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The Effects of Integrating Mathematics into the Physical Education Setting

An Action Research Report
By Steven Thompson and Jacqueline Robertson

The Effects of Integrating Mathematics into the Physical Education Setting

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in fulfillment of final requirements for the MAED degree

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Advisor _____

Date _____

Abstract

The purpose of this paper was to describe the effects of integrating mathematics curriculum into the physical education setting. The study was conducted in an elementary school in Northern Minnesota where a strong emphasis is being placed on preparation for standardized testing. The research was designed to find the results of integration in four classes of first-grade students. The data collecting methods used included pre- and post-assessments, observational journal, student feedback, and a teacher dialog. The results of the research indicated that integration enhanced the learning environment and improved mathematics performance for students. The data also showed that physical activity time for students decreased with an increase of instruction time. The implications of this action research will be extended to the third through fifth-grade level to determine if the integration process will positively impact their learning environment.

Keywords: integration, physical education, mathematics, curriculum

It takes a village to raise a child. This statement when applied to education has been under attack in recent years. The pressure placed on education through our legislation has taken away from the holistic approach of education. Due to these pressures, our school district has reduced instruction time in physical education class. With the reduced amount of time spent in physical education, our school is sacrificing the benefits of physical activity for the demands of standardized testing performance.

Although research has shown increasing academic time can enhance performance in core courses, it comes at the expense of physical activity time. The solution to this problem may lie within integrated classrooms. Integrated classrooms involve combining the curriculum of two or more courses in a lesson. Physical education has the opportunity to enhance student learning within the classroom through physical activity. This study aims to prove that the integration of core concepts within a physical education curriculum can provide a dual benefit of physical activity and classroom performance.

The research for this study was conducted at a public elementary school in Northern Minnesota. The school provides an education for students first through fifth grade. The school has a gymnasium that measures 82 feet by 58 feet. Within the gymnasium, there are eight basketball hoops, a 32-foot rock wall, and a retractable curtain to divide the space. Two storage rooms accompany the gymnasium that holds a variety of physical education equipment.

Currently, each class is scheduled to have four days a week of physical education. Physical Education classes last 30 minutes per session. Within this schedule, each class

is offered 120 minutes of physical education per week, instead of the maximum 150 minutes.

The subjects for this study are four classes of first grade students with a total of 91 students. The students in this study range from six to seven years of age. Physical education takes place Tuesday through Friday for 30 minutes for each first grade class. All first grade classes are combined with another first grade class with the exception of two classes on Tuesday and Wednesday. There is a paraprofessional that assists in three out of the four classes. The paraprofessionals do not have access to the research data.

Physical education is an important part of the educational experience of elementary students. The benefits of physical activity are helpful to the overall health and academic performance of all students. Integration allows students to participate in physical activity while reinforcing mathematic concepts.

School systems have been experiencing pressure to perform well in core curricular subjects (i.e., mathematics and reading) being that districts are evaluated on their mandated testing scores (Hall, 2007; Jones, 2012; Kitchen & Kitchen, 2013; Mead, 2013). Incorporating mathematics into the Physical Education curriculum can help foster content learning while staying physically active (Grube & Beaudet, 2005; Jones, 2012). When considering integration, teachers must look at benefits of physical activity, impact to learning core content, and effects of integration (Kitchen & Kitchen, 2013).

Physical educators can use integration as a method to help improve student learning and academic development within the physical education setting (Kitchen & Kitchen, 2013). According to Hall (2007), "Over the past decade, schools and teachers alike have had increased pressure placed upon them with respect to student academic

performance” (p.123). Academic concepts can be integrated into the physical education setting to help support the learning that is taking place within the classroom (Pangrazi & Beighle, 2010).

Academic learning is a large part of the school day for elementary students. However, looking at how the addition of physical activity affects a child’s ability to learn is a key component. Being physical active can help students improve attention spans, reduce stress and help students learn (Jones, 2012). Regular physical activity increases the amount of blood flow to the brain, which allows the body to feed the brain more glucose and oxygen (Hall, 2007). The positive effects of physical activity are important to understand when trying to improve a child’s academic performance (Kitchen & Kitchen, 2013).

In a study by Mead (2013), all participants had ten minutes to read a four-paragraph passage and complete a ten question multiple-choice assessment. Half of the students were randomly selected to engage in a 10-minute step test before completing the academic work. Mead’s (2013) study revealed that students that exercised immediately prior to reading the passage scored statistically higher than those who did not. Mead (2013) showed the increased amount of movement or physical activity before reading a passage and answering questions can affect their results. Factors such as weight, body fat, and blood pressure were not key factors in the students’ scores, but the students who performed physical activity before the assignment had better scores than the students who did not (Mead, 2013). In another study, Hall (2007) found that students who scored well on the Fitnessgram assessment also scored well on their standardized mathematics assessment. Students who reached the healthy fitness zone in three or more categories

scored higher on the state standardized test (Hall, 2007). Integrating physical activity and mathematics will further the mind-body connection. This integration can assist in the improvement of cognitive learning as much as it helps the body with strength and endurance (Jones, 2012). Combining physical activity and teaching core content can be a resourceful tool to help enhance student learning.

The push to increase student performance on standardized test has put less of an emphasis on specialized subjects such as physical education, which is not subject to standardized testing (Mead, 2013). Hall (2007) argued that integration may be the answer to help improve test scores and to keep physical education from being eliminated in the regular academic school day. Integrating math into the physical education setting may be the key to increasing academic learning time while maintaining maximum participation in physical activity.

According to Hall (2007), “Integration is the combining of two or more subject areas to help students understand and learn through different modes” (p. 123). The best practice of integrating math into the physical education setting is something that has to be considered in order for integration to transition successfully into the school (Grude & Beaudet, 2005). Classroom teachers and physical education teachers must come together to integrate lesson plans that meet the needs of both parties (Kitchen & Kitchen, 2013). Although collaboration is necessary for attempting to integrate core subjects into physical education, many classroom teachers and physical education teachers have minimal communication (DeFrancesco, 2004).

Integration may improve communication by motivating classroom teachers to come into the gym and see how curriculum concepts can be implemented into the

physical education setting (Pangrazi & Beighle, 2010). According to DeFrancesco (2004), “Young students learn more effectively by doing and moving, but in math classes, teachers typically use structured organizational formats to maintain appropriate student behaviors” (p. 22). This collaboration can enhance the educational environment if the classroom teacher and a physical education teacher both engage in active communication throughout the collaboration process (Pangrazi & Beighle, 2010).

The process of integrating and collaborating can provide the students with practical ideas for a math curriculum they are learning in the classroom. Integrating curriculum is a holistic approach to teacher content across the curriculum and strives to develop the whole child (Kitchen & Kitchen, 2013). This process may lead to a greater interest for students in multiple subject areas (Kitchen & Kitchen, 2013). Jones (2012) provided an example about, “teaching students the use of simple machine – letting them experience the working world around them while exercising their bodies” (p. 6). Generating interest in core subject matter or physical education curriculum could help students realize the usefulness of the information being taught in both settings (DeFrancesco & Casas, 2004).

