FUNDAMENTAL MOVEMENT SKILLS AND THE EFFECTS OF FOCUS OF ATTENTION ON THROWING AMONG AUTISM SPECTRUM DISORDER CHILDREN

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ABSTRACT

Although studies have reported on the overall gross motor skills among Autism Spectrum Disorder (ASD) children, limited attempts have been made on examining their throwing skills and the effects of different focus of attention (FoA) instructions on acquiring those skills. This study aimed to compare the Fundamental Movement Skills (FMS) and overhand throw skill between the ASD and Typical Developmental (TD) children. Ten ASD and 10 TD children aged from seven to 10 participated in the study. Test of Gross Motor Development (TGMD-2) was used to measure the FMS of both groups. ANCOVA test with age as covariate showed that the overall gross motor skills score of the ASD children were significantly poorer compared to their TD peers, similarly with the overhand throw subtest data analysis by Independent t-test. Follow-up study examined the effects of different FoA instructions on performing the throwing skill in a modified-petanque game among the ASD children. They were randomly assigned to two groups, External Focus (EF) and Internal Focus (IF). The EF group were instructed to throw the boules so that it moved in a parabolic trajectory as if they were “creating a rainbow” and land near the target. Meanwhile, the IF group were instructed according to conventional throwing techniques, concentrating on the mechanics of the throwing arm. A factorial two group x two tests mixed between-within ANOVA showed significant interactions with the EF group improved significantly in the post-test compared to the IF counterpart after two weeks of intervention. Simplified yet effective instructions could elicit effective learning among ASD children. Future research could examine the effectiveness of EF instructions on other fundamental skills among special needs children.

KEMAHIRAN PERGERAKAN ASAS DAN KESAN FOKUS TUMPUAN KEATAS KEMAHIRAN MELONTAR DALAM KALANGAN KANAK-KANAK AUTISME

ABSTRAK

Pelbagai kajian telah dijalankan bagi mengenal pasti kemahiran pergerakan asas (FMS) kanak-kanak Autisme (ASD), namun kajian ke atas prestasi kemahiran membaling dan arahan fokus tumpuan (FoA) yang berbeza bagi kemahiran ini amat jarang dijalankan. Kajian ini mengkaji tentang perbandingan FMS secara amnya dan ujian kemahiran melontar secara khususnya antara kanak-kanak ASD dengan kanak-kanak normal (TD) serta kesan arahan FoA yang berbeza terhadap kemahiran melontar bagi kanak-kanak ASD. Kajian perbandingan FMS dan subsetnya (iaitu kemahiran melontar) antara kanak-kanak ASD dengan TD. Seterusnya kajian ini meneliti kesan arahan FoA yang berbeza kepada pelaksanaan kemahiran yang sama. Sepuluh kanak-kanak ASD dan 10 kanak-kanak TD, berusia tujuh hingga 10 tahun telah mengambil bahagian dalam kajian pertama dan kanak-kanak ASD yang sama terus menyertai dalam kajian kedua. Ujian Perkembangan Motor Kasar (*TGMD-2*) digunakan untuk mengukur kemahiran pergerakan asas mereka. Ujian ANCOVA menunjukkan penguasaan kemahiran motor kasar kanak-kanak Autisme adalah agak lemah berbanding dengan rakan-rakan TD mereka, sama seperti keputusan kemahiran melontar melalui ujian-t tidak bersandar. Kajian susulan telah mengenal pasti kesan penggunaan arahan FoA yang berbeza pada kumpulan ASD yang dibahagi secara rawak kepada dua kumpulan iaitu Fokus Dalaman (IF) dan Fokus Luaran (EF) dalam permainan modifikasi-petanque. Kumpulan EF diarahkan untuk membuang *boules* supaya ia bergerak dalam lintasan parabola seolah-olah mereka "mencipta pelangi" dan mendarat berhampiran sasaran. Kumpulan IF pula diarahkan untuk mengikut teknik lontaran konvensional, dimana tumpuan difokuskan kepada mekanisme pergerakan tangan. Analisis dua kumpulan x dua ujian faktorial ANOVA menunjukkan interaksi yang signifikan dengan kumpulan EF menghasilkan prestasi lontaran yang lebih baik pada ujian pasca berbanding kumpulan IF selepas dua minggu intervensi. Arahan yang mudah dan berkesan perlu diterapkan mengikut tahap kefungsian kanak-kanak Autisme bagi mendapat pembelajaran berkualiti. Kajian masa depan boleh mengkaji keberkesanan arahan EF ke atas kemahiran asas yang lain bagi kanak-kanak berkeperluan khas.

