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The Effect of Small Space Physical Activity on School Performance

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Table of Contents

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Introduction

As teachers we are actively engaged in the learning process and we are constantly learning more about how learning occurs. Previous investigations have provided support for the notion that physical activity can improve students' academic abilities within the subject areas of math, language arts and physical education (Blakemore, 2003; Tremarche, Robinson & Graham, 2007). Helping children increase motor skills may have a direct impact on performance in math, reading, language arts, spatial awareness, and attentiveness (Jensen, 1998; Tremarche, Robinson & Graham, 2007). It has also been suggested that improved functioning for students in the academic, psychomotor and affective domains can contribute to a more positive self-concept for the individual student (Kovar, Combs, Campbell, Napper-Owen & Worrell, 2007; Laumann, 2006; Pangrazi & Gibbons, 2003; Pica, 1995). A better understanding of the nature of the relationship between physical activity and other aspects of education may lead to new possibilities for learning and may potentially reshape the way physical activity is utilized during the school day. In this study we examined how the frequent use of simple activities in classroom spaces impacted the learning of students in a grade 3 classroom.

Background

This project addresses the holistic nature of the child. There is preliminary research to suggest that improvements in spatial awareness enhance math, reading, and language development through small space physical activities (Maeda & Murata, 2004). Further, student participation in physical activity has been suggested to promote feelings of success and self-challenge, participation and cooperation with others, thereby boosting self-esteem and contributing to school performance (Kovar, Combs, Campbell, Napper-Owen & Worrell, 2007; Laumann, 2006; Pangrazi & Gibbons, 2003; Pica, 1995). Deficits in hand-eye coordination have been observed in children with learning disorders (Kavale and Forness, 2000). Specifically, difficulties in reading, math, spelling and writing abilities have been associated with decreased hand-eye coordination (Taylor Kulp, 1999); however, the nature of the relationship between hand-eye coordination and academic performance remains unclear (Barnhardt et al., 2005).

While there is considerable research to date that suggests a strong relationship between physical activity and student success in schools (Kovar, Combs, Campbell, Napper-Owen & Worrell, 2007), many of the activities researched require large spaces, expensive equipment and/or close supervision. These requirements pose a challenge for many classroom teachers who lack resources, including space and equipment, and work where the climate places restrictions on physical activity in the winter months. Also, some physical activities may exclude students with physical or cognitive challenges.

Motor skill development improves dramatically throughout childhood. Gross motor coordination typically sees the greatest development, with fine motor coordination developing over a longer period of time (Craig & Baucum, 2002). Children learn by experiencing motor skills through a variety of learning experiences that contribute to kinaesthetic learning, language development, spatial awareness, and musicality.

Coroso (1993), Lipowitz (1996), and Cohen & Goldsmith (2003) have studied how body/space awareness transfers to paper/space awareness. These studies investigated children using activities to cross the mid-line section of the body through some sample activities like touching their shoulders or jumping to the ceiling. Children who responded with only one hand during these physical activities applied the same response to paper quadrants when writing, colouring, and drawing. Children who could not cross the mid-line of their body tended to focus on the vertical extension of the paper and stopped reading at the middle of the page. Similarly, children who have trouble locating themselves in personal space, have difficulty spacing their letters on paper. Research into juggling has shown remarkable improvements in students' handwriting after participating in a juggling program during their school day (Lipowitz, 1996).

The whole child is involved in the process of negotiating knowledge through movement experiences. Craig & Baucum (2002) share that learning during the early years involves interaction between the perceptual-motor functions and cognition; in addition, motor learning requires certain conditions, such as readiness, practice, attention, competence, motivation and feedback. Children provide clues to their readiness when they begin to imitate the actions of others. When a child is engaged in motor learning, he or she is called to a state of attentiveness that requires an alert and engaged mind (Craig & Baucum, 2002),

and often feedback for the child is provided by his or her own behaviour. Children who engage in motor activity are testing their own knowledge, and practice is the key to motor development (Craig & Baucum, 2002; Graham, Holt/Hale, & Parker, 2004; Pangrazi & Gibbons, 2003). For example, a child who throws rocks into the river is learning some basics about weight, force, angles and trajectories, and a child who stacks blocks is learning about balance, special awareness, gravity, and personal challenge. Wadsworth (1971) refers to Piaget's theory stating that children must act on their environment in order to stimulate cognitive function. Through symbolic representation of actions, images and words, children make sense of their world, develop language, increase spatial awareness, and develop their own realities of learning.

Researchers have provided evidence that physical activity contributes to optimal brain functioning and learning. Jensen (1998) reported that vigorous physical activity can promote new brain cell growth. As well, recess time and other integrated physical activities help students simultaneously engage their brain and their bodies in learning (Graham, Holt/Hale, & Parker, 2004; Maeda & Murata, 2004). Other studies indicate that increased physical activity time during the school day lead to higher test scores in math, reading and writing, improved fitness, and improved classroom behaviour (Tremarche, Robinson & Graham, 2007).

Measures of visual-motor integration include measures of visual-perceptual ability and fine-motor coordination, and they require close cooperation between cognition and movement, i.e., brain-behaviour relationships. The performance of tasks of visual-motor integration also requires sustained attention or vigilance and motor impulse control, which are fundamental to attention (Barkley, 1990) and subsequently to learning. The brain has the capacity to grow and change in response to the environment, and to the interaction of the individual in the environment (Abbott & Ryan, 2006). The way that individuals behave in their environment influences brain development and subsequently affects learning (Blakemore, (2003); Graham, Holt/Hale, & Parker, 2004; Kovar, Combs, Campbell, Napper-Owen & Worrell, 2007; Pangrazi & Gibbons 2003).

