challenge is implementing them" (Anderson, p. 3). An article by Anderson and Helms from the *Journal of Research in Science Teaching* explores potential research areas within the established standards that would assist in the realization of the NSES and advance widespread practice and support both politically and educationally.

Academic standards within all current school disciplines represent an ideal for students, often neglecting the reality of the classroom. According to senior researcher P. Sean Smith in a report to the National Science Foundation about current reform efforts, "We saw little change since the introduction of the standards in how [science] is being taught." (Hoff, p. 11). "Science for all" and equity, both concepts found in the *Standards*, are terminologies that have insufficient research to provide educators with practical application for the classroom. Many teachers see a tension between teaching all students, including some they perceive to be uninterested or unable to achieve at desired levels, and providing to the more able or willing student the high level of instruction called for by the *Standards* (Anderson, p. 7).

The vision of the NSES recognizes the diversity in student's abilities, motivations, and interests. Likewise, the popular theory of Multiple Intelligence, developed by Gardner, attests to the diversity of students and their wide range of capacities (d. Gardner, p. 31). Gardner shook the educational community by his radical theory of Multiple Intelligences, developed from his research work and presented in his book *Frames of Mind* in 1983. According to Gardner, the theory of multiple intelligences is designed to support the implementation of goals for school improvements (a. Gardner, p. 20). In addition, the theory explains the need for cooperative learning and performance-based curriculum, a similar idea to the vision of the NSES.

A student's integration of material is the essence of learning. Personal integration involves students engaging in "real life learning experiences so that they can incorporate them into their own understanding of themselves and their place in the world" (Bergstrom, p. 29). Both the *Standards* and the theory of Multiple Intelligence encourage meaningful personal learning experiences whose main goal is to integrate information into student understanding. Academic integration changes the way a student looks at his/her world as a result of learned material. One of the avenues that educators have found that encourages personal student integration is project-based learning. There is a wealth of information on the project-based approach, but for the purpose of this paper, case studies and research have been presented as it relates to the science discipline.

<u>Statement of the Problem</u>

Science educators, in an effort to answer the *National Science Education Standards* call to action, are faced with a practical dilemma of addressing student diversity and maintaining the level of learning and integration of science concepts. While current educators can attest to the natural differences in student learning, few can implement a classroom strategy that allows for multiplicity, meets standards, and evaluates student integration of a body of knowledge.

This action research study will examine the middle grade student's preferred and natural intelligence as a prediction of learning and integration. Each student's natural or innate intelligence will be identified, based on the eight intelligences presented in Gardner's *Theory of Multiple Intelligence.* Using a project-based approach to science teaching, students will be exposed to all the multiple intelligences and be given the opportunity to choose their assignment tasks based on their preferred way of learning. Through means of an integration project, students will be allowed to represent their learning using any of the eight multiple intelligences. This research will provide insight into the most viable means to promote learning and integration in the classroom utilizing the multiple intelligence theory. Multiple Intelligence theory is unique to learning styles, however, the concepts tend to overlap in some respects and the terms are being discussed synonymously in our schools. If school reform is to accept multiple intelligence theory as a means of educational revolution, research needs to be done in our current classrooms to provide support and direction for future change.

Definitions

Integration For the purpose of this study, integration is defined broadly as the process of associative learning and memory which takes a body of knowledge and blends it into all aspects of the student's awareness. Integration is a way of personally viewing the world as a result of incorporating what you know from all areas of life, including personal experience, study, and instruction. In this study, students who express the project in their natural or innate intelligence are considered to be integrating.

Project-based Project-based is a method of teaching in the classroom that allows for students to participate in hands-on activities and to be investigative. Students participating in a project-based unit will choose what they would like to know about a science topic and assume the primary role of a researcher and developer. They are given freedom in choosing styles, tasks, and means to present their work. The teacher will take on the role as facilitator and guide the student's academic learning.

Limitations

The subjects were already assigned as a class pod by the school's administration.

The Multiple Intelligence Developmental Assessment Scale used in intelligence identification requires a 5th grade reading level.

Assumptions

The intelligence level of the subjects was normally distributed among students.

The ability level of the subjects was normally distributed among classes.

Subjects will participate equally during the project-based assignment.

Subjects will work individually and honestly during the integration project.

Adequate time will be allowed to complete the integration project.

Eighth grade students have reached the formal operational stage and can integrate knowledge.

