## ABSTRACT

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This study investigated the effects integrating geometry into physical education had on learning geometry concepts. Two fifth grade classes (N = 45) from an elementary school in La Crosse, Wisconsin were subjects in the study. Both classes received concurrent geometry instruction from their classroom teachers and gymnastics instruction from their physical education specialist. The physical education teacher taught a gymnastics unit integrated with geometry concepts to one class (n = 21) and a gymnastics only unit to the other class (n = 24). Each student took a 32- item geometry pretest before receiving instruction and a 32- item geometry posttest following instruction. The integrated groups' pretest mean score was 12.38 and posttest mean score was 25.29. The control groups' pretest mean score was 13.50 and posttest mean score was 20.96. An independent t-test for equality of means was used to determine if the groups' pretest scores differed. This test indicated no significant difference between the groups in the pretest ($p > .05$). An ANCOVA adjusted for the insignificant differences in pretest means and was used to determine if the groups' posttest scores were significantly different. It indicated that the groups' posttest scores were significantly different ($p < .05$). The results of this study indicate that integrating geometry into physical education increases geometry test scores

# THE EFFECTS OF INTEGRATING GEOMETRY INTO PHYSICAL EDUCATION

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TABLE OF CONTENTS

PAGE

ACKNOWLEDGEMENTS ..... iii

LIST OF APPENDICES ..... vi

CHAPTER

I. INTRODUCTION ..... 1

Purpose of the study ..... 1

Need for Integration ..... 1

Need for the Study ..... 2

Hypothesis ..... 3

Assumptions ..... 3

Limitations ..... 4

Delimitations ..... 4

Definition of Terms ..... 4

II. REVIEW OF RELATED LITERATURE ..... 6

Introduction ..... 6

History ..... 6

Defining Terms ..... 8

Models of Integration ..... 10

Multiple Intelligences ..... 13

Benefits of Integration ..... 14

Integration Works ..... 16

Problems ..... 18

Support ..... 20

CHAPTER PAGE

III. METHODS AND PROCEDURES ..... 22

Introduction ..... 22

Purpose of the Study ..... 22

Subject Selection ..... 22

Procedure ..... 23

Instrumentation ..... 24

Geometry Curriculum ..... 25

Statistical Treatment ..... 25

IV. RESULTS AND DISCUSSION ..... 26

Introduction ..... 26

Subject Treatment ..... 26

Results ..... 27

Discussion ..... 29

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS .. 33

Summary ..... 33

Conclusions ..... 34

Recommendations ..... 35

PAGE

REFERENCES ..... 37

APPENDICES ..... 40

LIST OF APPENDICES

APPENDIX PAGE

A. Robin Fogarty's Models of Integration ..... 40

B. Cindy Kurasch's STAIRS to Integration ..... 42

C. La Crosse School District Research and Development Request ..... 44

D. Informed Consent ..... 48

E. Integrated Lesson Plans ..... 50

F. Geometry Pretest and Posttest ..... 56

G. School District of La Crosse Elementary Math Expectations Geometry Grades 3-5 ..... 65

H. Raw Test Scores ..... 67

# CHAPTER I

## INTRODUCTION

As the twenty-first century approaches, educators struggle to keep up with a rapidly changing world. It is more important than ever that students gain critical thinking skills, problem solving strategies and the ability to draw from a variety of sources when faced with a complex problem or task (Klein & Doty, 1994). Education is built around the principle that students will learn what teachers teach. If that is true, then presenting subjects separately teaches students that they are separate. Real life problems do not come in dissected discipline packages; they often require the simultaneous application of knowledge acquired from various disciplines. An integrated knowledge base provides students with the tools to intelligently solve the problems they will face in the twenty-first century.

Many teachers struggle to keep up with the increased demands placed on them by school districts and state education departments which require them to teach more than the traditional reading, writing, and arithmetic. Linking content through integrated teaching is an effective technique that may help educators cover more content in less time (Kuhrasch, 1998; Lake, 1995). Teachers often look for ways to stimulate thought and increase enthusiasm. Interdisciplinary lessons often create an exciting atmosphere in the classroom or gymnasium.

Chapter One will describe the purpose, need, and hypothesis for this study. Chapter One will also provide lists of assumptions made about conditions for the study,

uncontrolled limitations, and researcher-imposed delimitations of the study. Finally, Chapter One provides operational definitions for a variety of terms used in this report.

## Purpose of the Study

The purpose of this study was to analyze the effect that integrating fifth grade geometry into a physical education gymnastics unit had on geometry test scores. Specific geometric concepts of angles and line relationships were integrated into a fifth grade gymnastics unit focussing on floor exercises such as rolls and balances.

## Need for the Study

Psychologists who study learning find that the events in which information occurs are just as important as how that information is delivered. Caine and Caine (1991) stated that those events are often thought of as impossible to research and are thus left unspecified and unstudied.

Research on integration and other process-oriented approaches to education is rare because there are inevitably many limitations to studying such complex environments. The experimental research model is not the ideal way to study the complexity of learning (Caine & Caine, 1991). Education researchers who have tried to control their experimental environments to fit the true experimental model have been forced to study the effects of a single, secluded factor. Brain research shows that the brain does not learn each factor or subject in seclusion, although educational domains reflect the misconception that there are classifications of learning: affective, psychomotor, and cognitive. In fact, all areas are interconnected; one can not be learned separate from the

other (Caine & Caine, 1991). Using brain research about learning to solve real world problems in the classroom is a challenge.

More research on the effectiveness of various teaching practices, including integration, is necessary if education is going to keep up with the changing demands of society. The pure experimental model of research falls short in investigating the mysteries of learning and effective teaching practices. When used concurrently with qualitative methods of research, such as ethnography, the results could provide evidence that may improve education and student achievement.

## Hypothesis

The hypothesis of this study was as follows: The integration of classroom geometry objectives into a physical education gymnastics unit will not result in a significantly changed rate of learning geometry.

## Assumptions

The following assumptions were relative to this study:

1. Physical education teaching behaviors that affect student learning were the same for each group.
2. The same gymnastics objectives were taught to each group.
3. All subjects received the same number of days of gymnastics instruction.
4. Classroom teachers presented their traditional geometry units.
5. The two classroom teachers may have taught geometry at different rates and using different techniques.

## Limitations

This study had the following limitations:

1. Various teacher assistants including a student teacher, university clinical students, and adapted physical education specialist may have helped with lessons.
2. The students were not randomly assigned to their classroom teachers.
3. Students absent during any day during this study may have missed crucial instruction.
4. Class sizes were not equal.
5. Study time varied from student to student.
6. Students learned at different rates.

## Delimitations

This study had the following delimitations:

1. The same teacher instructed all physical education classes and each class was 45 minutes long.
2. The gymnastics unit that was taught to each class was five days long.
3. Subjects for this study were limited to two fifth grade classes.
4. Only subjects who are involved in classroom geometry lessons were tested and included in this study.

## Definition of Terms

The following terms were used in this study:

Discipline - a specific body of teachable knowledge with its own background of education, training, procedures, methods, and content areas (Jacobs, 1989).

Floor Exercises – gymnastics stunts, such as balances and rolls, performed on mats.

Integrated Knowledge Base - subject areas connected in the mind of the learner (Kuhrasch, 1998).

Integration - content areas shared among two or more disciplines.

Interdisciplinary - a knowledge view and curriculum approach that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience (Jacobs, 1989).

Sequential Integration - two or more subjects share content areas simultaneously.

Chapter one defined the purpose, need, and hypothesis for the study. The assumptions made about study conditions, limitations, delimations, and operational definitions for terms used in the study were also identified in chapter one. Chapter two will review literature related to integrated curriculum.

# CHAPTER II

# REVIEW OF RELATED LITERATURE

## Introduction

This chapter provides an overview of the literature related to integrated curriculum. Chapter two reviews literature describing the history of education models, clarification of educational jargon, need for integration, types of integration, benefits of integration, integrated programs that work, potential problems associated with integration, and support for integration by major educational organizations. Available literature regarding the subject of integrated curriculum in a physical education setting is also be reviewed.

## History

There are as many theories about educational strategies as there are students to be educated. Most educators believe that our system of educating students does not maximize student potential nor meet the increasingly complex demands of our society. The predominant approach taken by American public schools separates knowledge into disciplines. Even elementary days are often fragmented into small discipline segments presented independently. One second grade student demonstrates this by defining mathematics as "something you do in the morning" (Jacobs, 1989, p. 1).

The fragmentation of subjects goes back to the days of Aristotle, who believed that knowledge should be divided into either the productive, theoretical, or practical discipline (Jacobs, 1989). On the other hand, Plato's ideal of "unity as the highest good in

all things" (Jacobs, 1989, p. 8) stresses a holistic approach to education, which emphasizes links between areas. These contrasting views of education held by Aristotle and Plato are just as prevalent today.

The departmentalization of American public schools in the second decade of the 1900's was a reflection of the Industrial Age (Rauhauser & Mclennan, 1995). Today's schools continue to structure themselves around the four disciplines of science, mathematics, history, and English. Subjects such as music, art, and physical education were often considered complementary or peripheral disciplines (Tchudi & Lafer, 1996). The fact that only seven states require physical education to be taught by a certified physical educator suggests that the profession continues to be thought of as insignificant (Stevens-Smith, 1999).

Some believed that Aristotle's departmentalized education encourages efficient learning and allows for effective evaluation of students (Cone & Cone, 1999a). They believed that students have the innate ability to make connections among subjects (Jacobs, 1989). According to Tchudi and Lafer (1996, p. 7) the very same disciplines which helped organize our knowledge and "bring order to our understanding... sometimes serve as blinders rather than lenses, limiting vision rather than enhancing it". In other words, we fail to see the big picture and the connections between subjects. Various teaching methods, including the integration of subjects, capitalize on Plato's holistic approach. Wilson, Malgren, Ramage, and Schultz (1993) stated that children do not view learning in terms of secluded disciplines, but rather have a holistic outlook on life.

