

Numeral Circuit, Physical Activity for Introducing Numeral Symbol to Developmental Coordination Disorder Children

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Abstract—Developmental Coordination Disorder (DCD) is the disorders that is related to motor motion, so it has influence on academic process and children’s daily activity. Children of DCD gets difficulty to follow physical activity and it has impact of unable in learning. Numeral circuit is the development of circuit game model. This research aims to know the impact of numeral circuit game for children of DCD designed with adding numbers in each number post for pre-school children experiencing the difficulty in differentiating numeral symbol. 15 children participate on this research. This research method is quantitative analysis (pre and posttest) states that numeral circuit including physical activity rise significantly $t = 0,385$ on the physical activity and $t = 0, 233$ on number sense.

Keywords—numeral circuit, physical activity, numeral number, developmental coordination disorder.

I. INTRODUCTION

Early childhood is the unique individual. Every individual has different ability one to another. The ability of early childhood includes the aspect of motor, cognitive, language, emotional social, religion value, morality and art holistically integrated on the activity in early childhood education. One of child development aspects including children learning process is motor skill and cognitive ability of children.

Motor skills and cognitive abilities play a crucial role in performing daily activities both in terms of self-care, eating, clothing, writing and so on [1], [2], [3]. Motor skills cannot be separated from the function of large muscles and small muscles of humans. Human’s hands and feet are an integrated system of functional motor and sensory components [4], [5], [6]. It connect directly to the brain, hands and feet to move from grasping, swinging, twisting, kicking, jumping, twisting, and doing

DCD is a disorder on human’s motor system caused by disorder of centre information that is not sync with the sensory system [7]. Children with disabilities of development coordination are not only difficult in performing physical activity, but also in cognitive matters. This is because motor coordination connects complex process with cognitive ability. Therefore the DCD child shows his inability to read, concentrate attention and have executive deficits, including in remembering/memory [3], [8], [9]. This is often found in pre-school. Most of teachers and parents does not realize that their child get DCD disorder because of the lack of information/reference. This case becomes a crucial concern because if there are no treatments and serious attention, the child will withdraw from the social environment due to his

inability to perform simple activities and will have an impact on teenage life and future.

Many previous research studies discuss the physical activity of limited DCD children and cognitive difficulties. One of mathematics concept is the reason to offer solutions of the problem [6], [7], [8], [9], [10]. The introduction of the child to the number symbol is the basic concept of mathematical logic ability, it is expected that the child is able to recognize and distinguish the number 1 from the others, then the next stage will be easier. The strategy offered in this issue is the numeral circuit. Numeral Circuit is a model game to train the child’s motor in every post / station. Because the basic is a game, then the most important point is fun for children and trains the muscles of children and there is the educational side in this game which is the introduction of numbers in each post.

This research can be a reference for teachers and parents as one of the strategies to train children of DCD to introduce the numeral symbol.

The rest of this paper is organized as follow: Section II describes the literature review. Section III describes the material and proposed methodology. Section IV presents the obtained results and following by discussion. Finally, Section V concludes this work.

II. LITERATURE REVIEW

In 3 decades, many researches refer to the clinical description and assessment of DCD diagnosis. The fact is that DCD prevalence is where boys are riskier than girls, the results is 5% of the population [11], [12], [13]. DCD is often a diagnosis along with other disorders such as Attention Deficit Hyperactivity Disorder (ADHD), or Autistic Spectrum Disorder [14], [15]. The need for physical activity to optimize the motor work of DCD child is very important, considering long term for DCD child. It is not only in the domain of physic(athletic competence), but also the social acceptance of the environment. Recent field studies, about 56% of DCD children are difficult to open with others and prefer to be alone [3], [5], [7].

The different Findings from research in [3] that uses experimental designs to test random performance to sort objects. The results shows that children of DCD do not significantly increase after being assigned the task of sequencing blocks. Individual analysis proves that there is an intervention to optimize the sequencing ability for DCD children. The writer concludes that if there are treatments and interventions, the ability of the child may increase.

If DCD children generally have difficulty in controlling their motor sensory (as described previously) then there are some other difficulties experienced by DCD children. Recent research describes that one of difficulties experienced by DCD children is the difficulty of understanding the mathematical concept [14], [15], [16]. Most of DCD children have problems with mathematics (procedural addition and reduction operations) involving fine motor. Developmental co-ordination disorder (DCD) in learning math and memory performance is related to disturbance in all four areas of memory function at their age level, so that their ability is lower than the ability of children of the age of them.

