Improve the Standing Broad Jump scores of pupils through the use of Plyometrics in fitness and conditioning programme during Physical Education

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Abstract

One glaring area of weakness amongst the pupils taking the National Physical Fitness Assessment (NAPFA) test is the Standing Broad Jump. Pupils tend to lack power in their lower limbs to carry their weight forward. This research aims to address this area of weakness and employs plyometrics in the school’s fitness programme to increase muscular power and performance in the Standing Broad Jump. The direction is motivated by research findings by professionals in the Sports and Physical Education circle. It is believed that the use of Plyometrics lead to a substantial increase in muscular power and performance in sports and muscular fitness. Subjects (Primary Four Level) of this research will undergo a customized fitness and conditioning programme using Plyometrics. Tests will be done and data will be collected before and after the implementation of the programme for data analysis and findings. Extending from the action research done in 2008, the research hopes to ascertain if the findings made last year is consistent with the cohort in 2009. The validation of this finding will add credence to the programme, making it effective and successful in helping pupils perform better in the Standing Broad Jump.

Introduction

The National Physical Fitness Assessment (NAPFA) test was introduced in Singapore schools. Since 1992, the percentage of students passing the NAPFA test has been used as an indicator of the fitness level of our student population. The NAPFA assessment in the Primary School consists of 6 stations:

1. Sit-ups Maximum in one minute
2. Standing Broad Jump Better of two distances
3. Sit and Reach Better of two attempts with floating zero point
4. Inclined Pull-ups Maximum in half-a-minute (15 or lower)
5. Shuttle Run Faster of two 4x10 metre attempts
6. 1.6 KM Walk/Run Minimum time on firm and level surface
The school’s NAPFA (2008) results highlighted a glaring area of weakness – the Standing Broad Jump. To pass the NAPFA assessment, one has to achieve a Bronze. Of the 20.9% who did not achieve Bronze, 15.11% of them failed the Standing Broad Jump. There are two root causes for failing the Standing Broad Jump. The pupil has to execute the jump correctly and have enough muscular strength in the lower legs. Despite the fact that the correct technique of doing the Standing Broad Jump had been taught and demonstrated to the pupils during Physical Education (PE) lesson, some pupils continued to perform poorly in this station. Therefore, we arrived at the deduction that the pupils did not exert sufficient strength in their lower limbs when performing the jump. Their lower limbs are weak and as a result, they cannot generate enough force to propel their weight forward. This applies to both thin as well as overweight pupils.

As teachers, effective teaching is very important. As such, each PE lesson requires extensive planning in order to have effective learning for every pupil. Then, the lesson is carried out (act) according to the plan that was drawn up for the lesson. While the teacher is conducting the PE lesson, he or she observes the reaction of the students to check for their understanding. It is interesting to note that the lesson does not end once the plan has been carried out. Teachers are constantly reflecting and reviewing the pedagogies / methods that are implemented in order to make sure that the pupils have improved. Upon reflection, the teacher may make changes to the lesson plan according to what he or she observed during the lesson. As a result, the original lesson plan is modified and the process repeats itself. The following figure below is a visual representation of the teaching process.

The teaching process closely resembles the basic ideas in Action Research (AR). AR provides a framework which teachers can use to improve teaching. Prompted by this emerging need, we decided to embark on action research journey that is being described in the following sections of this research study.

**Action Research Cycle One:**

Immerging and deriving the root definition of our problem situation.

**What is Plyometric Training?**

Plyometrics are training techniques used by athletes in all types of sports to increase strength and explosiveness (Chu, 1998). It may be defined as a type of exercise using explosive movements to develop muscular power, especially bounding, hopping, and jumping. Plyometrics training consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue (Baechle and Earle, 2000). Plyometric drills usually involve stopping, starting, and changing directions in an explosive manner. These movements are components that can assist in developing agility (Craig, 2004; Miller et al., 2001).