## Defining Terms

Correlated, fused, integrated, thematic, interdisciplinary, multidisciplinary, trans-disciplinary, pluridisciplinary, cross-disciplinary, and synergistic are all terms used to describe curricular styles that attempt to link subjects (Cone & Cone, 1999a; Lake, 1995; Tchudi & Lafer, 1996). Literature in the area of connecting disciplines can be confusing when distinctions between these terms are not clearly defined. Many references use the term "interdisciplinary" to include all teaching methods that combine two or more subjects. Other references use "integration" as an umbrella term to define all teaching of two or more disciplines concurrently. Some use the word "integration" in order to avoid using the word "discipline" because discipline has negative connotations of control or punishment (Tchudi & Lafer, 1996).

In the 1930's Vars (as cited in Tchudi & Lafer, 1996) defined two types of discipline-merging teaching techniques: correlated and fused. Correlation requires addressing the same topic or theme from two discipline angles. Multidisciplinary is a term used today that was coined by William Mayville in 1978 (as cited by Tcudi & Lafer, 1996) that is synonymous with correlation.

Fusing subjects requires a central focus (theme, topic, or problem) to be examined from more than two disciplinary perspectives. Instead of teaching two subjects parallel to one another, fused teaching by an individual teacher or a teaching team approaches one central focus through multiple disciplines. In today's terminology integrated, interdisciplinary, transdisciplinary, cross-disciplinary, and multidisciplinary may all fall into the fused category (Tchudi & Lafer, 1996).

The terms interdisciplinary, integrated, and thematic are often used synonymously and seldom used to distinguish between different models of discipline-merging teaching. Users of these terms rarely provide definitions and Lederman and Niess (1997) feared that teachers, administrators, curriculum developers, and state departments of education overlook critical differences between these models.

According to Lederman and Niess (1997, p. 57) "integration refers to a combined or undivided whole". In an integrated curriculum distinctions between different disciplines are unrecognizable to the learner. Humphreys, Post, and Ellis (as cited in Lake, 1995, p. 1) defined integrated curriculum as "education that is organized in such a way that it cuts across subject-matter lines, bringing together various aspects of the curriculum into meaningful association to focus upon broad areas of study."

Interdisciplinary teaching is a curriculum approach that applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic, or experience (Jacobs, 1989). Cone, Werner, Cone, and Woods (as cited in Cone & Cone, 1999a, p. 8) defined interdisciplinary as "an educational process in which two or more subject areas are integrated with the goal of fostering enhanced learning in each subject area." According to Lederman and Niess (1997) an interdisciplinary curriculum emphasizes connections between disciplines while disciplines remain separate.

Clearly, the line between technical definitions of integrated and interdisciplinary teaching is blurred. Many articles do not define the terms used, and some of the articles that do define these terms offer conflicting definitions. This paper will take a general

approach and avoid semantic arguments by using "integration" as a catch-all term under which all forms of discipline-merging teaching methods fall.

## Models of Integration

Robin Fogarty (1991) described ten levels of integration (see Appendix A) along a continuum from fragmented, where disciplines are separate and distinct, to networked, an approach directed by the learner through selection of a network of experts and resources. Connected, sequenced, shared, webbed, and integrated are five common levels of integration. Disciplines remain separate within the connected and sequenced levels of integration. Connected integration involves linking topics within a single discipline area without connecting one discipline to another. In sequenced integration similarities between disciplines are taught concurrently, but separately (Fogarty, 1991).

Disciplines lose more of their individual identity in Fogarty's shared, webbed, and integrated levels of integration. Shared integration requires team planning to focus two disciplines on the same concepts, skills, or attitudes. More commonly referred to as thematic teaching, webbed integration provides one meaningful theme as a base of instruction for many disciplines. Finally, integrated teaching involves connecting common skills, themes, concepts, and attitudes from multiple disciplines (Fogarty, 1991).

Cone and Cone (1999a) argued that Fogarty's ten models may be overwhelming and have developed three models of interdisciplinary teaching: connected, shared, and partnership. These functional models are not meant to be rigid or all encompassing, but are intended to be used as "guides to meaningful... integration" (Cone & Cone, 1999a, p. 10). Teachers may develop a learning model that can not be classified as connected,

shared, or partnership, but that meets their needs and the needs of their students (Cone & Cone, 1999a).

The connected model is the simplest interdisciplinary teaching model and one that may serve as an excellent place to start interdisciplinary teaching. It is simply the connection of content from any two subjects. The subjects remain separate, but one teacher works independently to integrate content from another subject into another subject.

Integrating two subjects through a similar concept characterizes the shared model of interdisciplinary teaching. The concept is part of each separate discipline and is taught through each discipline concurrently. This model involves two or more teachers collaborating on the timeline and shared content. Although the shared model is more complex than the connected model, the opportunity for student learning is greater (Cone & Cone, 1999a).

Partnership, the most complex curricular model, provides equal instruction of any two or more disciplines in one teaching effort. A team teaching approach is often used to implement the partnership model. Students perceive multiple subjects with a better understanding of their relationships to each other.

Nichols (as cited by Woods & Weasmer, 1999) identified sequenced, shared, and webbed models of integration. Sequenced integration requires similar units to coincide in several subject areas while each subject area remains separate. Shared integration links disciplines through a single focus using overlapping concepts. Nichols' webbed model

establishes a school-wide goal that focuses on a central theme (Woods & Weasmer, 1999).

Jacobs (1989) provided a six-model continuum of integration implementation. Like Fogarty (1991), Jacobs' (1989) continuum moves from traditional, discipline based instruction to a "complete program", characterized by curriculum shaped from students' day-to-day lives. Parallel disciplines, multidisciplinary approach, interdisciplinary approach, or an integrated day are options within Jacobs' continuum.

Rauschenbach (1996) provided three categories of integrated activities for physical educators: embedded, practice, and discovery. Embedded activities aim to challenge students by integrating other disciplines into a traditional physical education task. For instance, the physical education teacher may challenge students to count repetitions in multiples of five or in another language. Embedded activities require simple, imaginative adjustments and do not effect the physical education instruction.

Practice activities require more preparation by the teacher because the students are required to use motor skills to reinforce classroom subject knowledge. One example of a practice activity for the overhand throw provided by Raushenbach (1996) involved the students solving math problems by throwing beanbags at cells in a numbered grid. Practice and embedded activities are simple forms of integration that physical educators may apply to any lesson without much effort.

The final, purest, and most valuable integrative tasks defined by Rauschenbach (1996) are discovery tasks. Discovery tasks require students to analyze the relationships between different subject areas. The physical education activity and the classroom

subject must be chosen specifically because of their relationship to one another. For instance, the physical education teacher may ask students to identify Newton's laws of motion in physical education activities, then make a list of "Laws of Physical Activity" (Rauschenbach, 1996).

Clearly, there are many ways to offer integrated curriculum. As Jacobs (1989) pointed out, educators and administrators should review every option then pick and choose the option or combination of options that best fits their situation. Many factors must be considered when choosing an integration model. Schedule flexibility, faculty support, curricular requirements, and content assessments are some of the considerations that must be addressed before implementing any integrated teaching model.

## Multiple Intelligences

Howard Gardner presented the idea that people learn in eight different ways: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, intrapersonal, interpersonal, and natural (Gardner, 1993). Each of those intelligences are characterized by different methods of processing information. Gardner believed that all people have each intelligence, but demonstrate strengths in one or two intelligences. Traditionally, education has catered information to the linguistic and logical-mathematical learners. Students who are stronger in the other five intelligences often felt defeated when they left school (Teele, 1996). Redesigning the educational system to meet the needs of all students means that educators must recognize individual differences in learning styles and develop strategies that will enable them to efficiently teach to each intelligence.

The Teele Inventory of Multiple Intelligences (TIMI) can identify one's strongest

intelligence. Analyzing more than 6,000 inventory answer sheets revealed that the two most dominant intelligences throughout elementary school were spatial and bodily-kinesthetic. Interpersonal, bodily-kinesthetic, spatial, and musical intelligences were the strongest for middle level and high school students (Teele, 1996).

Bodily-kinesthetic learners process information through bodily sensations and are more likely to succeed when classrooms provide hands-on learning experiences involving movement (Gardner, 1993). Woods and Weasmer (1999) reported that "Kinetic learners... frequently struggle with a traditional segmented curriculum" (p. 23). Physical educators who integrate classroom subjects into their curriculum and classroom teachers who integrate movement experiences into their curriculum provide bodily-kinesthetic learners the opportunity to process knowledge through movement. "Gardner's seven intelligences are valued in the real world, why not value them in the classroom" (Rauchauser, 1995, p. 11) by teaching concepts through a variety of medians. An integrated curriculum, taught by specialists as well as classroom teachers, offers students a greater variety of authentic learning opportunities.

## Benefits of Integration

Our schools must find ways to prepare young people for the complex demands of the Biotechnical Age. According to Rauhauser and Mclennan (1995) in today's Biotechnical Age low-skilled, departmentalized jobs are few and far between. Problem solving (through higher order reasoning and critical thinking) and the ability to draw information from several areas are today's minimum standard for success (Klein & Doty, 1994; Lake, 1995). The skills needed to solve the problems we face today and those we

will face throughout the twenty-first century can only be developed if we redefine knowledge. Knowledge is not departmentalized, but rather integrated and complex (Wilson et al., 1993). Knowledge is not merely remembering information, but the ability to apply that information correctly to various situations.

Brain research has teamed up with education research to develop concrete theories regarding learning and the brain. Brain-based learning is one result of that research partnership. Brain-based learning rests on the fact that the various disciplines relate to each other and share common information that the brain can recognize and organize (Caine & Caine, 1991).

Educators know what works. As stated earlier, there is little experimental research to back them up, but through teaching and experimenting in their own classrooms with their own students many educators see results of interdisciplinary teaching techniques and draw positive conclusions from those results (Kuhrasch, 1998; Woods & Weasmer, 1999; Lake, 1995).

Kuhrasch, a physical educator, integrates curriculum in her classes. She developed the STAIR acronym to describe the benefits she has observed as a result of teaching integrated curriculum (see Appendix B). All of the benefits summarized by Kuhrasch's "STAIRS to integration" (Kuhrasch, 1998) are supported in the literature reviewed for this study.

First, students learn to apply skills to various situations and in various authentic environments. Acquiring and using information is a necessary life skill as we enter the

twenty-first century (Rauhauser & Mclennan, 1995). The ability to relate a skill to many different situations is essential for success in today's Biotechnical Age.