There is an increase of physical education teachers who are trying to incorporate learning of core subjects into their specialized curriculum (Couillard, 2012). The physical education teacher must have the knowledge of the content being taught and how the mathematic concepts are being taught in order to integrate the core content (Grube & Beaudet, 2005). Physical educators do not have the appropriate training in the mathematics curriculum, making it difficult to teach mathematic concepts (Kahan, 2008). Using key terms and similar ideas will be helpful when integrating classroom material

(Pangrazi & Beighle, 2010). The physical education teacher must have continual discussions with the classroom teacher and it might be helpful for the classroom teacher to watch the lessons being taught in the gym (Pangrazi & Beighle, 2010). The collaborative process must commit to the importance of each content area (Kitchen & Kitchen, 2013).

Integrating core subjects positively impacts working environment, different teaching methods, an outlet for kinesthetic learners, and acknowledgement for physical education teachers as educators (Pangrazi & Beighle, 2010). Prangrazi and Beighle found that the integration has benefits that go beyond the intended outcome of enhancing student learning. Spending extra time working collaboratively with your colleagues can improve the working atmosphere and assist in developing a greater level of respect for one another (Pangrazi & Beighle, 2010). Teaching core materials in the physical education setting may show colleagues what they are doing is important and in turn they may integrate physical activity into the classroom lessons (Grube & Beaudet, 2005).

The integration process must not take away from the physical education curriculum and the amount of physical activity time a student participates in during the school day (Grube & Beaudet, 2005). The challenge for physical education teachers will be to reinforce concepts learned in the classroom without foregoing physical activity (Grube & Beaudet, 2005). Grube & Beaudet argued that physical educators must focus on teaching physical education concepts first and attempt to reinforce core curriculum concepts second. Integration can be a very useful tool to enhance learning as long as it doesn't take away from the set goals of physical education.

There are limitations during the integration process that physical educators must

be aware of to be successful. Physical education teachers may have a difficult time finding the time to create lessons that include math into their curriculum (Pangrazi & Beighle, 2010). Also, each grade and class may be covering different material, which would make lesson planning and scheduling extensive (Pangrazi & Beighle, 2010). Other limitations that have been noted are the comfort level of material being taught, modifying for skill level and sacrifice of the physical education curriculum that is already in place (Pangrazi & Beighle, 2010). Although integration of academic concepts can be productive, the physical education curriculum should not be based around providing academic instruction (Pangrazi & Beighle, 2010).

Physical educators and classroom teachers can empower students to be effective learners by combining core concepts with movement activities. There are benefits to incorporating physical activity in the general education classroom as well as integrating core content into the Physical Education setting. Teacher must determine the type of integration they want and how they will successfully encompass both areas (Grube & Beaudet, 2005). Integration may help the entire school community to see how physical education can help in the development of the whole child (Kitchen & Kitchen, 2013). According to DeFrancesco & Casas (2004), "Physical educators have nothing to lose and everything to gain when they initiate, implement and continue to incorporate math skills into their lessons. Even slight gains in mathematics are significant to most teachers, parents and school administrators" (p. 23). In the course of our study, we are trying to determine what effects incorporating mathematics into physical education have on student performance in an elementary school setting. In our next section, we will describe the process we used to integrate mathematic concepts into the physical education

setting.

Methodology

The purpose of our research was to determine the effect of integrating mathematic concepts curriculum into the physical education curriculum. We wanted to find the answers to two questions regarding the topic. Would combining physical education activities and mathematic concepts help our first grade students understand money concepts? Would this type of integration make a difference in their overall learning experience? To find the answers to these questions we needed to collect some baseline data.

The first task in the process of collecting data was to discuss the mathematic subject with the first grade teachers. After meeting with the first grade teachers, we found that they would be teaching the concepts of coin recognition, value, and adding during our data collection time frame. Our goal was to reinforce the concepts being taught in the classroom, so using coins (Quarter, Dime, Nickel, and Penny) was the task decided upon during our meeting.

During the first week of data collection, we administered the pre-assessment form (Appendix A). We gave the assessment to our students with the instructions of filing out the sheet to the best of their ability. The students were told that we wanted to know what they already know about coins and not to worry about spelling because the words were written on the form. The students were then provided a pencil and a sheet. The students were placed in six-foot square areas that are located on the floor of the gymnasium. The objective of spacing the students was to eliminate the possibility of the students assisting

one another on the assessment. The test questions were completed one at a time with the sheet being turned over and pencil being placed on top to indicate they are ready for the next question. We wanted to be sure that everyone was given ample time to answer each question and did not feel pressured to work at a pace they were not comfortable with. The teacher then collected each sheet as the last question was answered. Once all students had completed their pre-assessment, the sheets were placed in a manila envelope to be analyzed at a later date. The first section of the pre-assessment provided a picture of each coin, front and back, with a space above for the students to write the name of each coin. The second section of the assessment was formatted the same way, but asked the students to identify the value of each coin. The third section provided two addition problems, which required the students to add three different coins together (Appendix A).

Once based lined data was determined, mathematic concepts were added to the curriculum. During the second week of our action project, the students participated in a game called *Relay Challenge* (Appendix B). This game focused on gross motor movements such as skipping, running, galloping, sliding, etc. The sub focus of this lesson was for students to understand coin recognition and coin value. The students entered the classroom and took a seat in front of the white board. Students were shown a sheet with circles that contained values or names of the coins (i.e., quarters, dimes, nickels, and pennies). The students were divided into groups of two unless there was an odd number in which case a group of three was used. Each group sat next to a designated hula-hoop placed on the perimeter of the gym space. In each hula-hoop, the teachers placed a coin recognition sheet (Appendix C). Once the music started, one student from each group traveled to the middle of the gym and retrieved a plastic coin using the

assigned gross locomotor movement. Only one student could travel to the middle at a time. Students were reminded to communicate with team members to complete the sheet properly. Once the sheet was completed, the students sat down next to their hoop and raised their hands for a teacher to check their sheet with an answer sheet. If the sheet was incorrect they were told to make the correct changes. If the sheet was correct, the students were to return the coins and were provided the next sheet called *Value Circles* (Appendix D).

During the third week, students played a game called *Capture the Flag* (Appendix E). Focus of this game was for students to work on skills of chasing, dodging, and fleeing. The sub focus was for students to understand coin recognition, coin value, and adding coins. The students entered the room, quietly sat in front of the listening board, and were reminded of the rules of *Capture the Flag*. Students have had previous experience with the game, however, without the math concepts. During the game if the students were tagged, they had to go to a designated area in the gym called “The Jail”. There was a teacher standing by each jail handing students a card with various coin addition problems. If the student could solve the problem on their own, they could leave “The Jail” immediately. If the student could not solve the problem, they waited for a teammate to come to the jail and help them solve the problem. If two students had a difficult time solving the problem on their own, they could ask for the teacher’s assistance.

Also during the third week, the students played a game called *Globe Ball* (Appendix F). The focus of this game was to work on skills of catching and throwing. The sub focus was for students to understand money recognition and value. Students

entered the gym and sat next to the listening board and were reminded of *Globe Ball* rules. During the game, if the students hit someone in the head with a ball, stepped over the midline, or someone caught the ball that they threw, they had to go to jail. A bucket of plastic coins was placed at each jail. The students were asked to choose a coin without looking. They then told a teacher at the jail the name and the value of the coin. Once they knew the name and the value, students looked at the sheet on the wall, which listed all of the coins and accompanying exercises. Students then completed the required exercises and returned to the game.

