

## IMPROVED MULTIPLICATION SCORES WITH PHYSICAL ACTIVITY ENHANCED MATH INSTRUCTION

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Children are smiling and laughing. They are jumping around on colored mats with numbers on them and are being physically active while at school. If asked, most people would initially guess the students were either at recess or possibly in a physical education classroom. In most schools that guess would probably be correct. However, at Bonneville Elementary a much different scenario is taking place - one that was unimaginable a decade ago. These students are actually preparing for the Florida Comprehensive Assessment Test (FCAT) by studying mathematics **and** they are enjoying themselves. Not only that, these students are learning 30% more than their fellow students who are being taught in the traditional manner of sitting behind desks.

With the numbers of children affected by youth obesity at epidemic proportions, the last thing that young children needed was to have physical activity levels reduced as the trend over the last 10-15 years has been to reduce physical education minutes per week with greater and greater emphasis placed on standardized test preparation (Eaton et al. 2006). However, a growing body of research is beginning to demonstrate that maybe the whole approach has been upside down. Dr. James Ratey from Harvard Medical is one of many researchers who have begun looking to see how physical activity impacts learning and academic achievement. The amazing findings are revealing that children who are actively

engaged in physical activity and movement while learning are more likely to perform better and achieve higher academically

(Ratey 2008).

Additionally young children who are engaged in physical activity also demonstrate a host of other characteristics that all contribute to the entire process. Children who receive recess before lunch have better nutrition (Bergman et al. 2003) and those children with better nutrition have been scoring higher academic achievement for some time (Pollitt 1995; Murphy 1998).

Incidence levels of behavioral issues decrease with physical activity during the school days as well, once the young children who are designed to move and run are not locked to their desks for hours at a time but are allowed to run off some of their naturally high energy levels (Kirkcaldy et al. 2002). Finally, self-esteem, self-confidence, and socialization all improve as children are allowed to move, interact and simply play (Kirkcaldy et al. 2002; Sonstroem et al. 1994; Ratey 2008).

Unfortunately, the challenge is to convince principals, superintendents, and school districts that success stories such as Naperville, Illinois and Titusville, Pennsylvania are not simply flukes where programs developed to increase physical activity levels of the student populations before, during, and after school have resulted in increased academic performance (Ratey 2008). Some schools are responding by walking clubs and groups before school and through a variety of programs after school designed to involve children in fun physical activities.

However, a number of truly innovative teachers are developing lesson plans that incorporate movement and physical activity into other curricular content areas such as music, science, and mathematics. This creative approach helps to meet the NASPE Guidelines of 225 minutes per week (Corbin 2003) and the state mandated physical activity minutes that many states have begun adopting but that are often unable to sufficiently meet simply through physical education and recess. Additionally, the fact that the students are out from behind their desks and moving their bodies is increasing blood flow and oxygen to the brain while increasing student interest and engagement.

One such program was developed by Dr. Debby Mitchell, an Associate Professor at the University of Central Florida, who has taught Physical Education for over thirty years. Her passion for working with kids and her concerns surrounding the youth obesity epidemic laid the groundwork for the development of GeoFitness, Inc. and her Meaningful Movement Mats that combine exercise with mathematics. The children practice their addition, subtraction, multiplication or division by stepping on the corresponding numbers on their mats that are designed to look like big calculators (See Figure 1).



The left side of the mat has spaces that the children use on for the arithmetic symbols (e.g. +, -, x, =) as well as the hand and arm motions that the children perform as they work through the mathematical equations and reinforce the arithmetic processes. The right side of the mat has spaces with money (dollar bill, quarter, dime, nickel, penny) so that the children can calculate mathematical problems using money problems. Finally, the left, front, and right sides are numbered numerically from 0 to 100 if the mathematical calculation provides the need for double digit numbers.