Kuhrasch (1998) stated that integration allows teachers to present more information in less time and with greater student enthusiasm. Students enjoy making connections between physical education and academic areas (Rauschenbach, 1996). Providing an enriched learning environment is a key contributor to student achievement.

Student attitudes improve when they are presented integrated curriculum. Jacobs (1989) stated that integrated curriculum is associated with better student self-direction, higher attendance, higher levels of homework completion, and better attitudes toward school. In addition, McIver (as cited in Lake, 1995) observed improved attitudes, work habits, and team spirit among students enrolled in an integrated program.

As Lake (1995) pointed out, teachers benefit as well. MacIver also found that teachers in an integrated program value the social support of working in teaching teams and are revitalized by new interests and teaching techniques. Marsh (1999, p. 130) stated that "teachers do not improve by remaining professionally isolated". Teachers can gain a better understanding of the knowledge, expertise, and teaching methods of other staff members as well as improve teamwork by working together to plan an integrated unit or curriculum (Cone & Cone, 1999a).

## Integration Works

According to Lake (1995) research on curriculum integration falls into three major categories. The largest amount of research is in the area of reports by teachers describing their integrated curriculum and experiences they had collaborating with

teachers to create thematic units. Many reports can also be categorized as descriptions of how to successfully implement an integrated curriculum. This report falls into the third and smallest category: comparison studies which determine the effectiveness of integrated curriculum on content learning and/or student attitudes (Lake, 1995).

The limited number of studies that report the effect of integrated curriculum on learning provide provisional rather than definite conclusions because they have various research flaws, many of which are extremely difficult to control in an educational setting. Many involve smaller numbers of participants than more traditional subject studies. Student achievement and the success of a curriculum can be altered by so many variables that it is difficult to accurately assess the success of an integrated curriculum or unit. Although limited and flawed, the research that documents the effect integration has on learning does support the implementation of an integrated curriculum in both elementary and secondary schools (Lake, 1995).

Integration is a technique used by many educators nationally. According to Caine and Caine (1991) a model of integrative learning taught at Guggenheim Elementary School in Chicago produced a significant increase in student achievement (compared with other schools in the district). Guggenheim is in the inner city and qualifies for Chapter One funding for disadvantaged and low-income students.

Werner (1999) discussed the results of his dissertation about the learning effect of integrating selected science concepts with physical education. In his study, he compared student learning between a group of students who learned the science concepts through movement experiences to a group of students who learned the same concepts only in the

classroom. The results of his study "demonstrated more of a positive learning effect for those children who learned the science concepts through active movement lessons than for those who learned the same concepts in a classroom setting only" (Werner, 1999, p. 5).

Research from every category regarding curriculum integration supports its positive effects. Kuhrasch (1998) and Lake (1995) summarized the following positive effects of integrated curriculum. Integrated curriculum helps students apply skills and develop positive attitudes towards learning. Students acquire an integrated knowledge base from the multiple perspectives encouraged through integrated curriculum. That integrated knowledge base produces faster retrieval of information. Finally, curriculum integration allows more quality time to be spent on curriculum exploration.

## Problems

New teaching methods or curriculum are difficult to implement, but once implemented, integrated curriculum saves time by teaching multiple concepts concurrently (Kuhrasch, 1998; Lake 1995). Two areas in particular have caused many teachers to become frustrated by integration: lack of structure, and "territorial teachers" (Jacobs, 1989). Developing an accurate scope and sequence for an integrated curriculum is more difficult than for a traditional segmented curriculum.

Some teachers may feel threatened by sharing their discipline. Since physical education is already thought of as a peripheral subject, it is easy to understand why integrating every other subject into physical education threatens some teachers. Integrating classroom subjects into physical education does not imply that physical

education curriculum is not valuable by itself (Werner, Simmons, & Bowling, 1989). Integration should not be a one-way investment. Stevens- Smith (1999) argued that integrating physical education and movement experiences into classroom instruction would complement the other academic curricula areas. Some physical educators fear that by integrating classroom subjects "physical education may lose its own identity and focus" (Placek, 1992, p. 340).

Cone and Cone (1999a) listed possible barriers to developing and implementing an integrated curriculum. Common planning time for teachers who integrate is essential and administrators who value efforts to integrate must provide support through professional development opportunities and by providing common planning time for teachers. Lack of parental support and understanding may also be barriers if the objectives and rationale for the curriculum changes are not clearly established. The most prevalent concern was that moving to an integrated curriculum would result in important content to be forgotten or lost while the purity of discipline areas suffer. Cone and Cone (1999a) conclude that although discouraging barriers exist, integrating curriculum is a "worthwhile risk" (p. 11).

Interdisciplinary curriculum does not threaten the existence of discipline-specific curriculum. According to Cone and Cone (1999a, p. 8) "the dialogue has shifted from comparing value and worth to finding a balance between teaching discipline-specific content and engaging in interdisciplinary teaching efforts". Both curriculum models have value and, if used appropriately, can be used together to provide the best education possible.

## Support

The Council on Physical Education for Children (COPEC) recognizes developmentally appropriate practices in the cognitive education domain as "experiences which encourage children to... integrate, analyze... and apply cognitive concepts... thus making physical education a part of the total educational experience" (Woods & Weasmer, 1999, p.21). According to Woods and Weasmer (1999), thoughtful educators follow COPEC principles by joining learning experiences from various disciplines in order to provide students the opportunity to apply a wide variety of concepts.

COPEC is only one of many educational organizations to support integrated curriculum. The Association for Supervision and Curriculum Development, the National Dance Association (NDA), the National Association for the Education of Young Children (CAEYC), and the National Association for Sport and Physical Education (NASPE) support the principle of interdisciplinary teaching (Werner, 1999). Publications regarding developmentally appropriate methods for NAEYC and NASPE "support interdisciplinary learning delivered by specialists working with classroom teachers" (Werner, 1999, p. 6).

NASPE's Physical Education Standards (NASPE, 1995) do not mention interdisciplinary education, but many of the sample benchmarks and assessments for each of the seven content standards for physical education require application of language arts components in order to meet physical education standards. NASPE assessment options which require language arts skills are student logs, student journals, interviews, written tests, and event tasks.

The Teacher Education Task Force (appointed by NASPE) described a thorough

teacher education model that uses concepts focussing on content knowledge, pedagogical knowledge, teaching and learning styles, and collaboration (Cone & Cone, 1999b). Content knowledge includes the ability to "understand how to relate physical education content with other subject areas" (Cone & Cone, 1999b, p12). Collaboration requires teachers to work with the community, parents, and colleagues and value all learning experiences, including those regarding other subject areas.

Chapter II examined various literature related to integrated curriculum. A historical perspective of curriculum was presented, today's confusing terms for different multiple subject curriculum models were defined, and multiple discipline teaching models varying in complexity were defined. The relationship between Gardner's theory of multiple intelligences and integration was considered along with benefits ranging from developing critical thinking skills to increasing teacher and student enthusiasm. Several previous studies and teacher testimonies about the effects of integration were also examined. Finally, Chapter II described some potential problems with implementing an integrated curriculum and reviewed standards set by national teaching organizations regarding integration.

# CHAPTER III

# METHODS AND PROCEDURES

## Introduction

The purpose of this chapter is to describe the methods and procedure for this study. A total of 45 fifth grade subjects from Harry Spence Elementary School in La Crosse, Wisconsin took a geometry pretest and posttest. Both groups received geometry instruction from their respective classroom teachers and gymnastics instruction from the same physical education specialist simultaneously. One group (the integrated group) received gymnastics instruction that integrated geometry concepts. The other group (the control group) only received gymnastics instruction from the physical education specialist.

## Purpose of the Study

The purpose of this study was to analyze the effect integrating geometry into a physical education gymnastics unit had on geometry test scores. Specific fifth grade geometric concepts of angles and line relationships were integrated into a gymnastics unit focussing on floor exercises.

## Subject Selection

Fifth grade was the chosen grade level for several reasons. Fifth graders were not randomly assigned to classes. These particular fifth graders had fewer discipline problems than other grade levels taught by the researcher. The researcher felt as though time taken away from the lesson to deal with possible discipline problems would affect the integrity of the study. As a first year teacher the researcher is still learning class

management techniques and felt the need to focus on physical education alone for the younger grades. Two of the school's three fifth grade teachers teach geometry simultaneously. It is necessary for both teachers to teach geometry as the researcher teaches gymnastics. Another reason the fifth grade was chosen was that they meet after a teaching preparation time, which would allow the researcher more time to mentally prepare as well as prepare any necessary changes in gymnasium supplies.

## Procedure

A Research and Development Request (see Appendix C) was submitted to the School District of La Crosse and this research was approved by the research and development committee prior to data collection. In addition, the University of Wisconsin-La Crosse Institutional Review Board approved of this research proposal.

A coin was flipped to determine which of the two fifth grade classes would be taught the integrated lessons. The researcher decided class A would be heads and class B would be tails and the class that landed up would be integrated. The coin landed heads up so class A received the integrated lessons. Class A would be referred to as the "integrated group" and class B the "control group".

The units integrated in this study were gymnastics and geometry. Each group's geometry pretest and posttest scores were compared between the group receiving geometry integration and the group receiving gymnastics instruction alone.

Students completed an informed consent form (see Appendix D) and returned it to the physical education specialist. One group received the integrated instruction while the other received gymnastics instruction alone. The students took a geometry pretest before

the gymnastics unit and posttest after the unit. The fifth grade teachers were supportive and willing to assist in this study.

The fifth grade classes took a 32- item written pretest measuring their knowledge of geometry before treatment. Students took the geometry posttest the day after completing their geometry unit. The classroom teachers administered the tests and did not answer any questions during the test. The researcher graded each test and allowed the classroom teachers to see them when the study was complete. The classroom teachers may use the tests for their own grading, but in the study student and teacher names were kept confidential. The classroom teachers were asked not to discuss the research project with the students while the units were being taught.

Each fifth grade physical education lesson was 45 minutes long. The School District of La Crosse uses a 6-day teaching cycle for elementary specialists. Each class met twice during the 6-day specialist cycle, or approximately five times in one month. The researcher developed and carried out lesson plans (see Appendix E). Each integrated lesson had at least one physical education objective and one geometry objective. Not all fifth grade geometry concepts were integrated into the 5-day gymnastics unit.

