International Journal of Physiology, Nutrition and Physical Education

Arief Darmawan
Department of Physical Education, Health and Recreation, Faculty of Education, Universitas Islam "45" Bekasi, Indonesia

Development of interactive multimedia-based manipulative fundamental movement model for primary school students

Arief Darmawan

Abstract
This study aimed to develop interactive multimedia-based manipulative fundamental movement model for primary school students. This research and development was packed in the form of interactive multimedia. Study method used was research and development from Borg & Gall using 10 steps. Subject of study was first grade students in primary school. Trial result for small group and large group describe that this model can be used quite well in overall. Effectiveness test result during pre-test was 603 while post-test was 965. In differences significance test using SPSS, we obtain t-calculated result was -16.525, db=39 and p value $0.00 < 0.05$ which means that there was significant differences before and after interactive multimedia-based manipulative fundamental movement model was used. Based on this result, it can be said that the developed manipulative fundamental movement model was sufficient and effective for primary school students.

Keywords: Development, manipulative fundamental movement, interactive multimedia, primary school

1. Introduction

I deliberately excerpt the legendary statement from former President of South Africa and winner of peace noble prize Nelson Mandela to support our faith that education is the main key to achieve success. If we want to fix our life, fix our future, fix our family, fix the community, fix the nation and even fix the world, thus the answer was only one: Education. In this context, high quality education was the compulsory requirement to create an advance nation's life. In the 21st century such as now, education has become the compulsory need for all class of people, unlimited for upper class, middle class and even low class people. Education is highly important and compulsory since early time.

Physical education and health is the lesson favored by the students, since it was done in the outdoor so that they could play and exercise, however, if physical education was not well-taught by the teacher, it was possible that the students might feel bored and thus material in physical education would not be delivered. Based on observation result done by author toward manipulative basic motion learning conducted by physical education teacher, it was known that teacher still use command and task learning approach. This kind of learning would work well, but several students still somehow less interested in the learning.

By this fact, author conduct interview toward the related teacher and obtain result that, teacher does realize if learning was quite monotonous. Teacher also suggests that there was lack of variation in manipulative fundamental movement learning to be used in actual learning. This was supported by sole learning source of the teacher which only limited on text book. For more details, comparison table was shown below:

Correspondence
Arief Darmawan
Department of Physical Education, Health and Recreation, Faculty of Education, Universitas Islam "45" Bekasi, Indonesia

Table 1: Comparison Table for Old Model and New Model.

Old Model	New Model
o Teacher has small number of variation in fundamental movement learning	o Teacher has lots of learning variation examples
o Teacher did not have teaching material in the form of interactive multimedia for the learning process	o Teacher has interactive multimedia learning material so that students would have new experience in it
o Teacher has several variation in learning but it was unknown whether those learning was effective	o Teacher has tested and effective learning variation, since it was already implemented in trials
o The current model was not yet known whether it was appropriate for student's characteristic or not	o Model was appropriate to student's characteristic
o Learning variation was not yet complete in overall	o Complete learning variation started from hand movement such as throwing until foot movement such as kicking
o Monotonous learning	o Varied learning

Perreira Jose *et al* (2016: 569) [23] explicitly stated that several model and teaching strategy should be considered when teaching physical education. Different approach should be considered as alternative option and teacher should keep the best one according to the unit of student's development. We cannot ignore opinion from Strac & Strel (2012: 62) [26] which suggest that teacher's higher competency in planning and deliver PE lesson would give positive contribution particularly for children's physical fitness.

McBride (2014: 123) [20] believe that learner should be placed in a situation when there was cognitive inappropriateness or mental dissatisfaction, and therefore learner would be motivated to ask for information and finding solution. Mawer (2003: 89) explain that if learner was to put into such situation, their cognitive function would be needed to think critically, such as comparing, differing, drawing conclusion, and testing their hypothesis.

Study conducted by Leser Roland, Baca Arnold & Uhlig Johannes (2014: 184) showed that the results of the questionnaire showed a positive agreement among the participants in the usability and assistance of multimedia for the sports practical course. Meanwhile, study result from Napitupulu Efendi *et al*. (2014: 1) [9] in his study regarding try out of twenty five students observations indicated that the product is good (mean pretest=31.39; mean post-test=32.54). His study concluded that the developed interactive multimedia learning model was effective to improve student's learning. Chen *et al*. (2016: 231) [4] conduct studied about manipulative movement which in conclusion explains that QPET practice play a significant role to contribute to student's manipulative skill competency.