During the fourth week, the students participated in an activity called *Scooterville* (Appendix G). We created an activity that we called *Scooterville*, which was a mini town set up in the gym. Students could participate as a citizen or a worker. Students had to pay for each activity that they wanted to participate in, such as: rock wall, movie theater, zoo, hospital, car wash, etc. After sitting at the listening board, the students were released by the color of their clothing to avoid collisions. Students were asked to find a line and sit with their scooter in their laps. Once the music started, the students were able to venture through the *Scooterville* town. During the first day of *Scooterville*, there was a sheet at the bank with the names of each coin that corresponded with an activity in the gym. The students then picked the appropriate plastic coin out of a Frisbee and showed the teacher. If the students were correct, they were free to participate in that activity. During the second day of *Scooterville*, the money sheet at the bank connected each activity with the value of the coin. The students would have to say the value and find the coin that represented that value. During the third and fourth day of *Scooterville*, students had to

look at the sheet where a number value was connected to each activity. Each activity cost a different amount of money ranging from four cents to 36 cents. Students had to collect the appropriate coins out of the Frisbees until they had the correct combination for their desired activity.

During the last week of data collection, the students took the post assessment form once again. The post assessment was the exact same test as the pre-assessment given week one of the data collection time frame. Our primary goal was to duplicate the same process as the pre-assessment. We used the same test, instructions, and setting as we did the first time. The tests were collected when completed and placed in a manila envelope. The following day the classroom teachers were given a student feedback sheet (Appendix H), which asked them to rate their feeling towards using mathematics in the physical education setting. The teachers were asked to read each question one at a time and to explain what each face means. We wanted to make sure that each student was given the same set of instructions and it was explained using the same description. We, also, used a teacher dialog (Appendix I) to determine the classroom teachers' thoughts and feelings on integrating mathematics into the physical education setting and if it had any carry over effects in the classroom. We will analyze this information to help determine the effect of integrating mathematics in the physical education setting.

Analysis of Data

The purpose of our study was to determine the effects of integrating mathematic concepts into physical education lessons. We used four different forms of data to measure these impacts. The students were given a pre-assessment and post-assessment to determine if the students made improvements in their coin recognition, understanding of currency value, and their ability to add the coins. During the course of integrating the mathematic concepts, we kept an observational record of the daily activities, participation, and notes on the successes or improvements needed each day. The students were also given an opportunity to provide us with feedback at the conclusion of our study to determine their thoughts and feelings regarding the use of money in physical education. Finally, we conducted an open dialog with each of the four first-grade classroom teachers to collect data about integration and its effect on classroom learning. We collected four different types of data to ensure our results would be valid and that we could draw meaningful conclusions.

The second set of data was our observational journal, which was collected throughout the integration process. This journal recorded information regarding instruction time, activity time, student participation, and observed lesson strengths/weaknesses. The general themes that were identified included: peer teaching, adaptations and loss of activity time.

The use of peer teaching became a common theme in our observational journal. We started by grouping students randomly during our lessons, but found that grouping by abilities could be helpful. At that point, we reviewed our pre-assessment sheets to see which students performed well and which students could benefit from peer help.

Partnering by scores helped our high scoring students to be more engaged by guiding and leading the lower scoring students. This proved to be beneficial during our partner activities as it allowed our higher scoring students to assist our lower scoring students. The lower scoring students were observed as being more active in the lesson and enjoyed the activity because they were experiencing success.

After using the pre-assessment scores to group students, we noticed a wide range of ability regarding coin recognition, values and addition. Student scores ranged from zero to 10, to a perfect 10 out of 10, and everywhere in between. The observational journals showed that this caused us to constantly adapted and modify lessons to meet the needs of all the learners. Some of the lessons we provided were tiered to help all learners be challenged, but successful. We adapted aspects of our lessons such as level of difficulty, how we grouped students and the format of our lessons. For example, if a student had difficulty understanding the value of each coin, it would be problematic for them to perform an addition problem using coins. All lesson adaptations we designed to keep students engaged and progressing at their full potential.

When interpreting our observational data sheet, we noticed that instruction time and student activity time were two common themes affected by integration. The instruction time during a regular class would typically take around three to four minutes. We noticed that during our integration process it would take an additional four to seven minutes of instruction time. This meant our instruction time was increasing each day. The effect of more instruction time also meant that the students were losing activity time. The amount of instruction time would vary from day to day and class to class. Therefore, there was a correlation between increased instruction time and decreased activity time.

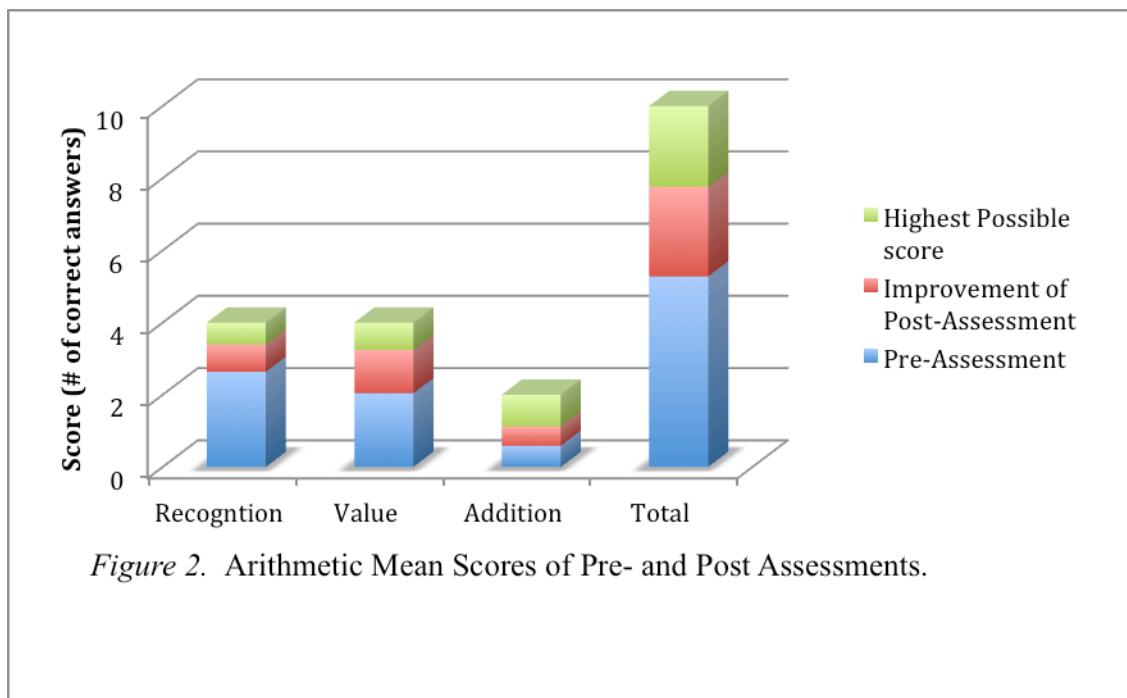
Throughout the integration process, we witnessed the benefits of peer teaching. Students were eager to help one another while learning coin recognition, value and addition. Peer teaching and adaptations were two strategies we used to create integrated lessons that met the needs of all learners. The integrated lessons created a positive environment for learning mathematics, but decreased the amount of physical activity time the students received during physical education. In conclusion, student may have benefited from the integration process, but lost physical activity time in the process.