## Instrumentation

The classroom teachers provided the researcher with the mathematics textbook (Fennell, 1992) that included the geometry pretest and posttest (see Appendix F). A panel of experts including the La Crosse School District curriculum committee reviewed the textbook and tests within the book. Students were given as much time as necessary to

complete the tests. Questions on the two tests were different but assessed the same geometry content. Tests were not returned to students until the completion of the study.

## Geometry Curriculum

The fifth grade classroom teachers in this study taught from the Elementary Mathematics Curriculum for grades three through five in the School District of La Crosse (see Appendix G). According to this curriculum fifth graders should be able to: explore strategies to find the circumference of a circle; know how to estimate and measure angles; reinforce fourth grade concepts; and know three types of triangles - equilateral, isosceles, and scalene. All fourth grade expectations were reinforced by each classroom teacher. The fourth grade expectations reinforced through the integrated gymnastics unit included the following: know concept of line segment, ray, lines, angles, vertex; introduction to parallel lines, intersecting lines and perpendicular lines; and know the three types of angles acute, obtuse, and right.

## Statistical Treatment

Raw test scores (see Appendix H) were entered into SPSS Version 8.0 and descriptive statistics were utilized to compare the two groups. A two-way test of independent samples was used to determine if mean pretest scores between the two groups were significantly different. An ANCOVA was used to adjust for pretest differences before determining if posttest mean scores were significantly different between the two groups.

This concludes the description of methods and procedures of the study. The next chapter will report study results and discuss those results.

# CHAPTER IV

# RESULTS AND DISCUSSION

## Introduction

The purpose of this study was to analyze the effect that integrating fifth grade geometry concepts into physical education has on geometry test scores. One class of fifth graders (n = 24) was taught a physical education gymnastics unit without geometry integration and the other fifth grade class (n = 21) was taught physical education with geometry concepts integrated into their gymnastics unit. The geometry integration focussed on line relationships and angles. Both classes received geometry instruction from their respective classroom teacher while the physical education teacher taught gymnastics. Classroom geometry instruction followed the La Crosse School District curriculum (see Appendix F) for elementary mathematics. Pretests were given to both classes prior to their geometry and gymnastics units. Both classes completed the posttests the day after their classroom geometry units ended.

## Subject Treatment

A total of 45 subjects completed the pre- and posttest. Subjects were fifth grade students at Harry Spence Elementary School in the La Crosse School District. The control group consisted of 12 females and 12 males while the integrated group was made up of 14 females and 7 males. The control class (or group) had 24 subjects. All 24 of those subjects attended physical education and classroom studies together. Of the 26 students enrolled in the integrated class only 21 were subjects used in this study. Of the

remaining five students, two were not present for the pretest and three were enrolled in special education classes. The three students in special education did not receive classroom geometry instruction, but they did receive physical education integrated gymnastics with the other 21 subjects.

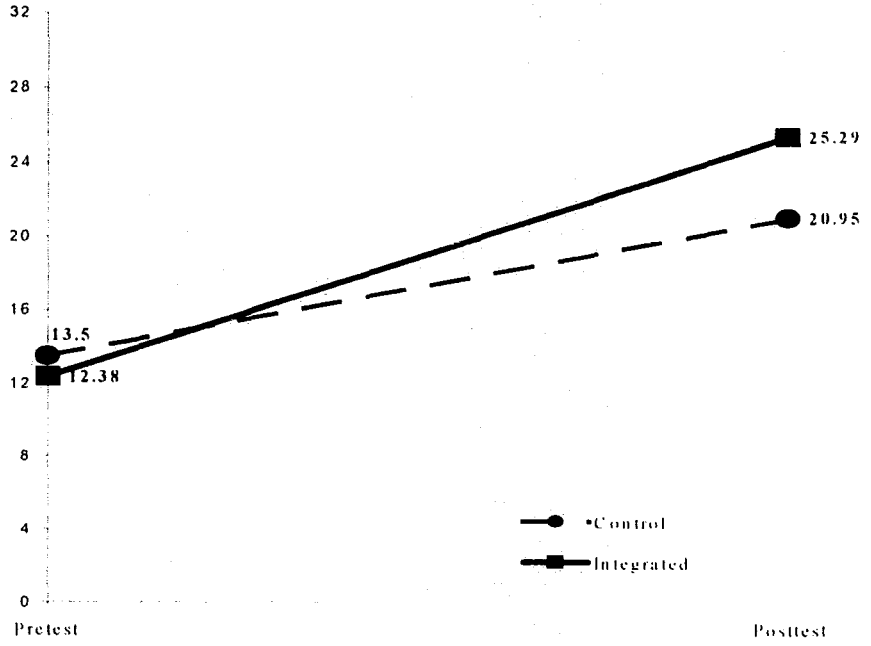
## Results

The means, standard deviations, and difference between pretest and posttest means for each group are summarized in Table 1. Figure 1 graphically represents the between group means.

Table 1. Means and Standard Deviations (SD) for Geometry Scores

| Group | N | Statistic | Pretest | Posttest | Difference |
|---|---|---|---|---|---|
| Control | 24 | Mean | 13.50 | 20.96 | +7.46 |
| | | SD | 4.53 | 4.83 | +.30 |
| Integrated | 21 | Mean | 12.38 | 25.29 | +12.91 |
| | | SD | 4.42 | 3.9 | -.52 |

Figure 1. Line graph representing mean pretest and posttest scores for both groups.




A p-value greater than .05 indicates that there was not a significant difference between the two groups. An independent t-test for equality of means indicated that the mean pretest score of the control group was not significantly different than the mean pretest score of the integrated group ($t = .836$, $p = .408$).

An analysis of covariance (ANCOVA) was used to test for significant differences between groups in the posttest means using the pretest means as the covariant. Although differences between pretest means were insignificant, the ANCOVA test adjusted for those differences before analyzing posttest means. The ANCOVA analysis indicated a

significant difference between the control group posttest mean and the integrated group posttest mean ($F = 20.36$, $p < 0.001$).

## Discussion

The hypothesis of this study was that integrating classroom geometry objectives into a physical education gymnastics unit would not result in a significantly changed rate of learning geometry. Results indicated there was a significant difference between the control and integrated groups in learning geometry. The control group posttest mean score was 7.46 points higher than its pretest mean score while the integrated group mean score increased by 12.91 points. As the results indicate, the null hypothesis was rejected.

According to Gardner (1993) there are at least eight different ways of processing information. People are able to process information in each way, or through each intelligence, but they exhibit strengths in one or two of the eight intelligences. Bodily-kinesthetic learners use bodily sensations to process information. A classroom teacher who integrates physical activities or a physical education teacher who integrates classroom objectives is especially beneficial to the kinetic learner. This researcher believes that integration in physical education benefits all learners, kinetic or not, by challenging them to use movement to make connections between subject areas. This use of movement in an alternative fashion creates an energy or enthusiasm that can greatly improve the learning environment.

Once educators develop ways to reach each student, they must ensure that what they reach students with is applicable to the increasingly complex demands of the twenty-first century. Research suggests that multiple discipline teaching techniques may prepare

students for the new and complicated problems of the Biotechnical Age (Klein & Doty, 1994; Lake, 1995; Rauschenbach, 1996; Rauhauser & Mclennan, 1995). Students who are guided to link geometric concepts to movement activities outside of the classroom are more likely to be able to apply those geometric concepts to a variety of authentic situations and environments. According to Caine and Caine (1991) brain-based learning is based on the fact that the brain recognizes similarities between the disciplines, in this case geometry and gymnastics. Integration of these subjects stimulates the brain and excites the learner.

Lake (1995), Cone and Cone (1999a), and Woods and Weasmer (1999) have documented cases where integrated curriculum caused an increase in teacher and student enthusiasm. Although enthusiasm was not measured and recorded in this study, it was noticeably higher in the physical education teacher and the students involved in integrated lessons. In the beginning of the unit students in the integrated group seemed to be confused or shocked by the use of geometric concepts in the gym. They responded quickly by the end of the unit started to make connections using the physical education teacher as a facilitator rather than a conductor.

Although differences in student attitudes were not measured or evaluated formally in this study, it was clear that students in the integrated physical education class were more actively engaged in their own learning. They began to ask inquisitive questions and make connections without the teacher explicitly defining the connections. This observation of student attitude supports the vast amount of literature that reports

improvements in student attitude in an integrated curriculum (Jacobs, 1989, Kuhrasch, 1998; Lake, 1995).

Research in the form of comparing student learning from integrated to discipline-based teaching is rare, but results from this study are comparable to similar integration studies. Peter Werner (1999) studied the effect integrating science into physical education had on learning. His findings were similar to the findings of this report. The students who learned science concepts both in their classroom and in physical education showed more of a positive learning effect than the students who learned science only in their classroom.

As Kuhrasch (1998) and Lake (1995) pointed out, integration is not always easy to implement. Integration, like team teaching and mentor programs, requires teachers to open their classroom to fellow teachers and share what they are teaching. This collaboration can be frightening, especially to teachers who have been isolated for years or who have been in threatening faculty environments. The atmosphere of the school has a great effect on whether teachers feel comfortable to take curricular risks. Teachers and administrators must be willing and comfortable enough to discuss the problems that integration may create.

Potential problems outlined by Cone and Cone (1999a) include the need for common planning time between teachers who integrate. Very little common planning time was used for this study. Although results indicated increased geometry attainment in the integrated group this researcher believes that utilizing a more complex and longer integrated unit could have made even greater gains. Common planning time would be

essential in order to develop a more complicated multiple discipline unit than the one used in this study.

Physical education organizations support the integration of academic subjects, but it is equally important for other education organizations to support the integration of physical education into the classroom. The responsibility to integration should not be on the shoulders of the physical educator. The weight should be shared among all educators and administrators. Without common planning time, proper training, parent and community education, and the freedom to try new curricula, teachers should not be expected to add to their already full schedules. Further, if physical education is not respected as a separate discipline it is not likely that the physical educator will want to integrate other subjects for fear of loosing their own. Support has been documented but it must be demonstrated through action in order to produce real change.

Chapter IV reviewed the treatment of the subjects during the study, the statistical results of the study, and a discussion regarding the implications of the study. The next chapter summarizes the findings and conclusions from the study as well as outlines suggestions for further research.