The Multiple Intelligence menu developed by Laezar identifies multiple intelligence. (Appendix A)

Hypotheses

1a. In project one, there is no difference between the number of students that test in specific natural intelligence categories and the number of students that actually use their tested method to demonstrate their integration at the .05 level of significance.

1b. In project two, there is no difference between the number of students that test in specific natural intelligence categories and the number of students that actually use their tested method to demonstrate their integration at the .05 level of significance.

2a. There will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score above the average on the post-test for project one at the .05 level of significance.

2b. There will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score below the average on the post-test for project one at the .05 level of significance.

2c. There will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score above the average on the post-test for project two at the .05 level of significance.

2d. There will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score below the average on the post-test for project two at the .05 level of significance.

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Chapter 2

CONCEPTUAL FRAMEWORK AND RELATED LITERATURE

"Science for All"

NSES Program Standard E states all students in the K-12 science program must have equitable access to opportunities to achieve the *National Science Education Standards* (National Research Council, p. 221). This standard is better known to educators and researchers as the equity principle, or "science for all." The *Standards* prescribe the inclusion of all students, requiring their active participation in challenging activities adapted to diverse needs.

Reform-based curriculum uses design principles that can promote evaluative understanding of science concepts and inquiry strategies and address the needs of diverse students (Schneider & Krajcik, p. 4). These ideas are at the heart of the constructivist philosophy and project-based learning. According to the National Research Council, teaching practice is responsive to diverse learners, and the community of the classroom is one in which respect for diversity is practiced (National Research Council, p. 46). However, recognition of varied multiple intelligences among students is an aspect of diversity that the NSES does not recognize directly.

MI Theory: Multiple Intelligences for the Classroom

A given person's intellectual performance will vary on different occasions and in different domains as judged by different criteria (Neisser, p. 78). The concepts of "intelligence" are attempts to clarify and organize a complex set of phenomena that includes understanding complex ideas, adapting to the environment, learning from

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experience, reasoning, and problem solving through thought applied to all concepts that are developed in the NSES. Gardner (1983) has developed a theory called Multiple Intelligence that identifies and describes eight distinct ways in which people can represent what they know and what they can do: Verbal, Logical-Mathematical, Spatial, Kinesthetic, Musical, Interpersonal, Intrapersonal, and Naturalistic. The concept of multiple intelligences is very content and context oriented – focusing on human potential, an idea related to the theme "science for all" (Silver, Strong, & Perini, p. 22-24).

Howard Gardner's theory of MI has rapidly been incorporated into school curriculums since it's inception in 1983, encompassing the educational system across the United States and beyond (Smith, p. 3). Many teachers accept MI theory and are attempting to teach students in the manner that will enhance their dominant intelligence(s). According to Gardner, multiple intelligences fit comfortably with an open approach to education. Teachers are planning projects, lessons, assessments, apprenticeships, and interdisciplinary curriculums around the theory, and the adaptations exhibit infinite variety (Campbell, L., p. 14). Taking a constructivist slant, some educators use MI theory to promote self-directed learning through complex projects. This allows for students to conduct their project highlighting their naturally strong intelligence. When students work in small diverse groups, exposure to all eight intelligences becomes a real factor in the learning process. In the MI classroom, the learner is the most important focus of the educational system (Guild, p. 30). "If we recognize multiple intelligences, we can reach more students, and give those students the opportunity to demonstrate what they have understood," says Gardner.

Garner's theory still contains many avenues for continued research and evaluation. Quantitative research conducted in a Maryland school showed that students who were taught using Multiple Intelligences generated a 20% increase on state standardized testing (Greenhawk, p. 62). However, one longitudinal study reported that MI theory was unproductive in the areas of student metacognitive activities and awareness as well as in the areas of student academic success (Smith, Odhiambo, & El Khateeb, p. 19). Yet, another study indicates that the employment of the theory shows an increase in students' responsibility for their own learning through an increase in academic output and a decrease in the incidents of inappropriate behavior, when used in a cooperative learning activity (Erb, p. 8). In an analysis by Rosenthal (1998), MI theory was concluded to be one viable instruction strategy for teachers in the struggle to enhance student self-esteem.

Gardner himself, in his book *Frames of Mind*, warns that his theory needs to be amply discussed and tested. Sternberg, a leading researcher in learning theories, asserts that although the theory is based on empirical findings, there is surprisingly little evidence of efforts to validate MI theory over the decade since its inception (Bouton, p. 6). Further research must be conducted to ascertain if MI theory is a productive theory in the K-12 setting (Smith, Odhiambo, & El Khateeb, p. 19).