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LIST OF ABBREVIATIONS

ASD	Autism Spectrum Disorder
TD	Typical Development
FMS	Fundamental Movement Skills
TGMD-2	Test of Gross Motor Development 2nd Edition
TGMD-3	Test of Gross Motor Development 3rd Edition
MABC-2	Movement Assessment Battery for Children 2nd Edition
IF	Internal Focus of Attention
EF	External Focus of Attention
UNICEF	The United Nation Children's Fund
ZNA	Zurich Neuromotor Assessment
LD	Learning Disability
DD	Developmental Delayed
ADI-R	Autism Diagnostic Interview-Revised
ADOS	Autism Diagnostic Observation Schedule

MSEL	Mullen Scales of Early Learning
IMMACS	Infant Motor Maturity and Atypicality Coding Scales
ADHD	Attention-Deficit Hyperactivity Disorder
VABS-2	The Vineland Adaptive Behaviour Scales 2nd Edition
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
CM	Centimetre
KPM	The Ministry of Education, Malaysia
JPN	The Department of Education, Pulau Pinang
GMDQ	Gross Motor Development Quotient
LDPE	Polyethylene Low Density
ICC	Intra Class Correlation
MVPA	Moderate-to-Vigorous Physical Activity

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Physical Education is one of the subjects included in the Special Education syllabus in Malaysia (Kurikulum Standard Sekolah Rendah (Masalah Pembelajaran), 2011). One of the main objectives of the Physical Education curriculum for Special Education is the acquisition of fundamental motor skills; involving both gross and fine motor skills (Kurikulum Standard Sekolah Rendah (Masalah Pembelajaran), 2011). Learning basic motor skills such as walking, running, jumping and hopping must be acquired by the Special Education students including Autism Spectrum Disorder (ASD) students. Autism is a developmental disability that affects verbal and nonverbal communication,

social interaction, symptoms significant before the age of three years and affects the performance of a child's learning (Winnick, 2011).

Autism Spectrum Disorder (ASD) is described as a neuro-developmental syndrome that is identified by deficits in communication, social interactions, unusual restricted and repetitive behaviours (American Psychiatric Association, 1994). Deficits in communication and social interactions such as refusing to have a conversation, prefer to be alone and being comfortable by playing alone in their own world, always get attracted to specific object and have repetitive movement of hand or leg are the main characteristics of an Autism Spectrum Disorder (ASD) child. Autism Spectrum Disorder (ASD) children also do not respond very well to verbal cues and long instructions (Breslin & Rudisill, 2011). Autism spectrum disorder usually begins in infancy, and the symptoms becomes severe within early three years of life (Lord, Cook, Leventhal & Amaral , 2013). An infant might show an abnormality such as delayed in crawling or skip a stage in their fundamental movements. The first to be alarmed are the parents, when they realised their child did not communicate using words, did not crawl or walk like their peers (Lord et al., 2013). Studies showed that ASD affected about 0.06% of children under the age of eight years old (Haq & Couteur, 2004). However, there are no two children or adults with autism have exactly the same profile, which made Autism Spectrum Disorder (ASD) a heterogeneous condition (Lord et. al , 2013). They differ from each other even if they were twins.

