IMPLICATIONS OF PHYSICAL EDUCATION ACTIVITIES AS REINFORCEMENT IN LEARNING MULTIPLICATION TABLES

By

NANCY LOUISE RIGGS CARLETON

Bachelor of Science
Phillips University
Enid, Oklahoma
1965

Master of Science in Education
Southern Illinois University
Carbondale, Illinois
1966

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
December, 1981

IMPLICATIONS OF PHYSICAL EDUCATION
ACTIVITIES AS REINFORCEMENT IN
LEARNING MULTIPLICATION
TABLES

Thesis Approved:

Betty Abercrombie
Thesis Adviser

M. A. Thompson

John G. Bayless

Jacob L. Zucker

Norman N. Durham
Dean of the Graduate College

ACKNOWLEDGMENTS

My sincere appreciation is expressed for the assistance and patience of the following committee members in guiding the completion of this dissertation: Dr. John G. Bayless, whose personality has lightened the pressures on various occasions; Dr. Mary Ann Thompson for her knowledge and experience with elementary children; Dr. Jacob D. Zucker, whose assistance in the critical stages of completion was encouraging and supportive. Dr. William Adrian's time and counsel were also invaluable in guiding my initial steps.

A special feeling goes with my thank you to Dr. Betty Abercrombie, the chairman of my committee. Her personal example directed me into this field, and her continued support and friendship have guaranteed her a special place in my heart.

Finally, this work is dedicated to Bob and Cathy . . . whose love sustained; whose sacrifice permitted; and into whose lives I can now return as a full-time participant!

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

"Elementary schools are changing, and their curricula are beginning to reflect more realistic and humanistic approaches to the child and to teaching."[1] If physical education is to remain an integral part of the elementary curriculum, new thought and action must become reality. Raths suggested that making education both rich and varied in experiences aids children in liking education.[2] Physical education's unique approach of educating through the psychomotor and physical domains[3] can speak clearly to this concept.

> Physical education can contribute to the curriculum and thus to the education of the child not only because of its unique content but also because of its capability for elaborating, reinforcing, and applying attitudes initiated in other progaram areas.[4]

Physical education is in a position to look beyond its specific contributions and reach out toward other areas of learning. Supporting and reinforcing the child's complete educational experiences in relation to cognitive learning is a challenge that has been produced through research and knowledge. Learning through motor activity is not a recent innovation, but its application with today's education demands a thorough understanding of a phenomenon--the child. Such understanding cannot be accepted through the subjective opinions of educational leaders and observers but must develop within the demonstrated learning that is provided in educational experiences.

Stimulating the mind through activity provides opportunities to explore, to develop awareness, and to use a highly motivated approach for more efficient education.[5] Alexander Lowen indicated that we have separated the mind-body relationship for too long, that our educational process maintains an unnecessary gap between mental education and physical education. He joined notable philosophers and educators, such as Aristotle, Rousseau, Spencer, and Dewey, in concern for the understanding of the united relationship of the mind and body and purported the belief that ". . . if mind and body are one, a true physical education should at the same time be a proper mental education and vice versa."[6]

Purpose of the Study

"There must be a complete understanding of physical education as an entity unto itself, as well as its interrelationship with other subject matter areas in the elementary school curriculum."[7] Teachers should recognize a responsibility in influencing change toward the educational development of children.

> Piaget's theory of intelligence, Montessori's teaching methods, and Bloom's cognitive domain provide some insight into the intellectual characteristics of children as applied to physical education . . . . Children learn through movement

> because movement concepts may be readily integrated with mathematics, science, language arts, social studies, music, and art.[8]

Exploring the integrated opportunities available through the united mind-body relationship as experienced in motor learning activities speaks to this approach to learning. Therefore, the purpose of this study was to explore the reinforcement value of physical education activities in learning multiplication tables.

Need for the Study

Cognitive based subjects have been approached through the physical education medium with successful results.[9,10] Although studies have been conducted that approached mathematical concepts through motor learning methods, the author could not find any study relating to reinforcing the learning of multiplication tables. Schminke, Maertens, and Arnold pointed out that:

> One-sided approaches to teaching elementary mathematics are unlikely to produce optimal results . . . Current learning theory suggests that children learn best when they are actively involved in the learning process.[11]

Ashlock indicated the value of learning through physical activity by stating that

> . . . if a child is to master the basic facts of arithmetic he must paractice 'pulling them out of his head' instead of always figuring them out the long way. A game situation frequently provides the prompting to respond quickly which is needed if recall is to be reinforced.[12]

Hypothesis

There is no significant difference in the learning of multiplication tables by subjects whose learning is reinforced through specifically designed physical education activities and by those who were not exposed to these same reinforcement experiences.

Basic Assumptions

The following basic assumptions were accepted in regard to this study:

1. Students did their best on all written tests.
2. Some increase in knowledge of multiplication was expected by all subjects.
3. The activities disigned for use with the experimetal group were appropriate for reinforcing learning of multiplication tables.
4. Subjects did their best when participating in the reinforcement activities.
5. Subjects received concepts and skills concerning multiplication prior to the fourth grade.

Limitations

1. Multiplication units presented within the classroom were taught in a fourteen week period.
2. Only ten days of physical education were set aside for specific reinforcement activities. Reinforcement through brief exercise participation occurred

on the other twenty-two days of physical education classes.

4. There was no control over the subjects' maturation levels or their readiness for learning multiplication tables.
5. Only one instrument was used to test the learning of multiplication facts.

Delimitations

1. Only fourth grade students attending Skyline Elementary School from September 15, 1980 to January 13, 1981 participated in the study.
2. The subjects tested represent fourth grade students' abilities in mathematics.
3. The study was concerned with cognitive learning of multiplication facts.
4. Only students receiving math instruction from the fourth grade math teacher participated in the entire study. Fourth grade students receiving math instruction within a special program (gifted and talented, learning disabled, educably mentally handicapped) were not included in the results of this study.
5. Selection of the multiplication tables to reinforce was made from responses given by the subjects in both the physical education and classroom activities while keeping the reinforcement as equal as

possible among "harder" tables.

6. Reinforcement came through utilization of four basic physical education activities plus verbal counting techniques used in exercising.

Definitions

1. <u>Motor Activity Learning</u>:

   Selection of an activity such as an active game, stunt or rhythmic activity which is taught to the children and used as a learning activity for the development of a skill or concept in a specific subject area. An attempt is made to arrange an active learning situation so that a fundamental intellectual skill or concept is practiced or rehearsed in the course of participating in the motor activity.[13]

2. <u>Integration</u>: the process of interrelating subject matter toward the total development of the child.

3. <u>Motivation</u>: "An internal state in which the existence of needs arouse the individual to seek ways of satisfying those needs."[14]

4. <u>Arithmetic</u>: "The art of computation with numerals."[15]

5. <u>Elementary School Mathematics</u>: "Measurement, relations of quantities, and properties from such subjects as geometry, algebra, and logic as well as computation."[16]

6. <u>Edumetric Properties</u>:

   The extent to which a test reflects the within-individual growth that traditionally has been of primary interest of educational testing; for example - teacher made tests.[17]

7. <u>Criterion-referenced Test</u>: "Permits us to determine

whether or not an examinee can display a clearly defined set of behaviors."[18]

8. Jumping Jacks: Stand with feet together, hands at the side of the body. Jump and land with feet shoulder-width apart and arms extended full reach above the head, palms touching. Jump back to the original position.

9. Toe Touchers: Stand with feet together, hands at the side of the body. Always keep the legs straight by not bending at the knees. Exercise by: (1) hands touch abdominal region, (2) hands reach down and touch the ground or as far as possible, (3) hands touch abdomen again, (4) stretch arms full extension above head, (5) return to beginning position. The count is given when first touching the abdominal region as you move toward the floor.

10. Instrument: A criterion-based test of fifty multiplication problems developed by the author for testing fourth grade multiplication ability of students in this study.

ENDNOTES

[1]Bette J. Logsdon, Kate R. Barrett, Marion R. Broer, Rosemary McGee, Margaret Ammons, Lolas E. Halverson and Mary Ann Roberton, Physical Education for Children: A Focus on the Teaching Process (Philadelphis, 1977), p. 9.

[2]Ibid., p. 70.

[3]Anthony A. Annarino, Charles C. Cowell and Helen W. Hazelton, Curriculum Theory and Design in Physical Education (St. Louis, 1980), n.p.

[4]Jan Felshin, More Than Movement: An Introduction to Physical Education (Philadelphia, 1972), p. 14.

[5]Edith E. Biggs and James R. MacLean, Freedom to Learn An Active Approach to Mathematics (Ontario, Canada, 1969), n.p.

[6]Alexander Lowen, Bioenergetics (New York, 1975), p. 62.

[7]James H. Humphrey, Child Learning Through Elementary School Physical Education (Dubuque, Iowa, 1965), p. 1.

[8]Carl E. Willgoose, The Curriculum in Physical Education (3rd ed, Englewood Cliffs, New Jersey, 1979), pp. 129-131.

[9]James Metcalf, "Teaching Writing in Physical Education," Journal of Physical Education and Recreation (November-December, 1979), n.p.

[10]Dorothy D. Sullivan and James H. Humphrey, Teaching Reading Through Motor Learning (Springfield, Illinois, 1973), n.p.

[11]C. W. Schminke, Norbert Maertens and William R. Arnold, Teaching the Child Mathematics (Hinsdale, Illinois, 1973), p. 3.

[12]Robert B. Ashlock and James H. Humphrey, Teaching Elementary School Mathematics Through Motor Learning (Springfield, Illinois, 1976), p. 16.

[13]James H. Humphrey, Education of Children Through Motor Activity (Springfield, Illinois, 1975), p. 8.

[14]Robert N. Singer, Ed., *The Psychomotor Domain: Movement Behaviors* (Philadelphia, 1972), p. 175.

[15]Lowell Keith, Paul Blake and Sidney Tiedt, *Contemporary Curriculum in the Elementary School* (New York, 1968), p. 208.

[16]Ibid.

[17]Ronald P. Carver, "Two Dimensions of Tests Psychometric and Edumetric," *The American Psychologist* (July, 1974), p. 512.

[18]James W. Popham and T. R. Husek, "Implications of Criterion-Referenced Measurement," *Journal of Educational Measurement* (Spring, 1969), p. 2.

CHAPTER II

REVIEW OF LITERATURE

Attention to the concept of integrative development between physical and intellectual aspects of learning has advanced within this century. As the force of discovery continues to focus our attention on the future of this development, it reminds us to consider the past and the steps which brought about the present ascent. The summative review in this chapter explores the relationship of movement and cognition toward useful curriculum integration between mathematics and movement activity.

Movement and Cognition

> Plato's postulation that learning could take place better through play, Locke's thoughts on a sound mind and sound body, Rousseau's belief that all children should receive plenty of wholesome physical activity early in life, and Pestalozzi's observations that children approach their studies with a greater amount of interest after engaging in enjoyable physical activity have all contributed to the modern idea that physical education and intellectual development are closely associated.[1]

Educational evolution is entwined with that of man himself. From the development of a symbolic necessity for language and symbols through the synthesis afforded by history and philosophy,[2] man's education has evolved. The reality of such evolution maintains itself in change, and the relationship between physical activity and intellectual endeavor has been a challenge to this change. The reality of the physical education of mankind has ridden the educational pendulum which has spanned eons and continues to challenge the direction of educational goals today.

The ancient Greek ideal of mind-body integration was mirrored in Plato's often quoted observation in The Republic, "No compulsion then, my good friend . . . in teaching children, train them by a kind of game, and you will be able to see more clearly the natural bent of each."[3] However, this high status of physical activity as an important portion of the education of the "whole self" that was accepted within the ancient Greek and Roman civilizations crumbled with their empires. The body and its activities came to be regarded as "evil" during the Middle Ages while the spiritual and intellectual aspects of education were sustained.

The Renaissance motivated the rusted pendulum to reactivate when concern for the ways in which the movement of children could aid the desired intellectual context was reborn. The close association between a child's mind and his body was of concern to educational philosophers like Rousseau and Froebel.[4] In Foundations of Physical Education, Bucher suggested the interest of Montaigne, Descartes, and Rousseau in the integrative relationship of mind and body:

> I would have his outward manners, and his social behaviors and the carriage of his person formed at

> the same time with his mind. It is not a mind, it is not a body that we are training; it is a man, and he ought not be divided into two parts.
>
> Montaigne
>
> It is a lamentable mistake, to imagine that bodily activity hinders the working of the mind, as if these two kinds of activity might not advance hand in hand, and as if the one were not intended to act as a guide to the other.
>
> Rousseau
>
> The union of mind and body has to be acknowledged as being for us primary and ultimate.
>
> Descartes
>
> To learn to think we must therefore exercise our limbs, our senses, and our body organs which are tools of the intellect.
>
> Rousseau[5]

Humphrey noted the interest of Friedrich Froebel in this mind-body relationship:

> In fact, the application of motor activity as a medium for learning was a basic principle of the Frobelian kindergarten early in the nineteenth century. It was based on the theory that children learn and acquire information, understanding and skills through motor activities in which they are naturally interested.[6]

Cratty indicated that "some schools of this period [1700-1800] went beyond the restrictions of the traditional desks and slates to include important lessons taught while the children were at play."[7] Cratty's Intelligence in Action pointed out that "The French writer Fénelon, who died in 1715, observed that some children could learn to read while playing."[8] Again, the pendulum on which the physical education of children was focused swung into motion.

The idea that "Educational goals should be constantly changing, or evolving, to meet the needs of the developing learner"[9] was evidenced in England, Germany and the United

States toward the latter part of the 1800's. Early experimental psychologists continued to explore the relationships between physical and intellectual functions of children. However, this research was mainly directed toward various physical aspects (sensory-motor functioning, reaction time, and such) predicting the higher intellectual functions of children.[10] At the turn of the century, some educators persisted with the concept that "placing the child in action might have educational advantages, and that certain performance tests might be at least predictive of how a child might function in life situations."[11] In France, Itard and Sequin worked with the retarded child, while in Rome, Montessori presented her educational concepts.[12] She involved the use of the whole body in various aspects of her programs and advocated games that contained academic content for both normal and atypical children.