Purwanto (2017: 33) [25] review several studies concerning impact of effective interactive multimedia in assisting the learning process. Lu & De Lisio (2009: 184) [19] explains that PE was focused only to improve or to master the movement and or mastering certain sports branch.

Learning media consist of explanation about fundamental movement, pictures and videos about fundamental movement material. Multimedia material and learning environments has also been developed for technical and tactical education. Baca *et al*. (2005: 38) give example including animation and video to help instructors and students to understand exercise movements and technical/tactical action as implemented in sports game. One of the special emphasizes lies in the organizing method of technical learning process. Leser *et al*. (2009: 55) [18] suggest an application to learn about tactic. This assumption was supported by analysis of Hoffler and Leutner (2007: 727) [13] which regard the effectiveness of teaching material toward understanding was such as in a real situation. Study by Wiemeyer, J (2008: 299) [28] review that multimedia technology has creates an impact in physical education learning and its science in cognitive domain.

2. Materials and Methods
2.1 Characteristic of Primary School Students
According to Gallahue (2006: 177) [10] physical characteristic and motor development of 6-10 years old children was: 1) Boys and girls range from about 44 to 60 inches (111.8-152.4 cm) in height and 44 to 90 pounds (20.00-40.8kg) in weight. 2) Growth is slow. 3) The body begins to lengthen. Fundamental movement skill (FMS) has become the basic for daily life and also to participate in physical activities, Wouter Cools *et al*. (2010: 597) [6]. Physical development in childhood was typically characterized by large variation in growth pattern.

2.2 Physical Development Phase in Childhood
Harrow (1972: 52) [1] describe that fundamental movement is the important movement pattern to form basic complex movement skill which consist of locomotor move, non-locomotor move and manipulative move.

Table 2: Phase of movement development and series of development stages according to Harrow (1972: 52) [1]

Age (year)	Movement Development Phase	Development Phase
0-2	Elementary or not perfect movement skill	Early childhood
2-7	Fundamental movement skill	Early childhood
7-10	General movement skill	Middle childhood
11-13	Special movement skill	Late childhood
14+	Specialized movement skill	Adolescence and adult

Participation in physical activities was highly important for children to fix their physical, mental and social health. Chen *et al* (2016: 102) [4] report that there was positive relationship between motor skill and physical activities participation. Gallahue and Ozmun (2006: 48) [10] divide motor development into 4 phases, which are (1) reflexes movement phase, (2) initial fundamental movement phase, (3) fundamental movement phase and (4) specialized movement phase. Primary school students at the age range 7-12 years old would categorized into specialized movement phase, in which this phase would highly depend on previous one, particularly in the maturity of fundamental movement skill.

2.3 Fundamental Movement Skill
According to Hidayatullah (2013: 48) [12], childhood was a critical period because it is the time where children formed the habit to achieve success, not success or very success. Mostly we found several children playing closely with their peers. This was in line with writing of Hidayatullah that 7 years old children was known as grouped age, because children would attracted to activities with friends and want to be part of a group (Hidayatullah, 2013: 9) [12].

Papalia (2014: 234) [22] suggest that children's skill was highly various, depend on their genetic factor and opportunity to learn and practice their motor skill. These fundamental movement skill was put in early childhood and important to encourage active lifestyle (Cools *et al*., 2009: 154) [7]. Even Cagno *et al*. (2014: 767) [3] explain that talent identification plan was designed to select young athlete with ability to achieve success in the future regarding sports. Pangrazi (2001: 4) [21] suggest that "fundamental skill is the beneficial skill needed by children as provisions in life and attitude".

Process to create movement did not occur automatically, but it was the accumulation of learning and practicing, which is by understanding the movement and repeating it over and over along with awareness concerning related movement.

Manipulative movement could take form in throwing, catching, kicking, and pushing; all of it was part of advance movement from more complex fundamental movement. Fundamental movement pattern did not occur naturally thus each children was suggested to obtain foundation for complex physical activities and exercises through fundamental movement skill (Lisa M. Barnett *et al*., 2016: 220).

Culjak *et al*. (2014: 124) showed that more non-organized children activities could improve their fundamental callisthenic skill and also development for *Fundamental Movement Skill*. Kristen E. Cohen *et al*. (2014: 1) [5] explain that children's participation in physical activities was highly important to improve children's skill. Higher physical activities in children would improve fitness (either cardio-respiratory fitness or muscle strength). Children routinely participated in physical activities would reduce anxiety and depression symptom. Khalaj & Amri (2013: 660) [15] suggest that gross motor skill is the foundation for sports and physical activities. Actually, focus on motor development has the implication toward very skillful sport development.