Fundamental Movement Skills consists of locomotor and manipulative skills. Manipulative skills are controlling objects (e.g., throwing, catching, striking, bouncing, kicking, pulling and pushing) whilst locomotor skills are performed mostly getting the individual from one point to another point (e.g., walking, running, hopping, galloping,

jumping, sliding and leaping) and they are usually performed in bipedal position (Staples & Reid, 2010). These skills are considered fundamental because they are considered as basis to more advanced or sport-specific skills (Burton & Miller, 1998). Fundamental Movement Skills (FMS) enable children to move through space (Zittel, 1994) and allow them to react in a suitable way to a variety of stimuli (Simons, Daly, Theodorou, Caron, Simons, & Andoniadou , 2008). When the fundamental movement skills are not acquired at an appropriate growth period, the child will lack in the foundation for participating in many physical activities (Todd, 2012). Studies that compared the FMS of children with and without Autism Syndrome Disorder (ASD) often reported that those with Autism Syndrome Disorder (ASD) scored below 1.5 standard deviation below than the mean (Berkeley, Zittel, Pitney & Nichols , 2001, Green, Baird, Barnett, Huber & Henderson ,2002, Jasmin, Sabawi Couture, McKinley, Reid, Fombonne & Gisel , 2009) in fundamental movement skills.

Autism Spectrum Disorder (ASD) children are usually characterised as a social deficit syndrome, but it is documented in the previous study of Kanner (1943) and Asperger (1991) that sensory motor deficits is present in Autism children (Whyatt and Craig ; 2012). Most of the previous studies always relate Autism with the core characteristics which are social and communication difficulties, echolalia, motor stereotyped behaviour, engagement in routines, repetitive behaviours and sometime aggression with self-injuries (Bodfish, Symons, Parker and Lewis ; 2000, Fox, Benito and Dunlap ;2002, Singh, Lancioni, Winton, Fisher, Wahler, Mcaleavey, & Sabaawi, ; 2006, Spain, O'Niell , Harwood & Chaplin ; 2016) but they always neglected other difficulties such as motor disabilities or delayed movement skills. This characteristics might be a minor symptoms but based on the previous study, it is presents in ASD children (Berkeley et.al ; 2001 , Staples and Reid ; 2010, Whyatt and Craig ; 2012). Children with ASD have been reported to exhibit motor skills which are poorer than

their peers without the disorder (Berkeley et.al , 2001, Staples & Reid , 2010). ASD children with deficit motor skills may not be able to participate actively with other children during playtime and recess and eventually they may adopt an inactive lifestyle and lack of social skills with peers (Mache & Todd , 2016).

The diagnosis of ASD with the identification of specific, pervasive motor problems can enhance further understanding of the presence neural integrity and make the identification of potential signs of autism easier (Whyatt & Craig , 2012). In terms of understanding movement behaviour, one must first understand the differences between movement skills and motor abilities (Staples & Reid , 2010). Movement skills consist of a goal directed movement patterns (Burton & Miller , 1998), for example, throwing a ball can be described according to the final outcome or the movement pattern used during the execution of skills, while the motor abilities refer to the underlying capacities that contribute to performance of movement skills (Staples & Reid , 2010).

Standardised tests of motor control and movement coordination are usually used by the medical practitioners and motor development researchers to study a wide range of movement abilities such as object control skills, manual dexterity and balance (Whyatt & Craig, 2012). To identify the persistency of motor deficits among ASD children, researchers always compared the scores from such tests and had shown to be used to categorise motor performance in ASD (Green et. al, 2002, Provost, Lopez & Heimerl ,2007, Staples & Reid , 2010, Hilton ,White, Zhang, Klohr & Constantino , 2011).

All of the studies provide evidence for a general motor impairment related to diagnosis of ASD but some of the studies provide specific skill results such as manual dexterity (Hilton et.al , 2007, Green et.al , 2002, Miyahara, Tsujii, Hori, Nakanishi, Kageyama, & Sugiyama , 1997, Provost et.al , 2007, Staples & Reid , 2010), ball handling skills (Manjiviona & Prior , 1995 , Miyahara et.al, 1997 , Green et.al , 2002 , Hilton et.al, 2007), catching and balance impairments (Ament, Mejia, Buhlman, Erklin, Caffo, Mostofsky & Wodka, 2015) when compared to their typically developing peers. However, a specific data and report on the throwing skills performance of ASD compared to typically development peers are largely unknown.