During the early 1900's little emphasis was given to the physical activity needs of the child. Studies reflected an interest in the isolation of the child's physical and intellectual capacities. The major concerns of people such as Binet, Thorndike, Terman, and Otis brought direct attention to intelligence and intelligence testing while physically oriented research concerned itself with various aspects of the child's ability to play games well. It took the writings of Strauss and Lehtinen, shortly after World War II, to bring about renewed interest in the motor component of the human personality.

> During the 1950s, and particularly during the 1960s, theorists began to suggest that motor activity, if properly applied, might enhance a number of perceptual, intellectual and academic functions in children and youth.[13]

LeBoulch aided this interest through his work in France. His interest in movement coupled with his experiences as a doctor of medicine motivated him to write not only articles regarding the academic-physical relationship but a book, L'Education Par Le Mouvement (Education Through Movement). His thoughts were echoed by Cratty in a summary statement regarding LeBoulch's contributions in this area:

> In summary, he suggests that the intellectual, spiritual, emotional and physical components of man are inseparable. He further points out that movement experiences in schools are equal in importance to reading, writing, and mathematics. He suggests that emphasis should be placed on lessons that permit the individual to establish relationships between the motor, intellectual, and emotional components of his personality . . . .[14]

Mosston, a cognitive theorist, impacted the education profession by providing a "Spectrum of Styles" that suggested the involvement of the learner in making decisions within the educational environment.

> The concept of the *Spectrum of Styles* proposes a theoretical construct and an operational design of alternative styles of teaching which gradually move *both* teacher and student along all four developmental channels[15] (physical, social, emotional, intellectual).

In the final stages of his spectrum, Mosston proposed the use of a considerable amount of intellectual interaction by the learner as he involves himself in problem solving through movement.

Cratty pointed out Kiphard's suggestion that "a properly conducted program of physical education should not only improve physiological functions, but also enhance emotional and intellectual potentials."[16] Such interest in the physical-mental relationship continued to help activate research between physical activity and intellectual endeavor. With the translation of this influential German's texts into English and a study of his contemporary theories linking movement and cognition, Kiphard's contributions in this and related areas will probably make an impact on future educational pursuits. A contemporary clinical psychologist who has also shown interest in motor activity as an educational tool is Frostig. Dr. Frostig's written work indicated ways in which educational goals and/or intellectual processes could be enhanced through various motor activities.[17]

Two of the most prolific contemporary writers and researchers in regard to learning through motor activity are Cratty and Humphrey. In reviewing their efforts, the author found a quantity of valuable information in regard to the capabilities of motor activity in aiding the cognitive skills deemed educationally desirable for today's society. Their theme supports the earlier conviction of Williams:

> When mind and body were thought of as two separate entities, physical education was obviously an education OF the physical; in similar fashion mental education made its own exclusive demands. But with new understanding of the nature of the human organism in which wholeness of the individual is the outstanding fact, physical education becomes education THROUGH the physical.[18]

As a cognitive theorist, Cratty's numerous books and articles, supported by research since the middle of the 1960's, outlined various models of how the relationship between movement and academic activities could be applied in today's public schools. He produced books suited for the classroom teacher which provided operative applications of movement that enhanced various academic areas; for example, _Active Learning Games to Enhance Academic Abilities_.[19] Other more scientifically oriented publications have also supported his theory of integrating movement with intellectual pursuits.[20,21]

Humphrey conducted research and focused attention on the effects that a variety of selected learning games and activities had in acquiring intellectual skills. Much of his work, begun in the early 1960's, was conducted within normal public school settings. He helped pioneer this motor approach to learning by applying his theories to various areas, among which were reading,[22] mathematics,[23] and "slow learners".[24] Humphrey has recently directed his work toward the involvement of parents actively participating in the early education of their children.[25] The studies conducted, which are outlined and discussed in his books and articles, helped support his belief in the worth of the learning activities he advocated. Humphrey maintained support of his theories not only from present-day experiences but from the beliefs of various philosophers and educators from the past.

> Close scrutiny of the possibilities of intellectual development through physical education

> reveals, however, that a very desirable contribution can be made through this medium. This belief is sustantiated in part by the affirmations made by such eminent philosophers and educators as Plato, Locke, Rousseau, Pestalozzi, and numerous others.[26]

Other contemporary authorities added their support to the necessity for recognizing the mental and physical association that enhance the education of the whole person. Cowell supported the interrelatedness of the motor, intellectual, social, and emotional development of the child, indicating that each aspect has influenced the others. Seeing individuals as indivisible, he did not believe in dividing instruction into segmented parts. He advocated the concept of teaching the child as a whole person.[27] Perhaps Oberteuffer summed up this concept best through his observation that:

> It is not possible to regard the 'physical' side of life as something apart to be healed by physicians, fed by cooks, and exercised by physical educators. The physical and mental are one, and what affects each effects the other.[28]

Disciplinary Integration

> In addition, the goals of all fields of study depend upon learning modalities and abilities for their fulfillment. In this sense, the content of one subject area becomes the means for learning or the medium for another. Physical education, then, must be understood as a distinct field of study with rational, carefully ordered goals for instructional programs; an important aspect of the life of youth during his years of school; and a basic medium of education in all of its concerns.[29]

The physical education of Americans was reflected in the necessity for survival in colonial America. Societal demands for intellectual and spiritual education were answered through the eary colonial schools. However, much of the early education obtained by children was often given in homes, church, or by tutors. Leaders like Thomas Jefferson, Benjamin Franklin, and Horace Mann verbalized and wrote regarding the potential of educating all of the children of the nation.[30] This early foresight was visionary but flexibility did not develop as an early companion, for the one room schoolhouses and Dame schools of our early ancestors were rigidly controlled.

"The curriculum pattern of the earliest schools in America was largely that of separate subjects."[31] Reading was not only the first subject required, but it has been a dominating influence on education since colonial times. The Massachusetts legislature of 1647 added writing to their curriculum and by 1775, when arithmetic joined these parent subjects, the triad of the Three R's was completed. "In fact the school of the Three R's (reading, writing, and arithmetic) emerged as a distinctly American school."[32] During the 1787-1865 nationalistic expansion of America, physical education was thought of as "knowledge about the organs and functions of the body plus the various agents which affected it, including exercise, diet, ventilation, and clothing."[33]

As America's society changed so did her values, and education evolved around emphasis on religion in the seventeenth century, "the eighteenth grammar, and nineteenth history and the twentieth service."[34] As the emphasis changed so did the school's curriculum. Beauchamp indicated that "the curriculum from 1775 forward was an additive process, and very little subtracting was done."[35] New subjects such as science, physical education, music, spelling, and drawing were added to the curriculum as separate subjects. Contemporary Curriculum in the Elementary School showed the addition of "physical exercises" to the curriculum around 1875.[36]

Having entered the school curriculum through the separate subjects door, physical education and other disciplines became involved in the varied curriculum innovations experienced throughout the history of America's public schools. The correlated subjects design of the early 1900's produced an effort "to establish a relationship among the various subjects in order that more transfer of learning could be effected for the pupils."[37] This emphasis was quite a shift from the previous pattern that had made little if any attempt to integrate learning among the various disciplines. The grouping of subjects into common areas, termed broad fields; an effort to utilize the problem solving method of study through establishing a core or base; the accent on activities, interests, and needs of the child, termed learner centered; the middle-of-the-road eclectic program; these and other curricular patterns reinforced the need for flexibility and produced various demands which required a multitude of adaptations by the various disciplines within the curriculum. Willgoose had perhaps echoed the thoughts of others when he noted "There is little question about the need for change and innovation. The only question is, 'How radical the change?'"[38]

Physical education's role in the curricula of the elementary school varied within the existing curriculum pattern and was influenced by demands as well as prejudices of individuals and society. Viewing physical education's only function as the conditioning of the body:

> To many persons in physical education and outside it, other values from the physical education experience loom larger than the educational ones; physical values come first, educational values a poor second, and only by chance.[39]

Perhaps the term "physical education" confused people in relationship to its adaptable educational applications. This variety in interpretations prompted Mackenzie to respond with an effort to rename the discipline.[40]

Oberteuffer and Ulrich indicated that the noun education was of great importance, although it was the adjective of action which promoted physical education's recognition within most curriculums. When emphasizing education, with the physical body as its tool, "physical education implies that someone, somehow, is being educated."[41] Without understanding in regard to this important fact, physical education teachers continued to be considered only specialists whose discipline had little contact or interest in regard to the rest of the intellectual or sociological aspects of the school.

"To remain consistent with the way life should be lived, the modern school curriculum should and does seek integration."[42] Integration encompassed the desire to bring together various parts into a whole, functional unity toward becoming complete. This search for integration among disciplines reflected the rising emphasis on education within physical education's curriculum. "The framework for physical education in the school program is an integrated view of the key concepts of the field of study in their potential contributions to the quality of living, and the commitments of education."[43]

Three basic method for integrating curriculum materials have been suggested by Henry: (1) reorganization of content into more genearl courses, (2) centering of content aobut problems of society, and (3) developing interrelationships among existing courses.[44] Perhaps the third method is most promising for physical education and could be developed by pedagogical integration that

> . . . may involve the relation between two or more subject-matter fields in such a way that the content of each area helps to provide for a better realizaion of the understandings to be developed in the other.[45]

One of the methods for providing integration of physical education with other disciplines is achieved through motor activity learning. "Physical education has a chance to teach through ALL of the organism, using all of its powers of perception and reception. Thus motor learning is seen as another avenue by which the organism responds."[46] Humphrey's summarization of his theory of motor activity concluded:

> . . . that children being predominantly movement-oriented, will learn better when what might arbitrarily be called ACADEMIC LEARNING takes place through pleasureable physical activity; that is when the MOTOR component operates at a maximal level in skill and concept development in school subject areas essentially oriented to VERBAL learning.[47]

Jackson pointed out that "attention and involvement are not the same conditions and the teacher would do well to keep the distinction in mind."[48] Giving the child more opportunities and ways to become involved, to maintain attention, and to develop cognitive knowledge through motor activity is supported by various authors.[49,50,51] In <u>How Children Learn</u>, Holt recommended that teachers and learners need to know

> . . . that vivid, vital, pleasurable experiences are the easiest to remember, . . . that memory works best when unforced, that it is not a mule that can be made to walk by beating it.[52]

Ball added his opinion that although games might be the outgrowth of natural activity

> . . . or contests contrived to accomplish a particular goal or objective, or diversions engaged in for fun and enjoyment, they continue to motivate, interest, excite, inspire, and provoke young and old.[53]

> In view of the fact that the child is a creature of movement, and also that he is likely to deal better in concrete rather than abstract terms, it would seem to follow naturally that the motor activity learning medium is well suited for him.[54]

Murray noted that "a developing child is motivated to DO things - to run, climb, throw, jump, hold, drop, open, and close."[55]

Although it seemed evident that physical educators had the proper tool (the total organism), a motivational aspect created through movement possibilities, and a curriculum capable of generating both excitement and enjoyment, the intimate relationship of the mind-body integrative possibilities had not been evidenced in far-ranging efforts. Humphrey noted that some physical educators pioneering this integration process placed extensive emphasis on the non-physical aspect of this relatinship to the extent of neglecting the physical needs of the child.[56] Lowen critically observed that

> Our educational process is still split between mental education and physical education . . . . Few teachers of physical education believe they can affect a child's learning capacity . . . . And, in fact, they rarely do.[57]

The integrative process was not designed to eliminate but rather to support, and educators were cautioned that activities included in integrative learning must meet the total growth and development of the child. Representative of the efforts made toward successful integration of physical and intellectual abilities, Echoes of Influence included no less than five articles dealing with integrative ideas and techniques used by various physical educators.[58] These efforts, along with others that have been reported, indicated that physical education could consider the mental education of students, and yet provide the unique physical learning which contiues to form the roots of the discipline as well as produce a "physical" education.

In reviewing the literature, the author found various advantages as well as problems associated with the integration of physical activity and academic endeavors. The following lists are a cumulative gleaning from the bibliographical sources used in this work and suggest some advantages and problems encountered in the integration of movement and cognitive learning:

Advantages of Integration -

1. Integrating movement with cognitive learning speaks to the education of the whole child. Combining these areas helps in providing desirable growth intellectually, emotionally, physically and socially.

2. The cohabitation of these aspects of learning provides for a unity among the various curricular subjects/disciplines.

3. Movement can provide pleasurable practice of academic skills. Activity learning breaks the "learning is work" syndrome: games are fun and not usually considered as mental drill or work.

4. The integration of cognitive skills aids in the understanding of physical education as education and not just conditioning or play.

5. A variety of activities and games can be used in introducing or reinforcing many academic concepts.

6. Integrating academic areas into the physical education program provides for a wider background from which the physical educator can select activities for introductory and reinforcement development.

7. Efforts in resesearch regarding the mind-body relationship have continued and further study in this area remains a challenge.

8. The activity medium aids in providing constructive methods of reaching the atypical child toward his cognitive development.

9. This combination provides a new approch to "old" materials or program designs in the physical education curriculum.

10. Movement activity usually requires closer supervision than that afforded the child as he sits in the classroom. Extended supervision and closer observation could meet security needs in children.

11. Such integration provides a "match" of children's needs for body activity/movement and the need to reinforce basic cognitive skills.

12. Anxiety over the learning of cognitive skills is often reduced when incorporated within a game or activity situation.

13. Responses are readily observable, and feedback is not delayed through paper work.

14. Classroom teachers can use their own creativity in redesigning some activities as suitable for use within the classroom setting or during various recess times.

