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Motor Development Index (MDI) Based on Combination of Human Development Index (HDI) and Sport Development Index (SDI) as a Success Parameter of Motor Development among Preschool Children: An Observational Study

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Abstract. The principle of development is the occurrence of changes that involve the functioning of the nervous system and muscles as well as the change itself concerning the quality of motion that can be measured by tests of motor skills. Changes of the quality in motor movement among children is determined by the factor of teachers/counsellors, infrastructure facilities, and the existence of environmental factors. In measuring successful motor development among preschool children, this paper proposes the Motor Development Index (MDI) to be used as one of the parameter indicator. MDI is a composite index that includes (1) child enrolment rate (2) availability of public service venues (3) gross and fine motor skills (4) availability of builders/instructors as well as (5) sources of financing. The results showed that MDI in motor development among preschool children is still very low, with the value of only 0.387. However, the proposed MDI measurement is better than Sports Development Index (SDI) of value 0.345. In the future, the MDI measure is proposed to be parameters of motor development success among preschool children as MDI components allows presenting a more comprehensive measure.

1. Introduction

Coaching and development in sports requires time and arrangement in an integrated manner with cross-sectoral and interdisciplinary handling, hence the active participation of the community especially the parents. The ability to perform sporting activities is highly dependent on the development of motor skills among children at their very early age. Nonetheless, motor development is often ignored and received less attention from caregivers, counsellors and even



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parents during the first five years of life (the golden years). This is due to lack of understanding on the basic roles of motor building, which requires specific development motion base pattern. Malformed motions will reduce efficiency in movement since it requires more energy, hence the ability of capitalizing the movement for sports performance during their later years.

In general, motor development among normal children follows similar pattern even though the development through each stage is different from one individual to another. This means individual variation in development is very complex and involves various elements that mutually influence each other. However, the age of preschool children is sensitive in receiving stimulus. Incorrect introduction to basic motion will result in the formation of incorrect motion patterns, and difficulty in correcting them due to long recovery time. Because every child is unique and their motor skills developed at different rate, the research questions in this study are as follows: (1) What are the parameters that can be used to measure successful motor development among pre-schoolers? (2) What elements from the basic motion pattern should be incorporated in such parameters?

On this basis, this paper proposes the Motor Development Index (MDI) to be used as one of the parameter indicator for a successful motor development among children. MDI is a composite index that includes (1) child enrolment rate (2) availability of public service venues (3) gross and fine motor skills (4) availability of builders/instructors as well as (5) sources of financing. Following [1, 2], the components required as parameters in determining the motor development index are shown in Figure 1.

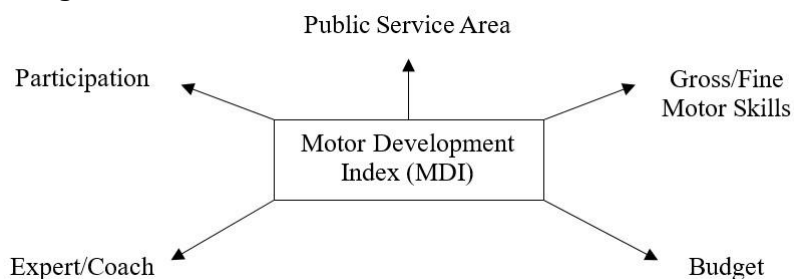


Figure 1. Parameters of MDI

Participation in MDI is measured through children play. Playing is children's activity that represents a form of their appreciation towards exercise and is part of an effort to develop awareness of health and fitness improvement. According to [3], playing can be grouped into three parts: social play, object play, and role play. [1] stated that motor game is important as it affects the learning process in acquiring motor skills as well as the development of emotional skills, creativity and imagination, self-esteem, and social relationships. [4] stated that by playing especially in a dedicated set-up interest area[5], children can train their fine motor skills with games such as puzzles, math manipulatives, magnifying glasses, small blocks, and construction toys. Movement such as painting, cutting, and constructing help to develop eyehand coordination and increase their skills and coordination as well as their confidence [6].