# CHAPTER V

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

### Summary

The purpose of this study was to determine what effect integrating geometry into a physical education gymnastics unit had on geometry test scores. The subjects were 45 fifth grade students in two different classes. Classes were randomly assigned to two groups. One class was assigned to be the control group and did not receive integrated instruction. The other class was assigned to be the integrated group and received sequential geometry integration in their five-lesson physical education gymnastics unit. Each group received geometry instruction from their respective classroom teachers while they received gymnastics instruction from the same physical education teacher.

The lesson plans (see Appendix E) were developed and taught by the researcher. Each class took the same geometry 32- item pretests and 32- item posttests (see Appendix F). The pretests were given the day before their classroom teachers started their geometry unit. The posttests were taken the day after each class finished their classroom geometry unit. Each classroom teacher taught the geometry unit from the La Crosse School District Curriculum (see Appendix G).

The integrated groups' pretest mean score was 12.38 and posttest mean score was 25.29. The control groups' pretest mean score was 13.50 and posttest mean score was 20.96. An independent t-test for equality of means was used to determine if the groups'

pretest scores differed. This test indicated no significant difference between the groups in the pretest ($p > .05$). An ANCOVA adjusted for the insignificant differences in prestest means and was used to determine if the groups' posttest scores were significantly different. It indicated that the groups' posttest scores were significantly different ($p < .05$).

## Conclusions

The results indicate that integrating geometry into a fifth grade gymnastics physical education unit increased learning of geometry as measured by difference in pretest and posttest scores. The integrated group learned geometry concepts better than the control group. There were, as there are in any educational setting, many limitations to this study. Integration may not have been the sole contributing factor, but it did contribute to the higher test scores.

Every teacher, regardless of their discipline area, can integrate without losing the identity or significance of their primary subject area. Teachers at every level should feel as though they are all members of the same team, striving to graduate students who are able to think critically in order to solve real world problems. Integration should not be a one-way process. Classroom subjects can be enhanced by the integration of physical education concepts. Integrating movement activities into academic subject instruction may help the classroom teacher reach students from every learning style or intelligence.

As this and other studies reviewed in Chapter II indicate, integration can benefit students as well as teachers. Although student and teacher attitudes were not measured and reported in this study, the researcher did observe increased motivation and

enthusiasm by the students in the integrated group. In addition, the researcher felt excited to offer integrated lessons and benefited from communicating with the classroom teacher about lesson objectives and methods of integration. Increasing teacher motivation and decreasing teacher isolation are benefits that may not be supported with concrete data, but they are just as valuable as any others. Physical educators often feel isolated from other school faculty and can use integration to share their curriculum and ideas with other teachers.

Simple integration used in this study produced significant results, which should encourage teachers to integrate. Every teacher could experience similar results by integrating movement activities into their classroom or by integrating classroom concepts into their gymnasium. Challenging and guiding students to make connections between subjects leads to benefits that far outweigh possible drawbacks.

## Recommendations

Based on the results of this study, several recommendations for future research may be suggested. High school physical educators often view integration as a valid curricular practice for the elementary or middle levels alone. Future research regarding integrating academic areas into high school physical education curriculum may find that integration can benefit the high school student academically as well as help the student in acquiring the skills taught in physical education. Research may also discover an increased motivation and sense of teamwork between teachers who integrated at the high school level.

This study was limited to the integration of certain geometric objectives into a five-day physical education unit. Future research involving longer units and more

academic objectives may result in even more of a positive learning outcome. In addition, future research on the effects of integration on test scores of an academic subject using a pretest, posttest, and a delayed posttest may reveal the effects of integration on content retention.

Gender differences were not investigated in this study. Future research, especially in the area of mathematics instruction should study effects integration has on one gender as compared with the other. Maybe future research can determine why many young girls are turned off to mathematics and how educators can prevent it.

Finally, rather than only testing academic content knowledge when the academic subject is integrated into physical education, it is suggested that researchers investigate the effects integrating has on physical education to determine if physical education content is sacrificed as a result of integrating an academic subject. Tests for physical education skill acquisition as well as physical education content acquisition may be utilized in future research.

## REFERENCES


Caine, R.N., & Caine, G. (1991). Making connections: Teaching and the human brain. Alexandria, VA: Association for Supervision and Curriculum Development.

Cone, S. L., & Cone, T. P. (1999a). The interdisciplinary puzzle. Teaching Elementary Physical Education, 10(3), 8-11.

Cone, T. P., & Cone, S. L. (1999b). Standards, assessment, and interdisciplinary education: Discovering and creating new links. Teaching Elementary Physical Education, 10(3), 12-14.

Fennell, F. (Ed.) (1992). Mathematics plus. Orlando, Fl: Harcourt Brace Jovanovich.

Fogarty, R. (1991). The mindful school: How to integrate the curricula. Palatine, IL: Skylight.

Gardner, H. (1993). Frames of mind. (10th ed.). New York: BasicBooks.

Humphreys, A., Post, T., & Ellis, A. (1981). Interdisciplinary methods: A thematic approach. Santa Monica, CA: Goodyear.

Jacobs, H. H. (Ed.). (1989). Interdisciplinary curriculum: Design and implementation. Alexandria, VA: Association for Supervision and Curriculum Development.

Klein, J. T., & Doty, W. G. (Eds.). (1994). Interdisciplinary studies today. San Francisco: Josey-Bass

Kuhrasch, C. (1998, July). Integrated curriculum. Paper presented in University of Wisconsin- La Crosse ESS 771, Current Issues in Physical Education, La Crosse, WI.

Lake, K. (1995). Close-up #16: Integrated curriculum. Northwest Regional Educational Laboratory. Available : http://www.ssec.org/idis/cohasset/InteCur.htm

Lederman, N. G., & Niess, M. L. (1997). Integrated, interdisciplinary, or thematic instruction? Is it a question or is it questionable semantics? School Science and Mathematics, 97(2), 57-58

MacIver, D. (1990). Meeting the need of young adolescents: Advising groups, interdisciplinary teaching teams, and school transition programs. Phi Delta Kappan, 71(6), 458-465.

Marsh, D. D. (Ed.). (1999). 1999 ASDC yearbook: Preparing our schools for the 21st century. Alexandria, VA: Association for Supervision and Curriculum Development.

National Association for Sport and Physical Education. (1995). Moving into the future: National standards for physical education. St. Louis, MO: Mosby.

Nichols, B. (1994). Moving and learning: The elementary school physical education experience. St. Louis, MO: Mosby.

Placek, (1992). Rethinking middle school P.E. Quest, 44(3), 330-341.

Rauhauser, W., & Mclennan, A. (1995). America's schools: Making them work. Chapel Hill, NC: New View.

Rauschenbach, J. (1996). Tying it all together: Integrating physical education and other subject areas. Journal of Physical Education, Recreation, and Dance, 67(2), 49-51.

School District of La Crosse. (1997). Elementary Mathematics Fifth Grade Guide. (Available from Hogan Administrative Center, 807 East Ave. South, La Crosse, WI 54601)

Stevens-Smith, D. A. (1999). Physical education in the classroom . . . you've got to be kidding! Teaching Elementary Physical Education, 10(3), 18-20.

Tchudi, S., & Lafer, S. (1996). The interdisciplinary teacher's handbook: Integrated teaching across the curriculum. Portsmouth, NH: Boynton/Cook.

Teele, S. (1996). Redesigning the educational system to enable all students to succeed. National Association of Secondary School Principals, 80(96) 65-75.

Vars, G. (1991). Integrated curriculum in historical perspective. Educational Leadership, 49(2), 14-15.

Werner, P. (1999). More than a passing fad, it's here to stay. Teaching Elementary Physical Education, 10(3), 5-6.

Werner, P., Simmons, M., & Bowling, T. (1989). Combining the arts and academics. Journal of Physical Education, Recreation, and Dance, 60(3), 55-57.

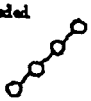
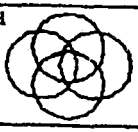
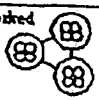
White, A. M. (Ed.). (1981). Interdisciplinary teaching. San Francisco Josey-Bass.

Wilson, L., Malgren, D., Ramage, S., & Schultz, L. (1993). An integrated approach to learning. Portsmith, NH: Heinemann.

Woods, A. M. & Weasmer, J. (1999). Integrated learning: Greater than the sum of its parts. Teaching Elementary Physical Education, 10(3), 21-23.

# APPENDIX A

# ROBIN FOGARTY'S MODELS OF INTEGRATION

| Name | Description |
| --- | --- |
| Fragmented | Separate and distinct disciplines. |
| Connected | Topics within a discipline are connected. |
| Nested | Social, thinking, and content skills are targeted within a subject area. |
| Sequenced | Similar ideas are taught in concert although subjects are separate. |
| Shared | Team planning and/or teaching that involves two disciplines focuses on shared concepts, skills or attitudes. |
| Webbed | Thematic teaching, using a theme as a base for instruction in many disciplines. |
| Threaded  | Thinking skill, social skills, multiple intelligences, and study skills are "threaded" throughout the disciplines. |
| Integrated  | Priorities that overlap multiple disciplines are examined for common skills, concepts, and attitudes. |
| Immersed | Learner integrates by viewing all learning through the perspective of one area on interest. |
| Networked  | Learner directs the integration process through selection of a network of experts and resources. |

# APPENDIX B

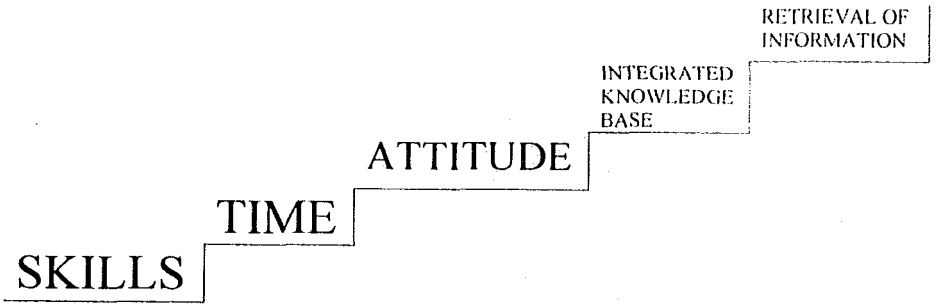
## CINDY KUHRASCH'S "STAIRS" TO INTEGRATION

# THE "STAIRS" TO INTEGRATION

CINDY KUHRASCH

BENEFITS OF INTEGRATED LEARNING:

- ☐ STUDENTS LEARN TO APPLY *SKILLS*
- ☐ TEACHERS ARE ABLE TO COVER MORE CONTENT IN LESS *TIME*
- ☐ STUDENTS *ATTITUDES* ABOUT LEARNING ARE IMPROVED
- ☐ STUDENTS DEVELOP AN *INTEGRATED* KNOWLEDGE BASE
- ☐ STUDENTS ARE ABLE TO *RETRIEVE* INFORMATION MORE EASILY



# APPENDIX C

## SCHOOL DISTRICT OF LA CROSSE RESEARCH AND DEVELOPMENT REQUEST

**SCHOOL DISTRICT OF LACROSSE**
**Research & Development Request**
**RESEARCH/SURVEY OVERVIEW**

Date November 23, 1998
Name of Applicant Jeanne Bastasch Phone 785-0873
Address 1614 King Street, La Crosse, WI Zip 54601
Title of research / survey The effects of integrating a classroom subject into a physical education unit.

