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Reaction Speed Training Sensor Aids Development for Taekwondo

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Abstract

Modern developed countries have used technology in the field of sports, and as a result, they frequently outperform their competitors. Some countries have yet to incorporate technology in sports since it is expensive, therefore they continue to rely on traditional techniques. The purpose of this study is to create a product that can be used for kick reaction speed training in taekwondo sports. This study is a development study that employs ten stages of development processes. In this study, data was gathered using product validation questionnaires, respondent questionnaires, interviews, and documentation. In this study, descriptive percentages were utilized as a data analysis technique. The findings of this study are in the form of a sensor tool based on a smartphone application for training kick reaction speed in the Taekwondo martial arts branch. Research result on a small-scale trial involving 10 athletes yielded a percentage score of 73%. A large-scale study including 45 athletes and 4 coaches yielded a percentage score of 92 percent athletes and 92 percent coaches, earning them the "extremely feasible" category. Conclusion this study resulted in a smartphone application -based sensor tool product with a function to train kick reaction speed in the taekwondo martial arts branch, which has a good tool effectiveness and gets a positive response from both coaches and athletes.

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INTRODUCTION

Sport is a physical activity that is very important to enhance human quality, and as a result people can be physically and mentally healthy (Akbar & Pramono, 2020). Regular exercise has the potential to improve human health and physical fitness (Guiney & Machado, 2013). In addition, exercise serves to achievement in both championships provincial, national or international. The strength of a country is no longer only seen from welfare, education, economic and military, but also in the form of athletic achievement (Muslima & Himam, 2016).

Martial arts are an activity that combines sports and art components, associated with the tradition of hand-to-hand combat or using certain tools that has the main purpose is to protect oneself from physical attack (Cynarsky & Skowron, 2014.) Martial arts not only used to self-protection, but also used for children's education, character cultivation, physical fitness, mental strength, spirituality, and achievement (Tadesse, 2017).

Taekwondo is a martial sport originating from Korea which is also popular in Indonesia, taekwondo consists of three basic words, namely; tae means the foot, for attacking the opponent with a kick technique, kwon means the hand to hit or hold the opponent's attack, and do which means the art or way of self-discipline (Tatya Admaja & Sugiyanto, 2019).

Some of the dominant physical components that must be trained continuously for martial arts athletes are reaction, coordination, and speed. These three things are closely related to some of the techniques needed in martial arts, that is kick technique, punch technique and defense technique. A good reaction will benefit the athlete in attacking both through kicks and punches. Fast reaction time will produce a good reaction speed, especially to visual stimulation, very important in martial arts to have a good reaction speed, therefore, it will benefit the athlete in gaining points (Cojocariu et al, 2015).

The government regulation of the republic of Indonesia number 16 of 2007, concerning the implementation of national sports, chapter ix article 72 regarding sports science and technology, also emphasizes that the government, regional governments and the community are responsible for carrying out the development of sport science and technology in a planned and sustainable manner to advance national sports. In the same government regulation above, in the third chapter article S1 paragraph (1), it is mandated that the development of sport science and technology is carried out through research, study, socialization, scientific discoveries and cooperation between research institutions and higher education institutions both nationally and internationally.

Technology is something that can't be separated from everyday human life in modern times as it is today. Nowadays, technology is developing very rapidly, which can be proved by looking at a lot of innovations that have been made, one of them is technological advances in sports (Putra & Rusdiana, 2019).

Developed countries currently have used technology to support the achievements of their athletes, for example developed countries that have succeeded in sports by utilizing technology such as the United States, Germany, and other countries (Giartama, 2020).

Countries that have involved technology in the implementation of sports tend to have a higher opportunity of achievement, that can be happen because technologically advances tools have a higher level of accuracy compared to manual tools (Kos et al., 2018). The involvement of technology in sports is not yet accepted in all countries, do to technologically advanced tools have an expensive price. Due to the high cost of high-tech tools, manual method and tools are still used (Permatasari, 2016).

Sensors are detectors that have the ability to measure some type of physical quality that occurs, such as pressure or light. The sensor will then be able to convert the measurement into a signal that will be readable by the electronic device that will perform the measurement and recording (Devi Fatma Nurlina, 2017).