15. Movement activity provides an avenue for creative participation as opposed to traditional conformity or drill.

Problems Associated With Integration -

1. Motor learning is viewed as a "remedy" for many problems regarding cognitive learning.

2. It is difficult to conduct sound research within the public school setting. The traditional dichotomy of mind-body is still strongly evident within many public schools today.

3. Not all children benefit from the motor/activity learning approach.

4. In its embryonic stage, motor learning related to cognitive development must guard against unsound practices. The harsh methods followed by some people could have adverse effects.

5. To ignore the motor development of the child in order to accent the cognitive element would be a false representation of the integrative process. Physical education could lose its unique identity and become just a "back-up" for academic endeavors.

6. Professional preparation of educators does not presently support this integrative concept through far-reaching efforts.

7. Free, unrestricted play activities might produce the same if not better results than those planned by educators.

8. There is usually a lag of decades from research to implementation.

9. If not well correlated, the integration of academics and motor activities could be viewed as an unnatural relationship.

10. Concentration on introductory/reinforcement aspects could overshadow the "fun" aspect so readily availble in bodily activity of children.

11. Classroom teachers may feel they are meeting the child's physical needs through the many marketed and created academic games now available for use within the classroom settings. The actual motor learning of the child is usually not considered as a goal in these games and this type activity would not be a true integrative process.

Rogers had pointed out that educators "must be able both to conserve and convey the essential knowledge and values of the past, and to welcome eagerly the innovations which are necessary to prepare for the unknown future."[59] Disciplinary integration could meet the need for passing on essential knowledge while actively engaged in creative learning experiences for children. "The opportunity is present but it has to be cultivated."[60]

> A well-conceived physical EDUCATION program can aid in the understanding of integrative processes and can enhance the relationship of the physiological, psychological, and other functional elements to development . . . . There are virtually unlimited ways to correlate physical education with other curriculum areas. With care and imagination they can be developed to the benefit of the participating areas.[61]

Mathematics

> Certainly the modern mathematics-reform movement is not a fad or temporary preoccupation with novel

> mathematics approaches. It validly reflects the continual need to change educational programs to keep them in line with the developing state of knowledge in the field as well as the needs of society.[62]

Early arithmetic knowledge consisted mainly of competence in computational skills. This gave children the background knowledge for future application in various occupations. Arithmetic was only a section or chapter in early textbooks until 1719 when Hodder's _Arithmetick: Or That Necessary Art Made Most Easy_[63] launched it onto its own pathway. The schoolmaster and the hickory stick kept memorization of rules, tables, and facts about numbers foremost in learning arithmetic. Oral repetition and extensive drill and practice procedures aided in the process of "strengthening the memory, developing the reasoning powers, and secure[ing] rapid and accurate computation."[64]

Perspectives in Elementary School Mathematics[65] is one of a number of publications that has provided a comprehensive history of the changes which brought about the development of mathematics. Concern for the overemphasis of computational skills, coupled with accumulating information about how chidren learn, were two of the major fctors that helped bring about the concept of mathematics as more than "exercise for the mind." Teaching creativity within a discipline that is an exact tool of communication and has been considered the most rigid sequential subject in the curriculum demanded attention in the child's early years.[66] "Changes in elementary school mathematics programs since the mid-1950s have been rather drastic."[67]

Paralleling this early approach to mathematics were a variety of methods and philosophies on how best to implement the new concepts that were being presented. Understanding math processes remained as a base for launching practice through variety in methods. The challenge of giving mathematics "life" developed; the goal was useful application in everyday experiences. Biggs and MacLean supported the belief that both variety of situation and flexibility of attitudes aided the child in regard to the stimulation necessary for his/her active participation in the learning situation.[68]

Educators from various disciplines recognized that "Developing the elementary school program must be truly a co-operative enterprise if it is to be done adequately."[69] Using the natural experiences of children to develop or reinforce basic ideas of mathematics produced a possible approach to the learning of facts. Educators could cooperate "so as to captivate the interest and attention - yes, even the spirit - of the children."[70] This spirit was often observed in the natural play and active movements of children.

> Games help teachers overcome problems connected with how children learn mathematics. They give children variety in the way they deal with a topic, allow them to actively participate in the learning process, provide repeated exposures without becoming tiresome, and enrich children's backgrounds.[71]

Humphrey predicted that not only games but "Certain active play experiences can provide the child with valuable experiences with the operations of arithmetic (addition, subtraction, multiplication, and division)."[72] Cratty supported this prediction when he indicated that "Virtually any mathematical operation can be employed in some kind of movement task."[73] Although movement activities and mathematics seemed to provide integrative opportunities, this author could find no study regarding the use of physical activity as reinforcement in learning multiplication tables. However, studies had been conducted in regard to motor activity and mathematics, especially involving young children.

One of Humphrey's studies involved thirty-five first grade boys and girls who were pretested on eight number concepts which were to be included in their regular classwork during a coming two week period. Ten boys and ten girls whose pretest scores identically matched were selected for the study. These twenty subjects then participated for two weeks in eight active games used as learning media for the development of the chosen concepts. Subjects were retested after the two weeks with results indicating a highly significant difference between pretest and posttest mean scores for the total group; boys showing greater change in learning than girls.[74]

Ashlock and Humphrey reported various exploratory studies regarding the relationship of motor activity learning and mathematical concepts. In one of these studies, 1,147 third grade subjects were involved with motor activity learning methods in developing concepts related to telling time. The forty-two classes studied were divided into groups of fourteen each. One group was taught by the drill method, the second through the developmental-meaningful method, and the thid group's learning was approached through active games. Classroom teachers taught their own classes following devised lesson plans and instructions for ten teaching days of twenty-minute periods. All individual groups were found to have learned from pretest to posttest with the highest level of probability found in the active game group. A comparison of posttest scores between groups produced no significant difference between any of the groups.[75]

Another study randomly placed sixty kindergarten subjects in three groups of twenty to determine if active or passive games provided learning experiences designed to develop arithmetic readiness skills and concepts at that level. The study also compared the selected activities with the traditional teaching procedures used with this kindergarten group. One-third of the subjects were taught through passive games, another third through active game participation methods, and the last group followed traditional procedures. Comparison of pretests and posttests indicated that learning had taken place in all groups and that, although not significantly better, the active game group had the highest mean gain. "Specifically, the findings showed that active games facilitated learning as well as or even better than the other approaches."[76]

Using motor learning activities as a practical and effective enrichment aid in teaching selected first grade mathematical concepts was the purpose of another study. After receiving classroom instruction half of the class (earlier divided by pretest scores) was given enrichment of the classroom concepts through a variety of physical education activities while the other half of the class (control group) participated in free play. After four weeks a posttest was given to the entire class, but no significant difference was found between the groups as a whole or for each sex separately. Further observation of data showed: (1) both groups started the study statistically equal; (2) mathematical concepts gain was high for both groups; (3) extended interval tests indicated retention was good, with the motor activity group more effectively retaining their learning as opposed to the control group when examined as boys and girls combined. Subjective evaluation by the classroom teacher indicated the study was valuable in enriching the mathematical concepts involved.[77]

Ashlock and Humphrey pointed out another study regarding motor activity learning and mathematics. First grade children were again used as subjects, but this study concerned the relationships between the techniques used by both physical education and classroom teachers in teaching the mathematical concepts selected. A question of whether the subjects could learn selected mathematical concepts through physical activity when taught by the physical education teacher was also considered.

A pretest was given to determine numbers readiness for grouping of first graders in arithmetic groups. The low group, as determined by this test, was used in this study and number concepts were taught to the control group by the classroom teacher. The physical education teacher taught the experimental group through motor learning activities. Nine class periods of thirty minutes each were involved before the subjects were retested. Both groups showed a significant difference at a high level of probability with the experimental group indicating a moderately higher level of probability. The concepts taught through motor learning by the physical education teacher supported the possibility of learning outside the classroom environment.[78]

Although Ashlock and Humphrey pointed out the limited amount of research done in this area, they felt that the following generalizations could be drawn from the studies with which they were familiar:

1. In general, some children tend to learn certain mathematical skills and concepts better through the motor activity learning medium than through many of the traditional media.

2. This approach, while favorable for both boys and girls, appears to be more favorable for boys.

3. The approach appears to be more favorable for children with average and below-average intelligence.

4. Many teachers report that for children with high levels of intelligence, it may be possible to introduce more advanced skills and concepts at an earlier age through the motor activity learning medium.[79]

This approach to learning in the area of mathematics brought on the comment by a classroom teacher that "the physical education teacher could be considered as a valuable co-worker with the classroom teacher in the development of mathematical concepts."[80] Rising and Harkin also supported this integrative cooperation when they recognized that:

> It is important to stress the contacts that mathematics makes with science, social studies, literature, and even physical education. Opportunities to do this abound, and provide students with a sense of the cohesiveness of their education, helping them to see how mathematics and other subjects apply to the real world.[81]

Earliest education depended on a combined mental-physical relationship for survival; learning through movement was essential. In time the educational pendulum swung toward an emphasis on intellectual development. Gradually educators came to realize that intelligence, social interaction, physical activity, and emotional involvement were closely interrelated. Today's education, with its emphasis on the total development of the child, should utilize the most appropriate methods when directing the learning of children. Although educators have demonstrated interest in the value and methods of integrating education, only a small amount of research of this nature has been completed. Therefore, this study sought to determine the results of reinforcing multiplication tables through physical education activities.

ENDNOTES

[1]James H. Humphrey, Child Learning Through Elementary School Physical Education (Dubuque, Iowa, 1965), p. 13.

[2]Philip H. Phenix, Realms of Meaning A Philosophy of the Curriculum for General Education (New York, 1964), n.p.

[3]James H. Humphrey, Elementary School Physical Education With Emphasis Upon Its Integration in Other Curriculum Areas (New York, 1958), p. 7.

[4]Deobold B. VanDalen and Bruce L. Bennett, A World History of Physical Education Cultural, Philosophical, Comparative (2nd ed., Englewood Cliffs, New Jersey, 1971)., n.p.

[5]Charles A. Bucher, Foundations of Physical Education (6th ed., St. Louis, 1972), p. 117.

[6]James H. Humphrey, Education of Children Through Motor Activity (Springfield, Illinois, 1975), p. 4.

[7]Bryant J. Cratty, Physical Expressions of Intelligence (Englewood Cliffs, New Jersey, 1972), p. 3.

[8]Bryant J. Cratty, Intelligence in Action Physical Activities for Enhancing Intellectual Abilities (Englewood Cliffs, New Jersey, 1973), p. 2.

[9]Raymond E. Keel and G. Thomas Rowland, "How Chidlren Learn: A Developmental Approach," The Elementary School Journal (May, 1974), p. 505.

[10]Bryant J. Cratty, Movement Behavior and Motor Learning (3rd ed., Philadelphia, 1973), p. 249.

[11]Ibid., p. 3.

[12]Cratty, Intelligence in Action Physical Activities for Enhancing Intellectual Abilities, n.p.

[13]Cratty, Physical Expressions of Intelligence., p. 40.

[14]Ibid., p. 44.

[15]Muska Mosston, *Teaching Physical Education From Command to Discovery* (Columbus, Ohio, 1966), p. 7.

[16]Cratty, *Intelligence in Action Physical Activities for Enhancing Intellectual Abilities,* p. 44.

[17]Marianne Frostig, *Movement Education: Theory and Practice* (Chicago, 1970), n.p.

[18]Jesse Feiring Williams, *The Principles of Physical Education* (8th ed., Philadelphia, 1964), p. 8.

[19]Bryant J. Cratty, *Active Learning Games to Enhance Academic Abilities* (Englewood Cliffs, New Jersey, 1971), n.p.

[20]Cratty, *Physical Expressions of Intelligence,* n.p.

[21]Cratty, *Intelligence in Action Physical Activities for Enhancing Intellectual Abilities,* n.p.

[22]Dorothy D. Sullivan and James H. Humphrey, *Teaching Reading Through Motor Learning* (Springfield, Illinois, 1973)., n.p.

[23]Robert B. Ashlock and James H. Humphrey, *Teaching Elementary School Mathematics Through Motor Learning* (Springfield, Illinois, 1976), n.p.

[24]James H. Humphrey and Dorothy D. Sullivan, *Teaching Slow Learners Through Active Games* (Springfield, Illinois, 1970), n.p.

[25]James H. Humphrey and Joy N. Humphrey, *Help Your Child Learn the 3R's Through Active Play* (Springfield, Illionis, 1980), n.p.

[26]Humphrey, *Child Learning Through Elementary School Physical Education,* p. 13.

[27]Charles C. Cowell, "Some Basic Beliefs Concerning Physical Education: An Educational Credo," *Physical Educator* (December, 1954), n.p.

[28]Delbert Oberteuffer and Celests Ulrich, *Physical Education A Textbook of Principles for Professional Students* (3rd ed., New York, 1962), p. 40.

[29]Jan Felshin, *More Than Movement: An Introduction to Physical Education* (Philadelphia, 1972), p. 144.

[30]Lowell Keith, Paul Blake, and Sidney Tiedt, *Contemporary Curriculum in the Elementary School* (New York, 1968), n.p.

[31]Oscar T. Jarvis and Lutian R. Wootton, The Transitional Elementary School and Its Curriculum (Dubuque, Iowa, 1966), p. 69.

[32]George A. Beauchamp, Basic Dimensions of Elementary Method (Boston, 1959), p. 115.

[33]VanDalen and Bennett, p. 371.

[34]Keith, Blake, and Tiedt, p. 116.

[35]Beauchamp, p. 116.

[36]Keith, Blake, and Tiedt, p. 122.

[37]Jarvis and Wootton, p. 71.

[38]Carl E. Willgoose, The Curriculum in Physical Education (3rd ed., Englewood Cliffs, New Jersey, 1979), p. 141.

[39]Oberteuffer and Ulrich, p. 365.