Research Question

Will students' academic performance improve as a result of frequent participation in small space psychomotor activities?

Purpose and Objectives

The purpose of this study was to determine whether children participating in small-space psychomotor activities produced measurable improvements in their psychomotor, cognitive, and affective learning patterns. The objectives were:

1) To determine if there were changes in reading, math, and language as a result of students participation in the activities; and

2) To determine if there were measurable changes in motor skill development as a result of students participation in these mid-line activities.

Research Methodology

Two grade 3 classes in one elementary school were identified as willing to participate in the project. One grade 3 class served as control group, for the sake of comparison, and one served as the engaged class, the students who received training in the specific physical activities of the study.

The activities chosen were such that they could be learned in physical education classes, or in the classroom, because they required very little space. All of the activities were within the guidelines for the grade 3 curriculum as established by Saskatchewan Learning.

The teacher of the engaged classroom, the principal, and two of the other investigators involved in the project attended Brain Gym® training sessions to learn the activities prior to initiation of the activities in the classroom. As a research team we attended a full one-day workshop to engage in the first component of a larger Brain Gym® certification program. We recognize that we are not certified instructors of Brain Gym®; therefore, we implemented the activities that we were taught within the workshop and those obtained through Brain Gym® resources provided at the workshop.

Following this training, a meeting was held with the research team to determine how these activities would be implemented in the classroom over the proposed 10 week scheduled period. It was decided that in addition to regular physical education classes, Brain Gym® activities, focus activities*, and in-motion physical activities would be incorporated to provide opportunities to practice the motor skills being learned as well as provide movement breaks throughout the day for general health and well-being. Small spaces included the classroom, hallway, and boot room. The following schedule was created (see Table 1):

TABLE 1: ACTIVITY OUTLINE

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-9:30	Brain Gym® (3 min)	Brain Gym® (3 min)	Brain Gym® (3 min)	Physical Education (30 minutes)	Brain Gym® (3 min)
9:30-10:00					
10:00-10:30	Physical Education (30 minutes)	**In Motion Physical Activity (3 min)		Brain Gym® (3 min)	**In Motion Physical Activity (3 min)
Recess					
10:45-11:45	*Focus Activity (5 min)	*Focus Activity (5 min)	*Focus Activity (5 min)	*Focus Activity (5 min)	*Focus Activity (5 min)
Noon					
12:45-1:15		Physical Education (30 minutes)			
1:15-1:45	Brain Gym® (3 min)		Brain Gym® (3 min)		
1:45-2:15	**In Motion Physical Activity (3 min)	Brain Gym® (3 min)	**In Motion Physical Activity (3 min)	**In Motion Physical Activity (3 min)	Physical Education (30 minutes)
Recess					
2:30-3:00					
3:00-3:30	*Focus Activity (5 min)		*Focus Activity (5 min)		*Focus Activity (5 min)

Brain Gym®: A licensed set of specific activities that cross over the mid-line of the body.

Physical Education: The regular lessons taught by the teacher and not related to Brain Gym® activities.

*Focus Activity: the main activity learned during the study period. The focus of practice for the two week prescribed period included: 1) juggling, 2) lummi sticks, 3) cup stacking, and 4) rhythmic ribbons.

** In Motion Physical Activity: Alternate physical activities to focus on cardio-respiratory health: Running on the spot, jumping jacks, front supports/back supports/crawls, lunges, dancing and aerobics.

The students were involved in physical activity for approximately 39 minutes a day on average for five days per week, which included management time (student instruction and equipment set up).

The equipment for the study was stored in the classroom and it was made readily available for the students at any time of the day. The students were also allowed to take activity packs home with them that included the equipment. The packs were available to encourage them to engage in outside-of-school practice and physical activity.

The focus activities consisted of four main activities that crossed over the mid-line of the body: juggling, lummi sticks, cup stacking, and Brain Gym®.

- Juggling involved using light weight scarves and/or bean bags. Students practiced with these objects, working towards juggling three at a time.
- Lummi sticks are small twelve-inch wooden dowels used for rhythmic and manipulative activities such as tapping, tossing back and forth, flipping, and twirling.
- Cup stacking is a sport that utilizes small plastic cups and challenges the students to stack, un-stack, and manipulate the cups in a variety of challenging ways. Speed and accuracy are stressed in this activity as well as following a prescribed routine that moves spatially from left to right.
- Brain Gym® is a licensed program of movements that are reported by the developers of the program to enhance learning by addressing sensory and spatial elements. The movements require the child to perform a series of prescribed movements such as to draw shapes in the air, move the right and left hands back and forth, and touch the elbow to the opposite knee. A key element stressed in Brain Gym® activities is that they cross over the mid-line of the body.

Rhythmic ribbons were added as an alternative activity and taught by one of the researchers during one physical education class. Long, colourful ribbons are attached to a small hand-held dowel and are manipulated in a variety of spatial contexts. Simple routines were created, alone or with a partner, that crossed over the mid-line of the body by making figure 8's, moving the ribbons and the body in a variety of different directions and rhythmically exploring movement with music.

One of the researchers taught the main activities to the children in the classroom. The researcher spent one-half day per week in the classroom at the beginning of each new two week period, and made subsequent visits to interact with the students and encourage their efforts. The teacher learned the activities with the students and was able to facilitate continued practice in the small spaces provided.

Each activity focus lasted two weeks. For example, the first focus activity was juggling, which was taught on a Monday at the beginning of the study. The students focused on this activity in practice times for two weeks. Juggling was subsequently followed by activities 2, 3 and 4, which were practiced in the same time frame and manner. Although the focus of the activity changed every two weeks, the students were still able to practice previously learned activities if they had spare time and their work assignments were completed.