The data that obtained by the researcher to conduct interviews with several national taekwondo experts, stated that the tools for training reaction speed were still few and ineffective. Development research conducted by researcher is strongly supported by taekwondo

expert to be developed. Therefore, based on the background above, the researcher is interested in conducting research on reaction speed training sensor aids development for taekwondo. The development of this reaction speed training sensor aids is expected to be one of the ways to improve taekwondo achievements in Indonesia.

METHOD

This type of study is research and development (Sugiyono, 2010). This study aims to develop a kick reaction speed training tool.

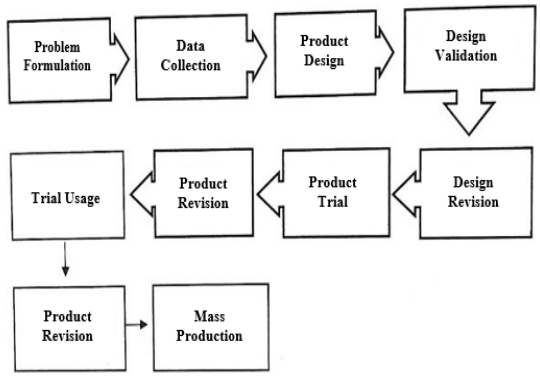

Figure 1. Steps for the Research and Development (R&D) Methods. Source: (Sugiyono, 2010)

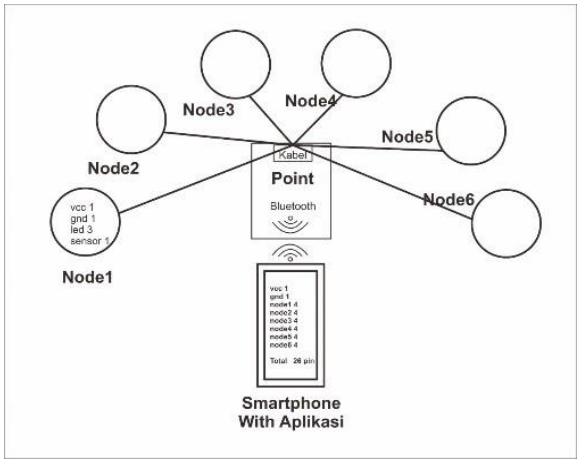

Figure 2. Sketch of Usage Procedure

Figure 3. Taekwondo Athletes Perform Reaction Exercises Using Developed Tools

The use of the tool when kicking, in the initial position the athlete stands in front of the tool then the eyes and ears see and listen to focus on the reaction speed tool that has been set by the coach. The athlete's response must be fast, the kick uses Yoep Chagi's kick, the kick is only done near the light sensor without hitting the tool using more energy, the distance between the tools is 1 meter. Kicks are taken when the lights are on, the duration of the lights consists of 1 to 10 seconds. The duration of the lamp that I used in this study was 3 seconds. The light only lights up for 3 seconds, if the athlete does not respond as quickly as possible, the light that will be kicked by the athlete immediately turns off and immediately switches to another light and so on. Athletes who do not have a quick response will not get points, points earned athletes who react quickly will get one point per light. . The duration of light exercise consists of 1 minute to 10 minutes, the duration of the exercise that I use is 1 minute. The lights turn on randomly and every 10 seconds the lights will change color, the color consists of red, blue and green. Given 1 minute to do the speed reaction exercise. The estimated light life time is 3 seconds for one kick, if the athlete's response is faster than the specified time, the result will be more than 20 times.

Table 1. Evaluation Classification

No.	Score	Category
1	31-40	Very Good Reaction
2	26-30	Good Reaction
3	20-25	Quite Good Reaction
4	>20	Not Good

Figure 4. Components of Tool Used in Research

The materials and their uses needed in the manufacture of Reaclight are as follows: (1) PCB Fiber, namely; for electronic lines and places for electronic components; (2) NRF24L01 Module, namely; as wireless communication between devices; (3) Arduino nano namely; control or brain of the device; (4) Push Button namely; to provide mechanical impulses / touch impulses; (5) The switch that is; to turn on the appliance; (6) Capacitor 10uf ie; as a signal stabilizer; (7) Mini Step up, namely; as a voltage reducer; (8) Charge Module, namely; for lipo battery charger; (9) 3.7v battery ie; as a tool resource; (10) Battrey 1S 3.7V module ie; to check the battery; (11) Bluetooth ie; as smartphone communication with tools; (12) RGB LEDs namely; as the main indicator (which can be lit); (13) Box 3D Print, namely; as protection or packaging. Reaclight is a sensor tool for reaction speed training based on a smartphone application that was originally modified by researchers. The initial idea for naming this tool was a collaboration between reaction and light, thus creating the name reactlight. This product is an original product and a modified tool from the researcher's own idea.