A study by Logan, Morera, Daly, Robinson, Wadsworth, & Rudisill (2010) on comparing two motor assessment, Movement Assessment Battery for Children-2 (MABC-2) and Test of Gross Motor Development 2 (TGMD-2) on elementary school children showed that the participants were classified as developmentally delayed according to the TGMD-2, but not the MABC-2. They suggests that researchers should considered the differences in motor assessments when identifying delays and describing motor competence in children. In the Logan and colleagues' study, the researchers suggest that the MABC-2 may be an appropriate measure of general motor competence, but the TGMD-2 is a better suited standardized test to specifically measuring the motor skill competence. Even the TGMD-2 and MABC-2 was said can be used to complement each other in measuring motor assessments performance, Physical Education teacher were recommended to use the TGMD-2 as a part of annual evaluation (Logan, Robinson, Rudisill, Wadsworth & Morera, 2014). This is the main justifications for using Test of Gross Motor Development 2 (TGMD-2) in this study.

Motor learning is defined as a relatively permanent change in a person's ability to generate motor skills as a result of training (Haibach, Reid, & Collier, 2011). However, the levels of motor control skills are not the same for every individual. Motor control is a complex process that encompasses the brain, muscles, limbs, and usually involved an external objects (Rosenbaum, 2009). Individuals with learning disabilities often show developmental delay and have difficulty in carrying out motor skills when compared with normal individuals (Chiviacowsky, Wulf & Avila, 2012).

It is estimated that one in every 600 children born in Malaysia as individuals with autism and statistics show that a total of 47,000 Malaysians are autistics (UNICEF, 2014) but the motor disabilities research among this population is still too low and very rarely published. A study by Manjiviona and Prior (1995) among Autism children in Australia reported that 66.7% of children with autism showed problems in motor control compared to their peers without autism (Leonard, Bedford, Charman, Elsabbagh, Johnson, Hill & Holmboe; 2014). Children with Autism shows weakness in motor skills when compared to normal children (Provost et.al, 2007, Green, Charman, Pickles, Chandler, Loucas, Simonoff & Baird, 2009, Staples & Reid 2010, Whyatt & Craig, 2011, Liu & Breslin 2013) and the components that showed significant difference from normal children are the object manipulation skills and visual-motor tasks (Provost et.al, 2007).

Autistics children also seen as abnormal in two significant components which are the disability in collecting information from the environment and use it to plan for an effective motor control and interference between the input stimuli to the production of motor movement (Gowen & Hamilton, 2013). To plan a motor control movement, the individuals must have cognitive skills and understanding in a movement. Whyatt

and Craig (2012) suggests that motor control weaknesses among the Autism children is not caused by the autism factors alone but is influenced by the child's cognitive abilities such as language proficiency of understanding verbal instructions given. Children with poor motor skills showed significant weaknesses in social communication skills (MacDonald, Lord & Ulrich, 2014) and Paquet, Olliac, Golse & Vaivre-Douret (2015) also suggested that more research on motor skills of children with autism to be compared with their cognitive skills to give more understanding about Autism shortcoming in motor control.

1.2 Problem Statement

In order to identify the precise area of motor disabilities deficiencies related to autism, specific tests should be conducted instead of a widely holistic overview of motor performance. For instance, in the Movement Assessment Battery for Children M-ABC (Henderson & Sugden 1992, 2nd edition, 2007), performance of two individual tasks which are throwing and catching, were combined to form an overall score for ball skills (Whyatt & Craig, 2010). An aggregated scoring like this complicates researchers to identify a specific disability in fundamental movement skills in ASD. In assessing ball skills among ASD children, most of the studies used Movement Assessment Battery for Children M-ABC (Manjiviona & Prior, 1995 , Miyahara et.al , 1997 , Green et.al , 2002 , Przysucha & Maraj , 2010 , Ament et.al, 2015) and only few used the Test of Gross Motor Development-2 (Pan, Tsai & Chu , 2009 & Staples & Reid , 2010). However, based on the study by Logan et.al (2010) on comparing the two motor assessments, Movement Assessment Battery for Children-2 (MABC-2) and Test of Gross Motor Development 2 (TGMD-2) on elementary school children, the finding

showed that the TGMD-2 was a better suited standardized test for specifically measuring motor skill competence in children. In order to specifically investigate the throwing skills of Autism Spectrum Disorder (ASD) children, TGMD-2 would be a better choice.