[7] stated that children playing area, whether open or closed, has to be paid attention to considering the amount of time that the children spend in a day. Within a preschool compound, motor development among children is very obvious. Preschool centres with adequate equipment and appropriate care, provides more opportunities for a healthy development of childrens motor abilities. Apart from schooling, the society in which a child lives in also forms a specific cultural context that favours certain aspects such as society and lifestyle of motor development.

The expert trainer or coach also plays a very big role in developing motor skills by giving good stimulation by tapping, massaging and stretching as well as giving the opportunity to try to do something repetitive motion. The motion in a child without counselling by a competent person leads to improper form of motion and this will have an impact on the formation of the wrong motion pattern, permanent errors will be difficult to change so how important the sports coach.

The number of human resources is based on the ratio between the number of trainers/instructors with the number of preschool children.

Finally, the motor development index also requires certain figures on the amount of costs are needed in funding children activities, both in the provision of facilities such as infrastructure, maintenance and procurement of environmental hygiene as well as the cost incurred by special parents only for the activities of children. The calculation of the amount is based on the amount of money spent by parents to exercise with the parents income, after determining the indicators are completed then each indicator is searched for the dimension index.

The need for a standardized instrument for assessing success in sports is urgent, based on the reality that the measure of success relies only on one component of sporting achievement, which is medals. Nonetheless, medals are not representative enough as achievements with medals are only suitable for the types of sports that are competed. Sport Development Index (SDI) was introduced to measure sport activities that are not contested or in the stage of observation [8]. SDI is a composite index of 4 basic dimensions, which are (1) participation, (2) open space, (3) fitness, and (4) human resources.

Participation is based on the number of people involved in sports activities as compared to the number of people in a specific area. Open space is based on the comparison between the area of land that is often used to exercise or sporting activities against the entire population in the area. Physical fitness is measured by Multistage Fitness Test, aerobic training, and anaerobic training. Finally, human resources are based on the comparison between the number of instructors and the population in the area.

[2] reported that the national Sport Development Index (SDI) for Indonesia is 0.345, which is considered very low as compared to maximum index value which is 1. The results were representing 30 provinces, 90 districts/cities, 270 sub-districts, and 8,100 respondents in the study involving 22 universities that have established the Faculty of Sports Science. Detailed results for Indonesian SDI is shown in Table 1.

Table 1. National Sport Development Index

No	Index	Dimension Index (DI)	National SDI
1	Participation	0.345	0.345
2	Open area/space	0.380	
3	Human resource	0.115	
4	Fitness	0.450	

The remainder of this paper proceeds as follows. Section 2 presents the works related to measuring motor development, Section 3 presents the proposed methods, Section 4 discusses the findings, and finally Section 5 concludes with some indication for future work.

2. Related Work

[4] cited a number of philosophical quotes on physical fitness. According to Socrates, one should try to keep his physical condition, because a healthy and strong physical body is the guardian of consistency for human beings. Plato believed that exercise is not really an end in itself but rather a tool to make the physical man healthy and strong. To Aristotle, the health of the mind is very dependent on the health of the body and Pierre de Coubertin suggested that moral and the form of the human body can be formed through exercise. The literature has shown that sport is inseparable from the world of education. The ultimate goal of sport is to be a unique vehicle in improving human nature, as a means to form a strong personality, and nurture noble character development. Therefore, each child has a characteristic that each individual can develop in accordance with the conditions he experienced including the development of his motor skills.

Physical education develops children based on three premises, whereby their motor skill development must be according to the age, the development follow similar sequences, and the progress of motor development is different from one child to another [3]. Individual motor ability highly depends on the element of strength, precision (according to their anticipation) and accuracy (in terms of their timing). The motion of reflex after birth is necessary to sustain life and the increasing age of this reflex motion will decrease. Because no children of the same age and the same sex have the same ability, the development of motor skills among children is important for them to gain independence, recognition, and social acceptance among peers [9].