To compare the data from the pre-assessment and post-assessment, we needed to break down each individual test. The pre- and post- assessments were the same assessment and given in the same setting each time. The assessment was broken up into three categories. The first category was coin recognition. This category had a picture of both sides of each coin with a space above to write the name of the coin. The answers did not have to be spelled correctly for the student to be awarded a point. This section accounted for four out of the 10 points. The second category was also worth four points. In this category, we were looking for understanding of coin value. The third category had two addition problems each worth one point. Each problem had a picture of three coins that students had to add together.

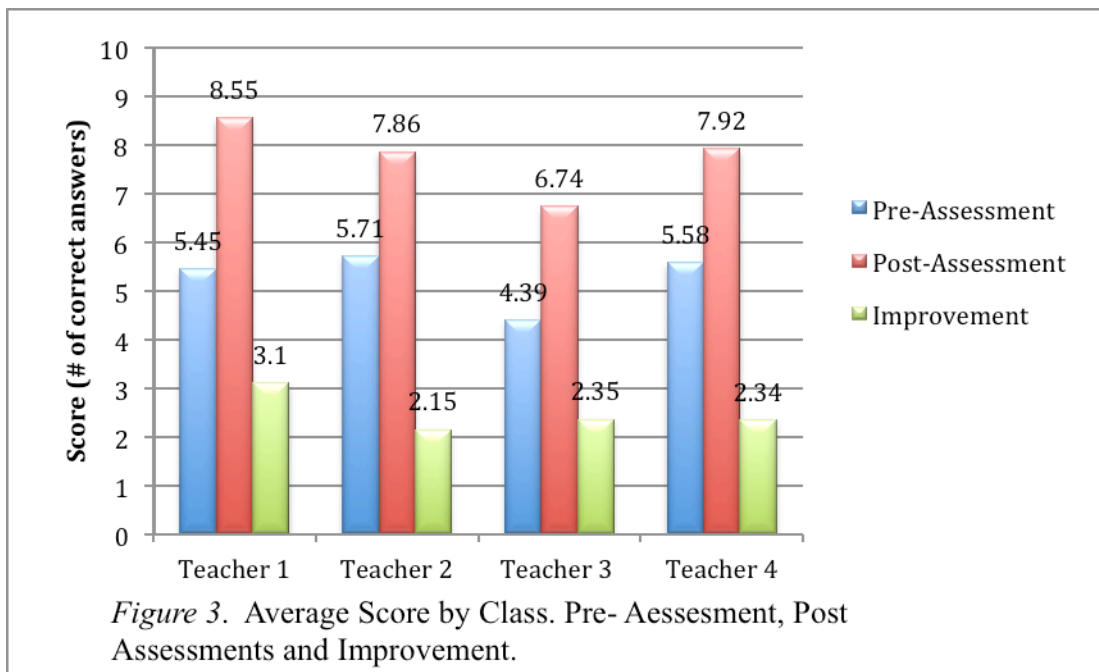
The pre-assessment data shown in Figure 1 is an overall collection of the four classes involved in the study. Each classroom teacher began covering coin recognition, value and addition to their classrooms after we administered our pre-assessment. This allowed us to get baseline knowledge regarding these mathematical concepts. On average, the 1st grade students completed the pre-assessment with 52.8% correct. The

majority of the students scored 6 out of 10 on the pre-assessment and 0 out of 2 on the addition component of the assessment.

The comparison of the pre- and post-assessments (Figure 2) presented obvious improvement in scores. In Figure 2, the color blue represents the pre-assessment while the post-assessment improvement is shown in red. The green provides a visual on the highest possible score the students could receive for each section of the assessment. The highest possible score on the assessment for a total was 10. On average, students received 2.64 out of 4 on the recognition portion of the pre-assessment and here was an improvement of 18.75%. The students also improved 30% for understanding values and 25% for understanding addition of coins. The students showed more understanding of recognition on the pre-assessment than value but made more of an improvement in the value portion of the post-assessment. The arithmetic mean for the total score went from 5.28 correct out of 10 to 7.76 correct out of 10.



The improvement shown in Figure 2 could have come from multiple avenues. During the integration process in physical education, money concepts were also being taught in the classroom. Classroom teachers did not have to follow the same lesson plans when working with their students on money recognition, value, and addition problems. Each teacher may have used different teaching methods to present the information to their students. As shown in Figure 3, each class revealed improvements from the pre-assessment to the post-assessment. These scores varied from classroom to classroom, but each class improved their class average by 37.6% - 56.8%. Teacher One’s students improved by 56.8% from the pre- to the post assessment. Teacher Two’s students improved by 37.6%. Teacher Three’s students improved by 53.5%. Teacher Four’s students improved by 41.9%. Teacher One had the greatest increase in performance. The differences in improvement percentages could come from the practices and teaching methods taking place within each classroom. The duration of time spent working on currency concepts also varied from teacher to teacher.



The pre and post-assessments provided the opportunity for us to evaluate the improvement levels of the students in each class and as a whole. According to the data from the pre- and post- assessments, students made progressive strides in the areas of understanding coin recognition, value, and addition problems. Therefore, the integration process had a positive influence on the students learning.

The next data collected was a set of four interviews with the first grade classroom teachers. The classroom teachers and students were the subjects of our study. All four teachers were asked a series of eight questions. The summary of the teacher interview data was organized in Table 1.

The importance of physical activity during the school day was a common theme noticed in the teacher interview. All teachers agreed that physical education during the school day supports academic achievement, but for different reasons. Teacher one stated “Physical activity and academic achievement provide a balanced for children.” Another teacher believed that activity was essential to the students and that it helped relieve stress. A teacher three stated, “Physical education is a great time to release energy, and the students are more engaged in the classroom after physical education class.” The classroom teachers seemed to believe there is a connection between the mind and the body, so that integrating lessons could help learner outcomes.

The next theme that stood out in the interview was that integrating money concepts into the physical education class made learning fun for students. The Scooterville activity was mentioned several times by all four teachers during the interviews. They loved the way it created a “hands-on” learning experience for their students in a practical way. One of the teachers said, “Scooterville incorporated using

money to purchase activities, and the students shared what they had done every day.”

Another teacher stated, ”I have found the students are excited about learning the same material in the classroom as they were learning in the gym.” The teacher dialog revealed that integrating created a positive attitude about learning money concepts, which showed during their classroom lessons. Overall, the feeling was that the students enjoyed integrated experiences and found that it played a large role in fostering the enjoyment of using money in the classroom setting.

Table 1

Teacher Dialog Summary

Questions	Teacher #1	Teacher #2	Teacher #3	Teacher #4
1. General thoughts about mathematic integration in to P.E.	Learning was fun.	Reinforce money concepts.	Make a positive difference.	Connected teachers through curriculum.
2. Does P.E. help support academic achievement?	Physical activity helps with academics.	Activity is key to academic success.	Yes. Engaged when they come back.	Yes.
3. Did you see any process from students beyond the norm?	Learning happened faster when taught in both settings.	Extra practice was good. Meets a wide range of learning styles.	Helped for the classroom store.	Learning beyond norm. Learned faster.
4. Did the students talk about using money in the gym?	Fun learning Math in PE especially with Scooterville.	Loved Scooterville. Value connected to size.	Shared everyday during Scooterville.	Nobody mentioned using money in the gym.

