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Submission date: 09-Jun-2022 01:09PM (UTC+0700)
Submission ID: 1853440508
File name: 4868-13825-1-PB_1.pdf (712.93K)
Word count: 3695
Character count: 18918

Budapest International Research and Critics Institute-Journal (BIRCI-Journal)
Humanities and Social Sciences
www.bircu-journal.com/index.php/birci
ISSN 2615-3076 Online)
ISSN 2615-1715 (Print)
Budapest Institute

Design of Sensor-Based Left Muscle Power Testing Tool

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Abstract

This study aims to develop a power tool where the test tool changes the manual to digital concept and a manual for the use of the test tool was developed. The products produced are the Power, and the manual for the use of the Power. This research was developed by adapting the research and development of the Borg & Gall model. The development procedure used includes several stages: 1) analyzing the content of the product being developed, 2) developing the initial product, 3) expert validation, 4) field testing, 5) product revision. qualitative. sampling technique used purposive sampling with a Phase I trial of 20 FIK students and a Phase II trial of 30 athletes from PON SUMUT. Furthermore, from the Phase I trial, which amounted to 20 people, the figure was 96% with Very Eligible, then from the Phase II trial, which amounted to 30 PON SUMUT athletes, it showed a figure of 91% in the Eligible

Keywords
Leg muscle power; sensor based; measurement tool

I. Introduction

Sports activity is one of the most important things to do in daily activities and serves to improve work ability to run optimally. Physical fitness is a need that must be met in order to carry out daily activities well, efficiently and effectively which will have a good impact on creating a quality life (Suharjana, 2013). The development of knowledge and technology is felt to have a lot of positive impacts marked by the innovation of technology used in the field of sport. Technology has many functions in sports (Loland, 2002). Technological innovation in the field of sports can increase effectiveness, efficiency, and accuracy so that it can assist in measuring power leg muscle. Physical activity is an inseparable part of the life of living things, ranging from simple to very complex activities. As a living creature, humans need physical activity as an effort to maintain the existence of their lives. Every individual in his life must be doing physical activities both intentionally and unintentionally, because physical activities are carried out with diverse and diverse purposes. (Sulaiman, et al. 2020)

In this all-digital era, there needs to be a new breakthrough for the development of digital tools in the field of sports so that they can easily achieve something that has been expected to be realized together into reality. The development of these sports' equipment is a success for sports people to make changes. major in the field of more advanced and modern sports. Facilities and infrastructure are needed, of course, for the development of sports globally (Esegine Diejomaoh et al. 2015). The new technology in this research is a vertical jump to measure power leg muscle Power leg muscles are very important and necessary for almost all sports because it is a basic physical ability for an athlete that needs to be honed and developed. Human needs are increasingly making people develop technological innovations and form new paths for sports organizations through the tools developed. (Ratten & Ratten, 2019).

The latest advances in technological innovation in the field of sports are needed for facilities and infrastructure in the field of sports. Technological innovation in the field of

DOI: https://doi.org/10.33258/birci.v5i2.4868

Budapest International Research and Critics Institute-Journal (BIRCI-Journal)
Volume 5, No 2, May 2022, Page: 10563-10569
e-ISSN: 2615-3076 (Online), p-ISSN: 2615-1715 (Print)
www.bircu-journal.com/index.php/birci
email: birci.journal@gmail.com

sports is expected to increase effectiveness, efficiency, and accuracy so that it can assist in more valid tests and measurements. The new technology in this study is vertical jump that functions to measure the height of a jump designed using digital technology. The importance of this research is to help sports coaches and educators in training young athletes to develop their ability to jump, because jumping is a fundamental technique in almost all sports. In addition, the overall definition of this research is to change the manual test and measurement tools towards the use of technology so that it is expected to be able to increase the level of validity of the test equipment.

The current test equipment and measurement power of leg muscle (vertical jump) which have been observed during the KONI athlete test in Medan City towards PON 2021 Papua, which was held at the State University of Medan are still using the manual method, where the initial and final achievement heights are in the measure through a meter that is glued to the wall then the athlete or tester uses flour that is coated in the hand, then tester jumps as high as possible with his hands held close to the meter that has been glued to the wall, the result measured is the last achievement of the hand that has been given flour and touch the tape measure that has been glued to the wall.