Development in motor skills is caused by the increasing role of the nerves, along with the growth of brain functions that affects the development of other functions. Children develop better from playing [8] as playing also affect the improvement of children's creativity [10]. When they were infants, the neurons are not yet connected to each other and will be connected after being given a stimulus, observing a particular object, comparing and solving from simple problems [11]. [12] researched on neural functions that affect motion, the motion that learns about the skills to achieve motion perfection, and the development of motion which is a change in motion behaviour. General pattern of motor development in a person is divided into two main components, which are pre-skill and skill. Pre-skill is further divided into three parts, which are reflective motion, sense integration, and motion pattern formation. Meanwhile, skill development includes motion refinement, appearance, and setback. According to the theory of the dynamic system [7], the development of motor skills gets input from stimulus that motivates it to react and exploit its perception to output a motion. The study of motor is not separated from the performance and body movement.

The development of motor skills among children can be categorized into two major parts, which are rough motor skills and fine motor skills. Rough motor movement is controlled by large muscles, whereas fine motor is controlled by small muscles [2]. According to [13], fine motor skills are manipulative skills that involves small movement and smalls muscles in parts of the body such as picking up using two fingers for picking up things, holding spoon and feeding themselves, threading, grasping a pencil to draw, cut, and dress [14]. Children also use fine motor skills in mathematics, or clapping their hands to learn syllables. Many movements performed with hands are considered fine movements because the smaller muscle of the fingers, hand and forearm are critical to the production of fingers and hand movement.

The aim of motor development is to achieve self body control when in action [1]. This development is shown through the exploitation of motor functions that are perfected over time. Motor development in children generally follows eight common patterns: (1) continuous movement from simple movement to complex, (2) has the same sequence pattern, (3) cell and nerve maturity, (4) from coarse motor movement to fine motor movement, (5) from reflex movements to coordinated movements, (6) development from head to tail, (7) proximo distal movements, and (8) bilateral coordination movements towards cross-lateral movement [14].

3. Materials and Methods

This research is an observational study and based on data analysis is a combination of quantitative and qualitative, sampling techniques by cluster random sampling. The research instruments are as follows.

- Participation rates are measured by a comparison between the number of preschool age children and the number of activity participants involved in physical activity.
- Public service locations are measured based on the difference between the area of children's playground both out door and in door with the number of preschool age children.
- Gross motor skills

- (i) sprinting twenty-five meters
- (ii) long jump without the start
- (iii) throw ball with one hand
- Fine motor skills
 - (i) arrange coca cola bottles into five, four, three, two, and one house models
 - (ii) walk on a two meter walkway back and forth, and d) Reflect the ball on the targetplane
- Staff coaches/trainers are measured based on a comparison between the number of people who are accustomed to helping to train/foster children in physical activities with the total population of preschool children.
- The source of the cost is measured based on the comparison between the amount of parent costs incurred to be allocated in various kinds of physical activity of children in the area. The analysis technique used in this study is by combining the indexes of each dimension by using a scale calculation of three element quantities, namely: actual value, maximum value and minimum value.

3.1. Research Design

Based on observational research methodology, the inferences in this study are drawn from a sample to a population within the district of Sleman of Yogyakarta, Indonesia. From the district of Sleman, three sub-districts were chosen and in turn, two urban villages were chosen from the sub-districts. Next, two kindergartens were selected from each urban village, whereby the final samples are 5 boys and 5 girls from each kindergarten in the respective urban villages. The sampling technique used was the cluster random sampling based on the samples collected from Figure 2.

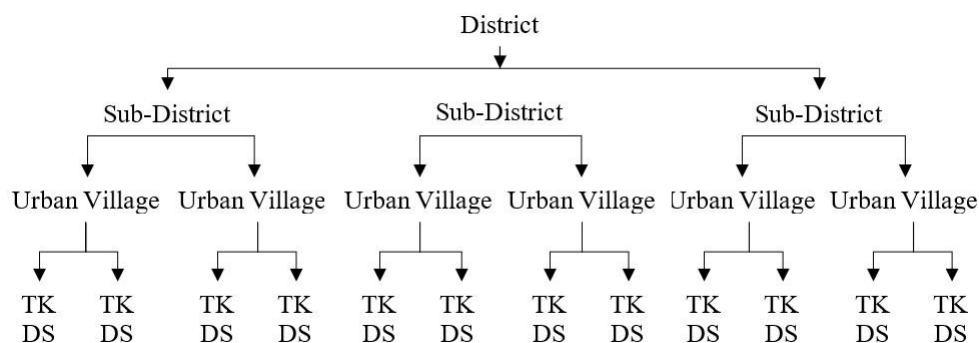


Figure 2. Observational Research Design

3.2. Data Collection

In this observational study, data was collected based on documentation, questionnaire, and test. Documentation was used to retrieve data from public service area, or the space used for children activity. Questionnaire was used to gather information on the type of activities the children have as well as the frequency of activity in a week. Finally, test was used to capture motor skills data including both rough motor and fine motor. Observation of secondary data was also used to determine factors that affect motor ability.