According to Tangkudung (2012: 67) [27], good condition would affect mental aspect such as improvement in job motivation, job passion, confidence, carefulness and others. Psychologically, physical condition would highly affect our activities, particularly in socializing.

Manipulative movement according to Gallauhe (2006: 218) [10] was "gross motor manipulation involves an individual's relationship to objects and is characterized by giving force to objects and receiving force from them".

2.4 Method
Approach and method used in this study was combination of qualitative and quantitative study (*mix methods*). Study method used was from research and development method of Borg & Gall. Study sites used was 3 Primary Schools such as Embun Pagi Elementary School in Jakarta, State Elementary School 4 Campurdarat in Tulungagung regency, and State Elementary School 1 in Balerejo Kauman, Tulungagung regency. Subjects were first grader of elementary school. Small scale trial was done with 10 students while large scale trial was done with 40 first graders. Effectiveness test was using *one group pre test* and *post test*. Instrument for pre test and post test was using manipulative fundamental movement test taken from Kirkendall (1980: 323) which consist of throwing and *passing-stopping*.

Data collection instrument used in this study were interview and learning observation. Observation was done to obtain information from expert and PE teacher as input and suggestion concerning implementation of manipulative fundamental movement learning process for first graders.

Research and development from Borg and Gall (1983: 775) [2] consist of ten steps which can be seen clearly from figure below.
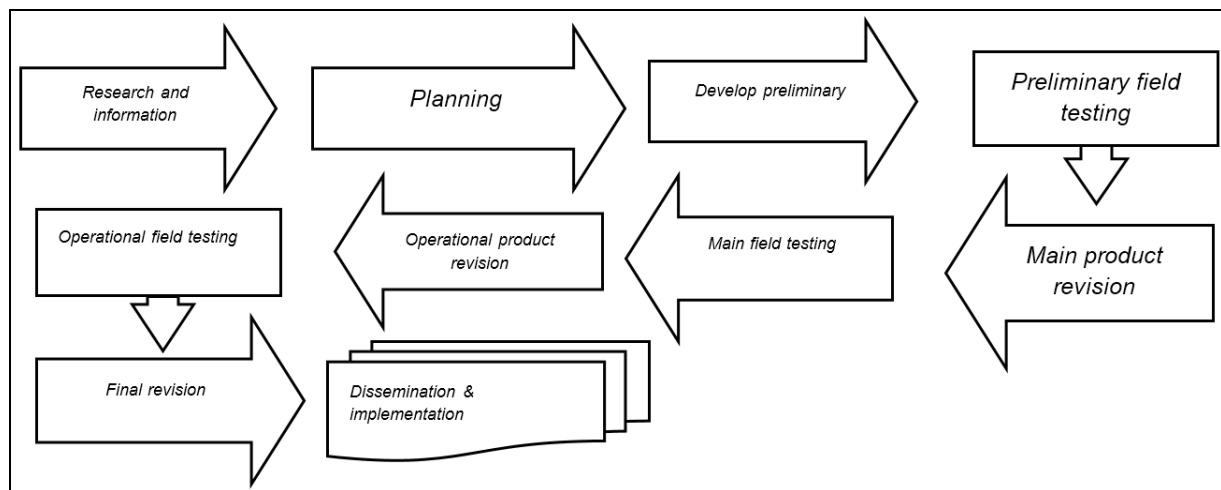
Fig 1: Development phase of Borg and Gall model

3. Result & Discussion
3.1 Result
3.1.1 Product Design and Development
Design and development for the product of manipulative fundamental movement learning for Primary/Elementary School based on interactive multimedia was done based on the result of needs analysis, observation, interview, and literature review relevant toward the developed model. Product design was aligned with Standard of Competences and Basic Competences used by schools which aligned with review of fundamental movement theories and motor development for children. Result in manipulative fundamental movement learning model development for Primary School which based on interactive multimedia was a product in *soft file* under format *.exe packaged in VCD. Components in this manipulative fundamental movement learning model for Primary School based on interactive multimedia consist of text, video, audio, animation and picture.

3.1.2 Interactive Multimedia Product
Below is the development result for interactive multimedia product development after all material was processed into one application.

Fig 2: Display of Manipulative Fundamental Movement Menu

In manipulative fundamental movement menu there were 19 variations available. In order to view and learn the related model, user could click each picture or model text.