This has actually become something that the validity of the test and vertical jump is questionable because it is not impossible when testster make a jump, not infrequently the tip of the hand or finger touching the meter cannot be seen by the assessor so sometimes it is not imaginative that athletes have to do this. jump to measure again, besides the result of flour sticking to the wall of the meter, it is not imaginary to make the assessor hesitate to determine where the end point of the testster is so the assessment must wipe the flour stuck to the wall of the meter before the testator jumps back, so this is a lot of energy and effort. At the time, whether it was the tester who conducted the test and the assessment that measured the test, it is better if in this era of digitalization there should be the use of appropriate technology to support the results and efficiency of that time. It is hoped that there will be an appropriate technological breakthrough to assist and actualize the test and measurement power so that the test and measurement power is more precise and its validity is unquestionable because its use using technological media is expected to be able to erode the doubts that have existed so far.

Then to strengthen the background of the problem described above, a needs analysis will be carried out which serves to see the extent to which the test equipment is needed to measure power leg muscleFrom the results of the needs analysis given to 10 people including coaches from 5 sports, namely Aquatic sports, Taekwondo, Basketball, Volleyball, Athletics and 5 athletes as testers who often test and measure power leg muscle. From these results it is known through the following percentages: 100% of athletes and coaches know the test equipment and measurement power, 70% of athletes and coaches say that the test and measurement power are ineffective and their level of validity is questionable, 100% of athletes and coaches have never seen and done sensor-based tests, 100% of athletes and coaches need a power to measure power, 100% of athletes and coaches want to get a power leg muscle sensor based.

So, from the results of the discussion/needs analysis above, the researcher is interested in conducting research with the title "Design Power" where the tool is expected to be able to answer the problems that have been disclosed and it is hoped that the tool to be developed will be able to advance technology in particular. in the treasury of Power as well as being a trigger for enthusiasm for sports people, especially in the Medan State University environment in developing sensor-based test kits that are in accordance with their respective functions.

II. Research Method

The research method used is a development research method with a qualitative approach. Development research is not to create theory or test theory but to develop Test Power Sensor-Based Limb Muscle. The development method used in this research is the Borg and Gall development model with 7 steps. This was done due to time and cost constraints. This is supported by Sukmadinata (2015) which states that development research can be stopped until a final draft is produced, without testing the results. The results or impacts of implementing the development of movement activities already exist in small group trials and large group trials. The 7 steps are explained as follows: 1) Conducting preliminary research (pre-survey), 2) planning, 3) product drafting, 4) initial testing, 5) revising the product, 6) Conducting field trials, 7) Conducting revision of the product. The stages in this research can be presented as follows: The details of the activities and indicators of research achievement can be seen in the following table:

Table 1. Details of Activities and Indicators of Research Outcomes

Activities	Implementation	Indicators of Achievement
1. Defining	1. Needs analysis of coaches and athletes Sports. 2. Needs analysis from experts 3. Sharing with lecturers from other universities. 4. Analyzing the basic problems faced by all lecturers related *power* to leg muscle	1. The demand for the results of the need for *power* leg muscle 2. Formulation of the design of *power* using 3. Benchmarking *power* at other universities. 4. Results of problem analysis
2. Design development implementation and evaluation	1. Identifying and analyzing *power* leg muscle 2. Designing product drafts 3. Validating 4. Conducting small group trials 5. Conducting large group trials 6. Evaluating product impacts 7. International seminars on *power* leg muscle 8. Digital-based assessment instrument manuals	1. Design of *power* leg muscle 2. Validation results of product drafts 3. Results of small group trials 4. Results of group trials 5. Results of product evaluations 6. Conducted seminars 7. Guidebook for the use of *Power* Muscle
Outer I	Test Tool *Power* Sensor-Based Leg Muscle Guidebook for Use of *Power* Sensor-Based Leg Muscles The	

Research subjects in this study were FIK students and athletes from the North Sumatran National Sports Competition PON Koni. For small group trials consisting of 20 students. The large group trial consisted of 30 athletes from the North Sumatra PON Koni PON. This research data was collected through qualitative and quantitative descriptive data. Qualitative data in the form of written interviews with inputs, suggestions, and responses from validators of experts, practitioners, observers and subjects. This type of quantitative data is obtained from the assessment scores given by validators, practitioners, observers, and subjects through validation activities and field trials. The data obtained were described in detail to determine the level of validity, practicality, and effectiveness of *power* the sensor-based leg muscle.

