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Development of digital based vertical jump test instruments

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Abstract. The purpose of this research is to develop a digital Vertical Jump measuring instrument. This is because so far there are often errors in data collection related to the ability of leg muscle explosive power that is done conventionally. Resulting in a conclusion that is less valid. And therefore it is necessary to develop an instrument based on digital leg muscle power that is effective in its use and is economically efficient. This research is a development study with a design model adapted from Borg & Gall. Samples of Faculty of Sport Science (FIK) students of Padang State University, amounting to 10 people for small groups and 40 people for large groups, and 6 experts as validators as a validation tool. Data was collected using a questionnaire and trial tool. Through the validity of the product moment test and the reliability test, Test and Retest. The process of developing and testing this tool was carried out with the validation of experts by using a questionnaire as an instrument of validation and the results obtained an average percentage of 91%, the results of small group trials obtained a correlation level of 0.98 and the reliability test with direct trials of 0, 99 with the category of reliability is very strong.

1. Introduction

Physical activity has many meanings in daily life where every physical activity is divided into the purpose and purpose of the activity, one of them for physical activity is Sports which is a necessity in the current era of globalization, not only for young people but even for sport promoted from a young age, in Law No. 3 of 2005 [1] concerning the National Sports System science, sports are all systematic activities that encourage, foster and develop physical and spiritual potential as well as social.

There are 4 basic components of the nature of achievement, namely, physical conditions, techniques, tactics and mental [2]. Physical condition (physical condition) in general can be interpreted by the state or physical ability [3]. In some sports the ability of leg muscle power is one of the physical aspects that is very important to support achievement, some examples of sports that require leg muscle power in achieving achievements include athletic sports which almost all match numbers require leg muscle power. Achievements can be achieved by a tiered



coaching system [4]. One obstacle that can hamper an achievement is the obstacle in the coaching and training system that is followed that is not in accordance with the ideal coaching pattern and has not yet utilized the technology to its full potential [5,6]. Measurement of leg power itself can be done with several instruments, according to Ismaryati [7], several test and measurement instruments to measure power tugkai are Vertical Jump, standing broad jump and Vertical arm-pull test.

In its implementation and its basic concept the measurement of Power tugkai using Vertical Jump measures the difference between the initial achievement and the final achievement by making a vertical jump. Then we get the centimeter size of the result of the jump which is an indicator of the level of leg power for those tested. In line with the opinion of Ismaryati according to Sri Haryono [8], Seeing the current era of globalization there are several tools that can measure limb muscle power that has been based on technology in its use according to Sri Haryono [8], a measurement tool for leg power, among others Jump DF and Force Plate. But in reality, he prefers to use conventional methods to measure leg power using Vertical Jump. In this case the researcher tries to develop and make a prototype tool that develops a Vertical Jump instrument based on digital, which will use sensors and software in the process of calculation and input of existing data. While in the process of research and development of this tool will involve several elements in it, among others, students majoring in electronics, physics and test and measurement experts who are in the environment of Padang State University. So researchers are interested in taking the title "Development of Digital-Based Vertical Jump Test Instrument" which is expected to be useful and useful to support the learning process of test and measurement courses at the Faculty of Sports Sciences and the achievement of Indonesia's achievements in the future as well as the development of sports science along with the development of science and technology.

The purpose of this study is to create an effective and efficient digital-based Vertical Jump test instrument after the validity and reliability tests. The usefulness of the results of this study is one of the supports and assets for the Faculty of Sport Sciences, Padang State University, as a learning tool for sports test and measurement courses, as well as aids in the measurement of limb power at the time of admission of new students. Then other uses of this tool if mass produced it will be a tool to support achievement in achieving the achievements of the sport that requires and as one of the conditions for researchers to complete master studies.

According to Winarno [9], in general, research objectives are research aimed at finding, proving and developing a thing. In this case the research objective of the Invention means that the data obtained previously is unknown. Research whose purpose is to prove that the data obtained needs to be proven due to doubt. While research with the aim of developing means to deepen and expand existing knowledge [10].

Power is a quality that allows a muscle or group of muscles to produce explosive physical work. According to [11], while according to Sukirno, [12] power or the ability of muscles to contract with maximum strength and maximum speed in responding to existing stimuli, using an-aerobic energy. Power can be divided into 2, namely cyclic and acyclic power, this type of difference is seen from the suitability of the type of movement or movement skills. Bompa (1990) in the book Ismaryati [7].