Most of the reported studies only investigated the gross motor development of the ASD children in general (Ozonoff, Young, Goldring, Greiss-Hess, Herrera, Steele, Macari, Hepburn & Rogers, 2007, Biscaldi, Rauh, Irion, Jung, Mall, Fleischhaker & Klein , 2014) and only some examined specific abilities like postural stability (Mache & Todd , 2016) and catching and balance (Ament et.al, 2015). Ozonoff et.al used four type of instruments which are Autism Diagnostic Interview-Revised (1994) , Vineland Scales of Adaptive Behaviour (1984) , Mullen Scales of Early Learning (1995) and Autism Diagnostic Observation Schedule (2002). Most of the instruments used to assess the severity and symptoms of Autism were conducted by the children's parents as the participants are 26 to 61 months old (2-5 years old). As this study's target population were the ASD children who were in primary school (7-10 years old), the TGMD-2 was proposed to be used as it was more suitable for children of that age group. Furthermore, the main researcher managed and controlled the test procedure instead of the parents or other untrained adults.

Biscaldi et.al (2014) used Zurich Neuromotor Assessment (ZNA) in their study which is a neuromotor assessment battery widely used in the German speaking country (Biscaldi et al, 2014). The tests consist of pure motor performance, adaptive motor performance and quality of movement, but it did not include complex object manipulation skills such as throwing and dribbling. Mache and Todd (2016) used the Test of Gross Motor Development-3 (TGMD-3), a newer version of Test of Gross Motor

Development standardized test from the Test of Gross Motor Development-2 (TGMD-2), but it is still in the validation process. Ament et.al (2015) used Movement Assessment Battery for Children-2 (MABC-2) and this study specified on catching and balance impairments in Autism Spectrum Disorder (ASD) children only, while this research investigated on throwing skills specifically in order to identify new findings on Autism Spectrum Disorder (ASD) motor skills disabilities.

During the Rio Paralympic Games 2016, our very own Mohd Ziyad Zolkefli won the Shot Put F20 event with gold medal (BERNAMA, 2016). Ziyad is an individual with intellectual disability. In the previous Paralympic Games London 2012, an Australian Paralympic athlete, Todd Hodgets had won the event and breaks the world record (Australian Paralympic Committee, 2016). Todd Hodgets is an individuals with Autism Spectrum Disorder (Disabled World towards Tomorrow, 2016) and by showing his potential in this shot put F20 event, it was proven that Autism Spectrum Disorder (ASD) people had potential in this event. Yet, so few studies had been done on Autism Spectrum Disorder (ASD) ability in throwing skills.

Although most of these studies reported their findings on motor disabilities among Autism Spectrum Disorder (ASD) children, a specific data on the throwing skills performance of Autism Spectrum Disorder (ASD) children compared to typically development peers are largely unknown. The main argument for this study was to investigate the throwing skill, one of the fundamental skill among Autism Spectrum Disorder (ASD) children. It is a basic skill in ball games which is used among the disability population as presented in the last Rio Paralympics 2016 games which included Boccia (similar to Petanque), Sitting Volleyball and Goalball (International

Paralympics Committee, 2016). It was also a skill which had brought Todd Hodgets, the Australian Paralympian with Autism Spectrum Disorder to the top of the world.