[40]Marlin M. Mackenzie, Toward A New Curriculum in Physical Education (New York, 1969), n.p.

[41]Oberteuffer and Ulrich, p. 364.

[42]Ibid., p. 345.

[43]Felshin, p. 144.

[44]Nelson B. Henry, Ed., "The Integration of Educational Experiences," The 57 Yearbook of the National Society of Education Part III (Chicago, 1948), n.p.

[45]Humphrey, Elementary School Physical Education With Emphasis Upon Its Integration in Other Curriculum Areas, p. 103.

[46]Oberteuffer and Ulrich, p. 354.

[47]Humphrey, Education of Children Through Motor Activity, pp. 7-8.

[48]Philip W. Jackson, Life in Classrooms (New York, 1968), p. 111.

[49]Cratty, Intelligence in Action Physical Activities for Enhancing Intellectual Abilities, n.p.

[50]Humphrey and Humphrey, Help Your Child Learn the 3R's Through Active Play, n.p.

[51]Oberteuffer and Ulrich, n.p.

[52]John Holt, How Children Learn (New York, 1969), p. ix.

[53]Howard G. Ball, "What's in a Game?" The Elementary School Journal (September 1976), p. 42.

[54]Humphrey, Education of Children Through Motor Activity, p. 11.

[55]Edward J. Murray, "Motivation and Emotion," in Foundations of Psychology Series - Personality, Richard S. Lazarus, Ed. (2nd ed., Englewood Cliffs, New Jersey, 977), p. 5.

[56]Humphrey, Elementary School Physical Education With Emphasis Upon Its Integration in Other Curriculum Areas, p. 100.

[57]Alexander Lowen, Bioenergetics (New York, 1975), pp. 61-62.

[58]Marie Riley, Ed., Echoes of Influence for Elementary School Physical Education (Washington, D. C., 1977), n.p.

[59]Carl R. Rogers, Freedom to Learn (Columbus, Ohio, 1969), p. 304.

[60]Oberteuffer and Ulrich, p. 366.

[61]Ibid., pp. 362, 366.

[62]Vere M. DeVault and Thomas E. Kriewall, Perspectives in Elementay School Mathematics (Columbus, Ohio, 1969), p. 31.

[63]Leonard M. Kennedy, Guiding Children to Mathematical Discovery (2nd ed., Belmont, California, 1975), p. 6.

[64]Marshall C. Jameson and Wm. Vernon Hicks, Elementary School Curriculum From Theory to Practice (New York, 1960), p. 68.

[65]DeVault and Kriewall, n.p.

[66]Joel L. Burdin and John D. McAulay, Elementary School Curriculum and Instruction The Teacher's Role (New York, 1977), p. 338.

[67]Humphrey and Humphrey, p. 113.

[68]Edith E. Biggs and James R. MacLean, Freedom to Learn An Active Learning Approach to Mathematics (Ontario, Canada, 1969), p. 6.

[69]Hollis L. Caswell and Arthur W. Foshay, _Education in the Elementary School_ (3rd ed., New York, 1957), p. 55.

[70]Howard F. Fehr and Jo McKeeby Phillips, _Teaching Modern Mathematics in the Elementary School_ (Reding, Massachusetts, 1967), p. 17.

[71]Leonard M. Kennedy and Ruth L. Michon, _Games for Individualizing Mathematics Learning_ (Columbus, Ohio, 1973), p. 2.

[72]Humphrey and Humphrey, p. 123.

[73]Cratty, _Active Learning Games to Enhance Academic Abilities_, p. 60.

[74]Humphrey, "An Exploratory Study of Active Games in Learning of Number Concepts by First Grade Boys and Girls," _Perceptual and Motor Skills_ (October 1966), pp. 341-342.

[75]Ashlock and Humphrey, pp. 59-60.

[76]Ibid., pp. 61-62.

[77]Ibid., pp. 63-65.

[78]Ibid., pp. 65-66.

[79]Ibid., p. 67.

[80]Humphrey, _Education of Children Through Motor Activity_, p. 35.

[81]Gerald R. Rising and Joseph B. Harkin, _The Third "R" Mathematics Teaching for Grades K-8_ (Belmont, California, 1978), p. 309.

CHAPTER III

METHODS AND PROCEDURES

This chapter describes the subjects and the methods and procedures used in this study. A discussion of the instrument and its validity and relaibility is also included.

The Subjects

Twenty-two boys and twenty-seven girls were selected from students attending Skyline Elementary School, Independent School District #16, Stillwater, Oklahoma during 1980-1981. Discussions with the Assistant Superintendent of Curriculum, the school principal, and several classroom teachers from various grade levels supported research that indicated mastery of multiplication tables (facts) during the fourth grade.[1,2] It was felt that since mastery of multiplication tables was one of the goals of the fourth grade program at Skyline, this grade was the most appropriate level in which to conduct the study.

The forty-nine fourth grade subjects in this study received their mathematical instruction from the same classroom teacher. Other fourth grade students who were involved in special programs (gifted and talented, learning disabled, educably mentally handicapped) and received their math instruction from different teachers were not exposed to the instrument used in this study. All fourth grade students were involved in the physical education program taught by the author.

Mathematics

Fourth grade students were divided among three classroom teachers at the beginning of the school year. Each class stayed with this homeroom teacher during the morning classroom activities. However, in the afternoon each teacher taught only one subject, mathematics, science, or social studies, and the classes rotated from teacher to teacher for instructional purposes. There was no grouping of fourth grade students according to mathematical ability. All students not involved in special programs received a thirty minute math class from the same teacher each afternoon.

The mathematics teacher's methods of instruction and daily lesson planning were not controlled by the study. The author did check closely and on a regular basis with the teacher in regard to her planning, and together they worked out the testing schedule. The cooperating teacher agreed to teach the major multiplication units in succession. By doing this the basic fourth grade multiplication instruction was completed by the end of the first semester of school.

The multiplication units lasted approximately fourteen weeks which encompassed sixty-eight school days. These units basically followed the adopted textbook which was used by the school district.[3] The pretest was given on September 15, midterm conducted on November 17, and the posttest was completed on January 12 or 13. All tests were given within the regularly scheduled time for math.

If a student was absent on a testing day, the subject was given the test on the first day he/she returned to school. If subjects did not return to school within three days from the testing date, they were dropped from the study. No subject was dropped from the study for failure to take the test within the alotted time limit. The subjects were given thirty minutes to complete each test, and were encouraged by the cooperating teacher to use as much of that time as they needed. Because of the rotating schedule for afternoon classes, subjects were not allowed to have more than the thirty minutes each testing time.

Possible reaction of the subjects to the pretest was of concern to the author. The design of the instrument was comprehensive, and thus included concepts that were not presented to the subjects during the third grade year but were included during the fourth grade. The subjects had not received multiplication practice during the fourth grade before the pretest, but had extensively reviewed addition as a prelude to the multiplication unit. Knowing that the pretest might cause anxiety among some subjects, but realizing that "Math anxiety is curable,"[4] certain measures were taken to reassure subjects before the pretest was given. The classroom teacher verbally explained and stressed the following points to the subjects:

1. No grade would be given in regard to test performance.
2. The test would give the teacher an idea of what they remembered from third grade and would aid her in understanding what she should review first in regard to the coming multiplication unit.
3. The test was comprehensively designed. It included concepts the subjects had covered during third grade, but it also contained concepts that they would not have until later during their fourth grade year. They were not expected to be able to understand all problems on the test at this time.
4. The subjects were requested and encouraged to try to do their very best.
5. A reminder was given that the test concerned multiplication and not addition; they should multiply and not add the problem.

If a subject brought a completed pretest to the teacher within five minutes, she looked through the test and then handed it back. The subject was encouraged to look it over again and see if there were some problems he/she might have missed and would be able to complete if the subject tried one more time.

Positive verbal reinforcement was given before both the midterm and posttests. The classroom teacher reminded the subjects to try each problem and to use the time allowed to complete and re-check their responses. The instrument was portrayed as an important aid for understanding difficulties subjects might be having with multiplication, but was not presented as part of their report card grade until the subjects took the posttest. The classroom teacher had asked the author for permission to use the posttest as a part of the students' math grades for the second nine weeks grading period.

As the pre-, mid-, and posttests were completed the classroom teacher gave them to the author for grading purposes. Upon completion of this grading, the tests and test scores were shared and reviewed with the classroom teacher but were not handed back to the subjects. As a motivational factor, the subjects were shown the difference in their individual pretest and midtest scores. After the posttest the difference between scores on pretest and posttest were also shared with the subjects.

Physical Education

Fourth grade physical education was scheduled on three consecutive days each week. The one hour morning time slot was divided into two thirty minute periods meeting from 9:55-10:25 and from 10:25-10:55. The first thirty minute period was termed Class 4A and the second period became Class 4B. These classes were later identified as experimental and control groups.

Since there were three fourth grade homeroom classes and only two class periods available for physical education, one homeroom class was divided into two groups. One half of this class participated in art or music with Class 4B while the other part of the class attended physical education with Class 4A. The two classes were then switched at the end of the thirty minute period. Assignment to Class 4A or Class 4B for the split group was completed at the beginning of the school year by both the music and physical education teachers. Equality in class size during art, music, and physical education was the most important factor in dividing the third homeroom class.

Having the fourth grade students divided into two groups for their physical education instruction corresponded with the need for both a control and experimental group within this study. Class 4A was termed the experimental group and Class 4B became the control group. All subjects were considered to have completed the study if they had attended school from September 15 through January 13 and had taken the pre-, mid-, and posttests. The physical education teacher met her classes a total of thirty-two days within this time period.

The twenty-five subjects in the control group that completed the study consisted of thirteen girls and twelve boys. This group participated in the regular physical education curriculum without any emphasis in regard to the reinforcement of learning multiplication tables. However, they were exposed to reinforcement in other cognitive based areas, such as science, art, music, and social studies.

There were fourteen girls and ten boys who completed the study within the experimental group. A total of ten classes were spent in participation of selected activities or games that were created or altered to help in reinforcement of learning multiplication tables, while at the same time reflected the physical education needs of the students through their regular curricular activities. This study was not directed at changing the physical education curriculum to fit the mathematical needs of the classroom or vice versa.

An explanation of the activities and games used for reinforcement of multiplication tables with this group can be found in Appendix A. Club Snatch, Manipulative Movement, and Tumbling were each used as reinforcement activities on two separate occasions. Four days were required to reinforce the selected multiplication tables when using the trampoline.

Besides the above mentioned games or activities, multiplication tables were used during the exercise period preceding class activity. An explanation of the two exercises that were selected for this purpose is found in the Definitions (Chapter I), and the procedure for integrating multiplication tables during exercises is explained in Appendix A. Through this method various multiplication tables were reviewed at the beginning of each class period.

Table I represents a cumulative review of multiplication table reinforcement in relationship to the number of times each table was integrated into physical education activities and exercises.

TABLE I

MULTIPLICATION TABLE REINFORCEMENT

Multiplication Tables	Times Used in Warm-up Exercises	Times Used in Game or Activity
3	9	0
4	10	3
6	11	5
7	11	7
8	9	5
9	10	2

Selection of the multiplication table to use for reinforcement was determined by the orally demonstrated difficulties in response during physical education classes and by difficulty noted through the subjects' classroom paper work.

There was no pressure placed on the experimental group in regard to their verbal mathematical responses. An atmosphere of fun was promoted throughout each activity, game, or exercise, but correction was given if the multiplication fact being reviewed was incorrect. Many times the subjects themselves provided corrections for one another. Also, group consensus regarding answers helped individuals who were insecure concerning multiplication problems presented for solution in the games and activities used during the study.

The same physical education and mathematics curricula were taught to both groups by the physical education and math teachers. All students took the pre-, mid-, and post-tests. The major difference between the experimental and control groups involved the integration of multiplication facts within the scheduled physical education activity for the experimental group. The multiplication activities used within the experimental group were aimed at providing "special activities that help them [children in the third grade and beyond] commit the facts to memory for immediate recall."[5]

Two different student teachers worked with the physical education teacher during the time of this study. The purpose and direction of the study was explained before they began working with the classes. The student teachers were allowed to work with the experimental group in the warm-up exercise portion of this study. However, whenever a game or activity (other than exercising) was used with the experimental group, the physical education teacher always conducted the class for that particular day. At times the student teachers instructed the parallel activity or game used with the control group since no reinforcement of multiplication tables was involved with those subjects.

Selection of the Instrument

When reviewing various marketed mathematical tests, some basic realities were observed: (1) multiplication was usually included as a section within a battery of mathematical skills being tested; (2) most tests were norm-based; (3) there was apparently no instrument which directly measured fourth grade level students' abilities in regard to only testing multiplication facts. Concluding that norm-based tests ". . . which are used to ascertain an individual's performance in relation ship to the performance of other individuals on the same measuring device"[6] were not the proper instruments to use in regard to this study, attention was turned to the edumetric dimension.

Carver contends that edumetric properties reflect the within-individual growth that has been the traditional interest of education testing.

> When the primary purpose of the test is to measure the gain or growth of individuals, for example, the measurement of knowledge, skill, or achievement, the test should be primarily evaluated using edumetric principles.[7]

Since this study sought to determine what individuals could do in respect to their own performance standard on the instrument, a criterion-referenced instrument needed to be established.

"To design a criterion-referenced test, the teacher must develop items and assemble them into an assessment instrument."[8] Singer and Dick consider the following characteristics essential for a good criterion-referenced test: (1) congruence with the objective; (2) clarity; (3) the response meeting the criterion as stated in the objective.[9]

A review of various teacher edition textbooks revealed tests available to the teacher in regard to testing mathematical facts. However, the author continued to search for other sources in regard to problem selection for multiplication testing due to the following considerations: (1) Skyline Elementary School would have a new fourth grade mathematics teacher for the 1980-1981 school year; (2) the extent to which this teacher would use the tests in the teacher's edition book was unknown; (3) a more extensive search could possibly reveal a wider base on which to establish the instrument; (4) the basic characteristics of criterion-referenced tests, as previously indicated, needed to be met.