Researchers have shown that plyometric training, when used with a periodized strength-training program, can contribute to improvements in vertical jump performance, acceleration, leg strength, muscular power, increased joint awareness, and overall proprioception (Harrison and Gaffney, 2001; Hennessy and Kilty, 2001). Plyometric are also used to increase the speed or force of muscular contractions, often with goals of increasing the height of a jump or speed of a punch or throw. Plyometrics are evident in most natural movements including jumping, hopping and skipping. Hence common games like hopscotch and activities like jumping rope and jumping jacks can also be considered to be plyometrics (Faigenbaum and Chu, 2001).
Hence, we seek to use plyometric drills to help to improve the pupils’ standing broad jump as it is a type of exercise training designed to produce fast, powerful movements. As the standing broad jump is used to test the pupils’ jumping ability, it is perfect for the pupils to have plyometric drills so as to improve their jumping ability and to improve the distance in their jumps.

Is Plyometric Training Effective On Children?
The American College of Sports Medicine (ACSM) supports the use of plyometric training on children as a safe, beneficial and fun activity (Faigenbaum and Chu, 2001). ACSM also contends that regular participation in plyometric training may also help to strengthen bone and regulate weight control. An additional benefit to children who are involved in sports training, plyometric training may also lower the risk of sports-related injuries.

An appropriately-designed programme and proper supervision is required for plyometric training to be a safe and fun method of conditioning children. Plyometrics are not intended to be a stand-alone exercise programme and should be incorporated into a well-designed overall conditioning programme. Faigenbaum and Chu (2001) also recommends that children should begin plyometric training with lower intensity drills and gradually progress to higher intensity drills over time.

Safety Considerations of Plyometrics
For the pupils’ standing broad jump to improve due to plyometric drills, we must take into consideration two factors. One factor is we must know the physics of plyometrics and another factor is that during the training, safety consideration must be taken into account.

Plyometric exercises carry increased risk of injury due to the powerful forces generated during training and performance, and should only be performed by well-conditioned individuals who are under supervision. Good levels of physical strength, flexibility and proprioception should be achieved before commencement of plyometric training. There will be risk of injury if the intensity and volume of the training programme exceeds the abilities of the participants (Faigenbaum and Chu, 2001).

The specified minimum strength requirement varies depending on where the information is sourced and the intensity of the plyometrics to be performed. Chu (1998) recommends that a participant be able to perform 5 repetitions of the squat exercise at 60% of their bodyweight before doing plyometrics. Core body (trunk) strength is also important.

Flexibility is required both for injury prevention and to enhance the effect of the stretch shortening cycle.

Further safety considerations include:

- **Age** - low-intensity and low-volume only for athletes under the age of 13 or for athletes who squat less than 1.5 times their bodyweight.
- **Surface** - some degree of softness is needed. Gymnastics mats are ideal, grass is suitable but refrain from training on hard surfaces such as concrete.
- **Footwear** - must have adequate cushioning and be well fitting.
- **Technique** - most importantly, a participant must be instructed on proper technique before commencing any plyometric exercise. They should be well rested and free of injury in any of the limbs to be exercised.
Plyometrics is not dangerous, but the potential for high intensity and stress on joints and musculo-tendonous units makes safety a strong prerequisite to this particular method of exercise. Low-intensity variations of plyometrics are frequently performed in various stages of injury rehabilitation, indicating that correct performance is valuable and safe for increasing muscular power in all populations.

Most exercises involve a muscular contraction that starts off rapidly, but decelerates suddenly before the end of the repetition. For example, lifting a barbell involves jerking the weight quickly into the air, then bringing this motion to a sudden halt. Plyometric exercises are characterized by the lack of such a declarative phase. They are open-ended movements into free space. Other animals take advantage of this effect; one is the kangaroo. If a kangaroo needed to use 100% new energy to contract its leg muscles every time it jumped, it would not be able to jump very far consistently. However, because of the muscles’ ability to store energy from its previous jump before like a spring, the kangaroo only needs to use a fraction of the total energy in the jump.

For children and youths, training loads are not completely understood. It appears, however, that conservative jumping programs which follow accepted training principles may enhance leg extensor power among children (Mekhonoshin, 1983). The training programme should also be modified overtime to help optimize gains and prevent overtraining and related injuries (Faigenbaum and Chu, 2001).

The above has led to the theme of this research study:
Improve the Standing Broad Jump scores of the pupils through the use of Plyometrics in our fitness and conditioning programme during PE.