The above display was one example of manipulative learning model in manipulative fundamental movement menu. In this display there were several media components such as text, animation, video and audio.

3.1.3 Model Appropriateness

Model appropriateness was tested by experts to give values and input so that it could fulfill the criteria of appropriateness in theoretical and empirical manner. Based on data and response collected from motor learningexperts, physical education experts, and learning technology experts, there were some parts of the product that should be revised. This was done to optimize development benefit for teachers and students.

3.1.4 Model Effectiveness

Table 3: Result of Gain Score Pretest and Posttest for Manipulative Fundamental Movement Skill for Students in SDN 4 Campurdarat Tulungagung

Number of Students	Pretest	Posttest
Overall amount	603	965
Average	15,1	24,1

Based on the table above it can be seen that average for pre test was 15,1 and average for post test was 24,1. Next phase after pretest and posttest data for student's manipulative fundamental movement skill were obtain, author conduct differences analysis for pretest and posttest value by looking for difference between pretest and posttest. T-test (pre test and post test) would be described below to view model effectiveness

3.1.5 Differences Significance Test

Table 4: Paired Samples Test

		Paired Differences					t	Df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	pretes – postes	-9.05000	3.46373	.54766	-10.15776	-7.94224	-16.525	39	.000

In differences significance test using SPSS we obtain t-calculated=-16.525, db=39 and p value=0.00<0.05 which means that there was significant differences before and after being given interactive multimedia-based manipulative fundamental movement skill. Based on the information above it can be said that manipulative fundamental movement model developed was effective for Primary School students.

3.2 Discussion

This study succeeds to conduct model development and create two main product forms. First was variation product of learning model in the form of text book, while the second was interactive multimedia product packed in VCD. Experts have agreed to try out all products with several revisions. During product trial, the model shows effective result with positive contribution in improving student's manipulative fundamental movement skill.

Prayitno and Sukadiyanto (2014) [24] suggest that fundamental movement skill has made students to become more active and happy because physical activities could facilitate children in

exploring its surroundings. Thus, the composed learning model was already suitable to children characteristic and highly appropriate to be used in physical education. Winarto (2015: 167) [29] conduct another relevant study with the title development of rigid (tegar) model for fundamental movement walking, running and jumping. His study concludes that development of rigid model could improve fundamental movement skill. Also, review concerning fundamental movement in physical education learning program also describe that to achieve objectives in physical education would be affected by several factor such as the ability of the teacher in developing learning program, learning model and sufficient facilities to support it.

4. Conclusion

Based on study results, it can be concluded that:

1. Research and development for this model results in a manipulative fundamental movement model based on interactive multimedia complete with its guidelines. This manipulative fundamental movement model consists of 19 manipulative fundamental movement variations. Variation in this manipulative fundamental movement was packed in interactive multimedia.

2. Based on the data obtained, from on field try out and discussion regarding study results, it can be concluded that from this interactive multimedia-based manipulative fundamental movement skill model development for students in Primary School, teacher and students can learn and implement manipulative fundamental movement learning in effective manner. This was based on result of model effectiveness test, which proved empirically that product (manipulative fundamental movement model development based on interactive multimedia) shown larger posttest value than pretest value.