3.3. Research Instrument

Motor development under investigation in this study includes both gross and fine movement of either locomotor (dynamic movement), nocturnal motion (static movement), and manipulative (hand and foot eye coordination movement) among preschool children aged between 5 to 6 years

old. In measuring the success of motor development among the children, this research proposed the use of Motor Development Index (MDI) as one of the success parameter. MDI is a composite index consisting of five basic dimensions such as follows.

- child enrolment/participation index (PI)
- public service areas index (PSAI)
- gross and fine motor skills index for children (GFMI)
- supervisor/instructor index (TI)
- financing sources index (FI)

In order to determine the most dominant factor in influencing motor development among children, the contribution of each factor has to be first calculated. The biggest factor of contribution is the dominant factor. For calculating the composite index of MDI, the Dimension Index (DI) for each dimension is determined by using the scaling the calculation of the three elements, namely: the actual value, the maximum value and the minimum value. The formula for DI is shown in Equation 1.

$$DI = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}} \quad (1)$$

After the dimension index of each MDI component is known, MDI can be formulated as shown in the Equation 2, where PI is the participation index, PSAI is the public service area index, GFMI is the gross and fine motor index, TI is the trainer index, and FSI is the financing index.

$$MDI = \frac{1}{5}(PI) + \frac{1}{5}(PSAI) + \frac{1}{5}(RSMI) + \frac{1}{5}(TI) + \frac{1}{5}(FI) \quad (2)$$

- Participation Index (PI): Child enrolment or participation index is the ratio between the number of preschool children within the area and the number of children involved in physical activity (playing).
- Public Service Area Index (PSAI): Availability of public service areas is the ratio between the number of kindergarten children and the size of public areas available. Basically this data is measured on the basis of comparison between children's play areas (both outdoor and indoor) against the number of preschool children in the area.
- Gross and Fine Motor Index (GFMI): Gross motor skills are the ability of the nervous system to control muscles or a group of muscles to perform motion that does not require coordination/mixture of various elements. In addition, only large muscle groups are involved. Among the skills involved are 25-meter sprint, long jump without prefix, throwing ball with one hand. Fine motor skills are the ability to control the nervous system against muscles or a group of muscles to perform motion that requires coordination or combination of several elements of motion. Among the skills involved include preparing the bottles into a model house 5-4-3-2-1 and 2-meter walk over the beam and return.
- Trainer Index (TI): Availability of the supervisors or instructors is the ratio between the number of teachers or sportsmen who performed training with the children in physical activities, against the number of preschool children in the area.
- Financing Source Index (FI): Source of financing is the ratio between monthly income of the child's parents (parental cost) and the cost undertaken for various physical activities in the area.

3.4. Data Analysis

The objective of this observational study is three-fold. First is to determine the success of basic motion pattern development among preschool children. Second is to identify the factors that

influence motor ability based on gender. Third is to identify the factors that influence the formation of basic motor ability among children. The analytical technique used in this study by combining the index of each dimension by using the scale of the calculation of the three elements: the actual value, the maximum value and the minimum value.

4. Results and Discussions

Kasihian is located in the north of the capital of Bantul, Special Region of Yogyakarta. Subdistrict of Kasihan is a buffer zone for development of Yogyakarta city. Sub-district of Kasihan is divided into 4 villages namely; Bangun Jiwo Village, Tirtonirwolo Village, Taman Tirto Village, and Ngestiharjo Village. Kasihan is located in the lowlands at an altitude of 70 m above sea level, tropical climate with the highest hot weather 34 degrees celsius and the lowest temperature 22 degrees celsius. Topographically, Kasihan has an area of 3,437,957 Ha with population of 15,559 heads of families and 121,995 people in total. From the total population, 61,090 are men and 60,905 are women with the density of are of 3,768/km². Most of the population are farmers.