Sources of data in this study obtained from quantitative and qualitative data. Qualitative data obtained from the results of questionnaires from material experts and media experts in the form of input and suggestions on product improvement. Furthermore, quantitative data was obtained from the answers of athletes, coaches and expert validators to the questionnaire questions. The research subjects conducted in this study were divided into 2 groups. One group in small-scale trials and the second group in large-scale trials. Small-scale trials, the test subjects at this stage amounted to 10 junior taekwondo athletes. In a large-scale trial, the subjects of this stage were 45 taekwondo athletes.

The instruments in this study consisted of 1). Product validation sheet, 2). Questionnaire for taekwondo coaches and athletes, 3). Interview.

The results of the evaluation of product quality aspects using the percentage classification table are as follows:

Table 2. Percentage Classification

Percentage	Classification	Meaning
75-100	Very Good	Very proper
50-75	Good	Proper
25-50	Quite Good	Quite Proper
0-25	Not Good	Not Proper

Source : (Sugiyono,2018)

This research uses descriptive percentage analysis technique. Descriptive percentage analysis technique is used to process the data obtained from the results of small-scale trials and large-scale trials. The results of data analysis became the basis for the improvement of this development research. The formula used is the percentage formula according to Sugiyono (2018).

$$P = \frac{f}{N} x100\%$$

RESULT AND DISCUSSION

Research development conducted by researchers through several stages. The research starts from initial product validation, product trials, namely small-scale trials and then use trials or large-scale trials until a mass product is produced where the product can be used for its benefits. This study involved 4 expert validators with their respective expertise, namely electronics experts totaling two validators and taekwondo material experts totaling two validators consisting

of national trainers. A small-scale product trial involving 10 athletes and 1 coach. The large-scale trial involved 45 athletes and 4 coaches.

The product produced in this study is a reaction speed training tool in taekwondo sports using sensors based on smartphone applications. This training tool before being used must be set in advance from the smartphone application, the features contained in the application consist of a bluetooth button, filling in the athlete's name, athlete's age, selection of sensor variations consisting of 3 variations, selection of sensor duration consisting of 1 second to 1 second. /d 10 seconds, the selection of the duration of the exercise consisting of 1 minute to 10 minutes, the existence of a start or stop button, and a score description.

Product validation is carried out using an instrument in the form of a questionnaire to find out how far this tool is said to be feasible to be tested. The questionnaire/questionnaire used in the research process as product validation data and the effectiveness of the tool will be analyzed using a percentage formula that will produce data on whether the product is suitable for use or not. At the same time, data checking was carried out by using other data collection such as documentation and discussions on more sources in the same way, namely the observations of researchers and experts. The discussion that was conducted after the trial process on a small scale and large scale development of a reaction speed training tool using a smartphone application-based sensor that was used to provide comments and input was one of the techniques for checking the validity of the data by experts. Descriptive notes are used to record and record all events carried out during the course of the study. Reflection is related to the proper provisions in the process of implementing the related usage trials in terms of knowing the effectiveness of the product development of reaction speed training tools using sensors based on Smartphone applications. During the trial, recording and taking photos were carried out in an effort to meet the adequacy of references and documentation.

Reaclight Tool Reaclight Application

Figure 5. Products Before Expert Validasi

Before the Reaclight product is tested, the product is validated by experts according to the sport branch. This research is a research on the sport of taekwondo. Sabeum David Abastyan and Sabeum Rheza Ariya Daniswara are national taekwondo trainers, he was chosen by researchers as experts in taekwondo martial materials. The research electronics expert asked Dr. Ir. Made Sudana M.Pd. IPM, as an electronics lecturer at the Universitas Negeri Semarang, and Oky Putra Pamungkas S.Pd as an electronics practitioner. The validator in this study observes Reactlight and fills out an evaluation sheet for this tool. This validation is used to revise the tool before it is used for small-scale trials.