## I. DEFINITION OF THE PROJECT

A. *Statement of the proposed project*

The project I am proposing is a study to demonstrate if integrating a classroom subject into a physical education unit will have an effect on student learning. I would like to integrate fifth grade geometry into my gymnastics unit while their classroom teachers are teaching geometry. One class will receive the integrated instruction while the other will receive gymnastics instruction alone. The students will take a geometry pretest before the gymnastics unit and posttest after the unit. I have talked with the fifth grade teachers and they were supportive and willing to assist me in this study

B. *Brief history of the problem*

There is very little research regarding the effects of integrated instruction and no research specifically studying physical education integration. Many physical educators are integrating health, anatomy, and physiology concepts into their curriculum, but subjects such as math are seldom integrated. There are two major philosophical questions regarding integration in physical education. One, does integrating classroom subjects imply that our own physical education objectives are not important enough to justify an entire curriculum? Two, will an integrated curriculum decrease student activity time? It is pointless to argue either point without knowing what benefits, if any, integration has on academic learning.

C. *Definitions of terms or key concepts*

Integration: "topic sharing" among two or more subjects
Sequential integration: two or more subjects share topics simultaneously
Integrated knowledge base: subject areas connected in mind
Information retrieval: the act of recalling data from memory

D. *Hypothesis*

Integrating classroom geometry objectives into a physical education gymnastics unit will result in increased learning of geometry.

## II. DESIGN OF THE PROJECT

A. *Proposed Starting Date:* January 4, 1999
*Completion Date:* February 12, 1999

B. *Extent of school personnel involved*

1. Number of pupils requested: 63

2. Grade levels involved: 5th
3. Estimated time required for each pupil: Approximately one hour outside of physical education class.
4. Estimated time required for each teacher: The teacher of the class receiving the integrated lessons will meet with me for approximately one hour before the unit begins to discuss subject content and objectives. We have already met to discuss this and he was more than helpful and receptive. I will also ask each teacher to record the time that they dedicate to geometry instruction.
5. Number of parents required: None
6. Estimated time required of each parent: None
7. Number of other La Crosse school staff requested: None
8. Estimated time required of other La Crosse Staff: None
9. Will information from the behavioral folder of pupils be required? No
10. Will the subjects be paid: No
11. Will a pilot study be necessary first? No
12. How will the anonymity of the subject be protected? Students will not put their names on their tests. Classroom teachers will not be named in the study. Classes will only be referred to as "Treated" and "Control".
13. Will parent permission be necessary? No

C. *Instrumentation (copies attached)*

Source:

Mathematics plus: Teacher's guide testing program. (1992). Harcourt Brace Jovanich, Inc.: Orlando, FL.

D. *Procedure for data collection*

The fifth grade classes will take a thirty-two item written test measuring their knowledge of geometry. The classroom teachers will administer the tests and I will ask them not to answer any questions during the test. I will grade the tests, then if the teachers want to use them for their own grading they may, but I will not record the student nor the teacher's names.

## III. METHOD OF EVALUATION FOR THE PROJECT

The project is being completed as part of my Master Degree thesis requirement. The project will be evaluated by the graduate faculty members on the thesis committee, chaired by Dr. Jeff Steffen and by Dr. Garth Tymeson, Associate Dean, College of Health, Physical Education, and Recreation and Dean of Graduate Studies at the University of Wisconsin - La Crosse.

## IV. SIGNIFICANCE OF THE PROJECT

A. *For the school district*

This project may serve as a stepping stone for further research directed toward the integration of classroom subjects and physical education. Meaningful study designed to maximizing student learning through innovative techniques

and strategies demonstrates the district's dedication to providing the best education possible.

B. *For education in general*

Classroom teachers have the difficult assignment of educating more than twenty individual learners. I believe that there are as many learning styles as there are students, but in general, students learn better when they can make connections between subjects. Integration may help make those connections for students. It is easier to recall information from an integrated knowledge base because of the increase in pathways for information retrieval. Integrating academic subjects into movement experiences offers students a way to learn by doing as they apply concepts to authentic situations.

Return to: Kathie Tyser, R&D Chairperson
Hogan Administration Center
807 East Avenue South
La Crosse, WI 54601
Contact at: 608-789-7661 or ktyser@mail.sdlax.k12.wi.us

# APPENDIX D

# INFORMED CONSENT

## INFORMED CONSENT FOR THE STUDY OF THE EFFECTS OF INTEGRATION OF CLASSROOM SUBJECTS INTO PHYSICAL EDUCATION

I give my informed consent to participate in this study of the effects of integration. I consent to the presentation and publication or other dissemination of study results so long as the information is anonymous and disguised so that no identification can be made. I further understand that although a record will be kept of my having participated in the study, all test results will be identified by number only.

(1) I understand that my participation in this research will involve my taking a pre and a posttest in fifth grade geometry.

(2) I have been informed that the purpose of this research is to study the effects of integrating fifth grade geometry concepts into a physical education gymnastics unit.

(3) I have been informed that this research will not increase the risk of injury due to involvement in physical education.

(4) I have been informed that all student test scores will be kept confidential and recorded by randomly assigned student identification numbers

(5) I have been informed that the teacher will answer questions regarding the procedures of this study when the lessons are finished.

(6) I have been informed that I am free to withdraw from the study at any time and receive an alternative physical education experience.

Concerns about any aspect of this study may be referred to the researcher, Jeanne Bastasch (785-0873) and thesis advisor, Dr. Jeff Steffen (785-6535).
Questions regarding the protection of human subjects may be addressed to Dr. Garth Tymeson, Dean of Graduate Studies, University of Wisconsin- La Crosse (785-8155).

_____ _____

Researcher Participant

_____ _____

Parent or Legal Guardian Date

# APPENDIX E

# INTEGRATED LESSON PLANS

Five Lesson Gymnastics Floor Exercises/ Geometry Unit

Lesson One

PE Objective: Cross- pad positions & forward rolls

Geometry Objective: Identification of right, obtuse, and acute angles & define and identify vertex.

Learning Experience 1 5 minutes

Right Angle Tag: Four students are chosen to be it. If other students are tagged they need to go out of bounds and make a right angle with some part of their body. If they stand on a right angle on the gym floor (corners of basketball keys, corners of volleyball boundaries, etc.) they are "safe" for two seconds.

Learning Experience 2 10 minutes

Mat Stretch: Two students per mat. Teacher leads class in stretches. Students will be able to identify types of angles made by different stretches. Stretches: butterfly, modified hurdler, straddle, lunge, back twist (J.C. Penney), arm circles, arm across body, arm behind ear, neck rolls (side, forward, side). Angles: acute, obtuse, right

*INTRODUCE GYMNASTICS RULES: ONLY ATTEMPT STUNTS TAUGHT BY TEACHER; ONE PERSON ON A MAT FOR STUNTS; TWO PEOPLE FOR STRETCHING, CROSS- PADS, OR JUMPS.

Learning Experience 3 15 minutes

Cross- pad Positions: Introduce cross-pad positions: sit ("L", tuck, straddle, pike, "V"), support (rear, front, stag), stand (straight, straddle, gym, pike), front scale, knee scale, and straight lie. Students will recognize acute, obtuse, and right angle

Learning Experience 4 10 minutes

Jumps: The student will demonstrate safe landings with their legs bent to absorb

shock and their arms extended in front of them. Straight jumps, straddle jumps, tuck jumps, and pike jumps will be practiced.

Learning Experience 5 5 minutes

The students make and practice a routine that must have a sequence including three jumps and three cross- pad positions.

Lesson Two

PE Objective: Review cross-pad positions and introduce forward rolls.

Geometry Objective: Estimation of angles & review types of angles: acute, right, obtuse.

Learning Experience 1 10 minutes

Knee Tag: Two students on each mat. Standing on the mat they attempt to tag one another's knees.

Stretch: Student leads class in stretches. Teacher asks students to estimate their body angles for each stretch.

Learning Experience 2 5 minutes

Cross-pad review: Teacher calls out positions then students perform that cross-pad position as fast as they can. Variation: Teacher calls out any angle between 0 and 180 and students choose a cross pad position that makes that angle with their hips as the vertex.

Learning Experience 3 15 minutes

Forward Roll Progression from easy to difficult: log roll, egg roll, tuck to tuck forward roll, stand to stand forward, straddle to straddle forward roll, pike to stand forward roll, and pike to pike forward roll.

Learning Experience 4

The student will practice a self-designed routine that includes at least one type of

forward roll, jump, and five cross-pad positions. The student must be able to classify and estimate angles for each stunt. Teach observation and questioning will be used to assess the students' routines.

Lesson Three

PE Objective: Review/practice forward rolls and introduce backward roll progression.

Geometry Objective: Review/practice estimation of angles.

Learning Experience 1 10 minutes

Mirror Tag: Three students are "it"; tagged students must freeze in place and form right, obtuse, or acute angles with their arms and legs. In order to be unfrozen other classmates must mirror their angles and call out what kind of angle they are making.