5. Did the students learn at a faster pace?	Speeding up the learning process.	Extra practice.	Yes. Repetition was helpful with integration.	Noticeable change in their ability.
6. Any changes in student's attitude about mathematics?	Not noticed, but any negative comments.	Excited about learning same subject in the gym as in class.	Hands on learning experience.	Positive outlook on money concepts.
7. What has been the greatest benefit?	Reinforcement of skills.	Reinforcement of classroom concepts.	Double exposure. Hands on learning.	Teaching the same concept in another setting is very beneficial.
8. What could be done to help improve this process?	Want more SCOOTERVILLE!		Bring Scooterville back to the classroom.	More planning.

The most common response during the interview process was that the teachers believed integrating helped to reinforce what is being taught in the classroom. One of the teachers stated, “Using money in the gym helped my students understand how to use the money in our class store.” They all realized that combining math and physical education gave the students extra practice time with math concepts, which was beneficial to student learning. This kind of experience was practical and gave a real life experience for the pupils. Two of the teachers also mentioned that combining the two subjects helped the students by providing a practical learning experience. Another teacher stated, “ The students were engaged in the learning process in the gym because of the way the concepts were presented. They got to actually touch and spend money instead of using worksheets.” All of the teachers liked the double exposure the students were receiving. Two of the teachers believed that the extra practice time was speeding up the learning

process. They both noticed their students were learning at a pace that exceeded the typical learning time frame. All four of the teachers were in agreement that reinforcement of math concepts was the greatest benefit of the integration process.

Integrating mathematic concepts into the physical education class did have a positive effect on students' attitudes towards money concepts. We did take note of one teacher stating "I need to plan my teaching better so that I'm teaching the same concepts at the same time and not just adding it in." Planning could be a point of reference for future integration practices. The first-grade teachers were in agreement that physical activity is very helpful to classroom learning and provided a hands-on learning experience. Integrating math concepts had a positive impact on the first-grade students' ability to recognize money, the understand value, and add money. The most commonly agreed upon benefit of the study was that integrating was enjoyed by the majority of students and was a great reinforcement of the core curriculum. Therefore integration may be a successful method for improving student learning and something that can be used in the future to enhance core curriculum.

The next data piece we collected was the student survey. When we tallied the results of the student feedback sheets (Figure 5), we used percentages to break down the responses. The blue portion of the pie chart represents the percentage of students that responded yes and the no responses are identified in red. The charts have the questions written in bold text at the top of the chart.

In Figure 5, 88% of our students said yes to the question of having fun with money in the gym while 12% of our students did not enjoy using money in the gym. The question concerning if they learned how to count money in the gym was represented in

Figure 5. The statistics were identical to those in Figure 5, 88% responded yes and 12% responded no.

Figure 5 asked the students if they learned how to add money in the gym. 90% of the students responded yes while 10% answered no. The final question was represented in Figure 5. We wanted to know if the students would like to learn more mathematics in the gym. The results showed that 81% of the students would like more mathematics integrated and 19% would not. This question had the highest percentage of no's in our feedback.

The fact that 19% of our students didn't want more integrated lesson made us think we may have overdone the integration. We then took a closer look at the "no's" in our student feedback sheets to determine if we could identify any patterns. Looking at the sheets that had only one "no" circled had a definite pattern. 60% of the students with one "no" answered no to question #4. Answering "no" to question #4 meant they enjoyed adding math in the gym, but did not want to do more of it. It was interesting to find that 70% of students that answered with a no answer also answered with two or more no's on their feedback sheet. There wasn't a dominant pattern noticed within this subgroup. However, the most frequent "no" combination of was found with question #1 and #4. This group of students didn't enjoy using money in the gym and did not want to do it in the future. We wondered if this subgroup didn't like integration or math, in general.

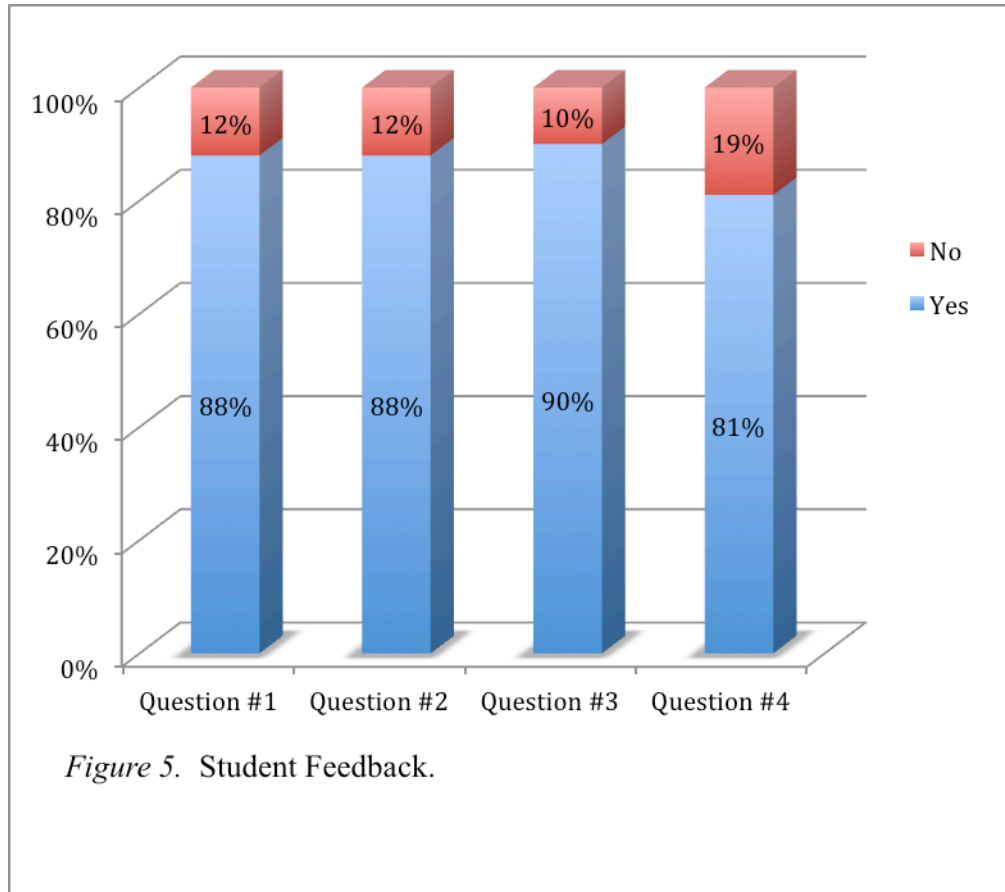


Figure 5. Student Feedback.

Question #1: I had fun using money in the gym.

Question #2: I learned how to count money in the gym.

Question #3: I learned how to add money in the gym.

Question #4: I would like to learn more math in the gym.

The student feedback led us to believe that the majority of our students enjoyed integrated instruction. These students also felt as though integration was helpful in learning about money concepts and they would enjoy integrated lessons in the future. The majority of students that answered “no” did so on multiple questions. Answering “no” led us to believe that these students may have already had a good understanding of the topic and were not challenged enough. We also considered that the math may have

been too complicated for the students or possibly the number of consecutive days of integration may have been too long. In conclusion, we found integrated lessons did enhance the learning environment for most students, but there were some concerns that we may need to address if we continue to integrate lessons in the future.