<u>Student Integration</u>

Integration is often thought of as "the big picture" or conceptual understanding of an idea. Webster's Dictionary defines "integration" as "to make whole or complete by adding or bringing together parts." Current reform trends in education have attempted to integrate or interconnect across persons and disciplines in an effort to make learning a process that involves the whole individual. Therefore, learning can be considered the process of integrating a body of knowledge so that it permeates all internal and external systems of thought, feeling, and behavior. In the words of Dewey, "The pupil must learn what has meaning, what enlarges his horizon, instead of mere trivialities" (Dewey, p. 78).

In an article by Larry Hessney, integrative learning takes into account that each person has multiple kinds of intelligence. Personal and academic integration becomes a wide-ranging process among diverse students, making it difficult to measure because each student integrates information differently. Research by Jurden (1995) and Kyllonen & Christal (1990) show that student working memory is a distributed processing system that works parallel, rather than unitary, in verbal and nonverbal systems (Jurden, p. 100). Furthermore, Gardner, founding father of the MI theory, states that we learn best when using our natural or innate intelligence (Emig, p. 47). Can this imply that students integrate information best when using their natural intelligence? According to one study among high school students, students who are using their natural multiple intelligence strength felt more confident, competent, participated more fully, and retained more information because they could more easily see connections (Emig, p. 50). Empirical evidence of the means and effectiveness of integration, specifically as it regards to the enhancement of students' conceptual understanding, needs further exploration (Pang & Good, p. 79).

Concepts are the primary cognitive information organizing strategies that create a structure or framework for our associative thinking capacities. According to Brooks and Brooks (1993), concepts provide the cognitive structure that makes it achievable for us to construct our own understanding of the world in which we exist. For example, students were able to solve scientific-reasoning problems better when they thought about why they set up a particular experiment, using conceptual understanding as well as algorithmic competence (Anderson, C., p. 751).

Flavell (1993) found that children become able to categorize objects in two or more ways simultaneously when they learned how various concepts are interrelated, knowledge that is likely to evolve, at least in part, as a result of formal education (a. Ormrod, p. 274). Research done in vocational classrooms found that teaching for integration is shown to produce better results compared to traditional methods. Trainees increased their application of knowledge and skills two to fives times and improved retention and the rate of learning (Hessney, p. 79). Results from current science teaching research support the general hypothesis about the utility of enabling students to derive conceptual linkages among models which represent physical phenomena at increasing levels of abstraction (Frederiksen, White, & Gutwill, p. 828). Furthermore, research done by Anderson (1993), Bedard & Chi (1992), and White & Rumsey (1994) concluded that students benefit more from acquiring facts, concepts, and ideas in an integrated, interrelated, and meaningful fashion; in other words, they benefit from developing a conceptual and interconnected understanding of academic subject matter (b. Ormrod, p. 283).

For integrative learning to occur, teachers must be willing to give up some control over the content of the curriculum and allow students to co-create the curriculum in partnership with them (Siu-Runyan & Faircloth, p. 25). Erlandson & McVittie conducted qualitative research in the form of case studies within a classroom that utilized integrative curriculum. Analysis of field notes and interview transcripts led to the discovery that the curriculum was integrated on two levels in this classroom: personal integration and subject integration (Erlandson & McVittie, p. 30). Students who experienced personal relevance within the unit evaluated the integrative experience positively and showed a transformation in their thinking. Subject integration across disciplines contributed to creating a "big picture" but proved to be mostly an organizational element that had little or no effect on learning (Erlandson & McVittie, p. 31). Similarly, survey research done based on Tinto's theory of integration showed that academic integration and social integration all had positive influences on student satisfaction (Liu & Liu, p. 16).

A longitudinal study published in 2002 showed that from ages 11-19 a person will have the broadest academic knowledge, as well as reading and writing skills (McArdle, Ferrer-Caja, Hamagami, & Woodcock, p. 36). Unfortunately, results reported in 1999 by Cobern, Gibson, & Underwood showed that the level of science integration within everyday thinking still remained low among sampled ninth grade students (Cobern, Gibson, & Underwood, p. 541). Our upper level science students are not developing the

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"big picture," especially in the earth and natural sciences, which foster a passion and lifelong learning for science.

