Sys Rev Pharm 2020;11(6):1279-1284
A multifaceted review journal in the field of pharmacy

Model of Physical Education in Digitalization Era: Improving Thinking Activities and Physical Conditions

IIS MARWAN[1], NIA ROHAYATI[2]

[1.] Departement of Physical Education, University of Siliwangi INDONESIA
[2.] Departement of Language Education, University of Galuh INDONESIA
iismarwan@unsil.ac.id, http://www.unsil.ac.id

ABSTRACT

Purpose: The era of the industrial revolution 4.0 applies digitalization in all systems, including sports equipment. The physical education learning process from being conventional can change using modern digitizing equipment. This study aims to make models of thinking and moving activities in the physical education learning process applying a microcontroller.

Methods: Research and development as the main method of this research. To see the effectiveness of quasi experiments used, for four weeks. Forty students (20 girls and boys) in grade VIII junior high school (ages 13 to 15 years) participated in the role model using microcontroller. Each group of 5 students makes a game by determining the direction of the envelop run to be passed with a map from a handphone. Group discussion can determine the agreement of the order that ran first and the direction (the way to think). The fastest average from the team to the finish is declared champion (movement activity). A complete factorial mixture variance analysis was performed, in which the grouping of abilities functioned as variables in thinking ability and physical quality. Hierarchical linear regression analysis is used to determine the effect of role games using a microcontroller, grouping conditions, and gender on thinking ability and moderate-strong physical activity.

Results: There is a significant increase in the application of microcontroller role games for physical education learning to critical thinking abilities and physical abilities (speed, agility, endurance, reaction speed, and flexibility) for both male and female students. There is a disordinal interaction between skill level and ability grouping on each of the three performance variables (percentage of success, level of thinking ability and physical performance increases). The level of thinking ability and performance significantly increased.

Conclusion: Physical education learning models with digitizing microcontroller role games improve critical thinking skills and physical abilities both individually and in group collaboration. The limitations of research do not reveal the game skills or physical strength.

Keywords: Physical Education Model, Digitalization, Thinking Activities, Physical Ability

INTRODUCTION

At present, the world is entering the era of the 4.0 th industrial revolution in which technology has become the basis in human life. Everything becomes infinite and unlimited due to the development of the internet and digital technology. This era has influenced many aspects of life both in the economic, political, cultural, artistic, and even to the world of education.

The progress of a country to catch up is very dependent on three factors namely education, the quality of institutions and the availability of infrastructure. Education is very important to improve quality human resources. Improving quality human resources requires quality education.

The relationship of education with the 4.0th industrial revolution is that education is demanded to follow the development of rapidly developing and sophisticated technology and utilize information and communication technology as a facility to expedite the learning process. The use of information and communication technology changes learning from teacher-centered to student-centered. Today the world is at the beginning of a revolution that fundamentally changes the way humans work and communicate with others (Schwab, 2016).

A series of new technologies have penetrated human life, influenced and changed the habits and procedures of life, and accelerated the development of science. Life today is often called experiencing technology disruption because of rapid changes that follow the progress and use of technology.

Teachers are required to be able to adapt to rapidly developing technology so that the learning tools and teaching and learning process are innovative and creative. Traditional education can no longer intensively involve students in the learning process and educate them to achieve the abilities and skills needed to live in the 21st Century (Thomas, et al. 2016). Digital technology is considered as a tool that can enable students to hone the ability to solve authentic problems as needed, not to act as a passive recipient of knowledge from the teacher. The e-learning model is only on the cognitive aspect, but psycomotor is not touched. (Moyle, K. 2010).

Physical education learning requires physical activity so that the learning process to move, as well as learning through movement, developing and enhancing individuals organically, neurovascular, perceptually, cognitively, and emotionally, increasing organic, neuromuscular, interpretative, social, and emotional abilities, producing complete humans, healthy and fit. The motion was consciously designed by the teacher and given in the right situation, so as to stimulate the growth and development of students.