III. Result and Discussion

There are several ways to measure power, one of which is the vertical jump. Vertical jump itself can be used as a reference in testing and measuring a person's jump height, but vertical jump still uses manual methods in measuring it without the use of Scien and Technology in its utilization, even though in this digital era there should be the use of appropriate technology in the field of sports, especially to measure the height of the jump, so it is hoped that the tool is able to answer the challenges of science and technology and sports development (tests and measurements). In addition, in order to answer the challenges of increasingly rapid technological developments in the field of sports, it is necessary to conduct a scientific study (research) using appropriate technology in producing an innovative product that is able to answer challenges in the digitalization era.

Furthermore, in this study, researchers develop vertical jump test and measurement tools by changing conventional (manual) test and measurement tools towards the use of technology which is expected to be able to answer the challenges of the digitalization era and as a test and measurement tool whose accuracy level is unquestionable because it uses sensor in measuring the height of a person's jump. In the implementation of tests and measurements of leg muscle power (vertical jump) where the sample will stand on a board designed as a test and measurement tool (vertical jump) then the sample will jump (vertical jump), the sensor will capture the jump height of the foot closest to the sensor, the jump results will be connected via Android, the results jumps are measured in cm.

3.1 Test Tool Power Sensor-Based Limb Muscle

Based on the results of the analysis conducted by the researcher, it appears that the power is questionable with some of the points that the researchers described previously, it is better in this digitalization era that there must be the use of appropriate technology to support the results and efficiency of that time. . It is hoped that there will be an appropriate technological breakthrough to assist and actualize the test and measurement power so that the test and measurement power is more precise and its validity is not in doubt because its use using technological media is expected to be able to erode the doubts that have existed so far. In addition, the measurements made (initial achievement - final achievement) focus on the tip of the closest finger touching the meter, this actually makes the tester jump vertical (upwards) and must also shift his concentration to the tip of the hand that touches the closest point to the meter.

3.2 Test Tool Design Power Sensor-Based Limb Muscle

From the results of observational studies, preliminary studies and needs analysis that have been carried out by researchers, researchers are interested in developing a power leg muscle sensor-based to measure power , where the tool is efficient and effective, the meaning of the word efficient itself is in terms of appearance where in the researcher's initial framework, the researcher wants to make a power leg muscle sensor based test tool vertical jump , but the difference is how to measure it directly based on sensors that will be connected to the android system The purpose of connecting the Android system as a counter to the final achievement is to make it easier for assessors to see it and easy to carry anywhere.

While what is said to be effective is that the tool that will be designed by the researcher is portable or can be carried anywhere, besides that the tester also does not have to hold flour in doing the jump, because the researcher plans to measure the power of the leg muscle through the jump that is done not focusing on the results of the achievement

(the hand closest to the meter) then the results of the vertical jump are calculated from the start of the foot closest to the sensor, the results of the vertical jump will be directly connected to the android system designed by the researcher making it easier in viewing the tester jump results.

3.3 Test Tool Power of Sensor-Based Limb Muscle

Test and measurement tool *vertical jump* that the researcher developed can be seen in the image below along with the details of the parts of the tool used to design the product for developing *vertical jump*.

Figure 1. *Product Design Power Sensor-Based Limb Muscle*

Procedures for Implementing Sensor-Based Limb Muscle Power Test and Measurement*:* Purpose **:To** measure *Equipment* leg muscle **Leg** test and measurement *power* power *(vertical jump)*

Equipment

1. *Testing* standing on a mat
2. The sensor is placed on the mat as a jump height gauge.
3. *Testing* performs a *vertical jump*
4. . The unit is measured using cm
5. . The result of the jump being measured is the foot closest to the sensor.
6. The result of the jump is connected to the Android device for calculation.
7. The category is said to be correct if the tester jumps up with straight legs.
8. The category is said to fail if the tester jumps up with the legs bent (knees bent).