The data obtained from filling out questionnaires and interviews with taekwondo experts and electronics experts became the basic guidelines for the results of the initial product development of reaction speed training aids, namely Reacligth. The first stage of validation was carried out on taekwondo expert validators, namely Sabeum David Abastyan, and Sabeum Rheza Ariya Daniswara in February 2021 in Semarang which resulted in a report that the tool in principle had worked according to the function that had become the main goal, but in the first stage of testing there were still shortcomings in smartphone applications, namely the absence of the led transition feature, set mode, the time on the device is not appropriate and the cellphone tripod is changed to a light tripod, to make it more sturdy when used. Here are the results of the first validation by a taekwondo expert:

Table 3. Taekwondo Expert Validation Result Phase I

No.	Expert Validator	Score	Percentage	Criteria
1	A1 (David Abastyan)	92	92	Very good and worth using
2	A2 (Rheza Ariya Daniswara)	81	81	Very good and worth using

Table 4. Results of Phase I Electrical Expert Validation

No.	Expert Validator	Score	Percentage	Criteria
1	B1 (Dr Ir. I Made Sudana M.Pd)	93	93	Very good and worth using
2	B2 (Oky Putra Pamungkas S.Pd)	84	84	Very good and worth using

Based on the results of the evaluation of taekwondo experts and electrical experts, it was found that the product met the criteria very well. However, the conclusion from the first stage of the product is that it is not suitable for small-scale trials because there are still deficiencies in the application and tools, so the expert recommends conducting small-scale trials after making improvements.

The second stage of validation can be carried out if the first stage of validation has been evaluated by experts, both taekwondo experts and electronics experts. Revisions, suggestions and inputs given by experts in the first stage will produce products that are ready to be tested in the second stage. The second stage of validation is carried out in March 2021.

Table 5. Results of Phase II by Taekwondo Expert Validation

No.	Expert Validator	Score	Percentage	Criteria
1	A1 (David Abastyan)	95	95	Very good and worth using
2	A2 (Rheza Ariya Daniswara)	86	86	Very good and worth using

Table 6. Results of Phase II by Electrical Expert Validation

No.	Expert Validator	Score	Percentage	Criteria
1	B1 (Dr.Ir Made Sudana M.Pd)	94	94	Very good and worth using
2	B2 (Oky Putra Pamungkas S.Pd)	91	91	Very good and worth using

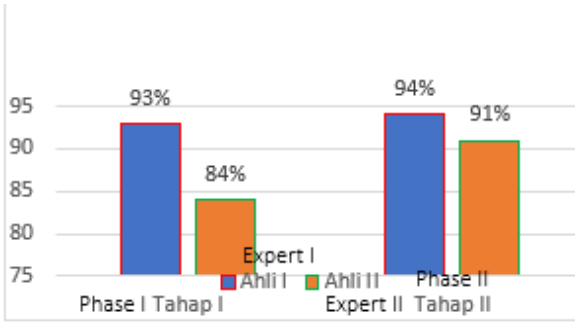

Figure 6. Comparison of the Average Percentage Results of Phase I and II Electrical Expert Validation

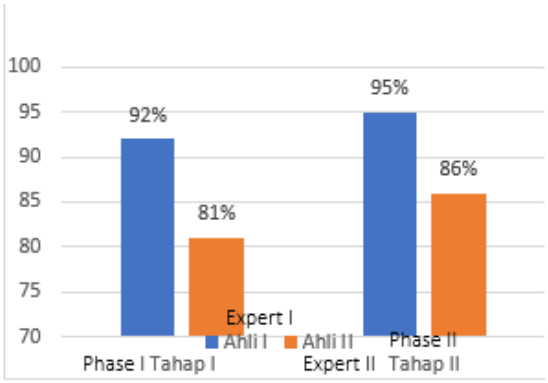

Figure 7. Comparison of the Results of the Validation of Taekwondo Experts Phase I and Phase II

Based on the results of the product validation phase II, it received several revisions because it was deemed sufficient and better than the previous product, then the product was ready

for large-scale trials and was categorized as suitable for use.

Table 7. Product Revision Phase I

No.	Revised Section	Reason for Revision	Suggestion for Improvement
1	Features in the application do not match	Unable to be used	Features Addition
2	Timer on device	Inaccuracy both minutes and seconds	Consultation and improvement
3	Mobile Tripod	Unsteady	Replace the lamp tripod

The first phase product validation process carried out in February 2021 was completed, the next step was to revise the product according to input from experts, in order to perfect the product, and then it could be tested on a small scale.