Since 2015, the United Nations Educational, Scientific and Cultural Organization (UNESCO) has positioned physical education (PE) to connect human movement to healthy living, social tolerance, conflict resolution, citizenship, and learning capacity needed in order to live a peaceful, healthy and active lifestyle (UNESCO, 2015).

Physical education is a medium to encourage the development of motor skills, physical abilities, knowledge,

sportsmanship attitudes, habituation of healthy lifestyles and character formation (mental, emotional, spiritual and social). (Marwan, Iis, 2017). We state further that allocating increased curricular time to PE alone is an effective intervention to improve student learning (Dean Dudley, Raewyn Burden. 2019).

The process of learning physical education traditionally and conventionally is done with the amount of active time in activities, but for now added the ability of high order thinking. Teachers are required to design challenging physical education learning, develop critical thinking skills, analyze, discover, arrange and apply problem solving steps, infer and reflect, with a balanced amount of physical activity time. (Marwan, Iis, 2018). Smartphone controlled has attracted researchers in last few decades at a great manner. (Deependra Pandey, Nihal Gupta. 2018).

Researchers focus on creating physical education learning models by utilizing the results of digital technology that can improve thinking and moving activities through the use of an android system connected to a microcontroller.

MATERIAL & METHODS

Participant. Forty students (20 girls and boys) in grade VII junior high school (ages 13 to 14 years) participated in the role model using microcontroller. Each group of 5 students makes a game by determining the direction of the envelop run to be passed with a map from a cellphone. Group discussion can determine the agreement of the order that ran first and the direction (the way to think). The fastest average from the team to the finish is declared champion (movement activity).

Experimental design. This type of research is Research and Development / RD, the method used to produce certain products, and test the effectiveness of these products (Sugiyono, 2013). The development model used is the Luther-Sutopo version of the development model known as the Multimedia Development Life Cycle (MDLC) method. The development model according to Luther (Sutopo, 2003), is carried out based on six stages, namely concept, design, material collecting, assembly, testing and distribution.

Instrument. Data collection using instruments included: interview guides for students, print validation sheets and applications by material experts, print validation sheets and applications by media experts, print validation sheets and applications by linguists, student questionnaire responses to applications, learning implementation sheets, sheets field notes, and concept understanding tests.

To measure the usefulness of the application resulting in an increase in physical components is carried out with tests of speed, agility, endurance, reaction speed, and flexibility. As for the ability to think critically using a mathematical ability test. The steps taken at the implementation stage include: (1) Development of test instruments, which consist of: define stage consisting of: (a) front-end analysis, (b) learner analysis, (c) material analysis, (d)) compile the test specifications, the design phase consisting of: (e) compiling the item item grid, (f) writing the item, (g) limited test reproduction, the developing stage consisting of (h) one to one, (i) qualitative analysis, (j) conducting test trials, (k) quantitative analysis, (l) revision, (m) assembling tests, the disseminate stage consisting of (n) mass production; (2) Carry out a test. After the step of developing the test instrument is complete, the next step is to conduct the test. Tests that have been prepared are given to the tester to be completed. The researcher will give respondents a high-level mathematical thinking ability test; (3) Interpreting test results.