**Action Research Cycle Two**

**Derivation of our Intervention Approach**

The inclusion of Plyometrics in our PE fitness and conditioning programme is to complement the existing fitness programme. It is not meant to substitute the existing PE curriculum. The current programme like the mass workouts, the SRC programme and the 1.6 Km weekly runs achieve their aim of building physical fitness amongst our pupils. The sessions used for skill and games acquisition is important. As most of the upper primary classes have only two periods of PE a week, it is impractical to replace either of the programmes with our new AR initiative. Riding on our experience using Plyometrics in 2008, it is not appropriate to employ Plyometrics exclusively as it is physically demanding. More over, pupils may find the exercises monotonous and this may affect their motivation.

The research team arrived at the decision to employ Plyometrics in our Fitness and Conditioning programme after studying some research articles. In general, it is agreed, amongst professionals in Sports and Physical Education circle that Plyometrics can lead to a substantial increase in muscular power and performance in sports and muscular fitness. However, we have to customise our own plyometric programme to cater to our pupils’ needs. We took into consideration their age group (10-12 years old), their own fitness level and the demands of the exercise. It is crucial to ensure that the exercises are safe and physically not too strenuous. A common set of exercises is identified: tuck jumps, squat jumps, lateral jumps, standing broad jumps, box jumps, and zig zag runs. We shared a common knowledge of the different types of jumps and how they are to be executed correctly. The choice of exercises was selected from this common pool but we agreed to have the liberty to customize the training to fit their pupils’ needs. We may increase or decrease the intensity of the exercise depending on the situation. An example of this is the use of circuit training where the PE teacher staggers the use of Plyometrics in different stations. This helps break monotony and alleviates the problem of muscle exhaustion.
To minimize disruption to the curriculum, the research is confined to a workable size. We decided to focus on two Primary Four Classes: 4-1 (29) and 4-5 (28). In all we have a test group of 57 pupils. We would conduct a Pre-Test to get the initial raw scores for the Standing Broad Jump. The pupils will then go through the Plyometric Programme for 8 weeks. A Post-Test will be done at the end of the 8th week to determine if the pupils have improved their Standing Broad Jump score.

Extending on the trial done in 2008, this research hopes to ascertain if the findings made last year is consistent with that of the cohort in 2009. The validation of this finding will add credence to the programme, making it effective and successful in helping pupils perform better in the Standing Broad Jump.

**Action Research Cycle Three**

**Our Intervention in Action**

**Participants**
The overall pupils sample tested was 57. This was made up of two classes of pupils of mixed academic abilities and gender.

<table>
<thead>
<tr>
<th>Level</th>
<th>NO. Of Pupils</th>
</tr>
</thead>
<tbody>
<tr>
<td>P4-1</td>
<td>29</td>
</tr>
<tr>
<td>P4-5</td>
<td>28</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>57</strong></td>
</tr>
</tbody>
</table>

All the pupils underwent a pre-test to collect their Standing Broad Jump scores. Thereafter, they would undergo an 8-week Fitness and Conditioning programme to strengthen their leg power and jumping technique. To determine if the programme is successful, a post-test was conducted after the pupils had successfully completed the fitness programme.

**The Training Programme**
The pupils in this research underwent fitness and conditioning programme designed by the research team. To minimise disruption to the school PE programme, it was agreed that the classes would continue with the 1.6 KM Run and training for skill acquisition. We would incorporate plyometrics in the fitness and conditioning programme and utilize one out of the three PE periods to do that. Pupils were therefore engaged in the use of plyometrics at least once a week following their PE curriculum.

Standard Plyometrics Exercises included:
- tuck jumps 3 x 6
- squat jumps 3 x 6
- lateral jumps 3 x 6
- standing broad jumps 3 x 6
- box jumps 4 x 8
- zig zag runs 3 x 6

Piper and Erdmann (1998) recommended a 6 week of plyometric programme, two times a week, using similar drills, sets and repetitions. It is recommended that the programme lasts from 4 to 6 weeks of high intensity training. The American College of Sports Medicine (ACSM) contends that plyometrics
training is a safe, beneficial and fun activity for children and adolescents provided that the programme is properly designed and supervised.