Table 8. Product Revision Phase II

No.	Revised Section	Reason for Revision	Suggestion for Improvement
1	LED lights off on one device	Delay	Change
2	Cable	Not connected	Apply adhesive glue
3	Green led light	Invisible	Change
4	Sensitive sensor	Error	Give sensor cover

The product validation process phase II which was carried out in March 2021 was completed, but got several revisions again, the next step taken by researchers was to revise or improve the product according to input from experts, in order to perfect the product, and then it can be tested on a large scale.

A small-scale trial was conducted in March 2021 for 10 taekwondo athletes at the LSG taekwondo training ground. Based on small-scale trials, the assessment of 10 athletes scored 59 out of a maximum score of 80 with a percentage of 73%. With this percentage, the product of developing reaction speed training equipment in taekwondo is included in the "Eligible" category.

Table 9. Large-Scale Trial Results

Subject	Score Obtained	Maximum Score	Percentage	Category
UPGRIS Athlete	88	99	88	Very Eligible
TC Athlete	98	108	90	Very Eligible
GTC Athlete	190	198	95	Very Eligible
Total Score	375	405	92	Very Eligible

Based on the large-scale trial table above, it can be seen that the assessment of 45 athletes consisting of 3 different groups of athletes got a total score of 376 out of a maximum score of 405, with a percentage of 92%. With this percentage, the product for developing reaction speed training equipment in sports is included in the "Very Eligible" category.

Based on large-scale trials, it can be seen the assessment of 4 taekwondo trainers from 3 different training places. UPGRIS trainer; 1 person, ThunderCloud taekwondo coach; 2 people, GTC coach; 1 person. The total score obtained is 37 out of a maximum score of 40, with a percentage of 92%. With this percentage, the product of developing reaction speed training tools in taekwondo is included in the "Highly Qualified" category.

Technology has an important role to help progress achievement, this was stated by the minister of youth and sports, Roy Suryo (2013) (Permatasari, 2016). Based on several relevant research that has been done, one of them is the research by (Swandana et al, 2021) with the title

"The Development of Speed and Reaction Resistance Training Tools for Taekwondo Kick Speed Using Pyongyo". The result of the research stated that developed tools can be used as speed and reaction resistance training tools for kick speed. So, it can be said that technology and reaction speed are interconnected. Development of technology in sport is very importand to use especially in Indonesia to improve athlete's achievement both in local and national (Syakur et al., 2017).

Speed reaction and kick action are the most important parameter in taekwondo martial arts (Ihsan, 2018). Good reaction speed, especially to visual stimulation is very important in martial arts, this will benefit the athletes in getting points from punches and kicks (Cojorariu et al., 2015).

The lack of facilities to train reaction speed of kicks and punches in martial arts in Indonesia is one of the problems for athletes to do reaction speed training (Rarasti dan Heri, 2019). Some problems that occur when the reaction speed training facilities are still conventional are gaps in training, athletes are more interested in being the kicker rather than the Pyongyo holder or kick target, then the next problem is the result of the training are not data, it makes athletes less enthusiastic in training, these problems are found during the study.

There a need for a breakthrough from the trainers or martial arts expert to develop media or training facilities that support increasing athlete reaction speed in martial arts (Rifqi, 2016). Based on the problem that occur above, then the researcher is interested to make a solution for the problem by conducting a research entitled "Reaction Speed Training Sensor Aids Development for Taekwondo", hopefully with this research can make athletes excited in training taekwondo kick reaction speed. The benefit of developed tools by researchers for athletes are; (1). Athletes can bring this tool easily, (2). This tool is flexible, can be used on the floor, or can be used with a holder such as a tripod, (3). This tool has a timer, timer for training duration from 1 minute to 10 minutes, and lamp switching timer from 1 second to 10 seconds, the timer can be adjusted to the athlete's condition, (4). This tool can automatically record the results of an athlete's training data by a smartphone application that has been set, so athletes can immediately see the score or their ability after doing reaction speed training with the tool.

CONCLUSION

Based on the research and the discussion regarding the reaction speed training sensor aids development for taekwondo, then it can be concluded: (1). This research produces a product in the form of a smartphone application-based sensor that can be used to assist the training of reaction speed in taekwondo that have been validated by a taekwondo expert and electronics expert, (2). The effectivity of the reaclight product can be seen by the result of the questionnaire by the athlete with a percentage of 92% and was categorized as suitable for use, (3). The acceptance of this product can be seen by the result of the percentage of athletes and taekwondo trainers with a percentage of 92% which states that the product is very eligible.

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