The learning process requires that new information become part of a coherent conceptual structure, yet no systematic attempt is being made to create a curriculum which reflects that requirement (Clark, p. 93). In 1986, Jerome Bruner stated that effective learning takes place in meaningful experiences – finding or creating connections between information and preexisting knowledge (Pittman, p. 16). In order for students to integrate information, a core of content must be established to which students can relate back, and they must be allowed to explore an idea in depth. Furthermore, there must be personal relevance to the topic.

<u>Project-based Approach in the Science Classroom</u>

In an effort to foster student integration, individual differences and intelligences must be addressed while maintaining the district standards and the *National Science Education Standards*. Research shows one viable approach to this challenge is through project-based science. Joseph Krajcik, a leading reformer promoting a project-based approach to science, states that a benefit of engaging in project-based science is that "learners develop deep, integrated understanding of content and process." (Krajcik, p. 15). In addition, project-based science is sensitive to the needs of a diverse group of students and meets the different needs through actively engaging them in personally relevant topics. A project-based reform science classroom was compared to a traditional classroom in a recent study conducted by a high school girl and her teacher (Chinn, p. 99-

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115). Melissa's research became "the project" and peer and teacher ratings were taken from both sides, from both middle school and high school. The results confirmed that students from the reformed program were much more positive and likely to enroll in additional science classes than students from the traditional approach. While grade-point averages differed only in the one-hundredths place, students using the project-based approach evaluated their quality of learning significantly higher than the traditional approach.

Students who are given opportunities to collect and analyze their own data in science class show a change in ideas, attitudes, and motivations for studying science (Stratford & Finkel, p. 10). The project-based approach relies upon four basic premises: Students (a) construct multiple representation of their understanding; (b) work on authentic, contextualized problems that are meaningful and complex; (c) collaborate in a community of learners; and (d) use cognitive tools to construct and represent knowledge (Marx et. al., p. 517). A "driving question" is offered to the students that is anchored in a real-world problem. Students then are free to explore and investigate the possibilities, concepts, and knowledge within a small collaborative team.

Project-based science is a nonprescriptive, nonlinear approach to science instruction, grounded in constructivist theory (Ladewski & Krajcik, 1994; Blumenfeld et al., 1991; Krajcik, Blumenfeld, Marx, & Soloway, 1994; Roup, Gal, Frayton, & Pfister, 1993) Four middle school teacher's case studies were reported that demonstrated the range of practices teachers used as they learned to enact project-based science (Marx et.

al., p. 534). Another research project used interviews to compare the beliefs, intentions, and actions of two highly regarded project-based science teachers. The teachers created variations on the approach to meet the needs of differing students, while maintaining the same basic framework and philosophies. While all teachers faced numerous challenges, teacher collaboration and individual tailoring of this approach led to both student and teacher learning (Laba & Abrams, p. 1).

Standardized testing, curriculum standards, and time management were significant concerns among teachers who followed a project-based approach to science (Scott, 1994; Ladewski & Krajcik, 1994). The NSES, while addressing diversity, inquiry-learning, and recognizing a holistic student, still demands specific content and benchmarks be reached for all students. In an experimental study of two groups of seventh-grade students, a new dimension of student achievement was stimulated among those using the reform approach. Students in the project-based groups exhibited better critical thinking, communication skills, and data collection and analysis. The researcher concluded, however, that students would benefit most if the project-based approach were incorporated into a school year punctuated by units of varying length, intensity, and learning styles (Scott, p. 75).

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Chapter 3

METHODOLOGY AND PROCEDURES

Selection of Subjects

There were 99 subjects for this research study taken from a middle school in East Tennessee. These subjects were all in the eighth grade with ages ranging from 12 to 14. There were a total of four science classes participating in the study, with each class having a total of 23 to 29 students. The intelligence of the subjects was assumed to be normally distributed. The eighth grade population of the school is approximately 450 students, with 7% below poverty level as determined by the percentage of students that receive free lunch.

Classroom Process

This experimental research took place over a period of five weeks. During these weeks, two project-based units were taught which incorporated and allowed for all eight of the multiple intelligences. These units were separated by a building block of traditional textbook coursework. Students were randomly selected by computer and placed in small groups of four to five students. Regular textbook reading and study guides were used throughout the unit.