A publication by the Norman Public Schools, Norman, Oklahoma[10] was found which had been designed for reinforcement of various mathematical skills. The Mathematics Coordinator for this school system indicated that although a statistical validity had not been established in regard to the content of this guide, mathematics teachers in Norman used the compiled work in various ways with regard to their mathematics program. Selected pages were used for extra practice sheets, as review problems, and for testing purposes. Five pages of one digit multiplication problems and five of two digit problems were included in this mathematical guide.

The instrument began to develop as discussions were held with both teachers and administrators in regard to the fourth grade mathematical goals; specifically multiplication. A review was made of the multiplication problems contained in both Mathematics Teacher's Edition[11] and the Computational Skills Reinforcement Program.[12] With the aid of classroom teachers, fifty problems from these sources were selected as representative of testing the students' knowledge of multiplication facts. These problems were then reviewed and discussed with mathematical personnel who had not previously been involved in the instrument selection process. Their suggestions were considered in regard to additions or changes that should be made to insure the testing of multiplication facts that should be learned by fourth grade students attending Stillwater public schools. The final selection of fifty problems was then completed by the author, and the instrument was established (Appendix B).

The instrument was designed as a comprehensive posttest to assess the achievement of objectives following instruction. However, it was also used for pretesting purposes in determining what objectives had previously been achieved prior to the study. The instrument was further included as an index of the learning that took place during the learning process and was termed a midterm test during the study.

Validity of the Instrument

Determining if the instrument measured what it indicated it measured was a necessity. "Regarding the classroom measuring instrument, validity is the single most important criterion for the use of tests in an educational situation."[13] If content validity (". . . how well the test items in a test represent the total content of that which is desired to be measured"[14]) was to be established, then a choice as to the method of determining validity had to be made. Keeping in mind that the content in this study was multiplication facts, Sheehan's suggestion that "The teacher is in the best position of anyone to judge the content of the course he is presenting"[15] supported the method chosen in regard to establishing instrument validity.

A total of fourteen authorities were asked to judge the validity of the instrument. Thirteen fourth grade teachers in the Stillwater public schools were asked to be authorities in judging in addition to Dr. Helen Cheek, Assistant Professor of Elementary Math Education at Oklahoma State University. All of the teachers had previous experience in teaching mathematics on the fourth grade level. Since they had also previously taught in this specific school system and were familiar with the goals and objectives of the mathematical program, they were considered to be authorities in regard to mathematical content on the fourth grade level.

Cooperation of the five elementary school principals was secured before approaching these classroom teachers regarding this study. The purpose and scope of the study was explained during meetings at the various schools, with questions answered regarding the study or the instrument. The authorities were asked to evaluate the instrument in regard to its validity in testing multiplication ability of fourth grade students who would have completed the multiplication units studies during fourth grade; a comprehensive test. A Validity Response Form (Appendix C), a sample of the instrument, and a return envelope were given to each prospective judge with a request to return the responses to the author within a seven day period. Names or school locations were not requested in order to give the judges freedom to respond without undue pressure. It was pointed out that their agreement in regard to judging the instrument was on a voluntary basis. They were asked not to discuss the instrument or to consult one another in regard to decisions concerning validity of the instrument.

A total of twelve validity judgments were returned with nine judges indicating that they felt the instrument was a valid test. Two judges questioned the validity for the following reasons: (1) "I would include the operation of addition since that is developmentally sequential - but your goal may be different" and (2) "I think some story problems should be included - children are weak in that area" (Appendix C). Another judge marked both 'yes' and 'no' qualifying her answer by the statement that "They were not introduced to anything higher than 3 digits times 2 digits. The better students should be able to recognize and carry out the process though" (Appendix C).

In regard to the first question of validity, the author felt the judge probably did not understand the instrument's focus on multiplication as the goal of the instrument. An extensive unit in review of addition was conducted before the pretest was given, and the student's ability to compute this algorithm should have been met before he/she was introduced to the instrument.

The involvement of word problems was discussed in the early stages of instrument design.

> Studies of elementary school students have shown that there is a high correlation between reading achievement and problem-solving ability in mathematics. Students certainly cannot solve the problems if they can't read them.[16]

Since reading skills were not considered in this study, it was felt that the inclusion of word problems might hinder the responses of some subjects; therefore, word problems were not included in the instrument.

The inclusion of problems larger than three digits multiplied by two digits was also considered in the early discussions of design. A consensus of opinion concluded that students should be able to recognize and carry out the multiplication process even though they had not been exposed to this process in previous practice as extensively as the instrument dictated. Opinions were expressed that a comprehensive test should not only assess but challenge; therefore, these problems were included within the final instrument.

Based on the responses from the judges, the author accepted the instrument as valid in testing the comprehensive multiplication knowledge of fourth grade level students.

Reliability

Payne indicated that reliability is "The extent to which a test is accurate or consistent in measuring whatever it measures."[17] This stability is a necessity when one realizes the variety of factors that influence test scores. In seeking to establish the dependability of the chosen instrument, this study concerned itself with determining reliability through the split-half method.

The instrument was divided into two equal tests of twenty-five problems each. The odd-numbered problems from the original instrument were combined to create Test A...R/ODD while even-numbered problems became Test B...R/EVEN (Appendix D). These two tests were administered to twenty-seven fourth grade students at Sangre Ridge Elementary School, Stillwater, Oklahoma on October 20, 1981. The students taking part in this split-half testing were selected because of the following group characteistics which paralleled those of the actual subjects in the study: (1) the school was designed on an open-classroom concept; (2) there was no fourth grade exposure to multiplication before the tests were administered; (3) there was an extensive review unit in addition before multiplication instruction began; (4) math instruction was conducted by the same teacher; (5) no ability grouping existed in the math class at the time the tests were given.

The Pearson product-moment correlation was applied to the raw data obtained from the fourth grade students tested at Sangre Ridge and yielded a correlation coefficient of .86886 between odd and even forms of the instrument. Sheehan indicated that testing authorities generally agree that a reliability coefficient must be at least .50 in order to conclude that the test is reliabile.[18] Accepting this interpretation, the .86886 correlation coefficient indicated the instrument was reliable in testing fourth grade multiplication knowledge.

This high correlation coefficient stimulated the author's interest in investigating reliability of the instrument as it applied to the subjects in this study. Thus, when the raw data for pre-, mid-, and posttests was prepared for computer analysis, the Pearson product-moment correlation was again applied. This treatment yielded high correlations similar to those obtained from the first split-half analysis. The reliability coefficient for the pretest was .87613, the midtest yielded a .87197, and the posttest showed a coefficient of .81268. These high correlation coefficients supplemented the earlier finding in supporting the reliability of the instrument.

ENDNOTES

[1]Lola June May, Teaching Mathematics in the Elementary School (New York, 1970), p. 102.

[2]Guy M. Wilson, Mildred B. Stone and Charles O. Dalrymple, Teaching The New Arithmetic What to Teach, How to Teach It, Provision for Professional Growth (New York, 1939), p. 153.

[3]Ernest R. Duncan, Coordinting Author, Mathematics Teacher's Edition Book 4 (Boston, 1978), n.p.

[4]Grace M. Burton, "Getting Comfortable With Mathematics," The Elementary School Journal (January 1979), p. 134.

[5]Leonrd M. Kennedy, Guiding Children to Mathematical Discovery (2nd ed., Belmont, California, 1975), p. 214.

[6]W. James Popham and T. R. Husek, "Implications of Criterion-Referenced Measurement," Journal of Educational Measurement (Spring 1969), p. 2.

[7]Ronald P. Carver, "Two Dimensions of Tests Psychometric and Edumeteric," The American Psychologist (July 1974), p. 513.

[8]Robert N. Singer and Walter Dick, Teaching Physical Education A Systems Approach (2nd ed., Boston, 1980), p. 173.

[9]Ibid., pp. 173-174.

[10]Normal Public Schools, "Computational Skills Reinforcement Program for Use in Algebra I, Plane Geometry, Algebra II," Teacher's Supplementary Materials, Norman, Oklahoma, 1977, n.p.

[11]Duncan, Mathematics Teacher's Edition Book 4, n.p.

[12]Normal Public Schools, n.p.

[13]Thomas J. Sheehan, An Introduction to the Evaluation of Measurement Data in Physical Education (Reading, Massachusetts, 1971), p. 212.

[14]Ibid., p. 48.

[15]Ibid., p. 213.

[16]Gerald R. Rising and Joseph B. Harkin, The Third "R" Mathematics Teaching for Grades K-8 (Belmont, California, 1978), p. 246.

[17]David A. Payne, The Assessment of Learning Cognitive and Affective (Lexington, Massachusetts, 1974), p. 503.

[18]Sheehan, p. 215.

CHAPTER IV

RESULTS AND DISCUSSION

The purpose of this study was to explore the reinforcement value of physical education activities in learning multiplication tables. Forty-nine fourth grade subjects participated in the study. These subjects received math instruction from one teacher with the learning of multiplication tables being reinforced through various activities in the physical education class.

The design of the study incorporated experimental and control groups. The major difference between these groups involved the integration of multiplication facts within the scheduled physical education class activities of the experimental group. The same instrument was used for pre-, mid-, and posttests in assessing cognitive learning of multiplication by all subjects.

The mathematical description of this study involved using the mean as the measure of central tendency with standard deviation used for assessing dispersion. Table II, III and IV indicate the results of these statistical applications for group description.

The 1.53 difference between mean scores indicated a close relationship between the pretest - midtest means. A

2.14 difference between standard deviation scores indicated another fairly close relationship, this time in connection with the distribution of both groups' scores from the means.

TABLE II

PRETEST TO MIDTEST

Group	N	Mean	Standard Deviation
Control	25	15.32	5.84
Experimental	24	13.79	7.98

TABLE III

MIDTEST TO POSTTEST

Group	N	Mean	Standard Deviation
Control	25	9.80	5.84
Experimental	24	11.38	4.84

Table III shows another close relationship of group means. It indicates a lower mean score for both groups in comparison to the pretest to midtest scores. However, the deviation from the mean became less for the experimental group when compared to pretest - midtest variation. The control group's standard deviation remained the same.

TABLE IV

PRETEST TO POSTTEST

Group	N	Mean	Standard Deviation
Control	25	25.12	7.04
Experimental	24	25.17	8.81

The closest relationship between mean scores is indicated by Table IV. A mean difference of only .05 existed between experimental and control groups. The 1.77 pretest - posttest standard deviation difference between the groups is less than the same comparison found in pretest to midtest (2.14), but more than the 1.00 difference between the groups found in the midtest - posttest assessment.

In reviewing the results of these measures of central tendency and dispersion, the two groups maintained a fairly close statistical relationship. The largest mean score difference between groups came in the midtest - posttest assessment. However, this 1.38 difference still indicated a close mean relationship between the groups. Although differences between means were noted, especially for the control group, the mean scores between the two groups maintained a homogeneous relationship.

Both groups experienced a drop in mean scores during the midtest - posttest period. These lower mean scores might have indicated a plateau in learning when compared to the first thrust of learning acquired in the beginning, as possibly indicated by the mean scores in the pretest - midtest assessment. The larger mean scores in the pretest - posttest period supported the assumption that advancement in learning would take place during the study.

Variation from the average score were also closely related when comparing the two groups. The largest standard deviation difference between the groups (2.14) was seen from pretest to midtest, perhaps indicating wide variations in levels of learning taking place at the beginning of the study. The standard deviation difference of 1.00 between the groups in Table III shows a decrease in group difference variation toward the end of the study. The 1.77 standard deviation difference between groups in the pretest - posttest assessment again indicated a close relationship between the two groups.

The experimental group had a smaller deviation from mean scores during the midtest - posttest period. The other two standard deviation scores, when compared to the control group, showed a larger deviation. The control group's deviation remained fairly stable throughout the period of the study, but showed an increase when comparison was made from pretest to posttest.

When looking at the statistical applications for mathematical description, the two groups showed a fairly homogeneous relationship. However, in order to extend the descriptive knowledge of these two groups, the range of the scores was considered. Table V shows the minimum and maximum range of each group for the three testing situations.

TABLE V

RANGE SCORES FOR BOTH GROUPS

Group	Pretest-Midtest		Midtest-Posttest		Pretest-Posttest	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Control	4.00	25.00	-4.00	18.00	11.00	40.00
Experimental	-1.00	25.00	2.00	19.00	6.00	41.00

The experimental group showed a more diversified range in scores except for the midtest - posttest scores. Again, the groups seemed to be fairly close in descriptive relationship.

The t-test for determining differences between the means of groups was applied. Results of this statistical treatment can be found in Table VI.

TABLE VI

t - TEST RESULTS

Test	t Value	Degree of Freedom	Probability
Pretest - Midtest	.77	47	.45
Midtest - Posttest	-1.02	47	.31
Pretest - Posttest	-0.02	47	.98

No significant difference was observed between the control and experimental groups with respect to the improvement scores from pretest to midtest ($t=.77$, $df=47$, $p=.45$).

No significant difference was observed between the control and experimental groups with respect to the improvement scores from midtest to posttest ($t=-1.02$, $df=47$, $p=.31$).

No significant difference was observed between the control and experimental groups with respect to the improvement scores from pretest to posttest ($t=-0.02$, $df=47$, $p=.98$).