External focus and internal focus of attention play an important role in learning motor skills and instructions for both focus are strongly associated with a person's cognitive level in order to understand the instructions. Instructions should be simple, clearly stated and the language must be appropriate to the functional level of the learners (Winnick, 2011). External focus of attentions refers to the effect of a movement on the environment (Wulf, Höß & Prinz, 1998) and internal focus of attentions refers to the focus on the movement of the body in producing a motor movement (Lohse, Sherwood & Healy, 2014). There are few studies concerning the internal focus and external focus of attentions on motor learning among children with learning disabilities (Chiviacowsky et.al 2012, Saemi et.al 2013) but the effect of internal and external focus of attention on motor learning among Autism children is largely unknown. Petanque is a game that requires skills and visual-object control motor where the players must toss the boules to be landed close to the jack for points (McNeely, 2012) and the skills needed in this game makes its essentials to be used in this study.

1.3 Purpose of the Study

This thesis comprised of two studies. The aim of the first study was to examine the Fundamental Movement Skills (FMS) generally and throwing skills specifically as a subtest in the Fundamental Movement Skills (FMS) of Autism Spectrum Disorder

(ASD) children compared to Typically Developing (TD) peers by using the Test of Gross Motor Development 2 (Ulrich,2000). By examining the throwing skills of Autism Spectrum Disorder (ASD) children in the first study, the researcher intended to investigate further in improving the ASD children's skill in throwing by examining the effect of focus of attention on developing throwing skills accuracy. Based on the first study, the researcher hypothesized that the throwing skills of the Autism Spectrum Disorder (ASD) children are significantly lower than the typically developing (TD) peers. In order to increase their performance in throwing skills, the researcher intends to apply the focus of attention instructions as an intervention to the performance of throwing skills performance among the ASD children in a modified-Petanque game. Hence, the aim of the second study was to investigate the effect of external and internal focus on attention in throwing skills performance among Autism Spectrum Disorder (ASD) children.

1.4 Objectives of the Study

This study comprises of two parts. The objective of the first study was to investigate the fundamental movement skills generally and the score of throwing skills specifically as a subtest in the Fundamental Movement Skills (FMS) of Autism Spectrum Disorder (ASD) children compared to typically developing (TD) peers by using the Test of Gross Motor Development 2 (Ulrich, 2000). The objective of the second study was to investigate the effect of external and internal focus on attention instructions in throwing skills performance among Autism Spectrum Disorder (ASD) children in a modified-Petanque games.

1.5 Hypotheses

The hypothesis of the first study was the fundamental movement skills and the throwing skills score of the Autism Spectrum Disorder (ASD) children group were significantly lower than the score of the typically developing (TD) peers group in the Test of Gross Motor Development 2 (Ulrich,2000). The hypothesis for the second study was there was a significant difference between the scores of the Internal Focus (IF) instructions group and the External Focus (EF) instructions group in throwing skills performance among Autism Spectrum Disorder (ASD) children. The EF instructions group would throw more accurate than the IF group.