It was stressed throughout the study that the activities the students were learning were part of their physical education program and we hoped that by being physically active, their minds and bodies would work better. Additionally, the students were encouraged to think about drinking increased volumes of water throughout the day and were asked to bring water bottles to school. The increased consumption of water is strongly encouraged in the Brain Gym® literature, based on the understanding that the body is comprised of approximately two-thirds water and that water is a necessary nutrient for cellular health and oxygen transportation within the body (Donatelle, Davis, Johnston, Munroe & Munroe, 1998).

Prior to the students' training in these activities, their motor skills development was measured using The Bruininks-Oseretsky Test of Motor Proficiency. The Gray Oral Reading Test, 4th edition (GORT-4) was also administered to assess oral reading. After the 10 weeks during which the physical activities were incorporated into the

school day, these same measures were used for post-testing. Students from both the engaged and control classrooms were involved in the pre- and post-testing. Only students who had given their consent, as well as the consent of their parents, for their participation in the study were assessed. However, all the students in the engaged classroom were involved in the physical activities because the small-space activities introduced by this study were within the curriculum set out by Saskatchewan Learning and did not represent a departure from the curriculum established for Grade 3 in Saskatchewan.

In addition to the standardized assessments, training and practice sessions were videotaped periodically to allow assessment of psychomotor development, language acquisition, and social interaction over the 10-week session. The students in the engaged classroom were given a questionnaire (see Appendix A) at the end of the study to gain insight into their experiences with the small space physical activities and to learn how the students assessed their affective experience with the activities. In addition, a focus group was conducted with the parents to gain a deeper understanding of the impact of the project on the participants.

Results

Thirty seven (37) children participated in the study – 20 children were in the engaged classroom and 17 in the control classroom. Of those in the engaged classroom, 9 were girls and 11 were boys. Of the 17 children in the control classroom, 6 were girls and 11 were boys.

Due to limitations in time, personnel, and budget, a randomly selected group of students from the control and engaged classes was given the GORT-4, including 8 students from the engaged class and 9 students from the control class. No significant differences were observed between the two groups at pre-testing or at post-testing on the GORT-4.

The Bruininks-Oseretsky Test of Motor Proficiency was administered to all of the participants in both the control and engaged classrooms. No significant differences were noted between the two groups prior to the initiation of the study or after the completion of the study. Further, there was no significant change in scores from the pre-test to the post-test for either group. However, the children in the engaged group did demonstrate improvements in their juggling (see Appendix B) and cup-stacking proficiency with students on average progressing from being able to toss 3 scarves 3 times consecutively to completing 10 cycles with the three scarves. Improvements in cup-stacking were observed in terms of alternating hand pattern, rhythm and sequence.

Discussion

The teacher in the engaged classroom is passionate about physical activity and its role in education, but until this study had not implemented it to this extent within the school day. He believes that doing the activities throughout the day helped him manage his classroom more effectively, especially when confronted with the challenges of inattention, off-task behaviours, and bullying. Reflectively, he stated:

> *I barely got to teach these kids in the beginning of the year. It was classroom management, classroom management, classroom management issues constantly. I noticed a difference in these issues from the first part of the year to the second... I believe [these activities] helped my kids focus on listening and remaining on task much better than the first part of the year when we weren't doing these activities.*

In addition to the schedule prescribed by the study, the students were observed by the classroom teacher to engage in the activities on their own during the school day. In addition, the teacher found other opportunities to incorporate physical activity into the day. He commented:

> *If I saw a need to re-focus the kids we would stop working and engage in our mid-line activities routine or alternative physical activities like running on the spot, jumping jacks, or dancing. The best thing for me is that the kids started to self-regulate… by recognizing they needed a movement break and they began to move on their own. I would catch kids doing Brain Gym® activities. They would come to me with new ways of incorporating the Brain Gym® ideas such as cross-crawl and creating new movement pattern ideas.*

The classroom teacher for the engaged class commented that before he would give the kids a test he would ask them "if their brains were ready". He said it was interesting to see how many students would spontaneously get up from their desks and go through a movement routine before they did the test. He felt that this demonstrated that the students seemed to believe that these activities might help them with their work.

In one instance, after a morning of engaging in Brain Gym®, physical education and the focus activity, the students attended their music class taught by another teacher. Afterwards, the teacher made a point of commenting that it had been the best music class with this group of students to date.

An important consideration in the design of the study was the inclusive classroom and the capacity for adapting the activities to encourage involvement by all children in the classroom. The classroom teacher noted that many of the activities were similar to those recommended by occupational therapists to help students improve their motor skills and focus, and further, that the children in his class with special needs were able to participate because of the capacity for the activities to be adapted in response to the varying abilities of the students.

As a group, the students improved in their performance of the activities and experienced success with juggling and their cup-stacking routines. It was also observed that during execution of the activities the students showed general improvement in behaviour, with fewer negative behaviours exhibited as the study progressed. As one of the researchers reflected:

> *There was one student who experienced temper tantrums and other negative behaviour regularly during both class time and activity time. When she began juggling and working with lummi sticks she was very frustrated and threw herself on the floor during practice times. I led her through the activities, adapting the language and instruction of the movements so that she was successful even at the beginning stages. By the post-test time period she was almost juggling three scarves and she was very proud of herself and much more in control of her emotions when she lost control of the object.*

Students in the engaged class made the following comments about the activities:

> *"The activities make you want to work harder."*
>
> *"Well, PACE [a Brain Gym® sequence] is actually quite fun but also difficult but when you finish it I feel more confident in working."*
>
> *"School is less boring and these activities make me more interested in being a learner."*
>
> *"It helps me think faster; I feel like a different person-I feel like I'm doing better in homework."*
>
> *One student commented that he thought if his Mom tried the activities she might be less stressed!*

The students rated how they felt about their psychomotor performance on the written questionnaire. They reflected on their performance on a scale of 1 (very hard) to 10 (very easy) when they began learning the activity and at the end of the

study. The students expressed belief in their increased psychomotor performance and these results can be seen in Appendix C.