The null hypothesis was accepted in concluding that there was no significant difference in the learning of multiplication tables by subjects whose learning was reinforced through specifically designed physical education activities nor by those who were not exposed to the same reinforcement experiences. A discussion related to the results of this study is found in the following chapter.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

> The young members of the human family are complex animals. To suggest that simplistic motor training programs will somehow alter their complex brain is an unrealistic retreat to archaic eighteenth century concepts, and removing meaningful movement experiences from the curriculum is a further retreat into the Dark Ages.[1]

The educational balance provided through integrative learning processes recognized the ". . . indisputable merit and meaning of movement in the life of the child."[2] Movement can be an important learning modality but suggesting that it underlies all cognition would be a gross overstatement. Ideally, education contributes to the total growth and development of children, and physical education has extremely unique and important functions within the educational framework. One of those functions involves maintaining an integral relationship with the total educational community through programs directed toward the development of the whole child: social, emotional, physical, and mental.

Studies have produced various results in applying motor activity learning to different cognitively based disciplines for teaching or reinforcement purposes. Research has implied functional relations between games and cognitive styles, but it is weak in drawing conclusions concerning the particular facets of the games or activities that have contributed to the observed influence.[3] This study concerned the reinforcement of learning multiplication tables through integrative processes experienced in physical education class activities.

Forty-nine fourth grade subjects participated in the study. The major difference between the experimental and control groups involved the integration of multiplication facts within the scheduled physical education activities of the experimental group. All subjects were given a criterion-based test assessing their knowledge of multiplication. The instrument was given three separate times and termed pre-, mid-, and posttests. No significant difference was observed between the control and experimental groups with respect to the improvement scores on the tests.

This study was conceived when the investigator began to integrate reinforcement of cognitive learning into the physical education classes. Multiplication tables were used as a counting cadence during various warm-up exercises, creating a cognitive challenge that paralleled the physical activity. The third grade mathematics teacher expressed her opinion that this reinforcement was a positive aid in the initial learning of multiplication tables for her third grade students. As the students experienced this exposure to multiplication, they demonstrated a growth of confidence in regard to verbalizing multiplication facts.

This particular study explored reinforcement on the fourth grade level where mastery of multiplication facts is a goal of the mathematics program. Perhaps reinforcement of multiplication tables through physical education activities would be more appropriate during the initial learning stage rather than during the "commitment to memory" stage advocated in the fourth grade.

The instrument used in this study was designed as a comprehensive assessment of multiplication knowledge for fourth grade students. Therefore, it incorporated testing knowledge of the standard multiplication algorithm. An instrument designed to test only multiplication facts, not the algorithm, might be more precise in showing improvement in learning multiplication tables. Also, a study that used two different instruments for testing purposes might be more accurate in assessing this learning. One instrument could test beginning knowledge of multiplication facts while the other would be designed to assess the knowledge obtained at the end of the learning process.

Although a cooperative relationship existed between the teachers involved in this study, there was no control by the investigator of the classroom instruction program. A team teaching effort between the physical education teacher and the cognitive based subject teacher (math, science, social studies and such) might be productive in paralleling both goals and processes in advancing learning. It should be pointed out that the classroom teacher can integrate physical activity into the classroom, recess, or free-time experiences of the student toward cognitive development. More study is needed to determine the effect of motor learning activity within the classroom learning experience. If the student receives reinforcement in various subject areas from different teachers and through varied experiences, education is reaching toward the goal of contributing to the total growth and development of the student. Cooperative planning and instruction would seem to be a positive way to supplement the learning process.

The investigator experienced frustration with the scheduling of classes and with interruptions at least once a month due to school assemblies or various programs that eliminated scheduled class times. The lack of physical education instruction for four consecutive days presented problems in carry-over value of instruction and physical participation. Significant results might be attained through more consistency in scheduling and the process of reinforcement. Also, an extended length of time spent in reinforcement might have provided more opportunities for advancement in the learning of multiplication tables. An extended time period would have lent itself to more variety in the physical education curriculum, thus providing more opportunities for reinforcement possibilities.

Variables such as sex, age, or cognitive ability could prove important in the outcome of furthur study. A larger population would provide extended possibilities for furthur investigation into the effect of motor activity learning in regard to cognitive reinforcement. Based on the subjective evaluation of the investigator and the mathematics teacher, longitudinal research of this nature should be continued and prioritized in future educational investigations.

Additionally, it would seem valuable to study the effect this method of integrative instruction has on a student's concept of physical education. Likewise, consideration should be given to whether this approach has developed/created a change in attitude on the part of the child toward involvement in physical education class or participation in physical activities.

This author supports future investigation into the reinforcement possibilities of cognitive learning on the elementary school level through motor learning activities. This integrative teaching method not only provides a challenge to students, but presents a new format for the teaching of physical activities. It challenges the cognitive abilities of the physical education teacher and directs him/her to be knowledgable in regard to the curriculum of the entire elementary school.

Today's physical education is more than "fun and games" or "teachers time out." It is an integral part of the educational process of learning; and as such, must uphold the responsibility for educating the total individual. Physical education teachers must be alert to the changes within their classrooms and search for better means of providing successful learning experiences for the child.

Humans are complex; they function in complex ways, and their behavior fluctuates due to the impingement of a large variety of variables. Learn all you can; then be prepared to change your mind when new evidence is forthcoming.[4]

ENDNOTES

[1]Bryant J. Cratty, Some Educational Implications of Movements (Seattle, Washington, 1970), p. 182.

[2]Bette J. Logsdon, Kate R. Barrett, Marion R. Broer, Rosemary McGee, Margaret Ammons, Lolas E. Halverson, and Mary Ann Roberton, Physical Education for Children: A Focus on the Teaching Process (Philadelphia, 1977), p. 9.

[3]Belen Collantes Mills, Understanding the Young Child and His Curriculum (New York, 1972), p. 140.

[4]Bryant J. Cratty, Perceptual-Motor Behavior and Education Processes (Springfield, Illinois, 1969), pp. 83-84.

A SELECTED BIBLIOGRAPHY

Annarino, Anthony A., Charles C. Cowell and Helen W. Hazelton. Curriculum Theory and Design in Physical Education. St. Louis: The C. V. Mosby Company, 1980.

Asher, James J. "The Total Physical Response Technique of Learning." The Journal of Special Education, Vol. 3, No. 3 (Fall, 1969).

Ashlock, Robert B. and Wayne L. Herman, Jr. Current Research in Elementary School Mathematics. London: Collier-Macmillan Limited, 1970.

Ashlock, Robert B. and James. H. Humphrey. Teaching Elementary School Mathematics Through Motor Learning. Springfield, Illinois: Charles C. Thomas Publisher, 1976.

Ball, Howard G. "What's in a Game?" The Elementary School Journal, Vol. 77, No. 1 (September, 1976), pp. 42-49.

Beauchamp, George A. Basic Dimensions of Elementary Method. Boston: Allyn and Bacon, Inc., 1959.

Biggs, Edith. Mathematics for Younger Children. New York: Citation Press, 1971.

Biggs, Edith E. and James R. MacLean. Freedom to Learn An Active Learning Approach to Mathematics. Don Mills, Ontario, Canada: Addison-Wesley (Canada) Ltd., 1969.

Biggs, J. B. Mathematics and the Conditions of Learning A Study of Arithmetic in the Primary School. London: National Foundation for Educational Research in England and Wales, 1967.

Bobbitt, Franklin. "The New Technique of Curriculum-Making." The Elementary School Journal, Vol. 75, 75th Anniversary Issue (September, 1924), pp. 70-77.

Bucher, Charles A. Foundations of Physical Education. 6th Ed. St. Louis: The C. V. Mosby Company, 1972.

Buffie, Edward G., Ronald C. Welch and Donald D. Paige. Mathematics: Strategies of Teaching. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1968.

Burdin, Joel L. and John D. McAulay. Elementary School Curriculum and Instruction The Teacher's Role. New York: The Ronald Press Company, 1971.

Burton, Grace M. "Getting Comfortable With Mathematics." The Elementary School Journal, Vol. 79, No. 3 (January, 1979), pp. 129-135.

Carver, Ronald P. "Two Dimensions of Tests Psychometric and Edumetric." The American Psychologist, Vol. 29, No. 7 (July, 1974), pp. 512-518.

Caswell, Hollis L. and Arthur W. Foshay. Education in the Elementary School. 3rd Ed. New York: American Book Company, 1957.

Choat, Ernest. Children's Acquisition of Mathematics. Great Britain: NFER Publishing Company Ltd., 1978.

Church, Kenneth R. "Children's Exercise: Facts and Fiction." The Elementary School Journal, Vol. 77, No. 2 (November, 1976), pp. 113-115.

Cohen, Richard B. and Robert H. Bradley. "Simulation Games, Learning, and Retention.," The Elementary School Journal, Vol. 78, No. 4 (March, 1978), pp. 247-253.

Collinge, James. "Teachers and Teaching Methods." The Elementary School Journal, Vol. 76, No. 5 (February, 1976), pp. 259-265.

Corbin, Charles B. Becoming Physically Educated in the Elementary School. 2nd Ed. Philadelphia: Lea and Febiger, 1976.

Cowell, Charles C. "Some Basic Beliefs Concerning Physical Education: An Educational Credo." The Physical Educator of Phi Epsilon Kappa, Vol. XI, No. 4 (December, 1954), pp. 99-100.

Cratty, Bryant J. Active Learning Games to Enhance Academic Abilities. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.

__________. Intelligence in Action Physical Activities for Enhancing Intellectual Abilities. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1973.

__________. Movement Behavior and Motor Learning. 3rd Ed. Philadelphia: Lea and Febiger, 1973.

__________. Perceptual-Motor Behavior and Education Processes. Springfield, Illinois: Charles C. Thomas Publisher, 1969.

__________. Physical Expressions of Intelligence. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972.

__________. Some Educational Implications of Movements. Seattle, Washington: Special Child Publications, Inc., 1970.

Devault, M. Vere and Thomas E. Kriewall. Perspectives in Elementary School Mathematics. Columbus, Ohio: Charles E. Merrill Publishing Company, 1969.

Dines, Z. P. Mathematics Through the Senses, Games, Dance and Art. Great Britain: NFER Publishing Company Ltd., 1973.

Duncan, Ernest R., Coordinating Author. Mathematics Teachers' Edition Book 4. Boston: Houghton Mifflin Company, 1978.

Fait, Hollis F. Physical Education for the Elementary School Child. 2nd Ed. Philadelphia: W. B. Saunders Company, 1971.

Fehr, Howard F. and Jo McKeeby Phillips. Teaching Modern Mathematics in the Elementary School. Reading, Massachusetts: Addison-Wesley Publishing Company, 1967.

Felshin, Jan. More Than Movement: An Introduction to Physical Education. Philadelphia: Lea and Febiger, 1972.

Fennema, Elizabeth. "Sex Differences in Mathematics - Learning: Why???" The Elementary School Journal, Vol. 75, No. 3 (December, 1974), pp. 183-190.

Flener, Frederick O. "If This Is Mathematics, Why Are the Children Climbing on the Tables?" The Elementary School Journal, Vol. 78, No. 3 (January, 1978), pp. 174-179.

Frand, Jason L. "A Strategy for Implementing Change of Mathematics Curricula." The Elementary School Journal, Vol. 79, No. 2 (November, 1977), pp. 118-123.

Frost, Joe L. and G. Thomas Rowland. The Elementary School Principles and Problems. Boston: Houghton Mifflin Company, 1969.

Frostig, Marianne. Movement Education: Theory and Practice. Chicago: Follet Educational Corporation, 1970.

Gaynor, John F. "Making Academics Count." The Elementary School Journal, Vol. 5, No. 5 (February, 1975), pp. 273-278.

Gerhardt, Lydia A. Moving and Knowing the Young Child Orients Himself in Space. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1973.

Getman, G. N. How to Develop Your Child's Intelligence. Luverne, Minnesota: Research Publications, 1962.

Halsey, Elizabeth. Inquiry and Invention in Physical Education. Philadelphia: Lea and Febiger, 1964.

Hart, Leslie A. "Don't Teach Them; Help Them Learn." Learning the Magazine for Creative Teaching, Vol. 9, No. 8 (March, 1981), pp. 38-40.

Henry, Nelson B., Editor. "The Integration of Educational Experiences." The 57 Yearbook of the National Society for the Study of Education Part III. Chicago: The University of Chicago Press, 1958.

Holt, John. How Children Fail. New York: Pitman Publishing Corporation, 1964.

__________. How Children Learn. New York: Pitman Publishing Corporation, 1969.

Humphrey, James H. "An Exploratory Study of Active Games in Learning of Number Concepts by First Grade Boys and Girls." Perceptual and Motor Skills, Vol. 23, No. 2 (October, 1966), pp. 341-342.

__________. Child Learning Through Elementary School Physical Education. Dubuque, Iowa: Wm. C. Brown Company Publishers, 1965.

__________. "Comparison of the Use of Active Games and Language Workbook Exercises as Learning Media in the Development of Language Understandings With Third Grade Children." Perceptual and Motor Skills, Vol. 21, No. 1 (August, 1965), pp. 23-26.

__________. "Comparison of the Use of the Physical Education Learning Medium and Traditional Procedures in the Development of Certain Arithmetical Processes With Grade 2 Children." Abstracts of Research Papers. Washington, D. C.: American Association for Health, Physical Education, and Recreation, 1968.

__________. Education of Children Through Motor Activity. Springfield, Illinois: Charles C. Thomas Publisher, 1975.

__________. Elementary School Physical Education With Emphasis Upon Its Integration in Other Curriculum Areas. New York: Harper and Brothers, Publishers, 1958.

__________. "The Active Game Learning Approach in the Reinforcement of Reading Skills." The Journal of Special Education, Vol. 1, No. 4 (Summer, 1967), pp. 369-373.

__________. "The Mathematics Motor Activity Story." The Arithmetic Teacher, Vol. 14, No. 1 (January, 1967), pp. 14-16.

Humphrey, James H. and Joy N. Humphrey. Help Your Child Learn The 3R's Through Active Play. Springfield, Illinois: Charles C. Thomas Publisher, 1980.