1.6 Research Framework

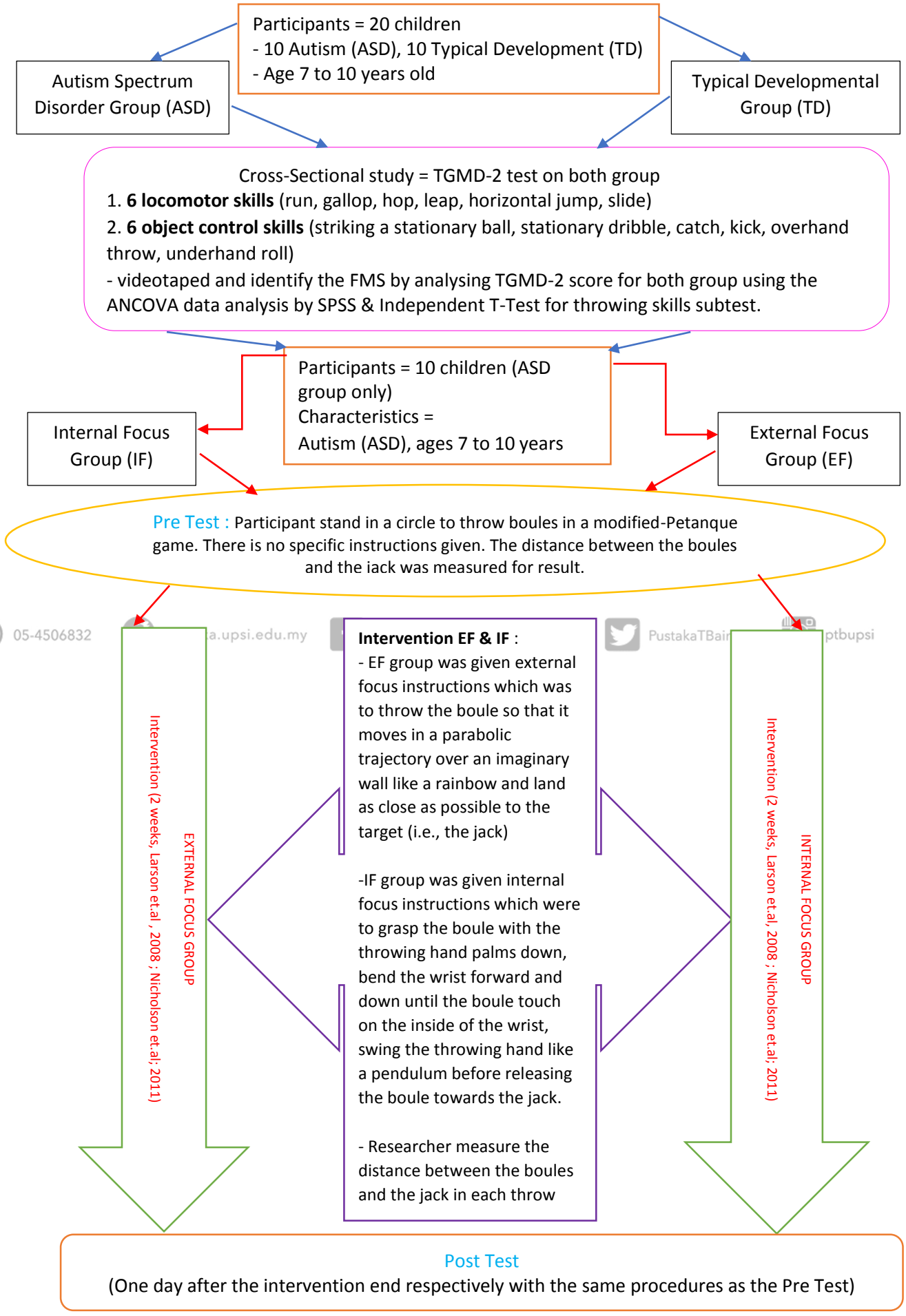

Figure 1.1 : Research Framework

1.7 Delimitations and Limitations

1.7.1 Delimitations

This study intended to investigate the Fundamental Movement Skills of Autism Spectrum Disorder children especially their throwing skills and the effect of different focus of attention instructions on their throwing performance. Thus, this study is only limited to the Autism Spectrum Disorder (ASD) children between the age of 7 to 10 as the participants. The researcher chose the Autism Spectrum Disorder children as they had shown a significant disabilities in motor control (Provost et.al, 2007, Green, Charman, Pickles, Chandler, Loucas ,Simonoff & Baird, 2009, Staples & Reid , 2010, Whyatt & Craig , 2011, Liu & Breslin, 2013). The participants were from 7 to 10 years old because the Test of Gross Motor Skills-2 is suitable for children between the ages 3 to 10 only (Ulrich, 2000). However, a year 1 student in primary school is 7 years old so it is practical for the researcher to access them easily, as it is a purposive and convenient sampling (Capio & Rotor, 2010).

1.7.2 Limitations

The limitation of the studies was a limited number of participants. It was difficult to have access to Autism Spectrum Disorder (ASD) especially in specific group such as Mild ASD of High Functioning ASD children between the ages 7 to 10 in a large scale as the Special Education schools in Malaysia have various types of students with disabilities. So the researcher had used Mild and High Functioning participants in this study. Several studies on Autism Spectrum Disorder (ASD) children have used less