Why should numeral circuit? This question connects all the findings of previous research. Numeral Circuit can be an alternative to train DCD child's motor. Physical activity on integrated numeral circuits in the form of games is to introduce the numeral symbol to the children. Physical activity is indispensable for DCD children. This is reinforced in the results of the study [7], [16], [17] that the executive function (EF) increases with physical activity performed. When DCD children train their motor with a numeral circuit game which means they do physical activity then their executive functional skills are also trained. Children are considered as a developmental period having high PA levels, but absolutely if this physical activity is not accompanied by other stimuli, cognitive function is not necessarily work optimally.

Executive function skill that can be developed through physical activity of numeral circuit for DCD children is paying attention, focus and memory and ability to control impulsive attitude [18], [19]. Paying attention and focus in remembering sequence and form of numeral symbol in numeral circuit game is a criteria to obtain the aim of numeral symbol. Paying attention and focus facilitate the work of the brain in remembering and processing the compound information in the brain. The attentiveness of attention and the ability of the brain to remember can control the impulsiveness of the DCD child [18] when the child cannot reach the target to recognize the number of numeral symbols. This means that the exercise is needed in physical activity so that the introduction of the numeral symbol and function of the child executive develop optimally

III. MATERIAL & METHODOLOGY

This section presents the material used and the proposed methodology.

A. Data

This research involves 32 kindergartens in Deli Serdang with the criteria of having physical control and health on children every month performed by paediatricians. Children recruited are 3-6 year age, do not have neurological / mental retardation or prematurity (<39 weeks of pregnancy) and do not have history of organic disease. Results from the recruitment, 15 children with the diagnosis selection process by DCD by medical doctors are in motion disorder and met the criteria of DSM-IV-TR [11]

B. Method

The analysis of Paired *t* test is performed using SPSS to monitor changes between pre-test and post-test. The result Measurement of pre and post of gross Motor Function measurement (GMFM) in physical activity [20] and

Introduction of numeral Symbol compared before the execution of numeral circuit and after numeral circuit implementation. Observations are made during the activities and assisted by peers. The field notes are a written note of what is heard, seen and experienced in data collection and reflection on the data.

C. Test and Procedure.

a) *The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)*

This test is to diagnose mild DCD on children. The used instrument is DSM-IV-TR from the American Psychiatric Association in 2000. More on this test is in The table II. Then to know motor ability of child, The used instrument is The Gross Motor Function Measure GMFM) [20] while the time of introducing the numeral symbol of children, uses the Cognitive instrument.

b) *The Early Numeracy Test is used to number sense of DCD children. Relational and recognition on scale numbers are used in analysis and applied in a pretest - intervention - post-test design (table 3)*

c) *Pre and post result measurements of Rough Motor Function Measurements (GMFM) are used to know the impact of physical activity of a numeral circuit game.*

The procedures of this work are given as follow:

- Numeral circuit are divided into 4 physical activity posts. In the first post of child does a zig zag number jump. In this post the child jumps over numeral puzzle carpet arranged in zig zag. At this level the child is tested and observed whether to jump over the carpet with one foot or two feet.
- In the second post, the DCD child throws ball that is given numbers into the prepared target. The accuracy and fine motor movement of children is judged based on the instruments that have been made.
- In the third post, the next movement in numerical circuit is by paing through the board. Stripboard is prepared with a height of ± 50 cm and length ± 2.5 meters. At the passing stage of the board, the DCD child is given handle on the first stage, and trained back on the forth stage without handle. Before you can board the board there is a symbol of numbers that have been prepared. This is to train the child's memory. So also at the finish of this post, there is a symbol of numbers that have been prepared.
- In the fourth post, children run with loads. Weighing loads ± 0.5 kg is a carrying case containing books. The balance and strength of the child's muscles are trained and measured with prepared instruments.
- At the end of the circuit, the DCD child is asked to show the number that is viewed during the course of the numeral circuit game. By training the child's memory of the introduction of the numeral symbol, this means developing the brain function of the DCD child's brain and its executive function.

Tables I, II and II respectively describe the diagnostic and statistical manual of mental disorders (DSM-IV-TR) provides four criteria to classify a child as having DCD; Means and standard deviations (SD) for two dimensions of science physical activity and number sense to paired *t*-test; and physical activity instrument (PA) and introduction of numeral symbol (NS).