Many positives came forth during the process of integrating mathematics into the physical education setting. Classroom teachers expressed positive opinions about students' progress and enjoyment of integrated learning during their physical education time. Although there were many positives on students learning to core content, the integrating process added extra instruction that lead to less activity time during physical education lessons. In conclusion, integrating mathematic concepts into the physical education curriculum had a positive effect on the student learning of core content. Physical education teachers and classroom teachers agreed that with minor modifications, integrating could be a beneficial method of teaching to enhance student learning. The data we have collected has given us great insight into how we will use integration in the future, which we will discuss in our Action Plan.

Action Plan

Looking back at the research, it is important to note the elements of our study that will impact the way we teach and our students learning processes in the future. The idea behind the study was that the students would learn core curriculum more efficiently through integrated lessons. This idea came forth when trying to find a new way to help our school achieve academic goals. Using integration without losing active movement

time was an essential component of our study as well. The results of this study will assist us in discovering new methods of teaching involving integration.

Integration of mathematics into the physical education setting proved to be a beneficial experience for student learning of core content. Before our research, we spent minimal time on integrating mathematics into our P.E. lessons. Due to the positive feedback and improvement of student learning at the first grade level, we will continue to collaborate with classroom teachers to discover new ways of integration. If each grade level would benefit from the integrated lessons, we would like to apply these teaching methods across grade levels throughout the year. We feel it would be difficult to develop an integrated curriculum for all grade levels at the same time. The development of integrated lessons is a process that will have to be applied over time.

To have successfully integrated lessons, physical education and classroom teachers must be involved and on board. The positive experiences from the research could open up different avenues for educating students for physical education teachers and classroom teachers. This collaboration between teachers could create a more cohesive work environment. Integration may also help the students feel that same level of connection by learning through integrated lessons. All teachers will have to find communication methods that are efficient and productive to maintain this collaboration. Methods of communication could include teacher meetings, emails, and Google drive. If this collaboration is successful, we could expand our integration methods to other subjects such as reading, spelling, science, and social studies. As physical educators, we will have to determine which classroom subjects best fit with the already develop

physical education curriculum. It is important that we do not take away from the physical activity time during P.E. to accommodate for core subject.

The research we conducted did impact on student learning. The classroom teachers taught currency concepts in the classroom, and those lessons were reinforced during physical education class. Therefore, students were provided double exposure to currency concepts being taught in both the gym and the classroom. Integration of mathematics into the physical education setting increased the amount of learning time for mathematics during the school day, which may have helped students improve conceptual/deep understanding of currency concepts. The improvement of students learning suggests that physical education should use integration for the benefit of enhancing core concept learning.

The intent of the research was to improve core content knowledge in the physical education setting. However, integration can take away from student activity time. It takes longer to give instruction when integrating. Therefore, integrating directly impacts the amount of exercise time the students receive in a day. Physical education teachers have limited time with their students. Therefore, we must maximize activity time to make integration most efficient.

The student feedback showed that the students enjoyed the integration process. Creating experiences that are hands-on in nature can generate more excitement for learning. This kind of environment motivates students to learn concepts that they may find less engaging in the classroom. Incorporating core learning with movement had the students involved in the gym and sparked more enthusiasm in the classroom as well. By

teaching the same content in multiple settings, we increase our chances of accommodating all learning styles.

The benefits of reinforcing and integrating mathematics into the physical education setting are evident. Although the students progressed, it's hard to determine what percentage of their learning came from the integration process. Classroom teachers were delivering instruction on the same topic that was being integrated into the physical education lessons. For our action research project, we wanted to provide an equal education for all students. To do so, we delivered the same lessons to each first-grade class within our school. To minimize other factors, we could integrate other mathematic concepts before they are being taught in the classroom. Also, we would like to incorporate an open-ended questionnaire as one of our forms of data may provide us with more in-depth information from student feedback.

After discovering the success that integration had on learning with the first-grade students, we would like to provide some of the same instruction in the second through fifth grade classes. We are unaware if these integration methods would be beneficial to all age levels. Meeting with the upper grade level teachers would be a necessary step to determine who would be interested and what curriculum we would be integrating. The level of difficulty in core content increases with each grade level, in turn, increases the complexity of integration. Also, students in higher-level classes may view physical education time as a time to relieve stress from academic pressures. Therefore, the integration at the higher levels may not be as readily accepted as a new method of learning. We can further our study by investigating activity time vs. instruction time,

student feedback with regard to specific feelings about integration, and historical data to help student preparation for MCA test concepts.

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Appendix A
Pre and Post Assessment

COINS: PENNY, NICKEL, DIME AND QUARTERS

Name: _____

What are the names of these coins?

--	--	--	--



How much am I worth?

c	c	c	c
---	---	---	---



ADD US TOGETHER!

+ + = <div style="width: 40px; height: 40px; border: 1px solid black; display: flex; align-items: center; justify-content: center;"> </div>
+ + = <div style="width: 40px; height: 40px; border: 1px solid black; display: flex; align-items: center; justify-content: center;"> </div>

Appendix B
Relay Challenge

Focus: Gross Motor Movements (skipping, running, bear crawl, etc.)

Sub Focus: Understanding Coin Recognition and Coin Value

Materials Needed: Gymnasium, CD player, 20 hula-hoops, 20 Coin Sheets, many plastic pennies, nickels, dimes, and quarters.

Introduction: This game combines elements of gross motor movement skills, money recognition, and value. The students may be familiar with the coins but their experience and understandings will vary. Recognition and value should be explained prior to participation in the game. The game requires both teachers to watch the whole gym and check the sheets as they are completed.

Prior Knowledge: The students will have relay and gross motor practice prior to adding the math concepts.

Rules:

- The students will begin seated next to a hoop and a sheet.
- A movement is called (crab walk, hop, gallop, walking backwards, etc.) and then the music will start and the game will begin.
- One student from each group will travel out to the middle and collect a plastic coin. The students will then use the same gross motor movement to travel back to the hoop and place the coin on the sheet.
- The next student may leave when the coin is placed on the sheet.
- The goal is to complete the sheet with the correct sequence of coins.

- The teacher will stop the music and the students will stop. When the music stops the teachers will change the gross motor movement.
- The game continues until all groups have completed the task.

Presentation:

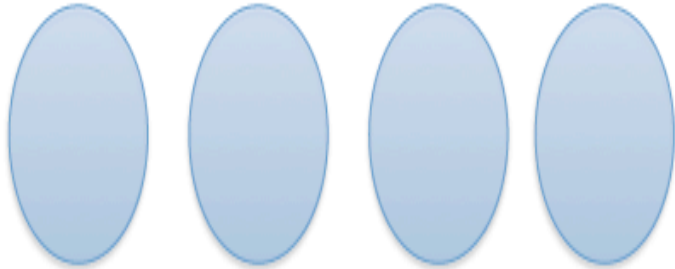
1. The class will be divided into groups of two or three (three, only if there is an odd number of students).
2. In the middle of the gym will be hundreds of scattered plastic coins, pennies, nickels, dimes, and quarters.
3. The teacher will call a gross motor movement and start the music, which indicates the start of the relay.
4. Each team will send one member out the middle to retrieve one coin to bring back to their group. The student is only able to grab one at a time and must grab one that is needed to complete their sheet; they are allowed to take the extra coins back if needed. They will not be able to grab a different coin, as that would be considered their turn.
5. The students will continue sending one player at a time until their sheet has been completed. The teacher will change the gross motor movement by stopping the music and announcing the new movement.
6. The group will continue sending one team member at a time until they have completed the sheet.
7. The group will raise their hand when they are finished and the teacher will check their sheet for accuracy.