5. References

1. Barnett Lisa M, Louise L Hardy, Ali S Brian, Sam Robertson. The Development and Validation of a Golf Swing and Putt Skill Assessment for Children. Journal of Sports Science and Medicine. 2015; 14:147-154.
2. Borg WR, Gall MD. Educational Research An Introduction. New York : Longman, 1983.
3. Cagno Alessandra di, Claudia Battaglia, Giovanni Fiorilli, Marina Piazza, ArrigoGiombini, Federica Fagnani *et al*. Motor Learning as Young Gymnast's Talent Indicator. Journal of Sports Science and Medicine. 2014; 13:767-773.
4. Chen Weiyun, Weimo Zhu, Steve Mason, Austin Hammond-Bennett, Andrew Colombo-Dougovito. Effectiveness of quality physical education in improving students' manipulative skill competency.Journal of Sport and Health Science. 2016; 5(2).
5. Cohen Kristen E, Philip J Morgan, Ronald C Plotnikoff, Robin Callister, David R Lubans. Fundamental movement skills and physical activity among children living in low-income communities: A cross-sectional study. International Journal of Behavioral Nutrition and Physical Activity. 2014; 11:49.
6. Cools Wouter, Kristine De Martelaer, Bart Vandaele, Christiane Samaey, Caroline Andries. Assessment of movement skill performance in preschool children: Convergent validity between MOT 4-6 and M-ABC. Journal of Sports Science and Medicine. 2010; 9:597-604.
7. Cools Wouter, Kristine De Martelaer, Christiane Samaey, Caroline Andries. Movement skill assessment of typically developing preschool children: A review of seven movement skill assessment tools. Journal of Sports Science and Medicine. 2009; 8:154-168.
8. Culjak Zoran, Durdica Miletic, Suncica Delas Kalinski, Ana Kezic, Frane Zuvela. Fundamental Movement Skills Development under the Influence of a Gymnastics Program and Everyday Physical Activity in Seven-Year-Old Children. Iranian Journal of Pediatrics. 2014; 24(2):124-130.
9. Efendi Napitupulu, Julaga Situmorang, Mursid R. The Instructional Model Development Based on Interactive Multimedia on Technical Mechanics Competence. International Journal of Education and Research. 2014; 2(8).
10. Gallahue, David L, Ozmun John C. Understanding Motor Development: Infants, Children, Adolescents, Adults. New York: McGraw-Hill, 2006
11. Harrow, Anita J. A taxonomy of the psychomotor domain: A guidefor developing behavioral objectives. New York: Longman, 1972
12. Hidayatullah M Furqon. Aktivitas Gerak pada Masa Kanak-Kanak. Solo: Cakra Wijaya Press, 2013.
13. Hoffler TN, Leutner D. Instructional animation versus static pictures: A meta-analysis. Learning and Instruction. 2007; 17:722-738.
14. Imam Santosa CWW. Pengembangan Model Tegar untuk Gerak dasar manipulatifBerjalan, Berlari, dan Melompat. Jakarta: PPS UNJ, 2015.
15. khalajNafiseh, saidonamri. Mastery of gross motor skills among preschool obese children. Journal Science, Movement and Health, 2013; XIII(2):656-661.
16. Komnas Penjas. Menuju Pendidikan Jasmani dan OlahragaBerbasis Riset. Jakarta: Kementerian Negara Pemuda dan Olahraga Republik Indonesia, 2009.
17. Leser Roland. Effectiveness of multimedia-supported education in practical sports courses. Journal of Sports Science and Medicine. 2011; 10:184-192.
18. Leser R, Baca A, Eder C, Karall E, Miko C, Uhlig J. Redesigning the Sport multimedial' E-Learning application. In: Proc. of the 14th Annual Congress of the European College of Sport Science, 2009.
19. Lu C, De Lisio A. Specific for Generalist: Teaching Elementary Physical Education. International Electronic Journal of Elementary Education. 2009; 1(3):170-187.
20. McBride RE. If You Structure It, They Will Learn. Critical Thinking in physical Education Classes. The Clearing House. 2014; 77(3):114-117.
21. Pangrazi, Robert P, Beighle Aaron. Dynamic Physical Education.Usa: Macmillan Pulising Company, 2001.
22. Papalia, Diane E, dkk. Menyelami Perkembangan manusia. Jakarta: Salemba Humanika, 2014.
23. Pereira, José. Sport Education and Direct Instruction Units: Comparison of Student Knowledge Development in Athletics. Journal of Sports Science and Medicine. 15, 569-577 http://www.jssm.org. 2016
24. Prayitno, Sukadiyanto. Pengembangan Model Pembelajaran Gerak dasar manipulatifuntuk Anak Usia 2-4 Tahun. Yogjakarta: Jurnal Keolahragaan UNY, 2014; 2(1).
25. Purwanto Didik. Development of playing skills sepaktakraw exercises models based on interactive multimedia. journal of indonesian physical education and sport. 2017; 3(1).

26. Starc G, Strel J. Influence of the Quality Implementation of a Physical Education Curriculum on the Physical Development and Physical Fitness of Children. BMC Public Health. 2012; 12(61):1-7.
27. Tangkudung, James. KepelatihanOlahragaPembinaan Prestasi Olahraga, Cerdas Jaya, Jakarta, 2012.
28. Wiemeyer J. Multimedia in sport – between illusion and realism. In: Computers in Sport. Eds: Dabnichki, P. and Baca, A. Southampton: WITPress, 2008, 293-317.
29. Winarto, Imam Santoso W. Pengembangan Model TEGAR untuk Gerak dasar manipulatifBerjalan, Berlari dan Melompat. Disertasi Doktor, tidak diterbitkan. Jakarta: Universitas Negeri Jakarta, 2015.