Our training programme was customised to our pupils’ needs and physical fitness. We employed the similar concept of using plyometrics but lowered the intensity of the training as we were concerned about potential injuries. We would use circuit-training, targeting different body parts instead of just focusing on the lower limbs, as focusing on one body part will fatigue the muscle very quickly. We were conscious of the danger of muscle overuse which can result in injury. Moreover, we were concerned that an overemphasis on Plyometrics might diminish motivation. Pupils found the training physically demanding and tedious. The regime may also bring about boredom. For this reason, we needed to customise our programme to include circuit-training, which provided variety; and chose games which promoted speed, agility and power. In addition, Instead of the recommended 4 to 6 weeks, we felt that it was better to stretch it to 8 weeks albeit with less intensity and customized exercises.

Typical circuit training involves 4 stations. The class was divided into 4 equal groups. As each PE period is only 30 minutes long, the pupils would concentrate on each station for 6 minutes before rotating to the next station. This would give a buffer of 4 minutes for the pupils to rotate from station to station.
1. Sit Ups / Incline Pull Ups (6 mins)
2. Shuttle Runs (6 mins)
3. Free Throws / Ball dribble (6 mins)
4. Box jumps / lateral jumps / Standing Broad Jumps (6 mins)

To motivate pupils and add fun to the training, we included games sessions in our programme. The choice of game is important. We would choose games like Soccer and Basketball as such sports demand exertion of the lower limbs and allow the pupils to strengthen their muscles. We see a co-relation here and believe that the games actually complement the plyometrics programme that we have in place.

A survey was also conducted for the participants of the project. From the findings of the survey, we hope to gain a better insight into the following: how the pupils feel about the training – whether or not it helped them improve their jump; what they feel are the reasons for their poor performance; whether they enjoy the training programme.

**Action Research Cycle Four**

**Evaluate the effectiveness of our intervention**

**Data Analysis and Findings**

![P4/1 SBJ Test Results](image)

P4/1 pass rate improved from 60.7% to 82.1%
Class 4-1

<table>
<thead>
<tr>
<th></th>
<th>PRE TEST</th>
<th>POST TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>17 (60.7%)</td>
<td>23 (82.1%)</td>
</tr>
<tr>
<td>FAIL</td>
<td>12 (41.4%)</td>
<td>6 (20.7%)</td>
</tr>
<tr>
<td>EXCUSED</td>
<td>0</td>
<td>0</td>
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</table>

4/5 pass rate improved from 46.4% to 71.4%
Class 4-5

<table>
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<th>POST TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS</td>
<td>13 (46.4%)</td>
<td>20 (71.4%)</td>
</tr>
<tr>
<td>FAIL</td>
<td>15 (53.6%)</td>
<td>8  (28.6%)</td>
</tr>
<tr>
<td>EXCUSED</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

Overall pass rate improved from 52.6% to 75.4%
### Combined

<table>
<thead>
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<th>PRE TEST</th>
<th>POST TEST</th>
</tr>
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<tbody>
<tr>
<td>PASS</td>
<td>30</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>(52.6%)</td>
<td>(75.4%)</td>
</tr>
<tr>
<td>FAIL</td>
<td>27</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>(47.4%)</td>
<td>(24.6%)</td>
</tr>
<tr>
<td>EXCUSED</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>57</td>
<td>57</td>
</tr>
</tbody>
</table>

**Overall Improvement**

- P4/1 registered a 82.1% improvement
- P4/5 registered a 72.4% improvement
- Total Percentage of improvement = 77.2%
## Comparison of results

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASS RATE improvement</td>
<td>26%</td>
<td>22.8%</td>
</tr>
<tr>
<td>Personal Improvement</td>
<td>88.8%</td>
<td>77.2%</td>
</tr>
</tbody>
</table>

### Overall Survey Results

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
<th>NO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I play sports</td>
<td>52</td>
<td>2</td>
<td>3.7</td>
</tr>
<tr>
<td>I exercise outside school hours</td>
<td>43</td>
<td>11</td>
<td>20.4</td>
</tr>
<tr>
<td>I enjoy PE</td>
<td>51</td>
<td>3</td>
<td>5.6</td>
</tr>
<tr>
<td>I think I improved</td>
<td>36</td>
<td>18</td>
<td>33.3</td>
</tr>
<tr>
<td>I believe that this training can help me improve</td>
<td>48</td>
<td>6</td>
<td>11.1</td>
</tr>
</tbody>
</table>