Table 2 shows the number of kindergartens within the sub-district of Kasihan and Table 3 shows the statistics for kindergarten children according to gender.

Table 2. Number of Kindergartens

No	Urban Village	Total Kindergartens
1	Bangun Jiwo	14
2	Tirtonirmolo	13
3	Taman Tirto	10
4	Ngestiharjo	14
Total		51

Table 3. School Age Kindergarten

No	Age	Sex		Total
		Male	Female	
1	5 years	720	733	1,453
2	6 years	812	751	1,563
Total		1,532	1,484	3,016

Table 4 shows the statistics of the teachers based on their education level and finally Table 5 shows the results from motor skills classification in the study. Finally, Table 6 shows the results for the MDI.

Table 4. Number of Teachers based on Education Level

No	Education level	Total
1	Kindergarten	242
2	Primary School	519
3	Junior High School	203
4	Senior High School	368
Total		1,332

Table 5. Motor Skills Classification

No	Classification	Total
1	Very High	18
2	High	18
3	Adequate	10
4	Low	10
5	Very low	4

Table 6. Results for MDI Parameters

No	Index	Dimension Index (DI)	National SDI
1	PI	0.511	0.387
2	PSAI	0.007	
3	GFMI	0.499	
4	TI	0.013	
5	FI	0.806	

5. Conclusions

The results showed that the motor development index of motor development of preschool children is still very low, this is indicated by the magnitude of the combined index (MDI) of only 0.3872147. Noting the magnitude of the index, when compared with the magnitude of the MDI index that moves between 0 to 1, the categorized motor development is still low.

Acknowledgements

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From: Helmy Kamal <helmy@uthm.edu.my>
Sent: 25 June 2019 11:40
To: Kukuh Wahyudin Pratama <kukuh@siswa.um.edu.my>
Cc: Panggung Sutapa <panggung_s@uny.ac.id>
Subject: RE: JICETS 2019 MDI

Dear Kukuh,

Congratulations! Based on the reviews by 2nd JICETS 2019 Technical Committees, your submission (2ND JICETS: 001-153) entitled "Motor Development Index (MDI) Based on Combination of Human Development Index (HDI) and Sport Development Index (SDI) as a Success Parameter of Motor Development among Preschool Children: An Observational Study" has been ACCEPTED for oral presentation at the conference.

You are therefore requested to submit the "Revised/Camera-ready paper" in Ms-Word file together with the "Similarity Report" before Thursday, October 31st, 2019. Revised/Camera-Ready paper is the revised full paper after considering the comments from reviewers. It is in full paper format as per sample from the conference website. The reviewers' comments, if any, are provided to assist you in preparing your revised/camera-ready paper. You may submit the Camera Ready paper via email.

We would like to remind you that the conference fee shall be paid before October 31st, 2019. Failing to pay during the stipulated period will result in ineligibility to have your paper published. Please email us the proof of payment once the payment has been made. The 2nd Joint International Conferences on Emerging Computing Technology and Sports (JICETS) 2019 will be held on 25th - 27 November 2019 in Aston Tropicana Hotel Bandung, Bandung, Indonesia.

Thank you for your cooperation and attention.
We are looking forward to seeing you at the conference.

Best Regards,
Helmy

ANNUAL LEAVE PLAN :

From: Kukuh Wahyudin Pratama <kukuh@siswa.um.edu.my>
Sent: 14 May 2019 11:17
To: Helmy Kamal <helmy@uthm.edu.my>
Cc: Panggung Sutapa <panggung_s@uny.ac.id>
Subject: JICETS 2019 MDI

Dear Dr. Helmy

I do apologize for disturbing.

Through this email, I send you our research article entitled "Motor Development Index (MDI) Based on Combination of Human Development Index (HDI) and Sport Development Index (SDI) as a Success Parameter of Motor Development among Preschool Children: An Observational Study" to be submitted in The 2nd Joint International Conference on Emerging Computing Technology and Sports 2019.
Thank you.

Best Regards,

Kukuh Wahyudin Pratama
Researcher
University of Malaya