The legs are divided into 2 parts, namely the muscles of the upper limbs and the muscles of the lower limbs, the muscles of the upper limbs or os femur are long and strong bones that support our entire body weight. Then the joints in the os femur between os coxae and os joints. Femur enters into the curve of the joint (acetabulum), part of the tuber joints [12].

Vertical Jump test (vertical jump or upright jump) is a fitness test that is commonly done to determine the leg muscle strength or explosive power of an athlete. This test is often used by professional athletes, especially to find out an athlete's development during training. The higher the jump, the stronger the leg muscle / explosive power of an athlete (Michelle Lovitt, 2004: 39) according to Asril [13], "Power test is a test used to measure power, including Vertical Jump conducted electric or manual aims to measure the leg muscle power towards the top ". This opinion was also strengthened by Bafirman and Apriagus [14]. One form to determine the explosive power and leg muscle power is the Vertical Jump instrument.

One well-known and often used formula is the Lewis Nomogram according to Evert A Herman (1990) in Primary (2013), body weight and gravity influence the results of a person's vertical jump "then the form of the Vertical Jump test in order to produce Power data that is directly united kg- m / sec.

$$POWER=(\sqrt{4,9})(BODYMASSkg)(\sqrt{JUMP - REACH SCOREm}) \quad (1)$$

Digitalization is a process in which a product is mixed with various electronic components that have an energy source from electricity or other fuel energy that is formed from a series so as to create a new process but facilitated by automation and programs that have been inputted from a software into a software (Fuad, 2013: 15). The digitization process certainly has advantages and disadvantages where the benefits of the process are being able to facilitate a job, optimizing a result of a job but one of the disadvantages of the digitization process is the process of programming a range of errors when something goes wrong in the program and the use of fuel that is not the same as human use but can save time and operational costs of a job if it is done perfectly.

In this research, the product that will be produced is the result of the development of the Vertical Jump instrument by manually calculating the Lewis nomogram which will be converted to digital by using a series that will be compiled automatically when taking weight data and then the difference. The vertical jump achievement will be converted into lewis nomogram formula and produces leg muscle power data output. Then the results of the output data will be displayed on the LCD display so that the measuring subjects can directly record data in the form of unified leg muscle power (Kg-m / sec).

The development of this instrument aims to provide effectiveness in reducing errors when recording the results of manual data in the form of weight data and the initial and final achievements in the manual Vertical Jump test process. Reducing the test time so that the time efficiency of the Vertical Jump test is digital based. The figure 1 is a sketch of a description of the product situation that will result from the development of a digital-based Vertical Jump test.

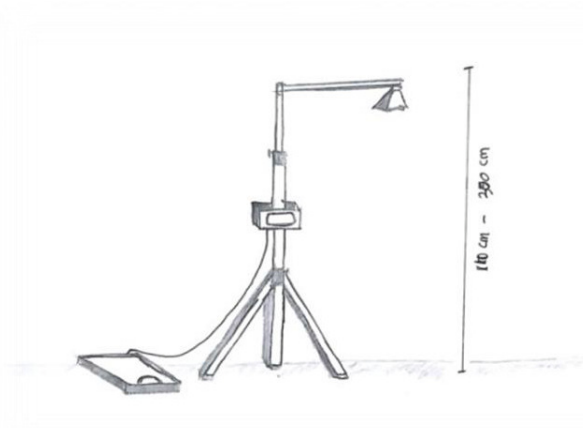


Figure 1. the development of a digital-based Vertical Jump test

2. Research Method

This research method is research and development. Research and development methods are methods used to produce certain products, and test the effectiveness of the product. This study aims to develop digital Vertical Jump instruments. In accordance with the aims and objectives of the study, the characteristics of the population in this study were the FIK students of the UNP Sports education study program, male so that the measurement results were not too significant between the sexes and so that the sample became homogeneous as a small group test subject and field test. Respondents who will be given questionnaires as instruments are experts in the assessment of instruments designed by experts consisting of: (a). IT expert (regarding the work procedure of the equipment, tool components and operating system used). In this case he is a lecturer in the faculty of mathematics and natural sciences majoring in Physics at Padang State University. (b). At the Expert Testing Evaluation and Sports Measurement Test phase here are the lecturers who are in charge of the Sports Measurement Evaluation and Test Course at the Faculty of Sports Science. (c). Sports physiology experts, in this case respondents who were given the questionnaire were lecturers who took the FAAL Sports course

The target population in this study is the FIK UNP Student Sports Education Study Program. The technique used in sampling required in this study is the need for samples as the object of testing the reliability of the instrument developed. In this case the technique used is purposive sampling and quota sampling techniques. This technique is a sampling technique with certain considerations that the sample determined is male because the number of students of Physical Education is dominated by men.