Stretch: Student leads class in stretches. Partners on mats estimate angles made by various stretches.

Learning Experience 2 15 minutes

Backward roll progression from easy to difficult: rainbow maker, back rocker, tuck to tuck, tuck to stand, straddle to stand, tuck to knee scale, one legged to knee scale, pike to pike

Learning Experience 3 15 minutes

Upside down stunt progression from easy to difficult: tripod, tip-up, headstand, mule kick, handstand, cartwheel, round-off, one handed cartwheel. Teacher asks students to identify what body angles are needed for each upside down stunt.

Lesson Four

PE Objective: Introduce combination stunts. Practice individual routines.

Geometry Objective: Review estimation of angles and vertex. Introduce line segment,

line, and ray.

Learning Experience 1 10 minutes

Number stunts: Each student is given a number between one and four. Students jog in between mats on gym floor. Teacher calls out a number and angle and the designated students perform one stunt of choice and one cross-pad position that has the designated angle with the hips as the vertex.

Students stretch while teacher asks them to represent a ray, line segment, and line with their bodies. Pointed fingers and toes represent arrows for rays and lines Fisted hands and flexed feet represent endpoints.

Learning Experience 2 15 minutes

Combinations of stunts from easy to difficult: knee drop to log roll, knee scale to forward roll, tripod to forward roll, back rocker to backward roll, scale to mule kick, v-sit to backward roll.

Learning Experience 3 20 minutes

The students will develop a routine (individual or with a partner) with ten gymnastics stunts, including at least one stunt from each of the following categories: forward rolls, backward rolls, upside-down stunts, combination stunts. Next to the stunt they will identify the type of angle created by their legs

## Lesson Five

PE Objective: Introduce low beam balances and stunts.

Geometry Objective: Introduce line relationships of intersecting, parallel, and perpendicular. Reinforce knowledge of terms: plane, line, line segment, and ray.

Learning Experience 1 10 minutes

Set-up: More than 50 slips of paper; the word plane, line segment, line, or ray

written on each slip; slips scattered in center of gym; large signs with the line representation of each word drawn on separate signs; each sign posted on a separate gym wall.

Students with dark shoes on will start in the "A" group and people with light shoes on will start in the "drop-out" group. When music starts the students in the "A" group must carry one word slip at a time to the correct picture sign and leave it under that sign. Students in the "drop-out" group will carry one word slip at a time from under the signs to the center of the gym. Students stretch.

Learning Experience 2 10 minutes

Set-up: Small signs surrounding the balance beam with the words and line representations of intersecting, parallel, and perpendicular geometric concepts

The students will travel on a line and then across a low balance beam maintaining balance, keeping their head up, and focussing on the end of the line or beam. The student will practice dip steps, pivot turn, front scale, tuck jump, backwards walking, and tuck and straddle jump dismounts. The student will create parallel, perpendicular, and intersecting line relationships with their legs while balancing on the line or beam.

Learning Experience 3 25 minutes

The students will practice and then perform a routine (individual or with a partner) with ten gymnastics stunts, including at least one stunt from each of the following categories: forward rolls, backward rolls, upside-down stunts, combination stunts. Next to the stunt they will identify the type of angle created by their legs.

# APPENDIX F

# GEOMETRY PRETEST AND POSTTEST

Name _____

# Pretest



**Choose the letter of the correct answer.**

1. Which of these has exactly two endpoints?

   A. ray  B. plane
   C. line  D. line segment

2. Which is the best estimate of the measure of this angle?

   A. 10°  B. 45°  C. 65°  D. 80°

3. Which polygon has eight sides of equal length and eight angles of the same measure?

   A. irregular octagon
   B. irregular hexagon
   C. regular octagon
   D. regular hexagon

4. A triangle has exactly two sides of equal length. What type of triangle must it be?

   A. isosceles
   B. scalene
   C. equilateral

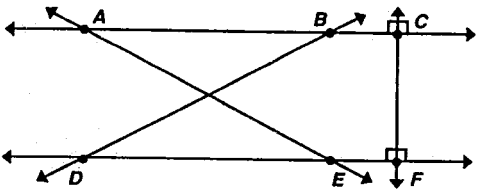
5. Which quadrilateral must have four right angles with opposite sides parallel and of equal length?

   A. trapezoid
   B. rectangle
   C. parallelogram
   D. rhombus

6. Which of these is a line segment that has the center of a circle and a point on the circle as endpoints?

   A. radius  B. chord
   C. diameter  D. not here

**Use the figure below to answer questions 7–9.**




7. Which line is perpendicular to $\overleftrightarrow{AC}$?

   A. $\overleftrightarrow{AE}$  B. $\overleftrightarrow{BD}$  C. $\overleftrightarrow{CF}$  D. $\overleftrightarrow{DF}$

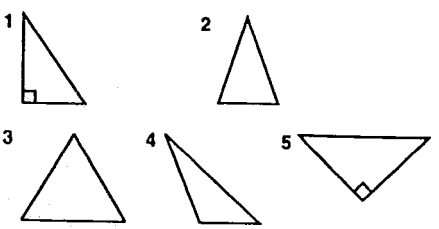
8. Which names a ray?

   A. $\overleftrightarrow{DB}$  B. $\angle DBC$
   C. $\overline{DB}$  D. $\overrightarrow{DB}$

9. Which is an obtuse angle?

   A. $\angle AEF$  B. $\angle DFC$
   C. $\angle CAE$  D. $\angle AED$

**Use the triangles below to answer questions 10–12.**




10. Which triangle is equilateral?

    A. 1  B. 2  C. 3  D. 4

Go on to the next page.

11. Which two triangles are right triangles?

A. 1 and 2 B. 1 and 5
C. 2 and 4 D. 2 and 3

12. Which two triangles are acute?

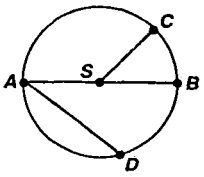
A. 1 and 5 B. 2 and 4
C. 2 and 3 D. 3 and 4

13. Which is a hexagon?

A. B.

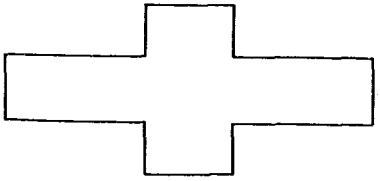
C. D.

14. Which is a diameter of this circle?



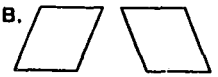

A. $\overline{AB}$ B. $\overline{AS}$ C. $\overline{SC}$ D. $\overline{AD}$

15. How many lines of symmetry does this figure have?



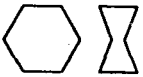
A. 1 B. 2 C. 3 D. 4

16. Which figures are congruent?

A. B. 

C. D.

17. Which figures are similar?

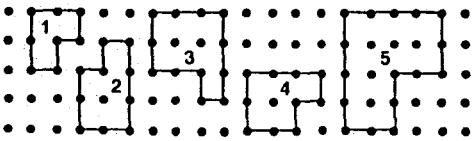
A.  B.

C. D.

18. Which figure has at least one line of symmetry?

A. B. C. D.

**Use the figures below to answer questions 19–20.**




19. Which is similar to Figure 1?

A. 2 B. 3 C. 4 D. 5

20. Which is congruent to Figure 2?

A. 1 B. 3 C. 4 D. 5

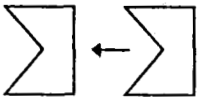
Go on to the next page.

Name _____

# Pretest

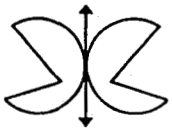


21. How was the figure moved?



A. slide
B. turn
C. flip
D. flip and turn

22. How was the figure moved?

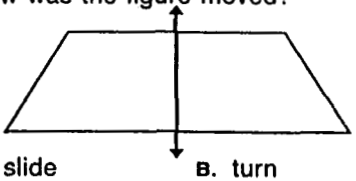


A. slide
B. turn
C. flip
D. slide and turn

23. How was the figure moved?

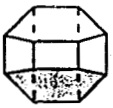
A. slide
B. turn
C. flip
D. slide and turn

24. How was the figure moved?



A. slide
B. turn
C. flip
D. flip and slide

25. What is this solid figure?

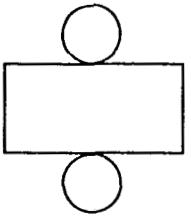


A. octagonal prism
B. octagonal pyramid
C. hexagonal prism
D. hexagonal pyramid

26. What solid figure has a square base and triangular faces?

A. triangular pyramid
B. square pyramid
C. triangular prism
D. square prism

27. What solid figure is formed from this pattern?



A. cone
B. sphere
C. prism
D. cylinder

28. How many vertices does a triangular prism have?

A. 3 vertices
B. 4 vertices
C. 5 vertices
D. 6 vertices

29. Tim's sister is 3 years older than Tim. Tim's brother is 4 years older than his sister. The sum of their three ages is their father's age. He is 37 years old. How old is Tim?

A. 6 years old
B. 7 years old
C. 8 years old
D. 9 years old

30. Sandra has 5 days left to practice running for a race. Each day she wants to run 1 kilometer farther than the day before. In all she wants to run 25 kilometers. How many kilometers should she run the first day?

A. 2km B. 3km C. 4km D. 5km

Go on to the next page.

Name _____

# Pretest



31. Tamara made a necklace. She started with 2 blue beads, added 1 red bead, 2 blue beads, 1 red bead, and so on, ending with 2 blue beads. If she used 32 blue beads, how many red beads did she use?

A. 15 red beads
B. 12 red beads
C. 10 red beads
D. 16 red beads

32. Seven people attended a meeting. Each person shook hands with each other person once. How many handshakes were there?

A. 6 handshakes
B. 7 handshakes
C. 15 handshakes
D. 21 handshakes

Stop!

Name _____

# Posttest



**Choose the letter of the correct answer.**

1. Which of these has exactly one endpoint?

   A. plane B. line
   C. ray D. line segment

2. Which is the best estimate of the measure of this angle?

   A. 35° B. 65°
   C. 85° D. 120°

3. Which polygon has 5 sides of equal length and 5 angles of equal measure?

   A. regular hexagon
   B. regular pentagon
   C. irregular hexagon
   D. irregular pentagon

4. A triangle has three angles smaller than a right angle. What type of triangle must it be?

   A. acute triangle
   B. obtuse triangle
   C. right triangle

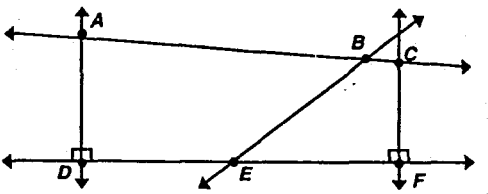
5. Which quadrilateral has exactly one pair of parallel sides?