3.4 Product Design Revision of Power Sensor-Based Limb Muscle

After the researchers made a *power*, the researchers then submitted the design to test and measurement experts, IT experts and sports lecturers. The aim is to get input and revisions regarding the design of a *power* sensor-based leg muscle

The design that the researcher gave to the expert did not get a revision, so that the researcher could proceed to the next stage, namely the manufacture of the product, because according to the expert, a trial should be carried out first to see the extent of the weaknesses and strengths as well as the effectiveness and efficiency of using the tool that the researcher had designed.

3.5 Product

Trial Phase I Phase I trials were conducted on 20 students of the Faculty of Sports Science. It aims to provide input and assessment of the results of trials conducted on samples to see the level of usefulness of the tool and the effectiveness of *power* the leg muscle sensor-based, so that it meets the theoretically and empirically feasible criteria.

The data obtained is then used as a basis in an effort to make revisions at a later stage. The results obtained in the field after conducting the Phase I trial were the work test tool *power* the leg muscle sensor-based system used can work quite well and the results of the jumps carried out are read perfectly by the distance calculation sensor (cm) connected to the IOP system on Android that is well listed.

From the results of trials conducted by researchers on 20 FIK students, it can be seen that they have been classified in the form of a questionnaire, by grouping them into 2 aspects, namely, material clarity, material aspects so that total of 20 questions are answered, the athlete's answers are grouped into 5 categories, namely SS (Strongly Agree), S (Agree), SD (Medium), TS (Disagree), STS (Strongly Disagree) with an assessment of 5,4,3,2,1. As for the results of the first phase of the trial for athletes, it is stated through the formula for the presentation of the maximum number of answers/scores x 100% with the following results. From the 20 small group trial samples with a total score of 1,938 divided by a maximum score of 2,000 x 100%, it resulted in a presentation of 96% with the **Very Eligible criteria.**

3.6. Test Results Phase II

Trial was conducted on 30 North Sumatera athletes including the sports Futsal, Takraw, Volleyball, Basketball, Football, this aims to provide input and assessment of the results of trials conducted on samples to see the level of usefulness of the tool and the effectiveness of *power* the leg muscle sensor-based, so that it meets the theoretically and empirically feasible criteria.

The data obtained is then used as a basis for improving the final product of *power* the leg muscle sensor based. The results that can be obtained in the field after conducting the Phase II trial are the work test tool *power* the leg muscle sensor-based whether it is feasible to use and meet the criteria referred to in the test tool *power* the leg muscle sensor based.

From the results of the trials carried out, it can be seen and classified in the form of a questionnaire, by grouping into 2 aspects, namely, material clarity, material aspects so that total of 20 questions are answered, the athletes' answers are grouped into 5 categories, namely SS (Strongly Agree), S (Agree), SD (Medium), TS (Disagree), STS (Strongly Disagree) with an assessment of 5,4,3,2,1. As for the results of the second phase of the trial for athletes, it is stated through the formula for the presentation of the maximum number of answers/scores x 100% with the following results. Of the 30 samples of Phase II trials with a total score of 2,743 divided by a maximum score of 3,000 x 100% resulting in a presentation of 91% with **Very Eligible criteria.**

IV. Conclusion

From the results of the research that has been carried out, the researcher concludes that power is feasible to be used in conducting tests and measuring vertical jumps test tool power a sensor-based leg muscle stakeholders can more easily see the tests and measurements of vertical jumps and can also be used as evaluation material, especially in improving athlete jumps. This development research produces a test power sensor-based leg muscle which is expected to work effectively and efficiently so that it can be an

attraction for athletes and coaches in activities to determine the athlete's jump as well as for future researchers.

This test tool is expected to provide convenience in measuring the athlete's jump height as well as accuracy in seeing the results of the athlete's ability to jump. In the implementation of tests and measurements, the data will go directly to the IOP device in the Android system.

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