In response to the written questionnaire the students compared and rated the activities from most to least favourite and provided reasons for choosing the activity (see Appendix D):

Cup stacking was the #1 favourite activity, chosen by 15 out of 19 respondents for the following summarized reasons:

- *The activity was fun and exciting.*
- *Speed of the activity (it was fast).*
- *Shifting positions with the body and switching objects from hand to hand was enjoyable.*
- *It wasn't too hard and they found success with the activities.*

Only two students chose juggling because they found it fun.

One student chose lummi sticks because he liked throwing things and catching them sort of like aiming.

One student chose Brain Gym® because it allowed students to stretch and exercise.

Their least favourite activity was Brain Gym® (7/19), which was identified as:

- *Boring, confusing, weird, silly.*
- *It had nothing to do with having fun.*

Followed by lummi sticks (6/19) because:

- *It doesn't seem to make a difference.*
- *It's more difficult.*
- *You can get hurt.*
- *Sort of boring.*

And finally by juggling (5/19) because:

- *It was hard.*

When students were asked if they would continue with the activities their responses were as follows (see Appendix D):

Cup Stacking:	yes (19)	no (0)
Juggling:	yes (12)	no (7)
Lummi Sticks:	yes (9)	no (9)
Brain Gym®:	yes (11)	no (7)

When asked generally what they liked or disliked about doing these activities the students responded with the following statements.

I liked these activities because:

- *They were fun*
- *It was good to be able to do these activities in school*
- *Exercise*

- *They were interesting and I could go fast*
- *Provided a break in the day*
- *They exercised my brain*
- *The activities improved my skills*
- *The activities made me feel relaxed*
- *One student liked being a guinea pig and being in the study*

I disliked the activities because:

- *They made me feel behind*
- *It was hard*
- *It took a long time to do it*
- *You still need to do it exactly right*
- *My hands get sore*
- *Brain buttons [Brain Gym®] hurt*

Parent Focus Group

The focus group was attended by only two parents. The two parents who attended commented that they had seen at home examples of the activities from the study in which the children were engaged. One parent stated that her daughter talked about the activities fairly frequently and expressed her frustrations associated with not being able to juggle three scarves. She demonstrated to her mother activities such as cross-crawls, brain buttons and balancing techniques, and at other times the mother observed her daughter doing the activities on her own in the living room. The parent went on to say that she observed significant improvements in her daughter's behaviour this year in terms of better problem-solving strategies and higher tolerance. The other attending participant commented that her child is a "physical kid" who likes to do more than sit, so small space physical activities were well-suited to her. She, too, observed her child bringing home the activities and practicing them on her own, so she felt that the small space activities were good for children like her daughter. Both parents noticed an improvement in their children's social skills and self-confidence over the course of the study.

Problems and Limitations

An obvious limitation of this study was the small size of both the control and engaged groups, with further reductions in numbers for various aspects of the study due to student absences. In addition, we were limited in testing with the GORT-4. In part this limitation was a response to concerns about over-testing and in part it recognized the resources (personnel, time, and cost) required to complete the testing. Because of these factors, differences between the groups would have needed to be large in order to be considered significant.

As is the case with any study involving people, the unexpected can affect the course of the investigation. In this study, there was a period of time when the regular classroom teacher was not present in the engaged class, which may have affected implementation, and subsequently the results, of the program.

A third limitation of the study was that only two parents participated in the focus group discussion about the study; therefore, generation of themes and common ideas regarding the study was not possible.

Implications for Future Research

While this study did not yield significant findings with respect to the impact of small space physical activities on academic performance, the limitations of the study and the significant body of research regarding the relationship of physical activity and academics suggest that an expanded version of the study might be worthwhile. In the future, however, we suggest a number of changes to the design and implementation of the study.

First, a longer lead time prior to the study might allow the research team to educate parents more about the nature of the study and perhaps secure more buy-in on the part of the parents. This parental support might, in turn, encourage the children to engage in these activities outside of school. Similarly, as suggested by the parents at the focus group, inviting the parents and other teachers in the school to learn the activities either prior to the start of the study or concurrently with the children might also facilitate more engagement in the activities.

Providing an impetus at the end of the study, such as an exhibition or competition with respect to juggling, lummi sticks and cup-stacking, might also encourage follow-through with the activities.

Conducting the study over a longer period of time and with larger groups, perhaps two grades or classrooms, might reveal significant findings that were not detectable with a smaller sample size.

A concern voiced in the early discussions of this study by all members of the research team and by the School Division was the exposure of students to over-testing. Future investigations will need to take this into account in the design of the study.

An interesting observation was made by the classroom teacher for the engaged class about the ease with which he was able to incorporate physical activity breaks into the school day. Future studies might allow for more “opportunity-based activity breaks” and correlate the frequency and cumulative time of these breaks with other measures of interest. In addition, as was also noted by the teacher, the students appeared to monitor their own level of attention and spontaneously chose to engage in these activities throughout the day. This development, too, could be more carefully monitored in future investigations.