Humphrey, James H. and Virginia D. Moore. "Improving Reading Through Physical Education." Education, Vol. 80, No. 9 (May, 1960), pp. 559-561.

Humphrey, James H. and Dorothy D. Sullivan. Teaching Slow Learners Through Active Games. Springfield, Illinois: Charles C. Thomas Publisher, 1970.

Inbar, M. and C. S. Stroll. "Games and Learning." Interchange, Vol. 8 (September, 1970), pp. 53-61.

Ismail, A. H., John Kane and D. R. Kirkendall. "Relationships Among Intellectual and Nonintellectual Variables." The Research Quarterly, Vol. 40, No. 1 (1969), pp. 83-92.

Jackson, Philip W. Life in Classrooms. New York: Holt, Rinehart and Winston, Inc., 1968.

Jameson, Marshall C. and Wm. Vernon Hicks. Elementary School Curriculum From Theory to Practice. New York: American Book Company, 1960.

Jarvis, Oscar T. and Lutian R. Wootton. The Transitional Elementary School and Its Curriculum. Dubuque, Iowa: Wm. C. Brown Company Publishers, 1966.

Johnson, George Ellsworth. Education by Plays and Games. Boston: Ginn and Company, 1907.

Johnston, A. Montgomery, Editor and Paul C. Burns. Research in Elementary School Curriculum. Boston: Ally and Bacon, Inc., 1970.

Keel, Raymond E. and G. Thomas Rowland. "How Children Learn: A Developmental Approach." The Elementary School Journal (1974), pp. 501-507.

Keith, Lowell, Paul Blake and Sidney Tiedt. Contemporary Curriculum in the Elementary School. New York: Harper and Row, Publishers, 1968.

Kennedy, Leonard M. Guiding Children to Mathematical Discovery. 2nd Ed. Belmont, California: Wadsworth Publishing Company, Inc., 1975.

Kennedy, Leonard M. and Ruth L. Michon. Games for Individualizing Mathematics Learning. Columbia, Ohio: Charles E. Merrill Publishing Company, 1973.

Larson, Leonard A. Foundations of Physical Activity Applications as Disciplines and Professions. New York: Macmillan Publishing Co., Inc., 1976.

Leininger, Ellen Velie. "Back to Basics: Underlying Concepts and Controversy." The Elementary School Journal, Vol. 79, No. 3 (January, 1979), pp. 166-173.

Logsdon, Bette J., Kate R. Barrett, Marion R. Broer, Rosemary McGee, Margaret Ammons, Lolas E. Halverson and Mary Ann Roberton. Physical Education for Children: A Focus on the Teaching Process. Philadelphia: Lea and Febiger, 1977.

Lowen, Alexander. Bioenergetics. New York: Penguin Books, 1975.

Mackenzie, Marlin M. Toward a New Curriculum in Physical Education. New York: McGraw-Hill Book Company, 1969.

May, Lola June. Teaching Mathematics in the Elementary School. New York: The Free Press, 1970.

Metcalf, James. "Teaching Writing in Physical Education." Journal of Physical Education and Recreation, Vol. 50, No. 9 (November-December, 1979), p. 38.

Miller, William C. "What Will the Future Bring for Education?" Phi Delta Kappan, Vol. 60, No. 4 (December, 1978), pp. 287-289.

Mills, Belen Collantes. Understanding the Young Child and His Curriculum. New York: The Macmillan Company, 1972.

Mossman, Lois Coffey. The Activity Concept An Interpretation. New York: The Macmillan Company, 1938.

Mosston, Muska. Teaching Physical Education From Command to Discovery. Columbus, Ohio: Charles E. Merrill Publishing Co., 1966.

Murray, Edward J. "Motivation and Emotion." In Lazarus, Richard S. (Ed.), Foundations of Psychology Series - Personality. 2nd Ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.

Norman Public Schools. Computational Skills Reinforcement Program for Use in Algebra I, Plane Geometry, Algebra II. Norman, Oklahoma, 1977.

Oberteuffer, Delbert and Celeste Ulrich. Physical Education A Textbook of Principles for Professional Students. 3rd Ed. New York: Harper and Row, Publishers, 1962.

Payne, David A. The Assessment of Learning Cognitive and Affective. Lexington, Massachusetts: D. C. Heath and Company, 1974.

________. The Specification and Measurement of Learning Outcomes. Waltham, Massachusetts: Blaisdell Publishing Company, 1968.

Peddie, Bill and Graham White. Testing in Practice A Guide to the Preparation and Making of Tests, Formal Examinations and Informal Assessments. New Zealand: Heinemann Educational Books, 1978.

Phenix, Philip H. Realms of Meaning A Philosophy of the Curriculum for General Education. New York: McGraw-Hill Book Company, 1964.

Popham, W. James. Criterion-Referenced Measurement. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1978.

________. "Normative Data for Criterion-Referenced Tests?" Phi Delta Kappan, Vol. 57, No. 9 (May, 1976), pp. 593-594.

Popham, W. James and T. R. Husek. "Implications of Criterion-Referenced Measurement." Journal of Educational Measurement, Vol. 6, No. 1 (Spring, 1969), pp. 1-9.

Rahmlow, Harold F. and Katheryn K. Woodley. Objectives-Based Testing. Englewood Cliffs, New Jersey: Educational Technology Publications, 1979.

Raths, Louis E. Teaching for Learning. Columbus, Ohio: Charles E. Merrill Publishing Company, 1969.

Riley, Marie, Editor. Echoes of Influence for Elementary School Physical Education. Washington, D. C.: American Alliance for Health, Physical Education, and Recreation, 1977.

Rising, Gerald R. and Joseph B. Harkin. The Third "R" Mathematics Teaching for Grades K-8. Belmont, California: Wadsworth Publishing Company, Inc., 1978.

Rogers, Carl R. Freedom to Learn. Columbus, Ohio: Charles E. Merrill Publishing Company, 1969.

Ruff, Thomas P. and C. Orlich. "How Do Elementary-School Principals Learn About Curriculum Innovations?" The Elementary School Journal (April, 1974), pp. 389-392.

Schminke, C. W., Editor, and William R. Arnold. Mathematics Is A Verb Options for Teaching. Hinsdale, Illinois: The Dryden Press Inc., 1971.

Schminke, C. W., Norbert Maertens and William R. Arnold. Teaching the Child Mathematics. Hinsdale, Illinois: The Dryden Press Inc., 1973.

Shankman, Florence V. "Games Reinforce Reading Skills." The Reading Teacher, Vol. 22, No. 3 (December, 1968), pp. 262-264.

Sheehan, Thomas J. An Introduction to the Evaluation of Measurement Data in Physical Education. Reading, Massachusetts: Addison-Wesley Publishing Company, 1971.

Singer, Robert N. Motor Learning and Human Performance: An Application to Physical Education Skills. New York: The Macmillan Company, 1968.

__________, Editor. Readings in Motor Learning. Philadelphia: Lea and Febiger, 1972.

__________, Editor. The Psychomotor Domain: Movement Behaviors. Philadelphia: Lea and Febiger, 1972.

Singer, Robert N. and Walter Dick. Teaching Physical Education A Systems Approach. 2nd Ed. Boston: Houghton Mifflin Company, 1980.

Sullivan, Dorothy D. and James H. Humphrey. Teaching Reading Through Motor Learning. Springfield, Illinois: Charles C. Thomas Publisher, 1973.

Tobias, Sheila. "Math Anxiety: What You Can Do About It." Today's Education, Vol. 69, No. 3 (September-October, 1980), pp. 26E-29E.

Torrance, E. Paul and R. E. Myers. Creative Learning and Teaching. New York: Dodd, Mead and Company, 1970.

Trivett, John V. Games Children Play for Learning Mathematics. New Rochelle, New York: Cuisenaire Company of America, 1974.

VanDalen, Deobold B. and Bruce L. Bennett. A World History of Physical Education Cultural, Philosophical, Comparative. 2nd Ed. Engelwood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.

Warnock, Florence M. "Opportunities for Teaching Health in the Elementary School Through Motor Activity." The Journal of Health and Physical Education, Vol V., No. 8 (October, 1934), pp. 15-18.

Werner, Peter H. and Elsie C. Burton. Learning Through Movement Teaching Cognitive Content Through Physical Activities. St. Louis: The C. V. Mosby Company, 1979.

Westcott, Alvin M. and James A. Smith. Creative Teaching of Mathematics in the Elementary School. Boston: Alyn and Bacon, Inc., 1967.

Willgoose, Carl E. The Curriculum in Physical Education. 3rd Ed. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1979.

Williams, Mary Heard. "Does Grouping Affect Motivation?" The Elementary School Journal, Vol. 73, No. 2 (November, 1972), pp. 130-137.

Williams, Jesse Feiring. The Principles of Physical Education. 8th Ed. Philadelphia: W. B. Saunders Company, 1964.

Wilson, Guy M., Mildred B. Stone and Charles O. Dalrymple. Teaching the New Arithmetic What to Teach How to Teach It Provision for Professional Growth. 1st Ed. New York: McGraw-Hill Book Company, Inc., 1939.

APPENDIXES

APPENDIX A

ACTIVITY AND GAME DESCRIPTIONS

GAME

<u>ACTIVITY</u>: Club Snatch

<u>PHYSICAL CONCEPTS</u>: Agility, eye-hand coordination, stopping and starting quickly, running, tagging, and dodging.

<u>DESCRIPTION</u>: The class is divided into two equal teams that line up facing each other. A plastic bowling pin is placed an equal distance between the team's lines. Each individual team member is given a number. The teacher then calls a number and the players from each team who were given that number run to the center and try to snatch the club before the opponent does. When the club is snatched the player with the club runs back to his team's line. If he reaches his team before being tagged by his opponent, a point is awarded his team. If the opponent tags the club snatcher before he reaches his team's line, no point is received. The club is returned to the middle of the room, players return to their own lines, and another number is called. The team with the most points at the end of the class time wins the game.

<u>CONTROL GROUP</u>: The control group was given consecutive numbers when they played the game.

<u>EXPERIMENTAL GROUP</u>: The experimental group was given sums of various multiplication tables as their individual numbers. For example: When reinforcing the multiples of four and seven the subjects were given individual numbers like 12, 14, 16, 20, 21, 28 and so forth. The teacher would call

out a multiplication problem (7 X 8) and the players from opposing teams whose individual number was the sum (56) of the problem called would take their turn at trying to snatch the club. After being given the individual numbers/sums, teams were given a brief time to get together and check the sums/individual numbers to see which multiplication tables were being reinforced and to secure the correct responses and possible problems in their minds.

The author had previously created various methods of changing the basic game of Club Snatch and had used variations when playing this game within the physical education classes. To the experimental group subjects, the use of multiplication sums instead of consecutive numbers was viewed as just another way to play the game. As with previous variations they had experienced, once the subjects caught on to this change from the basic game the activity went smoothly.

PARTICIPATION: Club Snatch was played on two different days.

COGNITIVE LEARNING: The multiplication tables used by the experimental group during participation in this game included 4, 6, 7 (twice) and 8.

GAME

ACTIVITY: Manipulative Movement

PHYSICAL CONCEPTS: Subjects were introduced to various sizes, shapes, textures, weights, and flexibility of equipment. They used their hands and sometimes their bodies to manipulate the equipment so they could transport it as quickly as possible to the designated area. The locomotor skills were changed so the subjects had to adapt to various ways of moving the equipment; walk, run, skip, gallop, slide, hop, jump and/or leap.

EQUIPMENT: The equipment included rhythm sticks, golf tees, erasers, whiffle balls, bean bags, fleece balls, plastic jump ropes, tennis balls and both six and eight inch nerf balls. This equipment was placed in individual baskets and arranged in a circle in the middle of the room. Six stations were placed the same distance from the equipment and a tumbling mat marked each station's position. In the middle of each mat an orange cone marker was placed that divided the mat in half.

DESCRIPTION: Squads competed against one another for points toward becoming winners at the end of class. One person from each squad, called the runner, represented the squad by gathering the correct amount of equipment needed and arranging it properly on his squad's mat. The squads were placed behind the mat while runners stood in front. Runners changed with each problem given and every two problems the squads rotated to the next station so the equipment in front of the squads would continually vary.

On the given signal, runners executed the required locomotor movement toward the equipment. They then gathered the correct amount of equipment required by the problem that had just been given. It was sometimes hard for the subjects to handle the needed equipment in one trip but they were allowed to make as many trips as necessary. Runners could choose from any of the equipment and did not have to use the equipment directly in front of them.

Upon returning to the mat with the secured equipment, the runner placed it in the proper manner on each side of the cone and then sat down. The first runner correctly solving the problem by gathering and placing his equipment properly, and using the locomotor movement required in that round, gained a point for his team. The teacher would check the answers of runners as they were seated. When a point was earned by a runner that round was over. Equipment was replaced in the proper baskets and the squads prepared for the next round.

<u>CONTROL GROUP</u>: The control group dealt with problems in addition or subtraction. For example: "Six plus eight is ___. Ready? Go!" The runner could check with his squad to make certain he knew the correct answer. Since the answer in this example is fourteen, the runner would collect ONE piece of equipment, say an eraser, and FOUR pieces of another type of equipment, like golf tees. Carrying this equipment back to the proper mat the runner would place the

eraser to the <u>left</u> of the cone and the four golf tees to the <u>right</u> of the cone. The equipment had to be placed in straight rows and from left to right as the answer would be read on paper. He then sat down.

<u>EXPERIMENTAL GROUP</u>: The experimental group was given multiplication problems to solve such as 7 X 7. The runners would respond with equipment placement representing forty-nine.

<u>PARTICIPATION</u>: Manipulative movement was played on two different days.

<u>COGNITIVE LEARNING</u>: Control group: addition/subtraction. Experimental group: multiplication tables 4, 6 (twice), 7 (twice) and 8.

GYMNASTICS

ACTIVITY: Tumbling

PHYSICAL CONCEPTS: Practicing the proper execution of previously learned tumbling rolls and demonstrating the skill level of each individual student.