   A. rhombus
   B. rectangle
   C. parallelogram
   D. trapezoid

6. What line segment connects two points on a circle but does *not* pass through the center of the circle?

   A. radius B. chord
   C. diameter D. ray

**Use the figure below to answer questions 7–9.**




7. Which line is parallel to $\overleftrightarrow{AD}$?

   A. $\overleftrightarrow{DF}$ B. $\overleftrightarrow{BE}$ C. $\overleftrightarrow{CF}$ D. $\overleftrightarrow{AC}$

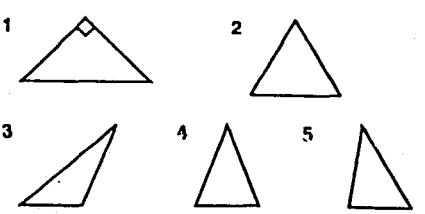
8. Which names a ray?

   A. $\angle ACD$ B. $\overleftrightarrow{AC}$
   C. $\overrightarrow{AC}$ D. $\overline{AC}$

9. Which is a right angle?

   A. $\angle ADE$ B. $\angle DEB$
   C. $\angle FEB$ D. $\angle EBA$

**Use the triangles below to answer questions 10–12.**




10. Which triangle is a right triangle?

    A. 1 B. 2 C. 3 D. 4

Go on to the next page.

11. Which two triangles are scalene?

A. 2 and 4 B. 3 and 4
C. 1 and 5 D. 3 and 5

12. Which two triangles are isosceles?

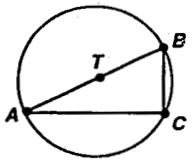
A. 1 and 4 B. 3 and 4
C. 3 and 5 D. 1 and 5

13. Which is an octagon?

A. B.

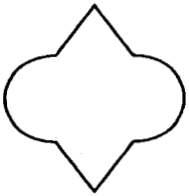
C. D.

14. Which is a radius of this circle?




A. $\overline{AB}$ B. $\overline{TA}$ C. $\overline{BC}$ D. $\overline{AC}$

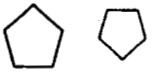
15. How many lines of symmetry does this figure have?



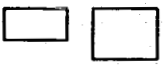
A. 1 line B. 2 lines
C. 3 lines D. 4 lines

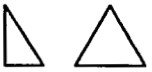
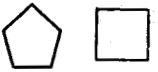
16. Which figures are congruent?

A. B.

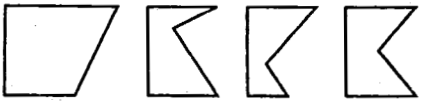
C.  D.

17. Which figures are similar?

A. B. 

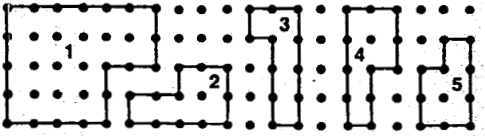
C.  D. 

18. Which figure has at least one line of symmetry?



A. B. C. D.

**Use the figures below to answer questions 19–20.**




19. Which is similar to Figure 1?

A. 2 B. 3 C. 4 D. 5

20. Which is congruent to Figure 2?

A. 1 B. 3 C. 4 D. 5

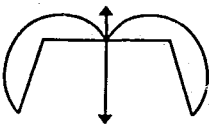
Go on to the next page.

Name _____

# Posttest

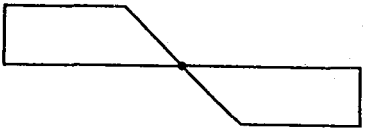


21. How was the figure moved?



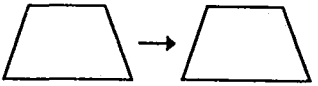
A. flip
B. slide
C. turn
D. slide and flip

22. How was the figure moved?



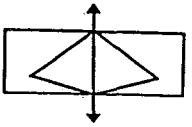
A. flip
B. slide
C. turn
D. slide and flip

23. How was the figure moved?



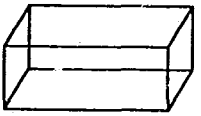
A. flip
B. slide
C. turn
D. slide and flip

24. How was the figure moved?



A. flip
B. slide
C. turn
D. turn and slide

25. What is this solid figure?

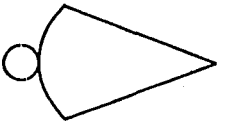


A. rectangular prism
B. rectangular pyramid
C. square prism
D. square pyramid

26. What solid figure has two triangular bases and rectangular faces?

A. triangular pyramid
B. rectangular pyramid
C. triangular prism
D. rectangular prism

27. What solid figure is formed from this pattern?



A. pyramid
B. sphere
C. cylinder
D. cone

28. How many vertices does a cube have?

A. 4 vertices
B. 6 vertices
C. 8 vertices
D. 12 vertices

29. Kevin has 3 days left to practice before his piano concert. Each day he plans to practice for 15 minutes longer than the day before. In all he wants to practice for $4\frac{1}{2}$ hours. For how long should he practice the first day?

A. 45 min
1 hr
C. 1 hr 15 min
1 hr 30 min

30. Juan, Barb, and Ali recycled 140 cans. Barb recycled twice as many as Ali and 10 more than Juan. How many cans did Ali recycle?

A. 15 cans
B. 20 cans
C. 30 cans
D. 50 cans

Go on to the next page.

Name _____

# Posttest



31. Carla made a border using brown and gold tiles. She began with a brown tile and then added 2 gold tiles, and so on, ending with a brown tile. If she used 20 gold tiles, how many brown tiles did she use?

A. 10 tiles
B. 11 tiles
C. 12 tiles
D. 19 tiles

32. Five people entered a tournament. Each person played one game with each other person. How many games were played?

A. 5 games
B. 8 games
C. 10 games
D. 16 games

Stop!

APPENDIX G

SCHOOL DISTRICT OF LA CROSSE ELEMENTARY MATH EXPECTATIONS

GEOMETRY GRADES 3-5

| 3RD GRADE | 4TH GRADE | 5TH GRADE |
|---|---|---|
| • Know concept of right angle<br>• Know plane figures- sides & corners<br>• Know solids- faces, edges, corners and curved surfaces<br>• Know concept of point, line and segment<br>• Explore line of symmetry<br>• Know congruent figures<br>• Know the perimeter of different shapes using standard and nonstandard measurements<br>• Understand the concept of area | • Know the center, radius, and diameter of a circle<br>• Know concept of line segment, ray, lines, angles, vertex<br>• Introduction to parallel lines, intersecting lines and perpendicular lines.<br>• Know the three types of angles acute, obtuse, and right<br>• Recognize similar and congruent shapes<br>• Know lines of symmetry<br>• Know how to recognize, copy, compare, and construct polygons through octagons<br>• Know how to construct quadrilaterals- square and rectangle | • Explore strategies to find the circumference of a circle<br>• Know how to estimate and measure angles<br>• Reinforce 4th grade concepts<br>• Know 3 types of triangles- equilateral, isosceles, and scalene |

School District of La Crosse. (1997). Elementary Mathematics Fifth Grade Guide

# APPENDIX H

# RAW TEST SCORES

| | group | gender | score1 | score2 |
|---|---|---|---|---|
| 1 | control | boy | 7.00 | 20.00 |
| 2 | control | girl | 18.00 | 27.00 |
| 3 | control | boy | 13.00 | 12.00 |
| 4 | control | girl | 10.00 | 15.00 |
| 5 | control | boy | 13.00 | 23.00 |
| 6 | control | boy | 11.00 | 16.00 |
| 7 | control | boy | 13.00 | 27.00 |
| 8 | control | boy | 6.00 | 14.00 |
| 9 | control | girl | 6.00 | 13.00 |
| 10 | control | boy | 14.00 | 23.00 |
| 11 | control | boy | 16.00 | 25.00 |
| 12 | control | girl | 19.00 | 23.00 |
| 13 | control | girl | 14.00 | 24.00 |
| 14 | control | girl | 18.00 | 22.00 |
| 15 | control | girl | 12.00 | 16.00 |
| 16 | control | girl | 26.00 | 27.00 |
| 17 | control | girl | 8.00 | 19.00 |
| 18 | control | boy | 15.00 | 24.00 |
| 19 | control | boy | 15.00 | 25.00 |
| 20 | control | boy | 15.00 | 19.00 |
| 21 | control | girl | 12.00 | 25.00 |
| 22 | control | boy | 13.00 | 16.00 |
| 23 | control | girl | 12.00 | 27.00 |
| 24 | control | girl | 18.00 | 21.00 |
| 25 | exp | girl | 6.00 | 25.00 |
| 26 | exp | boy | 8.00 | 24.00 |
| 27 | exp | boy | 12.00 | 25.00 |

| | group | gender | score1 | score2 |
|---|---|---|---|---|
| 28 | exp | boy | 13.00 | 30.00 |
| 29 | exp | boy | 14.00 | 24.00 |
| 30 | exp | boy | 15.00 | 27.00 |
| 31 | exp | girl | 21.00 | 31.00 |
| 32 | exp | boy | 9.00 | 26.00 |
| 33 | exp | girl | 17.00 | 23.00 |
| 34 | exp | girl | 12.00 | 29.00 |
| 35 | exp | boy | 7.00 | 24.00 |
| 36 | exp | boy | 15.00 | 27.00 |
| 37 | exp | boy | 22.00 | 28.00 |
| 38 | exp | boy | 12.00 | 22.00 |
| 39 | exp | boy | 12.00 | 25.00 |
| 40 | exp | boy | 14.00 | 26.00 |
| 41 | exp | girl | 5.00 | 12.00 |
| 42 | exp | boy | 12.00 | 24.00 |
| 43 | exp | girl | 8.00 | 23.00 |
| 44 | exp | boy | 11.00 | 29.00 |
| 45 | exp | girl | 15.00 | 27.00 |