Conclusion

We cannot draw conclusions regarding the specific effects of physical activities that cross the mid-line of the body from this study. There were no measurable academic improvements in the physically engaged class that can be attributed to the small space physical activities. The physically engaged group and the control group that did not engage in any other physical activities outside of physical education had very similar scores in post-testing, despite the engaged class's participation in an additional 15-19 minutes of activity per day outside of the regular physical education class. While this demonstrates no positive effects of the activities on school performance, neither does it suggest that the additional 75-95 minutes of physical activity per week had a detrimental effect on the students' academic performance.

However, the classroom teacher of the engaged class reflected at the end of the study:

> *I watched my students self-regulate themselves and become more aware of their own behaviours and how they felt. To me these are life skills and if we have managed to encourage the children to be more aware of themselves and their behaviours without losing academic benefits then why wouldn't I implement these activities within their school day?*
>
> *If everything else academically stays the same, in my estimation, these activities make the school day better for my students. They have fun, experience enjoyment, and refocus. So if the school becomes a better place to be [for the children and for the teacher], that's a positive in itself.*

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APPENDIX A:

Questionnaire for Students about Their Experiences with Small Space Physical Activities

1. When I started to learn to juggle I found it:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

2. Now my juggling mark would be a:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

3. When I started to learn lummi sticks I found it:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

4. Now my lummi sticks mark would be a:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

5. When I started to learn cup stacking I found it:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

6. Now my cup stacking mark would be a:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

7. When I started to learn brain gym I found it:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

8. Now my brain gym mark would be a:

   1 2 3 4 5 6 7 8 9 10

   Very hard . . . . . .easy

9. Circle your favorite activity:

   Juggling lummi sticks cup stacking brain gym

10. Why did you pick this one?

11. Circle your least favorite activity is:

    Juggling lummi sticks cup stacking brain gym

12. Why did you pick this one?

13. Will you keep doing these activities? Circle your answer beside the activity.

    a. Juggling yes no

    b. Lummi sticks yes no

    c. Cup stacking yes no

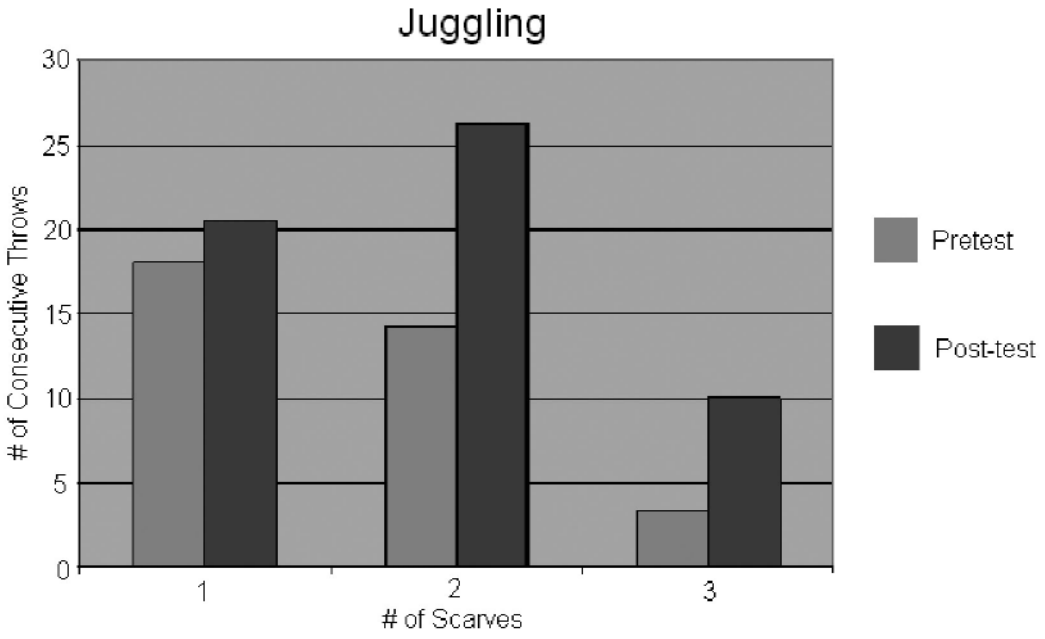
    d. Brain gym yes no

14. How do these activities make you feel?

15. What did you like about doing these activities?

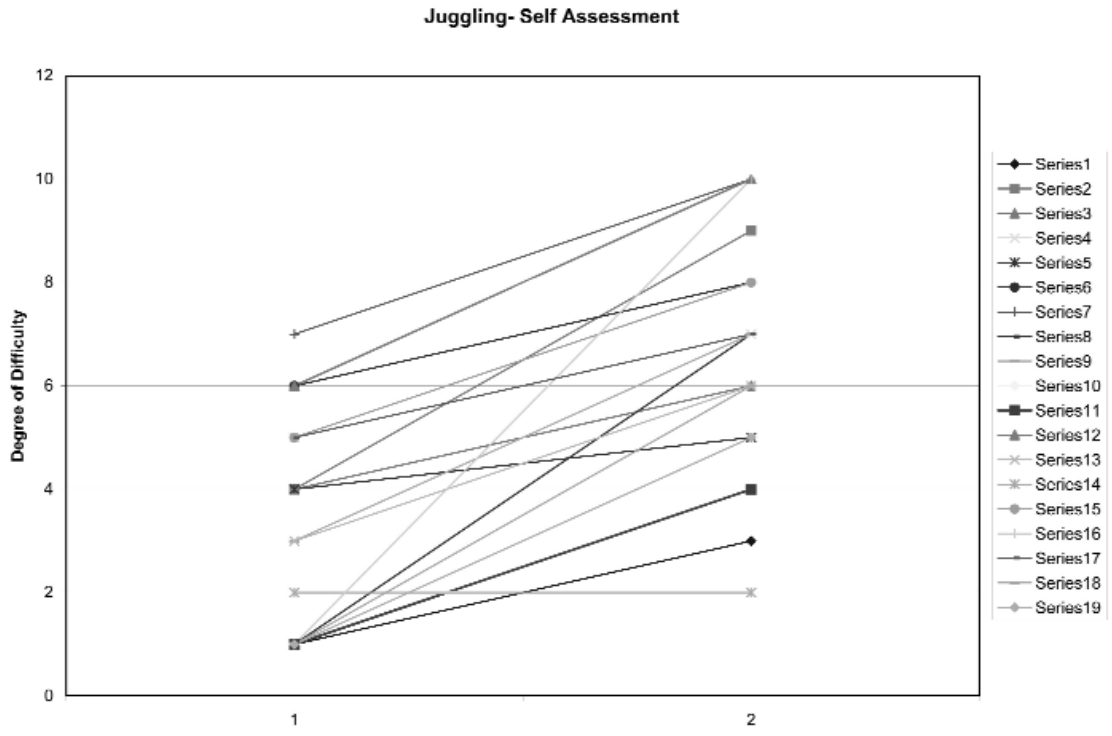
16. What did you not like about doing these activities?

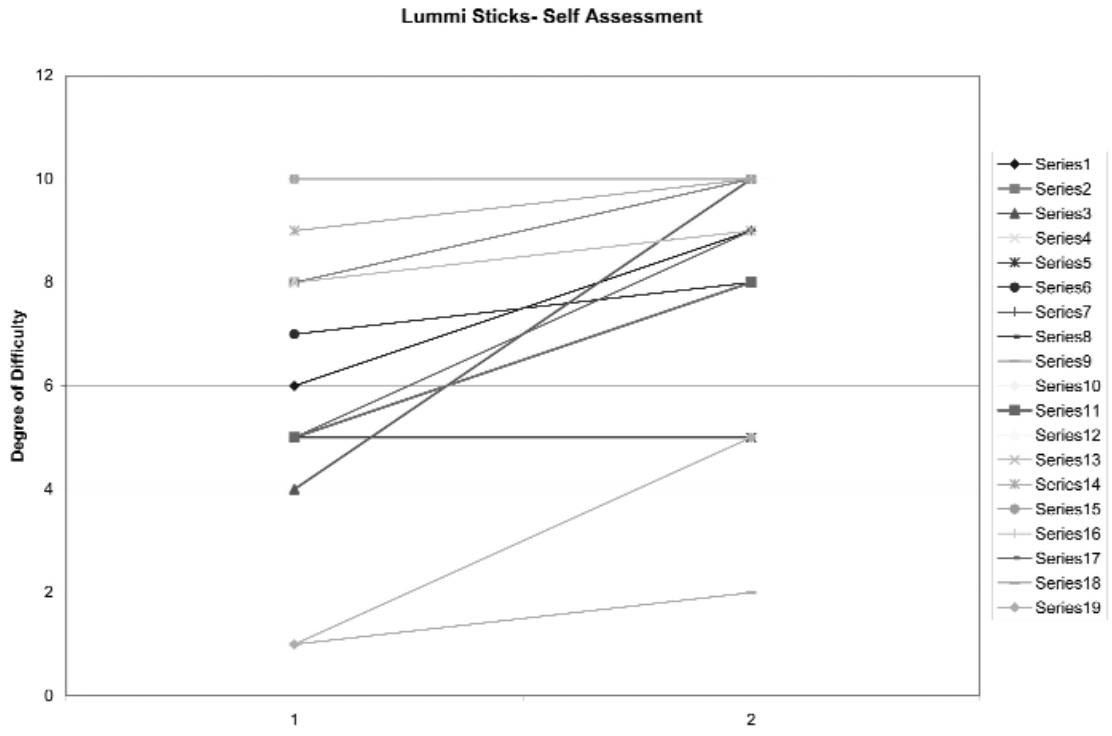
APPENDIX B:
Student Proficiency in Juggling