Testing Procedures

Each subject was given a "Multiple Intelligence Developmental Assessment Scale for Children" (MIDAS) test which should have accurately diagnosed a student's natural or preferential intelligence. Numerous studies have been conducted that attest to the reliability and validity of this test developed by Shearer, a professor of multiple intelligence research and consulting from Kent State University (C. B. Shearer, p. 1). The MIDAS test took approximately 45 minutes to complete. One entire class period was devoted to the administration of the MIDAS.

During each experimental project-based unit, students were given two and a half weeks to complete the project in a collaborative group setting. Each project consisted of eight tasks, based on the eight accepted multiple intelligences, in which student groups chose five tasks to complete. After each experimental unit, students were allowed one entire class period to individually complete a project that represents their integration, or learning, of the unit's material.

Using an intelligence menu, students were given the opportunity to choose from the eight intelligences how best to represent their integration. A sample of the intelligence menu can be found in Appendix A. Students were given a participation score that was entered into the grade book. However, the style, information, or amount of material was not graded. In an effort to prevent creativity from being stifled, students who had chosen one of the "object-free" intelligences such as musical or verbal-linguistic were allowed to ask for permission to continue their project work at home that same evening. This was with the understanding and commitment that the subject will work individually and honestly.

In addition to the integration project, students were given a standardized post-test from the textbook course bank. These tests covered each unit's material and were scored.

Statistical Analysis

At the 0.05 level of significance, a chi-square analysis was conducted between the number of subjects that fall into the several expected natural intelligence categories and the number of students that choose their natural intelligence during the integration project.

At the 0.05 level of significance, a chi-square analysis was conducted between the number of students who scored above average on the post-test and used their natural intelligence for the integration project, and students who scored below average and used their natural intelligence for the integration project.

Chapter 4

RESULTS

Analysis of the Data

A chi-square analysis was conducted between the number of subjects that fall into the several expected natural intelligence categories and the number of students that choose their natural intelligence during the integration projects (Table 1 and 2). Because of the distribution, data was collapsed and the spatial category was compared against all the others. At the 0.05 level of significance, a definite statistical difference occurred for both projects. The number of subjects differed between projects one and two because of student absences. Students who did not complete the project when assigned were excluded.

Project one was a geologic time unit that covered textbook material and used individual work and group projects to accomplish unit objectives. During this unit, students studied dinosaurs, fossils, earth origin, and the geologic time scale. A considerable number of students, 70 out of 92, chose spatial to demonstrate their integration of the project material (Table 1). Therefore, Hypotheses 1a, which states there is no difference between the number of students that test in specific natural intelligence categories and the number of students that actually use their tested method to demonstrate their integration at the .05 level of significance for project one, is rejected.

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Table 1

Hypothesis 1a : Project 1		
	Other Intelligences	Spatial
Expected (MIDAS)	86	6
Observed (Project choice)	22	70
X^2 = 3.72208E-55 n=92	p = sig. > .05 level	

Project two was an astronomy unit that covered textbook material and used individual work and group projects to accomplish unit objectives. During this unit, students studied our solar system, stars, galaxies, and earth-moon-sun systems. Again, a considerable number of students, 57 out of 99, chose spatial to demonstrate their integration of the project material (Table 2). Therefore, Hypotheses 1b, which states there is no difference between the number of students that test in specific natural intelligence categories and the number of students that actually use their tested method to demonstrate their integration at the .05 level of significance for project two, is rejected.

Table 2

Hypothesis 1b : Project 2		
	Other Intelligences	Spatial
Expected (MIDAS)	91	8
Observed (Project choice)	42	57
X^2 = 2.18165E-23 n = 99	p= sig. >.05 level	

A chi-square analysis was conducted between the number of students who scored above average on the post-test and used their natural intelligence for the integration project, and students who scored below average and used their natural intelligence for the integration projects (Table 3, 4, 5, and 6). Again, the data was collapsed because of the distribution. The chi-square compared the spatial category against all the others. At the 0.05 level of significance, with one degree of freedom, a definite statistical difference occurred for both projects, within both score groups.

The median test score for the combined classes was determined for each test and this designated the dividing point for high and low scores. The range of scores for project one post-test was 77 to 213. This test had a possible 200 points plus an extra credit bonus question. A considerable number of students, 33 of the 44 subjects, whose test score was above the median chose spatial to demonstrate their integration of the project material (Table 3). Hypotheses 2a, which states there will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score above the average on the post-test at the .05 level of significance for project one, is rejected.