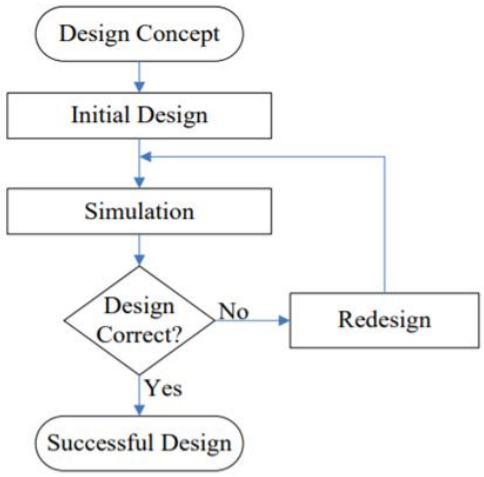
Statistical analyses. Distribution normality and homogeneity of the data were initially assessed by using the Shapiro-Wilk and Levene's tests, respectively. Data were expressed as the mean ± standard deviation, and the level of significance adopted for all analyses was $P < 0.05$. ANOVA two way with repeated measurements (group vs. sessions) was used to analyse the performance among the sessions and group. The training effect on 10 m sprint was evaluated through of ANOVA three-way with repeated measurements (group [SS x CS] vs. start type in the 10 m test [standing x crouch] vs. time [pre- x post-training]). In case of significant difference, Tukey post hoc was used. Cohen's effect size was calculated by the difference between the pre- and post-training values divided by the pooled standard deviation16. The values found were defined as trivial ($d < 0.2$), small ($0.2 < d < 0.5$), moderate ($0.5 < d < 0.8$) and large ($d > 0.8$) (COHEN, 1988).

The stages of making a microcontroller tool design for physical education learning are carried out as developed by Uzedhe O. Godwin, et al. (2013). Any design process comprises a basic sequence of tasks that are performed in various situations. Assuming that we have an initial concept about what should be achieved in the design process, the first step is to generate an initial design. This step often requires a lot of manual effort because most designs have some specific goals that can be reached only through the designer's knowledge, skill, and intuition. The next step is the simulation of the design at hand.

Figure 1 The Design Loop (Uzedhe O. Godwin, et al. 2013)

RESULTS OF THE RESEARCH

This research produces a product in the form of an android system that is connected to a microcontroller that functions to create a network on the intended path. The product of this



research was made by utilizing the Emindmaps application, with the aim of getting a concept map that is not only a concept map but also contains material, animation, and interactive multimedia in the concept map.

The description of the learning process is carried out in stages of five students in a team, discussing to make a route that must be traversed using a smartphone that is connected to a microcontroller, the path traversed like an envelope run, each student is required to save a flag on each designated post for which they are assigned, sequentially student number and destination post. If there is an error saving the microcontroller flag, it must be repeated from the beginning. The fastest team play role playing method to complete the task (saving flags according to the post) is declared the winning team. (Schwartzbeck, T.D & Wolf, M.A. 2012).

The results of development research have been summarized in several stages in accordance with the development model which consists of 6 stages, namely concept, planning (design), material collection, manufacture (assembly),

experiment (testing) and distribution, (Davies, 2011); (Eppler, 2006) explained that concept maps are networks that connect interconnected concepts and ideas that are interconnected with each other, besides describing important concepts, they also connect between existing concepts. because it is more concise and not confusing when studied, the concept map used by the e-mindmaps application, the e-mindmaps application is used because it is easier to use and can be accessed via smart phones with the help of playstore so as to facilitate student learning.

The next stage is the development or stage of making media. In making media adapted to designs that have been designed. In the development process, validation is carried out to determine the feasibility of the media. (Marwan, Iis, 2019). Validity test is carried out on expert certified physical education instructors (teachers). Sugiyono (2013) states the validity of non-test instruments is sufficient to meet construct validity. Testing the validity of construction can be used the opinions of experts (judgment experts). According to Messick as quoted by McClure (1999) the value obtained by the media that has been validated by experts can be a reference to determine whether the media can be used by researchers for further testing or not.

Based on the results of the calculation of data validation of teaching materials based on android applications by media experts, the attractiveness component of the application has a decent criterion with a very good predicate and other components have a decent criterion with a good predicate. Overall, the application has a percentage of 80.83% and has decent criteria with good predicate. Georgiev, et al (2004) explained that despite all its shortcomings, mobile learning will become more popular with the advancement of information and communication technology. Mobile learning in general use in traditional education in accordance with educational needs to improve its quality.