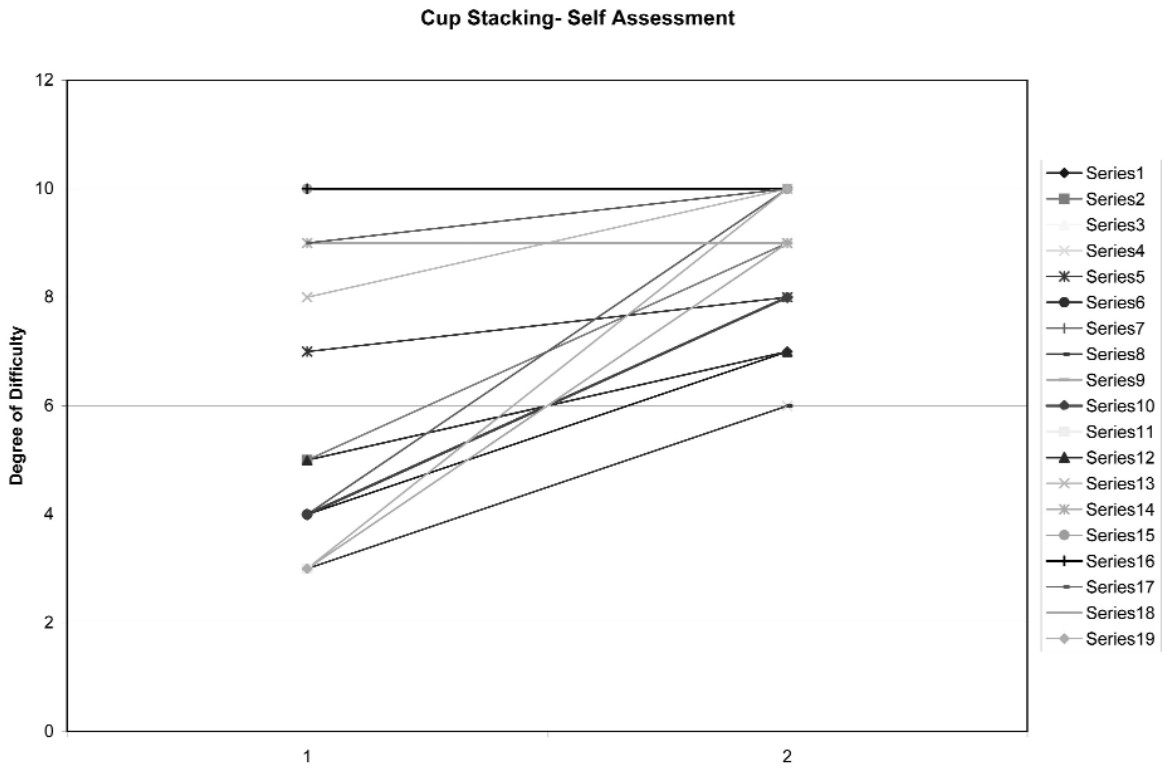


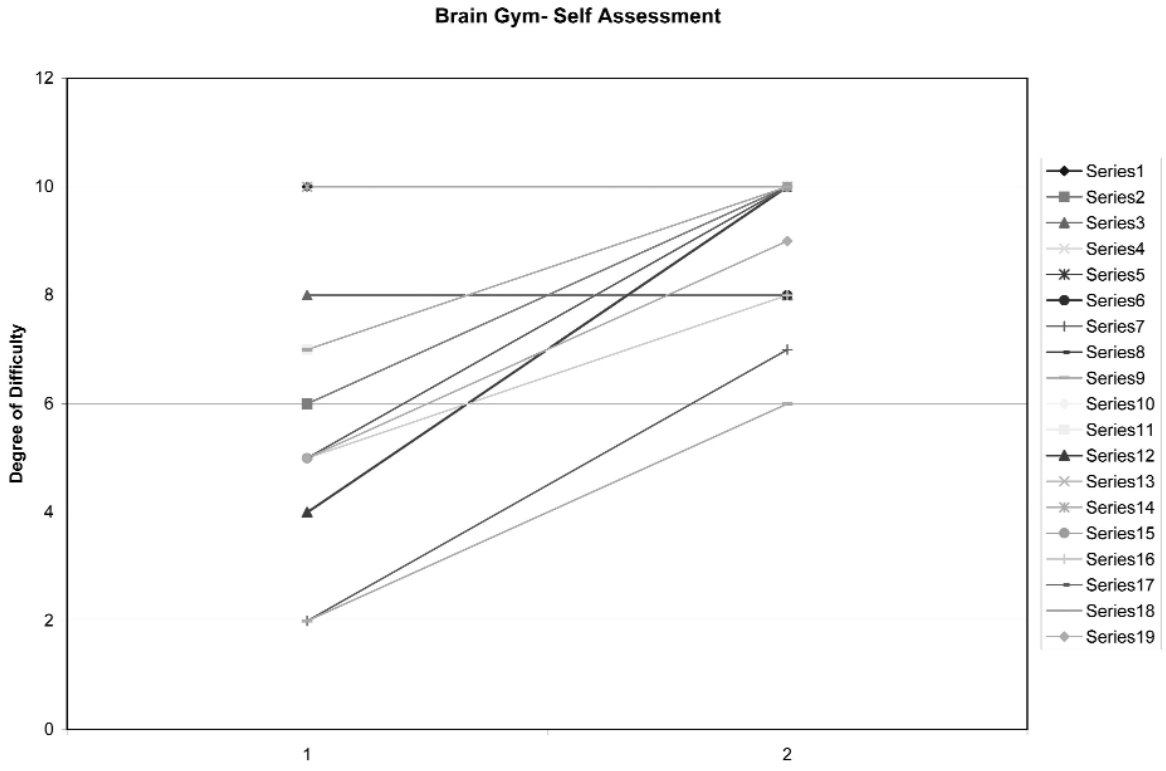
APPENDIX C:

Student Self-Assessment of Improvement in Physical Activities – Juggling, Lummi Sticks, Cup Stacking and Brain Gym