Quota sampling is a sampling technique using pre-determined quota so that the research process does not take too much time and saves research costs. Then the sample to be taken in this study amounted to 40 students.

3. Results and Discussion

Validity comes from the word validity which means the extent to which the accuracy and accuracy of the gauge (test) in carrying out its measurement function (Azwar, 2011), then the instrument is tested using a small group in which a sample of 10 people perform a measurement of limb power test with the test and retest method. The sample used as a small group was

students of sports education study programs who were taking lectures on rhythmic gymnastics conducted by taking data located in the FIK laboratories of Padang State University from these results, thus obtained sig. (2-tailed) equal to $0.00 < 0.05$, the data is said to be highly correlated and significant while the correlation coefficient is 0.98.

3.1. FAAL sports expert

The physiologist who is a validator in the research development of IT-based Vertical Jump Test is Mr. Prof. Dr. Sayuti Sahara, M. Kes, AIFO and Dr. Bafirman HB, M. Kes, AIFO He is one of the FAAL lecturers related to tests and measurements at the Faculty of Sports Science, Padang State University.

Table 1. Results of validity by FAAL sport expert

No	Expert	<i>f</i>	N	<i>p</i> (%)	Eligibility Category
1	FAAL Sport	69	75	92%	Very Good / Decent
2	FAAL Sport	68	75	91	Very Good / Decent

3.2. Expert Sports Evaluation and Measurement Tests

The Sports Evaluation and Measurement test expert who became a validator in the IT-based Vertical Jump test development study was Dr. Damrah, M.Pd and Dr. Arsil, M.Pd He is a lecturer at the Faculty of Sports Science, Padang State University. This validation was carried out on March 2019 by way of practice in the field, describing the tool and how it works in the field accompanied by an assessment instrument in the form of a questionnaire.

Table 2. Results of evaluation and measurement test

No	Expert	<i>f</i>	N	<i>p</i> (%)	Eligibility Category
1	TPO	79	85	93%	Very Good/ Decent
2	TPO	80	85	94%	Very Good/ Decent

3.3. IT expert

The IT expert who became a validator in the research development of this IT-based Vertical Jump test was Mr. Yohandri, M. Si, Ph.d and Mairizwan, M.Sc. He was a lecturer in Physics at the Faculty of Natural Sciences, Padang State University. This validation was carried out on April 2019 by practicing in the field, describing the tools and how it works in the field accompanied by an assessment instrument in the form of a questionnaire.

Table 3. Results of evaluation and measurement test

No	Expert	<i>f</i>	N	<i>p</i> (%)	Eligibility Category
1	IT Expert	81	85	95%	Very Good / Decent
2	IT Expert	55	65	85%	Very Good / Decent

3.4. Test reliability

Reliability test on this tool is used to see the reliability level of the tool by using the Test and Retest method and the calculation of the product moment statistics, the following results are obtained as shown in table 4.

Table 4. Results on reliability test

Correlations			
	Group	Test	Retest
Test	Correlation Coefficient	1.0	0.99
	Sig. (2-tailed)		0.00
	N	40	40
Retest	Correlation Coefficient	0.99	1.0
	Sig. (2-tailed)	0.00	-
	N	40	40

In the table it can be explained that the correlation coefficient obtained from the measurement of leg muscle power is 0.99 with the category "Very Strong" with the meaning that it can be said to be reliable and consistent in its use.

4. Conclusion

Based on the results of data processing and analysis of the results of research that has been done, regarding the development of digital-based Vertical Jump instruments the following conclusions are obtained: (1). The tool is said to be valid with the proper categories of 4 expert validators in the fields of IT, IT and instrumentation, evaluation and test of sport measurement and Sports physiology experts with an average percentage calculation of 91%. (2). The results of small group trials state that the Digital-based Vertical Jump test instrument has a 98% correlation level and is said to be valid. (3). The results of the reliability test with a large group trial using the Test and Retest method obtained a correlation coefficient of 0.99 with the category of reliability "Very Strong"

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