Based on the calculation of the results of the validation of an Android-based application by a material expert. The relevance component of the material and organizing the material has a decent category with good predicate, while the effect component for the learning strategy has a decent category with a very good predicate. Calculation of overall product eligibility percentage shows that the android-based application has a decent category with a good predicate (81.1%) so there is no need for a comprehensive revision. Teaching materials after being validated, will be revised according to the input based on the results of the validator review, then tested according to 15 students. Based on the trial results getting a value of 91.25 with very interesting qualification criteria and can be used without revision, the validation values are detailed in Table 1

Table 1. Results of student assessment on medium group trials

No	Aspect	Number of Indicators	Maximum Score	Validation Score	Percentase (%)	Category
1	Victory	8	32	29	91,9	Very good andNo revision needed
2	Clarity of material presentation	4	16	14	91,25	Very good andNo revision needed
3	Efficiency	4	16	15	96,8	Very good andNo revision needed
4	Multimedia interactivity	4	16	15	96,8	Very good andNo revision needed
	Total	20	80	73	91,25	Very good andNo revision needed

The results of the validation of the media and design experts are presented in Table 3, then the level of achievement of teaching material eligibility can be calculated. The results of the calculation of the percentage of 91.25% and included in the category of very good, but still revised according to the suggestions and responses of students testing.

After the device model developed is accepted as feasible by a physical education expert, a trial is carried out on the effectiveness of the equipment developed. The results are as shown in Figure 2.

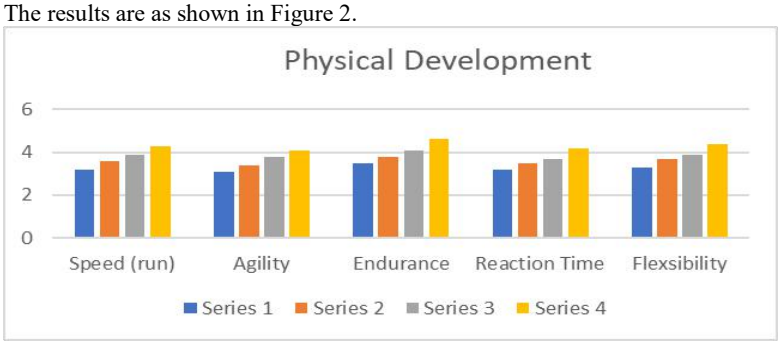


Figure 2 Physical Development

Figure 2 shows the increase in physical development aspects of running speed, agility, endurance, reaction speed and flexibility every week. After correcting and calculating, the data obtained from students' high-level mathematical thinking ability test results in Figure 3 below:

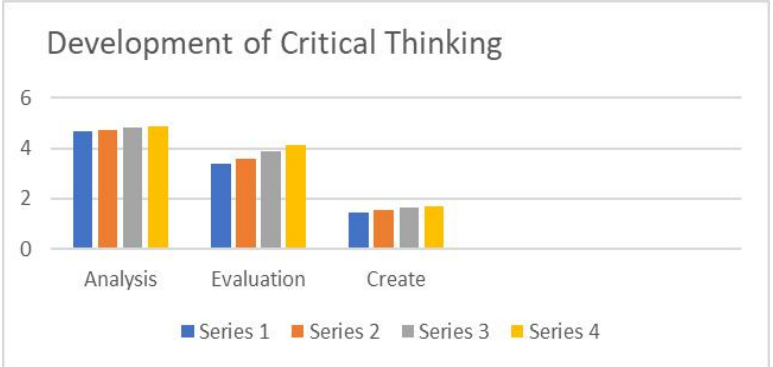


Figure 3 Development of Critical Thinking

Based on Figure 3 it can be concluded that students' high-level mathematical thinking ability is quite good. As for the details of students' high-level mathematical thinking abilities, when viewed from the indicators, the ability to analyze, evaluate, and create students all fall into sufficient criteria.

