



## Development of Science and Technology in Sports Through Test and Measurement Tools Shoulder and Wrist Android Based

Ilmi Arifin \*<sup>1</sup>, Amir Supriadi <sup>2</sup>, Ibrahim Sembiring <sup>3</sup>

<sup>1,2</sup> Sports Coaching Education, Faculty of Sports Science, Universitas Negeri Medan, Medan, Indonesia

<sup>3</sup> Health Physical Education and Recreation, Faculty of Sports Science, Universitas Negeri Medan, Medan, Indonesia

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### Abstract

The purpose of this study is to produce Android -based shoulder and wrist. This research was conducted on students of the Faculty of Sports Sciences and North Sumatra PON athletes in December 2022. Types of research used in this study were development research with Research & Development (R&D) research designs from Borg and Gall. This research was conducted with 9 research stages, namely, (1) Research and Information Collecting, (2) Planning, (3) Developing Preliminary Form of Product, (4) Preliminary Field Testing, (5) Main Product Revision, (6) Main Field Testing, (7) Operational Product Revision, (8) Operational Field Testing, (9) Final Product Revision. The population in this study by using students of the Faculty of Sports Science and the North Sumatra Taekwondo Pelatda athlete. The technique of picking up using purposive sampling with a trial of phase I of 20 FIK students and the phase II trial of 30 athletes in North Sumatra Taekwondo Pelatda. Furthermore, from the trial of phase I, totaling 20 people showed 96% with very feasible criteria, then from the phase II trial of 30 North Sumatra Taekwondo Pelatda athletes showed 91% with a very decent category. From the results of research /feasibility tests conducted by test experts and measurements, IT experts and sports academics show 96% with a very feasible category, so that it can be used. On the basis of the data obtained, the development of Android -based shoulder and wrist test equipment is declared feasible to be developed as a test tool and measurement of shoulder muscle and wrist.



\*Corresponding email : [ilmiarifinarifin@gmail.com](mailto:ilmiarifinarifin@gmail.com)

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## INTRODUCTION

Sports achievement is a compound phenomenon, because there are many factors that influence it. One of the influencing factors is the development of sports technology. In the modern era, the development of technology in sports is very rapid. Evidenced by the many changes ranging from sports infrastructure, sports learning methods and others. The development of sports technology is considered very important to advance sports achievements, especially in Indonesia. Today the development of science and technology (science and technology) is very rapid. Along with the rapid development of science and technology, there are many innovations from various studies that are growing rapidly as well. Various human activities in everyday life have also been greatly assisted by advances in science and technology, including in the field of sports which have been assisted in the process of training and matches. Support from science and technology plays a big role in helping athletes to achieve so that starting from talent search, training, tests and measurements, athletes and coaches are also helped. The development of science and technology in improving the ability of athletes to carry out tests and measurements is very necessary because it is hoped that when science and technology takes part in the world of sports, especially in terms of tests and measurements, test equipment will be more effective and efficient.

The latest advances in technological innovation in the field of sports are urgently needed for facilities and infrastructure in the field of sports. Technological innovations in the field of sports are expected to increase effectiveness, efficiency and accuracy so that they can assist in terms of more valid tests and measurements. The new

technology in this study is test and measurement technology. Shoulder Clears digital-based which functions to measure shoulder flexibility using digital technology. The importance of this research is carried out because it is to help sports coaches and educators in training young athletes to develop the ability to see the flexibility of the shoulder muscles needed by several sports. In addition, the overall definition of this research is to change 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 kits. One of the test tools that will be developed by researchers is a test tool shoulder wrist. This tool was developed using technology in recording the results of shoulder flexibility. The new technology in this study is the shoulder flexion test and measurement technology (shoulder wrist) which serves to measure the flexibility of the shoulder using digital technology. The importance of this research is carried out because it is to help sports coaches and educators in training young athletes to develop skills in terms of shoulder flexibility. In addition, the overall definition of this research is to change 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 kits. Shoulder flexibility test and measurement tool shoulder and wrist what the researchers observed at the time of the PELATDA KONI North Sumatra athlete's physical test which was carried out at the GSG (Gor Versatile) Jl Williém Iskandar, it was seen that the test to measure the flexibility of the shoulder muscles was still using a manual method, meaning that the test equipment was still using the manual method. , meaning that the test and measurement tools are still using conventional methods. It is hoped that there will be an appropriate technological breakthrough to assist and actualize tests and measurements shoulder

and wrist so test and measurement shoulder and wrist it is more precise and its validity is not in doubt because its utilization by using technological media is expected to be able to erode the doubts that have existed so far. In addition, the use of a wooden meter as a reference in measuring the distance measurements taken by athletes is not quite right, especially in the modern era and increasingly advanced technological waves, causing the level of relevance to be something that should be focused on, applying science and technology in the world of sports causes efficiency and the effectiveness of test and measurement tools is even more valid because changes in tests supervised by humans have turned into test kits designed using technology that need to be designed and become a focus in research that researchers will design.