### Reasons I did not do well

<table>
<thead>
<tr>
<th>Reasons I did not do well</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I do not know the technique</td>
<td>12</td>
<td>22.2</td>
</tr>
<tr>
<td>I do not have strong legs</td>
<td>27</td>
<td>50.0</td>
</tr>
<tr>
<td>I am too short</td>
<td>5</td>
<td>9.3</td>
</tr>
<tr>
<td>I am too heavy</td>
<td>8</td>
<td>14.8</td>
</tr>
<tr>
<td>I was nervous</td>
<td>23</td>
<td>42.6</td>
</tr>
</tbody>
</table>
The combined results are encouraging. Total pass rate for the Standing Broad Jump improved from 52.6% to 75.4% after the implementation of the plyometrics programme. Although not all the pupils managed to pass the test, a significant 77.2% of them improved their personal score. This finding is important as it supports the finding that the 8-week training programme is effective in helping pupils improve their Standing Broad Jump score. We contend that it is not necessarily fair to insist that each child score (125 cm for Girls, 137 for Boys) to pass the station. This is especially so when children experience different growth spurts in their primary school life.

The pupils developed stronger muscular strength in the lower limbs (thighs and calf muscles), which enabled them to jump farther. The constant exposure to plyomerics which harnesses the short-explosive power of the lower limbs helped the pupils to perform better. Not withstanding the pivotal role of the use of plyometrics in strengthening the pupils’ muscular strength in the lower limbs, the correct technique of jumping is another important factor determining the success of the Standing Broad Jump Score. It is important to note that the researchers took pains to instruct the pupils to jump correctly as far as possible.

The programme was found on prior research done on plyometrics but customised to meet the pupils’ needs and physical fitness levels. We designed the programme taking into consideration the following:

1. Duration - increase duration to 8 weeks
2. Safety - manage intensity, ample rest, avoid taxing same muscle group.
3. Motivation - include games which target the lower limbs eg: Soccer, Basketball, sprints.

We observed that pupils fatigue quickly when performing plyometrics. To ensure that they do not get injured or overuse their muscles, we developed a circuit, making sure that the pupils avoid using the same muscle group repeatedly. And the pupils were allowed a longer duration of 8 weeks to strengthen their lower limbs. This longer duration allowed us to tweak our training programme – we were able to lower the intensity. This made it more manageable for the pupils. We also observed that pupils grow weary of the same routine of training and lose motivation. To address this problem, we included selected games like Soccer, Basketball and Sprints in our training programme. The carefully selected games demanded exertion of the lower limbs which complemented our Plyometric programme.

The survey results reviewed revealed some interesting findings. 50% of the pupils surveyed thought that they did not do well because they lacked power in the lower limbs. This supports our assumption that the major reason why pupils do not perform well in the Standing Broad Jump is because they lack muscular strength in the lower limbs. 88.9% of the pupils surveyed felt the training helped them improve their SBJ scores. And 94.4% of the pupils also revealed that they enjoyed the PE lessons – a testament that Plyometrics need not be grievous but fun. We also learnt that the inclusion of games can break the monotony of training hence improving motivation and performance.

Conclusion

The cohort in 2008 achieved 88.8% improvement after undergoing an 8-week plyometrics programme. The 2009 cohort, however, achieved a lower 77.2% improvement. There could be a myriad of reasons why the 2009 cohort did not better the scores achieved in 2008. The cohort may be generally weaker or as the survey reviewed, 42.6% of the pupils were nervous when they performed the test. The positive results nevertheless support the finding that Plyometrics improve the Standing Broad Jump scores of...
the pupils.

This research suggests that Plyometrics can be meaningfully infused into the training programme of our PE curriculum. It is effective and need not compromise the scheme of work (SOW) of the school curriculum if the games and activities are meaningfully and thoughtfully selected and pupils properly engaged and supervised.

Acknowledgement

We are grateful to our colleagues and student participants who gave their invaluable comments and suggestions that have helped us in our research for incorporating Plyometrics in our Physical Education Lessons. We would also like to thank Jean Sia, our Vice Principal, for providing the stimulating opportunity for inducing and completing this research work. Last but not least, our special thanks go to Mrs Chua for her guidance whose much sought-after advice and suggestions made this whole project a reality.
References