DISCUSSION

Physical education is an educational process that utilizes physical activities that are planned systematically, aimed at developing and enhancing individuals organically, neumuscularly, perceptually, cognitively, and emotionally, within the framework of the national education system, Rosdiani (2013). The process of learning to move, and learning through motion. The hallmark of physical education is learning through experiential movement to achieve teaching goals through implementation, physical activity, play and sports, (Marwan, Iis. 2019)

The physical education learning process still has to do physical activities, the more optimal it can be to produce optimal physical conditions. Without moving does not describe the process of physical education, meaning physical education is carried out with mobile activities.

With the development of digital technology, physical education teachers need to use it as needed. Digitizing has many advantages in managing data, including: unlimited storage of data volumes, saving storage, can be accessed anytime through the internet, easily accessed by keywords, digital data management is cheaper, and data can be accessed simultaneously by many people (Managed Outsource Solution, 2017).

Various forms of data and information digitized are collected in large numbers, become digital sources for various purposes, and are further developed. If digitizing is the process of transferring data to digital, then digitization explains the strategy to adopt the latest information and communication technology to utilize various digital information and data from various sources. This digitalization can increase productivity, efficiency and effectiveness when used appropriately (Balachandar, 2015).

Creativity is basically an internal ability at the level of ideas, to create and bring up new ideas. Psychologists create categories of product-oriented creativity and process-oriented creativity (Smith, 2005). Product-oriented creativity assumes that creativity is interpreted as an original work product and is useful for meeting certain needs (Lederman & Vagt-Traore, 2004). Process-oriented creativity refers to mental processes that involve a person's creative potential to develop new ideas, problem solving and self-actualization (Lederman, & Vagt-Traore, 2004).

The creativity of students can be developed through a learning process that is based on the ability to manage the learning process, giving freedom to students to create and take risks for success or failure (Bauer & Kauffman, 2006; Craft, 2005). In his study of creativity, Robinson (NAACCE, 1999) put forward 3 characteristics of creativity, including imagination, purpose and originality.

Mulgan and Albury (2003) define the essence of innovation as 'new ideas or ideas that bring about change or results', or more fully explained as the creation and implementation of new processes, products, services, methods that result in significant improvements in efficiency, effectiveness and quality. When associated with creativity, it can be concluded that creativity and imagination are the seeds of the ability to innovate. (James, V. et al. 2004).

There are two assumptions that underlie the approach to creativity in education. First, as stated by Craft (2001) and Bauer & Kauffman, (2006) creativity is universal, not only owned by a handful of great individuals, but truly everyone has creative potential. Educational experts have a belief that children are naturally creative people, who have an internal drive to develop themselves, express and use their capacities, be open and tend to be interested in new things. (Jackson, N., et al. 2006). This natural potential can recede and disappear if it is not nurtured and developed through intervention and a conducive environment (Feldman & Benjamin, 2006; Maslow 1996).

Digital learning is designed to provide opportunities for students to develop critical reasoning and problem solving, through collaboration and communication with other students through the provision of assignments and the use of information resources prepared by organizers and online sources open to the public. (Fryer, M. 1996). In the learning scenario students are directed to explore creativity, innovation and creativity. (Seel, N.M. ed. 2012). On the one hand, the abilities and skills gained contribute to the achievement of learning outcomes, but more than that can open horizons of students' insights and interests in other fields that were not previously thought of.

The smart phones have penetrated so deep into the lives of an individual that they have become an indispensible component in one’s life. Instead of designing another gadget for control of home appliances, the hand held smart phone of every individual can be made as a controlling device and this also makes a sense. (Mabu Sarif B, Navatha K, Hari Tarakesh LVS, et al. 2018).

The installation of this microcontroller needs a strong signal, so it does not interfere with the learning process. The type of connection affects the signal processing and should be precisely considered when designing signal processing embedded into programmable analog signal processors. (Adam Krzysztof Piłat, and Jakub Klocek. 2012).