8. After, the sheet is checked the group must return all coins to the middle. The group is then provided a second sheet to complete if there is time left in the class period.

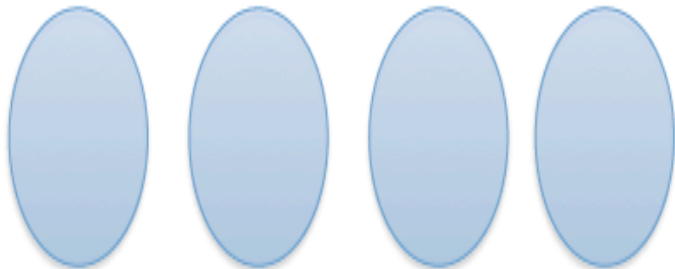
Extend: Dribbling, stick handling, or other manipulative can be used for the gross motor movement to extend the lesson.

Appendix C
Coin Recognition Sheet

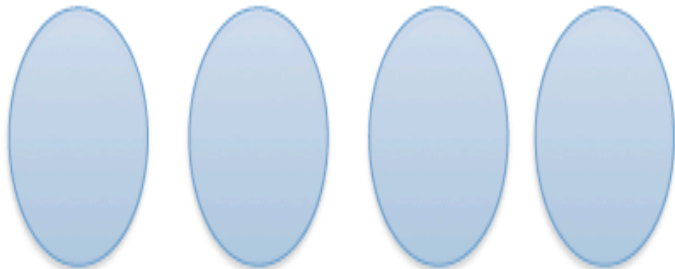
Dime



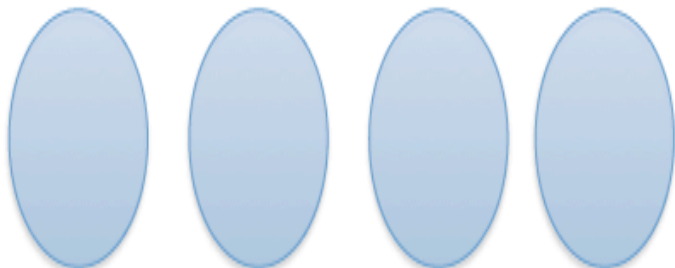
Quarter



Penny

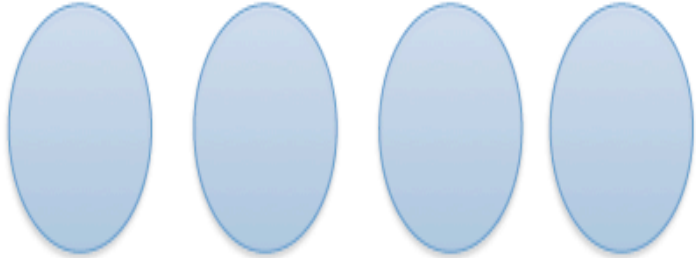


Nickel

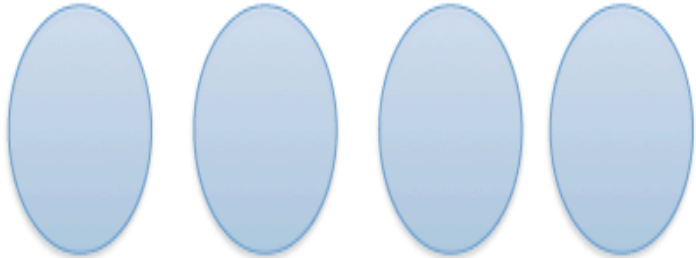


Appendix D
Value Circles Sheet

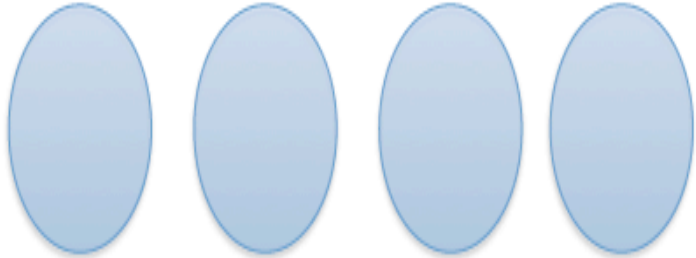
5 Cents



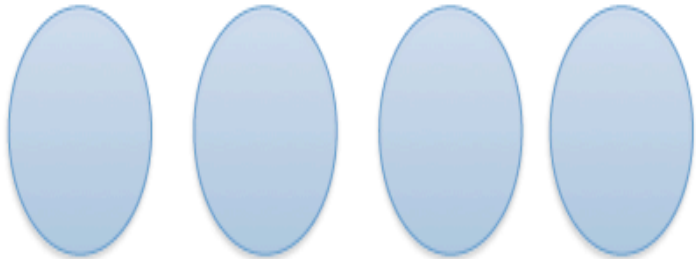
10 Cents



25 Cents



1 Cent



Appendix E
Capture the Flag

Focus: Chasing, Dodging, and Fleeing

Sub Focus: Understanding Money Recognition, Money Value, and Adding Money

Materials Needed: Gymnasium, CD player, 8 medium sized cones, 6 large cones, jersey, and a deck of Everyday Math cards.

Introduction: This game combines elements of chasing, dodging, fleeing and money recognition, value, and adding. The students may be familiar with the coins but their experience and understandings will vary. Recognition, value, and adding should be explained prior to participation in the game. The game requires both teachers to watch the whole gym and check for adding accuracy at each jail.

Prior Knowledge: The students will have played Capture the Flag prior to adding the math concepts.

Rules:

- Both teams start the game seated in their jail with 3 guards standing, one standing in front of the jail and two guards standing near the three flags.
- When the music starts the game begins.
- Your team scores a point if a player crosses the centerline and grabs a flag bringing it back without getting tagged.
- A player that is tagged, after crossing the line, has to go to the opposing teams jail.
- Players can get out of jail if they can solve the coin problem or an untagged teammate can enter the jail and help solve the coin problem.

- Once a player has solved the coin problem they can go back to their side with a raised hand indicating that have been freed from jail.
- Sliding, diving, and tagging to hard and they go to jail.
- Change is song equals a change in guards.

Presentation:

1. The two classes will be divided into two even groups. Each group will gather inside their team jail at the beginning of the game. Each jail will be an 8 foot square made with the medium sized cones. The flags (jerseys) will be placed on top of 3 large cones on each side of the gymnasium and placed in a parallel line with the back cones of the jail. The centerline of the gym floor will divide the two teams. One team will wear jersey to recognize the players on each team.
2. It will be explained that there are two guards for the three flags and one guard for the jail. They are responsible to tag players that are trying to capture a flag or save a teammate from their jail. The guards will change at the end of each song.
3. The teacher will start the music and the game will begin. All the players will exit their jail and begin play.
4. Players that cross the line and are tagged, slide, dive, or tag to hard go to the other teams jail.
5. The teachers will stand near the jail to hand out the math cards. The students will have to add the coins on the card together to get out of jail. Teammates that make into the jail without getting tagged can help solve the problem and

get them out of jail. The students will then check their answer with the teacher, if the answer is correct they are both able to get out of the jail. Once freed they must walk back with a raised hand (indicating they are free) to their own side. They are now able to capture flags or help free teammates from jail.