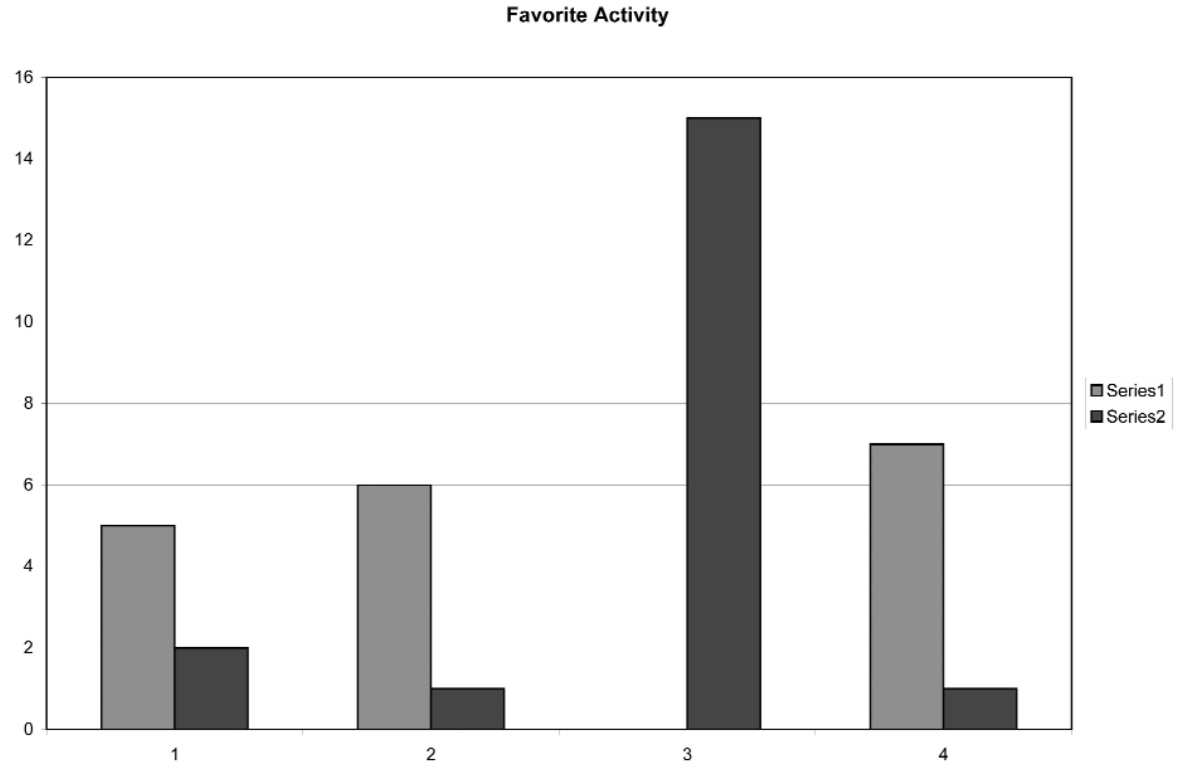


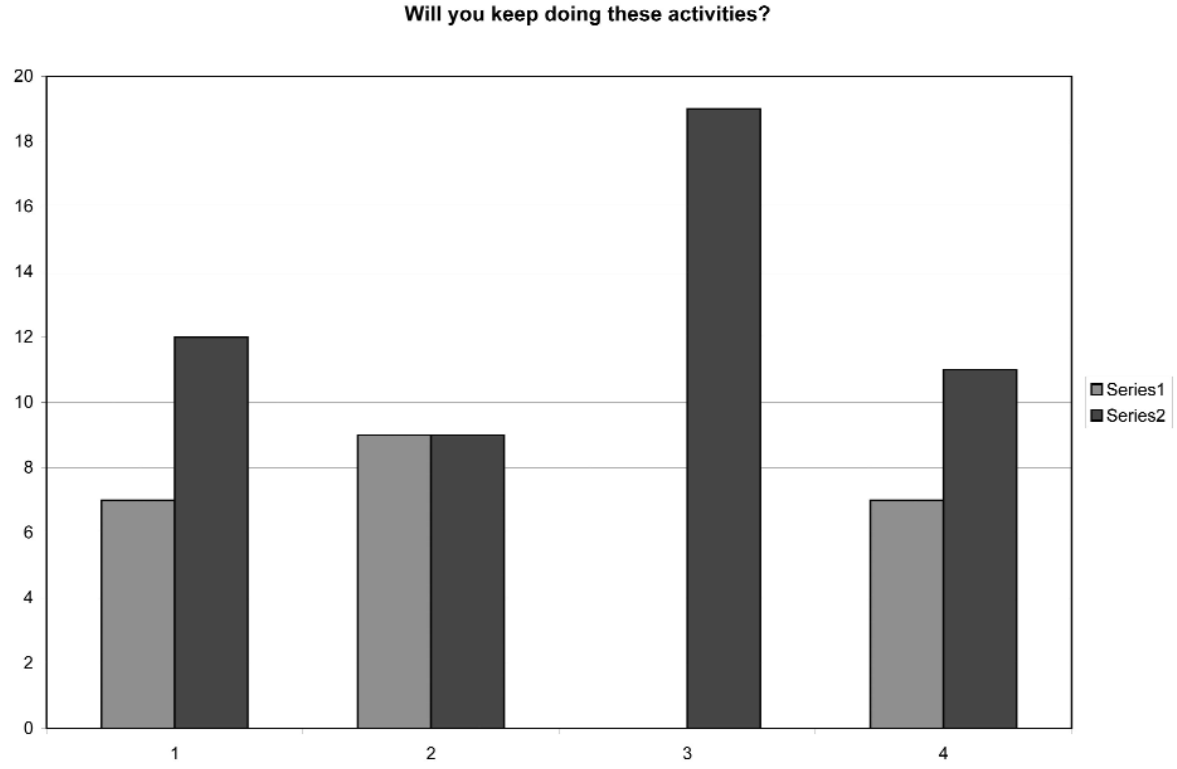



Cup Stacking- Self Assessment
Degree of Difficulty
12
10
8
6
4
2
0
1
2
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10
Series11
Series12
Series13
Series14
Series15
Series16
Series17
Series18
Series19


Brain Gym- Self Assessment
Degree of Difficulty
12
10
8
6
4
2
0
1
2
Series1
Series2
Series3
Series4
Series5
Series6
Series7
Series8
Series9
Series10
Series11
Series12
Series13
Series14
Series15
Series16
Series17
Series18
Series19

APPENDIX D:
Student Ratings of the Activities





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