In addition, the teacher's understanding of ways or techniques to activate students' creativity and innovative power is inadequate, not to mention the unavailability of infrastructure that is a barrier. Sahlberg (2009) identified the possibility of a 'fear of failure', worrying about failure, which could weaken the capacity of teachers in schools and students to take risks, thus hampering the development of abilities and opportunities for creativity and innovation. Characteristics of effective teaching were demonstrated by all participants regardless of curricular emphasis. (Julene Ensign, Amelia Mays Woods, and Pamela Hodges Kulinna. 2016).

Educators sometimes feel very well established by teaching and managing learning, so they are reluctant to try new ideas and ways that are considered out of the ordinary. The use of information technology in teaching and learning is still not a common thing to do. (Moore, J. L., et al. 2011). But seeing the rapid development of digital usage in society, educators are also affected by having high enough digital readiness, so that they are ready to 'get out of the safe zone' and enthusiastically explore new approaches to learning. Therefore, educators must at least be accustomed to using various online gadgets, and have adequate information literacy.

The microcontroller is set the program to take a decision for any given input and provide the output according to input operation, then it takes the decision to drive the motor in order to drive the motors in the forward and backward direction and then left and right direction. (Versha Kashyap, Bhawna Saini, Anil Kumar, Praveen Kumar, 2019).

These findings suggest that the pre-professional socialization experiences of teachers also include the development of

cultural templates, biases, and values, and that many teachers may not accurately or critically reflect on their teaching practices. (Sara B. Flory and Nate McCaughtry. 2014).

Teachers rated themselves as significantly more often reinforcing and modeling good sportsmanship and punishing poor sportsmanship than students reported. Coaches rated themselves as significantly more often reinforcing and teaching good sportsmanship than perceived by their athletes. (Nicole D. Bolter, Lindsay Kipp, and Tyler Johnson, 2017).

The findings align with and extend to previous research that suggests technology experiences must be dynamic, authentic, and tailored for individuals at different stages of technology adoption. (Jun-Hyung Baek, et al. 2017).

The findings of this study are in response to that physical education teachers have been criticized for not implementing progressive or innovative instruction resulting in enhanced student knowledge and skills for lifetime participation in physical activity. (Ben D. Kern, Kim C. Graber, Amelia Mays Woods and Tom Templin. 2019).

CONCLUSIONS

This research found a new product consisting of a physical education learning model by utilizing industry advancements 4.0 consisting of an android digitizing program that is integrated with a microcontroller so students can work together in determining the direction that must be traversed in this way to improve thinking skills and help in accelerating. Through this model created by well-built groups. It is important to be informed about the improvement in critical thinking skills and physical abilities obtained after the fourth week of the learning session. Digital-assisted learning is designed to provide opportunities for students to develop critical reasoning and problem solving, through collaboration and communication with other students, through the provision of assignments and use of information resources provided by physical education teachers. Research limitations do not reveal game skills.

The spectrum of creativity and innovation in the use of technology is very broad, encompassing not only the development of student creativity as a result of education, but also the use of computer technology to create models and modes of creative learning, as well as various development of learning materials that attract and motivate students, which are developed independently by the teacher physical education.

In the learning scenario students are directed to explore creativity, innovation and creativity. On the one hand, the abilities and skills gained contribute to the achievement of learning achievements, but more than that can open horizons of students' insights and interests in other fields that were not previously thought of.

RECOMMENDATION

The development of industry technology 4.0 by connecting to the microcontroller program can be utilized for physical education learning as long as the creative and innovative teacher creates teaching models, learning activities or learning objectives. In this way can arouse student motivation, so that the learning process is active, and fun.

Physical education teacher training is needed in developing learning innovations by utilizing the results of innovative industry 4.0 technology.

Finally, future studies must investigate the effects of various types of innovative industry technology for the benefit of physical education at various educational levels.

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