Table 3

Hypothesis 2a : Project 1 *High Scores Above 162*		
	Other Intelligences	Spatial
Expected (MIDAS)	43	1
Observed (Project choice)	11	33
X^2 = 7.92514E-29 n=44	p = sig. > .05 level	

Students whose test score was below the median also preferred spatial to demonstrate their integration of the project material (Table 4). Coincidentally, 11 of the 43 in the low scores used their expected MIDAS intelligence for the project, shown in table 4, as did the high scores shown in table 3. Of the 48 subjects, 37 chose the spatial demonstration from the intelligence menu of all eight multiple intelligences. Hypotheses 2b, which states there will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score below the average on the post-test at the .05 level of significance for project one, is rejected.

Table 4

Hypothesis 2b : Project 1 *Low Scores 162 or Below*		
	Other Intelligences	Spatial
Expected (MIDAS)	43	5
Observed (Project choice)	11	37
X^2 = 4.29845E-28 n = 48	p= sig. >.05 level	

Likewise, in project two a significant number of students chose spatial to demonstrate their integration of the project material in both high and low score categories. The range of scores for project two post-test was 105 to 247. The second test had 250 points possible plus an extra credit bonus question. A substantial number of students, 26 of the 47 subjects, whose test score was above the median chose spatial to demonstrate their integration of the project two material (Table 5). Hypotheses 2c, which states there will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score above the average on the post test at the .05 level of significance for project two, is rejected.

Table 5

Hypothesis 2c : Project 2 High Scores Above 200		
	Other Intelligences	Spatial
Expected (MIDAS)	46	1
Observed (Project choice)	21	26
X^2 = 2.21931E-13 n=47	p = sig. > .05 level	

Students whose test score was below the median also preferred spatial to demonstrate their integration of the astronomy project material (Table 6). Of the 52 subjects, 31 chose the spatial demonstration from the intelligence menu of all eight multiple intelligences. Hypotheses 2d, which states there will be no significant difference between the expected and the observed use of natural multiple intelligence for those who score below the average on the post test at the .05 level of significance for project two, is rejected.

Table 6

Hypothesis 2d : Project 2 Low Scores 200 or Below		
	Other Intelligences	Spatial
Expected (MIDAS)	45	7
Observed (Project choice)	21	31
$X^2 = 1.17698E\text{-}11$ n = 52	p= sig. >.05 level	

Uncollapsed data tables can be found in Appendix D.

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Chapter 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

Summary

The focus of this research was to study how 8th grade students integrate conceptual information in the area of science, and its relationship to individual diversity and multiple intelligence. The project-based approach allowed students to learn in personally diverse modalities using a linear or nonlinear fashion based on personal choice. A student's natural multiple intelligence, based on results from the MIDAS test, did not show evidence of better integration skills. However, more students chose the spatial intelligence to represent their integration.

The first project-based unit was Geologic Time. This included fossils, the geologic time record, dinosaurs, and evolution. The second project-based unit was Astronomy. This unit included concepts like the solar system, earth-moon-sun systems, stars, galaxies, and space exploration. Both units were comparable in length and material. In addition, each project offered a task for each of the eight multiple intelligences.

Conclusions

Student integration of science concepts does not apparently coincide with student multiple intelligence. Instead, from these results one would conclude that the average adolescent student would integrate better with spatial and visual understanding. Furthermore, in the middle and upper grades our schools have starved our students of their creative artist outlets. When given the integration assignment, it is possible that more students chose to spatially or visually represent the material because it was abnormal from other school requirements. Perhaps also students feel less threatened representing material spatially as a result of extensive visually creative opportunities in early elementary grades.

As the weeks progressed, students became more aware of the variations in tasks and intelligences. As the results show, more students ventured out and tried something different to represent their integration during the second project. In addition, students who showed higher academic standing on the unit test did not exhibit integration in the other intelligence areas more so than the students who received lower scores on the unit test.

In most traditional school settings, learning is typically considered to be memorization rather than conceptual understanding or integration. Because the unit test used was developed from test bank questions, logical and linguistic intelligences were more prominent, but not exclusive.

Recommendations

The researcher recommends that more research be done in the area of integration as it relates to the multiple intelligence theory. Perhaps integration itself is an intelligence of its own that draws heavily upon visual conception. It was obvious from student project work that some students, more than others, could convey the connection of ideas and science concepts using any one of the multiple intelligence menu items.