6. The game is continuous and only stops when the music stops, to change guards or talk to the students. When a flag is captured the students return it to an opposing player and is placed back on the large cone. The teacher can decide if keeping score is desired.

Appendix F
Globe Ball

Focus: Catching and Throwing

Sub Focus: Understanding Money Recognition and Value

Materials Needed: Hula-Hoops, Foam Balls, Coins (quarters, nickels, dimes, and pennies) and exercise sheets.

Rules:

- Balls start on the middle line.
- Start behind the line on your stomach.
- When the music starts you do **2 perfect pushups** and activate the ball.
- **Activate the ball** by bringing it back to the black line where you started.
- 1 guard for each globe
- If someone **catches the ball you threw** or you **hit someone in the head** you have to go to jail.
- The students must go to the jail and choose a coin out of a bucket. They must state the name and value of the coin. There is a sheet on the ball that connects each coin to an exercise. The students must perform that exercise as many times as the coin is worth.
- If a team knocks down another team's globe, they can set it back up as long as one is still standing.
- If all globes get knocked down the other team wins.

How to start a new game:

- Stop the music and have the students sit quiet.
- Tell them when you say go they will set up for a new game.
- You wont start the music until they are quiet.

Presentation:

1. The two classes will be divided into two even groups. Each group will lie on the line on opposite ends of the gym. Foam balls will be place on the centerline dividing the two teams. Each team will have three globes. The globes are made out of six hula-hoops. The first hoop is lying on the ground. The next two are leaning against each other with the base of the hula-hoop in side the bottom hula-hoop. The next to are leaning against each other the opposite direction. The top hoop is place on top of the structure. These globes are place in the back half of the court.
2. Each one of the globes has 1 guard. The guard must change to a new guard once the song changes. The rest of the students must go grab a ball (no more that two) and bring it back to the black line to “Activate” the ball. Activation only takes place at the beginning of the game.
3. If a globe gets knocked down, it can be set up as long as there is another globe standing. If all globes are down on one side, the game is over. Students may not throw at globes that are being rebuilt.
4. During the game, if the students hit someone in the head with a ball, stepped over the midline, or someone caught the ball that they threw, they had to go to jail. A bucket of plastic coins was placed at each jail. The students were

asked to choose a coin without looking. They then told a teacher at the jail the name and the value of the coin. Once they knew the name and the value, students looked at the sheet on the wall, which listed all of the coins and accompanying exercises. Students then completed the required exercises and returned to the game.

Appendix G
Scooterville

Game Description:

A mini town was set up in the gym. The students could travel around using their scooters. There are different activities that the student could choose to participate in. Some of these activities include the rock wall, Movie Theater, zoo, hospital, newsstand, coffee shop, car wash, ect.

Materials Needed:

Parachutes	Cones	Cups
Rockwall	Signs	Scooters
Mats	Pencils	Jump ropes
Newspapers	Paper	Balance beam
Rubber animals	Plastic money	Hats

Jobs in Scooterville:

- Students must each have their own scooter.
- Students can either choose to be a citizen of the town or they can choose to be someone with a job.

Tow Truck Driver

This student has a larger scooter with a rope attached. The students can give people rides who have earned a ticket at the bank (See Ambulance Driver)

Train Conductor

The Train conductor starts at the Train Station. S/he has three scooters that are tied together. If students want a ride they must go to the bank and do a money problem to get a ticket. If they earn a ticket, they can give it to the train conductor for a ride. The students can sit on the train and leave their scooter upside down at the train station.

Ambulance Driver

The ambulance driver has a larger scooter and a hat with an “A” on it. Attached to their scooter is a rope that they can use to tow other students to the hospital.

The citizens can ask the ambulance driver for a ride to the hospital, but they must give them a ticket they receive when they go to the bank.

Mailman

Citizens can pay to write a letter to a friend in Scooterville. They can go to the Post Office and write a letter and put it in the “out-going” box. The mailman picks up the mail and brings the letters to the appropriate people in Scooterville.

Road Construction Worker

This worker can go around and make sure all the signs are up and fix anything that has fallen down.

Police Officer

The police officer wears the police hat to show the other students who s/he is.

Police officer has “jail” tickets that he/she can give out to the citizens of the town.

Police can give tickets to students who are not following the rules of the road. The students must stay on the lines on the floor when traveling around on their scooter.

If a student receives a ticket, they must go to jail. They must do 5 push-ups to get out of jail.

Citizens

Students can choose any color scooter as long as it is available.

Students must earn money at the bank by showing their knowledge of coin recognition, coin value and coin addition. (SEE Bank Variations)

Students can participate in a variety of activities available in Scooterville (SEE Activities).

Bank Variations:

DAY 1: Coin Recognition: Each activity stated what coin they student needed to participate in the activity. If the activity said they needed a quarter, the student would have to go to the bank and show the teacher which coin was a quarter.

DAY 2: Coin Value: Each activity cost 1 cent, 5 cents, 10 cents or 25 cents. The had to go to the bank, tell the teacher the amount they needed to do the activity and show them which coin matched the amount of money they needed.

DAY 3: Coin Addition: Each activity cost a different amount of money ranging from 4 cents to 36 cents. The students had to go to the bank and take out that amount of money. They had to show their teacher the correct amount before they go do the activity.

Activities: Students must go to the bank before they participate in each activity. There is a list at the bank stating how much each activity cost. Depending on the day (1, 2 or 3), the students must solve the coin problem.

Rockwall

- Students must keep their feet in the brown area and hands in the grey area.
- No jumping off of the rock wall.

Coffee Shop

- Can stop by the coffee shop and chat with a friend for a minute.

Gas station

- Each student must fill up at least once during the class period.

The gas station consists of ropes hanging from the pull-up bars. The students must grab the end of the rope and place it in the middle of their scooter to fill it up.

School

- The students can go into the school and read one-page of an age-appropriate book about physical activity.
- The school is made up of mats to surround three sides. The books are placed inside of the school and are not to be taken out.

Car wash

- The car wash is made up of two mats on each side with a small parachute draping over the top. The students can enter from one side and exit out the other.
- Only one student passing through the car wash at once.


Presentation:



- Students come into the gym and sit in front of the white board to listen to the rules of “Scooterville.”
- Rules of Scooterville were introduced to the students.
- Students we asked to get a scooter and sit on a line on the gym floor.
- Once the music started, the students could travel around and explore what Scooterville had to offer.
- Once student found and activity they wanted to participate in they would have to go earn money at the bank.



Appendix H
Student Feedback Sheet



What do you think?

CIRCLE "YES" OR "NO"

1. I had fun using money in the gym.	YES 	NO 
--------------------------------------	---	---

2. I learned how to count money in the gym.	YES 	NO 
---	---	---

3. I learned how to add money in the gym.	YES 	NO 
---	---	---

4. I would like to learn more math in the gym.	YES 	NO 
--	---	---

Appendix I
Teacher Dialog

1. What are your general thoughts about integrating math concepts into the physical education setting?

2. Do you believe physical education helps supports academic achievement?

3. Did you see progress with any students or group of students beyond the norm during this process?

4. Did the students mention any thoughts about money concepts used in the gym?

5. Did the students seem to learn their money skills more quickly than with previous math concepts taught in the classroom?

6. Did you see any change in the student attitudes about mathematics, as it relates to money, during the integration process?

7. What do you believe was the greatest benefit of this study?

8. What do you think could be done to help improve this process in the future?