CONTROL GROUP: The control group worked on its skill in regard to the various types of tumbling rolls but used other methods of demonstrating skill development.

EXPERIMENTAL GROUP: The experimental group competed by squads in answering proposed multiplication problems. Squads were divided into teams of two people each with a new team representing its squad every time a problem was presented. Any combination of previously practiced tumbling rolls could be chosen by individuals in regard to their physical response to the problems. Subjects were encouraged to use the rolls that were reflective of their skill levels. Incorrectly executed rolls were not acceptable and disqualified a team for the problem.

For example: "Nine times five equals __. Ready? Begin." Two people represented each squad. With an answer of forty-five, the first person would execute four good rolls of her choice and then run to sit at the end of the room opposite her squad. Her teammate could then complete the answer by executing five correct rolls of his choice and skill level. He would then join his teammate by running and sitting down beside her. Together they verbally repeated the problem and gave their answer. The first team to both physically and verbally complete the correct answer received a point for its squad. The squad with the most points at the end of class time was the winner.

The teacher was the judge in regard to correct responses; any team member who executed a roll incorrectly disqualified his/her team for that problem. A verbal error also disqualified teams. If they so desired, teams could consult the rest of their squad before they began their response. The competitive spirit of this activity did not prove to be a safety hazard as eliminating teams through incorrectly executed rolls encouraged precise physical responses.

PARTICIPATION: The procedure was practiced one day and used as a competitive activity between the squads the next day.

COGNITIVE LEARNING: The multiplication tables used with this activity included 6, 8, and 9.

GYMNASTICS

ACTIVITY: Trampoline

PHYSICAL CONCEPTS: Focus, dynamic balance, recovery skills, elementary stunt execution, spotting techniques, jumping form.

DESCRIPTION: One of the alternating stations used during the gymnastic unit was the trampoline. While following the basic rules and regulations in regard to using this equipment, students were exposed to using various cognitive skills at the same time as their physical skills were practiced. Violations of any trampoline rules by any student was an immediate forfeit of the right to jump.

CONTROL GROUP: As each squad rotated to the trampoline the teacher would call out a cognitive problem. The student would jump out the answer by using elementary stunts that had been practiced and learned earlier. Verbal response was sometimes required during the physical action.

For example: "What is five plus seven?" The student would immediately begin to jump and perform basic stunts twelve consecutive times, and then execute a correct stop. If she did not jump the correct number of times or failed to execute correct form, stunts, or stopping techniques she would forfit her turn. If her jump was correct she would be given another problem; usually in another cognitive area. For example: "Good. Now recite the alphabet from J to U. Ready? Begin." The student would immediately begin to jump and execute basic stunts while reciting the correct section of the alphabet.

The control group was never given multiplication problems. Subjects who had to forfeit turns were given another turn after all squad members had completed their turns.

EXPERIMENTAL GROUP: The same basic procedures were used with these subjects. However, their cognitive exposure was designed to reinforce multiplication facts. For example: "What is eight times eight?" The student would jump SIX times; execute a correct stop; jump FOUR more times; execute another correct stop; and then would verbally respond, "Eight times eight is sixty-four."

If a student was not certain of the answer to a given problem, she could ask any of the students safety spotting around the trampoline to help by; 1) giving the answer, or 2) supporting what the jumper thought the correct answer was for that problem. If a student jumped or orally gave the incorrect answer (8 X 8 = 63) the safety spotters were to correct the answer immediately. This kept the spotters as well as the jumper involved in the activity. As this activity progressed spotters enjoyed verbally counting the number of jumps and stunts executed. This helped them keep track of the jumps/stunts in order to correct the jumper if necessary.

PARTICIPATION: It took four days to give each experimental group subject two separate turns (of approximately five minutes each) on the trampoline.

<u>COGNITIVE LEARNING</u>: Control group: addition, subtraction, colors, spelling, alphabet recall, and geography. Experimental group: the multiplication tables used included 4, 7, 8 (twice) and 9 (twice).

APPENDIX B

CRITERION-BASED INSTRUMENT

CRITERION-BASED INSTRUMENT

NAME: ______________________________ Number Correct ________

DATE: ______________________ Pre Mid Post

Group: C E NI

Multiply the following:

1.) 5 x 3	2.) 1 x 1	3.) 4 x 4	4.) 3 x 0
5.) 6 x 6	6.) 0 x 8	7.) 6 x 7	8.) 8 x 7
9.) 6 x 8	10.) 7 x 9	11.) 9 x 8	12.) 7 x 7
13.) 43 x 2	14.) 21 x 3	15.) 19 x 5	16.) 28 x 3
17.) 48 x 6	18.) 637 x 1	19.) 542 x 2	20.) 823 x 3
21.) 912 x 4	22.) 376 x 2	23.) 816 x 5	24.) 217 x 4

Page 2

NAME: ______________________ Date ________

Multiply the following:

25.) 191 x 6	26.) 604 x 5	27.) 697 x 8	28.) 938 x 9
29.) 2143 x 2	30.) 5914 x 5	31.) 28 x 25	32.) 50 x 62
33.) 300 x 27	34.) 605 x 30	35.) 409 x 32	36.) 608 x 69
37.) 24,239 x 4	38.) 6,020 x 10	39.) 3,006 x 34	40.) 6,582 x 46
41.) 93,153 x 24	42.) 84,696 x 63	43.) $2.69 x 10	44.) $4.35 x 40

PR M PO

Page 3

NAME: ______________________ Date ________

Multiply the following:

45.) $6.18 x 33	46.) $4.64 x 51	47.) $6.49 x 18	48.) $7.12 x 25
49.) $9.95 x 46	50.) $3.28 x 74		

APPENDIX C

INSTRUMENT VALIDITY

VALIDITY RESPONSE FORM

The enclosed test is a criterion based instrument concerning multiplication. I would appreciate your evaluation as to its validity in testing fourth (4th) grade knowledge of multiplication tables.

Do you feel that this test is a valid measure of the knowledge fourth grade students should acquire by the time they have completed units 4, 5, 7, and 10 in Mathematics (Houghton-Mifflin Company, Boston; 1978) Fourth Grade Level?

YES ________ NO ________

If not: What would you add? ____

____

What would you not include? ________________________________

____

If you were to use this test to group fourth graders on their ability in MULTIPLICATION, how many answers would they need to have correct to be considered above average? ________ of average ability? ________ of low ability? ________.

Thank you for your cooperation.

Nancy Carleton

NEGATIVE RESPONSE AND COMMENT - ONE

The enclosed test is a criterion based instrument concerning multiplication. I would appreciate your evaluation as to its validity in testing fourth (4th) grade knowledge of multiplication tables.

Do you feel that this test is a valid measure of the knowledge fourth grade students should acquire by the time they have completed units 4, 5, 7, and 10 in Mathematics (Houghton-Mifflin Company, Boston; 1978) Fourth Grade Level?

YES ________ NO ✓

If not: What would you add? I would include the operations of addition since that is developmentally sequential but your goal may be different

What would you not include? ________

If you were to use this test to group fourth graders on their ability in MULTIPLICATION, how many answers would they need to have correct to be considered above average? 40-45 of average ability? 30-35+ of low ability? less then 3

Thank you for your cooperation.

Nancy Carleton

NEGATIVE RESPONSE AND COMMENT - TWO

The enclosed test is a criterion based instrument concerning multiplication. I would appreciate your evaluation as to its validity in testing fourth (4th) grade knowledge of multiplication tables.

Do you feel that this test is a valid measure of the knowledge fourth grade students should acquire by the time they have completed units 4, 5, 7, and 10 in Mathematics (Houghton-Mifflin Company, Boston; 1978) Fourth Grade Level?

YES ________ NO ✓

If not: What would you add? I think some story problems should be included. Children are weak in that area.

What would you not include? ________

If you were to use this test to group fourth graders on their ability in MULTIPLICATION, how many answers would they need to have correct to be considered above average? 40 of average ability? 30 of low ability? 20

Thank you for your cooperation.

Nancy Carleton

NEGATIVE RESPONSE AND COMMENT - THREE

The enclosed test is a criterion based instrument concerning multiplication. I would appreciate your evaluation as to its validity in testing fourth (4th) grade knowledge of multiplication tables.

Do you feel that this test is a valid measure of the knowledge fourth grade students should acquire by the time they have completed units 4, 5, 7, and 10 in Mathematics (Houghton-Mifflin Company, Boston; 1978) Fourth Grade Level?

YES ✓ and NO ✓ *

If not: What would you add? More 4 digits times 1 digit

What would you not include? 4 digits times 2 digits
5 digits times 2 digits

If you were to use this test to group fourth graders on their ability in MULTIPLICATION, how many answers would they need to have correct to be considered above average 50- 43 of average ability? 42-35 of low ability? 34-0.

Thank you for your cooperation.

Nancy Carleton

* They were not introduced to anything higher than 3 digits times 2 digits. The better students ~~are~~ should be able to recognize and carry out the process though.

APPENDIX D

SPLIT-HALF TESTS

SPLIT-HALF TEST A...R/ODD

NAME: ______________________   Number Correct: __________

TEST A....R/ODD

Date: ______________   L   H

Multiply the following:

1) 5 x3	2) 4 x4	3) 6 x6	4) 6 x7	5) 6 x8
6) 9 x8	7) 43 x 2	8) 19 x 5	9) 48 x 6	10) 542 x 2
11) 912 x 4	12) 816 x 5	13) 191 x 6	14) 697 x 8	15) 2143 x 2
16) 28 x25	17) 300 x 27	18) 409 x 32	19) 24,239 x 4	20) 3,006 x 34
21) 93,153 x 24	22) $2.69 x 10	23) $6.18 x 33	24) $6.49 x 18	25) $9.95 x 46

SPLIT-HALF TEST B...R/EVEN

NAME: ______________________ Number Correct: ________

TEST B....R/EVEN

Date: ______________ L H

Multiply the following:

1) 1 x1	2) 3 x0	3) 0 x8	4) 8 x7	5) 7 x9
6) 7 x7	7) 21 x 3	8) 28 x 3	9) 637 x 1	10) 823 x 3
11) 376 x 2	12) 217 x 4	13) 604 x 5	14) 938 x 9	15) 5914 x 5
16) 50 x62	17) 605 x 30	18) 608 x 69	19) 6,020 x 10	20) 6,582 x 46
21) 84,696 x 63	22) $4.35 x 40	23) $4.64 x 51	24) $7.12 x 25	25) $3.28 x 74

APPENDIX E

RAW DATA

TABLE VII

EXPERIMENTAL GROUP

Subject Number	Pretest	Midtest	Posttest
01	29	30	47
02	5	30	35
03	18	39	48
04	27	39	45
05	10	30	42
06	17	32	45
07	20	29	43
08	21	30	45
09	10	25	32
10	27	42	44
11	13	30	47
12	4	26	35
13	8	27	40
14	23	28	36
15	24	30	44
16	11	29	48
17	21	30	37
18	4	28	32
19	27	29	46
20	20	19	27
21	5	28	46
22	14	31	41
23	16	21	34
24	5	29	45

TABLE VIII

CONTROL GROUP

Subject Number	Pretest	Midtest	Posttest
01	15	25	41
02	21	35	44
03	16	28	44
04	6	28	27
05	13	28	38
06	20	24	41
07	15	23	35
08	17	42	49
09	3	27	34
10	15	27	40
11	6	23	32
12	30	37	44
13	21	31	44
14	5	29	45
15	11	23	23
16	9	31	27
17	2	17	31
18	7	19	31
19	9	29	43
20	17	30	38
21	15	30	48
22	10	30	42
23	11	33	41
24	12	30	41
25	9	19	20

TABLE IX

SPLIT-HALF RELIABILITY SANGRE RIDGE ELEMENTARY SCHOOL CLASS A

Subject Number	Test A Odd	Test B Odd
01	2	2
02	2	2
03	3	3
04	3	4
05	3	5
06	4	5
07	5	5
08	6	7
09	6	11
10	7	11
11	8	12
12	10	14
13	13	14
14	15	15
15	19	19

VITA

Nancy Louise Riggs Carleton

Candidate for the Degree of

Doctor of Education

Thesis: IMPLICATIONS OF PHYSICAL EDUCATION ACTIVITIES AS REINFORCEMENT IN LEARNING MULTIPLICATION TABLES

Major Field: Higher Education

Minor Field: Health, Physical Education, and Recreation

Biographical:

Personal Data: Born in Bristol, Virginia, July 31, 1943, the daughter of S. G. and Anna Louise Riggs, Jr.

Education: Attended elementary school in Winter Park, Florida; junior high and high school education received in Miami, Florida; high school diploma received in 1961 from Southwest Miami Senior High School; received the Bachelor of Science degree from Phillips University, Enid, Oklahoma in 1965 with a major in Health, Physical Education and Recreation; obtained the Master of Science in Education degree from Southern Illinois University, Carbondale, Illinois in 1966; completed requirements for the Doctor of Education degree at Oklahoma State University, Stillwater, Oklahoma in December, 1981.

Professional Experience: Graduate teaching assistantship, Department of Health, Physical Education and Recreation at Southern Illinois University, Carbondale, Illinois, 1965-1966; high school physical education teacher and coach, Great Bend Senior High School, Great Bend, Kansas, 1971-1977; elementary physical education teacher, Skyline Elementary School, Stillwater, Oklahoma, 1978-present.

Professional Organizations: American Alliance for Health, Physical Education, Recreation, and Dance; Kansas Association for Health, Physical Education, and Recreation, Kansas Education Association; Great Bend Education Association; Oklahoma Association for Health, Physical Education and Recreation; Oklahoma Educational Association; Northern Oklahoma Education Association; Stillwater Education Association; Kappa Delta Pi (Lambda Chapter); Phi Epsilon Kappa (Gamma Psi Chapter).