TABLE I. THE DIAGNOSTIC AND STATISTICAL MANUAL OF MENTAL DISORDERS (DSM-IV-TR) PROVIDES FOUR CRITERIA TO CLASSIFY A CHILD AS HAVING DCD

No	Indicators	Yes	No
1	Performance in daily activities that require motor coordination is substantially below given the person's chronologic age and measured intelligence. This may be manifested by marked delays in achieving motor milestones (e.g., walking, crawling, sitting) dropping things, "clumsiness," poor performance in sports, or poor handwriting.		
2	The disturbance in criterion A significantly interferes with academic achievement or activities of daily living.		
3	The disturbance is not due to a general medical condition (e.g., cerebral palsy, hemiplegia or muscular dystrophy) and does not meet criteria for a Pervasive Developmental Disorder.		
4	If mental retardation is present, the motor difficulties are in excess of those usually associated with it		

TABEL II. MEANS AND STANDARD DEVIATIONS (SD) FOR TWO DIMENSIONS OF SCIENCE PHYSICAL ACTIVITY AND NUMBER SENSE TO PAIRED T TEST

	Pre-test		Post-test		N	T	Correlation	Sig .
	Mean	SD	Mean	SD				
Physical Activity	4,9333	,9615	7,8000	,99043	15	-8,527	-0,242	0,385
Number Sense	5,1333	,67612	7,6000	1,05560	15	-8,047	0,328	0,233

TABLE III. PHYSICAL ACTIVITY INSTRUMENT (PA) AND INTRODUCTION OF NUMERAL SYMBOL (NS)

Variable	Indicators	Items
Physical Activity	<ul style="list-style-type: none"> • Strongness • Accuracy • Agility 	15 items
Introduction of Numeral Symbol	<ul style="list-style-type: none"> • Understanding of form • The difference of number form • Description of numeral symbol form 	15 item

IV. RESULT AND DISCUSSION

This section presents the obtained results and following by discussion.

A. Result

The analysis of paired t test (Table II) states that both the physical and the recognition of the numeral symbols in the measurements are increased but it is not significant during treatment relation numbers performed (PA: $t = 0.385$; NS: $t = 0.233$). Good results from physical activity (PSTE) and expected outcomes from the introduction of the number symbols (NS) of DCD children increase from pre-test to post-test. This provisional result shows that the strategy generates a number that increases the child's recognition of the number symbols at several meetings.

B. Discussion

The main purpose of this research is to investigate whether DCD children with difficult motor control and child sense number increase with strategy of numeral circuit game. This study reveals that DCD children have interrelated problems. If the ability to run physical activity has difficulty then the ability of the executive function also experienced the same thing, in this case ability of memory work to be able to identify each symbol of the numbers becomes not easy. From our data, it can be concluded that the problems that they face can be expanded into more complex domains, such as the ability to calculate and reduce operations and so on.

More details, the problems found are in facts and procedural knowledge (involving knowledge of numeral systems and mental calculations). In coordination between the work of the brain and sensory DCD children are able to move their muscles to do something, but in terms of speed, the response is still too slow. On the task in post 1 that is jumping in zigzag, most children still jump like walking. The muscles are not yet sturdy to jump. This also affects the foothold content of numeral symbols. When the child jumps, the child is not fully aware of the numbers that he jumps and the understanding of the shape of the numeral symbol. This problem requires more complex procedural knowledge related to executive function in the focus of attention and memory work [21], [22], [23], [24].

DCD children often do not recognize concurrent motor tasks, causing difficulties in learning one activity to another. For example, in the first post and the second post, the shift of motor work on post 1 and post 2 are different. They have difficulties in generalizing motor work before and new situations. It is not easy for them to respond to change.

The child's meta-cognitive process of DCD in his brain memory is the accumulation of previous experience storage and this plays an important role [21] in effect on the activities ever undertaken. In this study, the numeral circuit is repeated in 4-5 meetings. Each the meeting uses a different cognitive assessment system from normal children, in children DCD, the power and memory system are little slower. So in practice, the strategy of numeral circuit game, the influence on the ability to recognize the numeral symbol of change does not happen instantly. Due to the cross-sectional design, we cannot draw any conclusions about the causal causes behind this problem [25], [26], [27]. Scientific explanations are emphasized on the nervous system associated with symbolic

and symbolic knowledge as well as with measurable measurements

V. CONCLUSION

To conclude, most DCD children do not only have problems with the motor system, but also difficulties with mathematics, in this study it is specified the number sense of the child. Strategies with numeral circuit games can be an alternative to introduce the numeral symbols in DCD children as well as to train their motor. Furthermore, it is recommended occupational therapy in DCD children, so that motor skills are more optimal. Further research is need more detailed longitudinal research on the cause of the problem both in mild and severe DCD disorders.

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