Two elementary school classes at Bonneville Elementary were recruited to participate in the pilot program and the classes were split so that each class was separated into ten students in the test group and eight students in a control group

that did not participate in the physical activity math integration. Both classes were given a ninety question mathematics pretest and given five minutes to complete the test. The average score for each group was 27 correct responses. The students were then taught multiplication as normal. However, the experimental group received an extra 10 minutes of physically active math instruction using the Meaningful Movement Mats twice a week for six weeks when the rest of the class participated during normal physical education time. As a result, the experimental group received an extra 120 minutes of mathematics that also elevated their heart rates and increased oxygen levels to the brain. The students were actively engaged and having fun - while learning math!

At the end of six weeks both groups with students from each class were given a post-test to measure learning. One child from the control group who had not participated in the active mathematics learning group did not take the post test. The results were impressive. The students participating in the active learning mathematics group increased their average number of correct responses to the problems by an average 29 in one class and 32 in the second class for an overall average increase of 31 correct responses. By comparison, the students who received the traditional multiplication instruction as normal but without the active learning mathematics engagement component also showed an increase in learning as measured by correct responses as one would hope. However, the two control groups only increased by an average of 17 and 24 correct responses respectively for an overall average increase of only 20.5 correct responses.

When the control and experimental groups were compared, the experimental group demonstrated a 66% greater learning increase from the pretest scores. **What makes this even more impressive is that these classes represented the average school classroom and included representation of students designated as gifted, exceptional special education (ESE), special learning disability (SLD), autistic, and speech or language services. One autistic child in the experimental group even increased his score from a pretest score of 2 correct responses to a posttest score of 30 correct responses.**

All students in both the experimental group and the control group passed their FCAT examinations and feedback from the program was extremely positive. Unfortunately, it may be difficult to a follow up study next year for one simple reason. The classroom teacher was so impressed with the outcomes that she has even started using the Meaningful Movement Mats for the control group students!

## **Strategies**

Every classroom will be different and each teacher will have their strengths and weaknesses and level of comfort for introducing new teaching strategies into their classroom. Additionally, many teachers may be concerned that their children may not perform as well on the standardized mathematics areas if they do not teach the same way they have always taught. The following suggestions are made as ways to integrate **physical activity enhanced instruction** into your classrooms.

1. **Addition, Subtraction, Multiplication, Division.** The teacher calls out a mathematical equation or writes it on the board and then the students repeat the equation out loud while stepping on the appropriate spaces on the mat. At the conclusion, the student must step on the final answer to the equation. **Great exercise to support quiz reviews and follow up learning after main exercise.**

2. **Multiples.** The students learn multiplication tables by increasing the counting in multiples of 2, 3, 4, 5, etc...

3. **Solving math problems with money.** Students can use the symbols on the mat to calculate mathematical calculations using dollars and cents. It is amazing that the children will feel like they are actually in possession of the money!

4. **Changing Levels and Numbers of Body Parts in Contact with the Floor.** The teacher can challenge their students by changing the direction for each exercise to modify the level that the student interacts with the mat or the floor to a low, medium, or high level and change the number and type of body part with which to give the correct answers. Creativity should always be awarded. **Remember playing Twister? (See Figure 2)**



5. **Spelling Mathematics.** The children are asked to step on the correct answer and then step on the corresponding letters to spell the number.

6. **Directional Math.** The numbers and corners of the mat or floor can be used to distinguish the points on a compass and the students can be given directions toward a destination.

7. **Geometric Math.** Students are presented with geometric shapes and are challenged to create these three-dimensional shapes on their mats or in their personal space.

### Tips for Generating Enthusiasm for Learning Math

1. Make the activity a fun experience that rewards the children for hard work in class. If the activity is fun, the students will be tremendously engaged.
2. The use of music adds a great flare to the exercises and creates a sense of excitement and fun even if it is only on in the background. We all know music with a good beat will make the children want to move and dance anyway!
3. Keep the activity moving. A fast paced activity helps keep the heart pumping and the children engaged. If the activity is used as a supporting activity as with the example given, a little more latitude for fun and enjoyment can be allowed.
4. Make sure each child has their own personal space or mat and can hear the instructions.
5. Allow some children to take the lead in small groups.
6. **Model the Behavior Yourself! We can also use a little more exercise and the children will love to see you so involved!**



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