The researcher also recommends that further analysis be conducted on an individual level in the area of integration. A post-hoc test could prove viable to explore more individualized results. A longitudinal, qualitative study may provide more psychological and educational insight into the adolescent minds as they integrate material from the world around them.

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APPENDICES

APENDIX A

Integration Project Multiple Intelligence Menu*

Choose to represent this unit's information using one of the following ways:

- Linguistic: Write a poem, myth, legend, short play, or news article
- Math/Logical: Describe the patterns or symmetry
- Kinesthetic: Make task or puzzle cards
- Visual/Spatial: Chart, map, or illustrate through pictures
- Musical: Create a rap or song
- Interpersonal: Design a service project
- Intrapersonal: Describe one of your personal values
- Naturalistic: Describe changes in the local or global environment

*Menu created by David Laezar.

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APPENDIX B
Parent Approval Form

Mrs. Lisa Cutshall
7900 Johnson Drive
Box #335
Knoxville, TN 37998

Dear parent(s),

My name is Lisa Cutshall and I have been working as an intern in your child's eighth grade science classroom with Mrs. Shawn. I am a graduate student at Johnson Bible College where I am conducting an action research project to fulfill a requirement for a Masters Degree. This project consists of an in-class project to measure your child's level of integration of a particular unit in Earth Science from the course textbook. This project will supplement the regular coursework and tests and provide an opportunity for your child to express what they have learned in their own unique way. In addition, each student will take a widely recognized and certified test in class to measure their natural mode of intelligence based on a theory which is frequently used in our school systems today.

Upon consent, your child will be anonymously included in the data. In addition, the name of Farragut Schools will remain anonymous. I ask for your help in allowing your child to participate in this study, and if you have any question, please give me a call at the middle school. Thank you!

Sincerely,

Lisa C. Cutshall

- -

I, ___________________________, allow my child, _______________________, to participate in Mrs. Cutshall's action research project, and understand that the students' names will remain anonymous.

____
Intern (date)

______________________ ______________________
Parent/Guardian (date) Classroom Teacher (date)

____
Principal (date)

APPENDIX C

KNOX COUNTY SCHOOLS
ANDREW JOHNSON BUILDING

Dr. Charles Q. Lindsey, Superintendent

September 26, 2002

Lisa C. Cutshall
7900 Johnson Dr. #335
Knoxville, TN 37998

Dear Ms. Cutshall:

You are granted permission to contact appropriate building-level administrators concerning the conduct of your proposed research study entitled, "The effects of student multiple intelligence preference on integration of earth science concepts and knowledge within a middle grades science classroom." In the Knox County schools final approval of any research study is contingent upon acceptance by the principal(s) at the site(s) where the study will be conducted. Include a copy of this permission form when seeking approval from the principal(s).

In all research studies names of individuals, groups, or schools may not appear in the text of the study unless *specific* permission has been granted through this office. The principal researcher is required to furnish this office with one copy of the completed research document.

Good luck with your study. Do not hesitate to contact me if you need further assistance or clarification.

Yours truly,

Mike S. Winstead, Ph.D.
Coordinator of Research and Evaluation
Phone: (865) 594-1740
Fax: (865) 594-1709

Project No. 111

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APPENDIX D

Hypothesis 1a : Project 1

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	20	6	5	9	16	11	20	5
Observed (Project choice)	4	70	7	4	1	1	1	4

Hypothesis 1b : Project 2

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	20	8	6	11	17	11	22	4
Observed (Project choice)	7	57	9	17	0	3	1	5

Hypothesis 2a : Project 1,
High Scores above 162

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	13	1	2	5	4	6	9	4
Observed (Project choice)	2	33	3	3	0	1	0	2

Hypothesis 2b : Project 1, Low Scores 162 or below

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	7	5	3	4	12	5	11	1
Observed (Project choice)	2	37	4	1	1	0	1	2

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Hypothesis 2c : Project 2, High Scores above 200

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	11	1	2	5	7	7	11	3
Observed (Project choice)	3	26	2	10	0	2	0	4

Hypothesis 2d : Project 2, Low Scores 200 or below

	Logical	Spatial	Ling.	Kinest.	Inter.	Intra.	Music	Nat.
Expected (MIDAS)	8	7	4	6	10	4	11	2
Observed (Project choice)	4	31	7	7	0	1	1	1

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