Researchers are interested in conducting a needs analysis to see how far the tool can be needed by user through the calculation of quantitative data which is translated through a needs analysis questionnaire, as for user here the intention is to users with a total of 10 people of whom are trainers strength and conditioning (SC) Pelatda KONI SUMUT from 5 sports, namely sports that use test and measurement tools shoulder and wrist including Bolling, Taekwondo, Bodybuilding, Roller Skating, Archery and 5 athletes as tester who often perform tests and measurements shoulder and wrist. From these results it is known through the following percentages: 100% of athletes and coaches know the test and measurement tools shoulder and wrist, 70% of athletes and coaches say that test and measurement tools shoulder and wrist ineffective and the level of validity is questionable, 100% of athletes and coaches have never seen and carried out tests and measurements using technology, 100% of athletes and coaches need test and

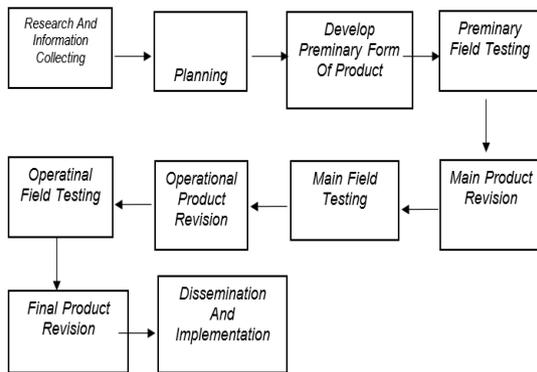
measurement tools shoulder and wrist android-based to measure shoulder muscle flexibility, 100% of athletes and coaches want to get a test and measurement tool shoulder and wrist android based.

Several studies regarding test and measurement tools have been carried out by previous researchers (Mesnan, 2021) which explains that the development of test and measurement tools shoulder and wrist which was developed is able to answer the world's challenges to science and technology-based shoulder flexibility test and measurement tools. In addition, the use of Android in sports is a breakthrough that must be developed and applied in an era of increasingly rapid global onslaught. other components may have. Several studies regarding test and measurement tools that have been carried out by previous researchers which are used as the basis for a conceptual framework through relevant research include (Aditya Gumantan, 2021), (Aditya Gumantan, 2020), (Romi Faraz N, 2021)

## METHODS

The method used in this study is the Research & Development (R&D) approach in this process using a quantitative approach and using the Research & Development (R&D) research design from Borg and Gall which consists of ten steps, among others.

- 1) Research and Information Collecting
- 2) Planning
- 3) Develop Preliminary of Product
- 4) Preliminary Field Testing
- 5) Main Product Revision
- 6) Main Field Test
- 7) Operational Product Revision
- 8) Operational Field Testing
- 9) Final Product Revision
- 10) Dissemination and Implementation



**Figure 1.** Borg and Gall Development Steps

The techniques used for data collection in this study used questionnaires, interviews, documentation, and observation. The questionnaire was used to find out the respondents' opinion of the android-based shoulder and wrist test and measurement tool. Observations are used to see the needs needed in the field. The questionnaire is a data collection tool that contains a number of questions or statements that must be answered by research subjects. Based on its shape, questionnaires can be open and closed. Data analysis aims to organize data in a meaningful way so that it can be understood. In this research on the development of an android-based shoulder and wrist test tool, data analysis techniques were used with quantitative analysis techniques with percentages. This technique is used in order to obtain quantitative data analysis obtained from distributing questionnaires to trial samples.

## RESULT

There are several ways to measure the flexibility of the shoulder and hand muscles, one of which is the shoulder and wrist. The shoulder and wrist itself can be used as a reference in carrying out tests and measurements of the flexibility of a person's shoulder and arm muscles, but

currently the existing shoulder and wrist devices still use manual methods to measure them without the use of science and technology in their use even though in this era This digital all-rounder should have the use of appropriate technology in the field of sports, especially for measuring the flexibility of the shoulder and hand muscles, so that it is hoped that this tool will be 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 carry out a scientific study (research) using appropriate technology to produce an innovative work product that is able to answer challenges in the digitalization era. Furthermore, in this study, the researchers developed a shoulder and wrist test and measurement tool by changing the conventional (manual) test and measurement tool 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 level of accuracy is beyond doubt because use a sensor to measure the flexibility of a person's shoulder muscles. In carrying out the shoulder and wrist tests and measurements where the sample will hold a stick (shoulder and wrist) designed by researchers to measure the flexibility of the shoulder and hand muscles by means of the sample lifting the vertical height of the shoulder and wrist device, the sensor will capture the height of the arms and shoulders from the position Initially, the results of shoulder and wrist measurements will be connected via Android, the results of shoulder and wrist measurements are measured in cm.

### Scale Product Trial I

The Phase I trial was conducted on 20 students of the Faculty of Sports Science. It aims to provide input and an assessment of the results of the trial conducted on the sample to see the level of usefulness of the tool and the effectiveness of the Android-based shoulder and wrist test kit, so that it meets the theoretically feasible criteria. and empirical. The data obtained is then used as a basis for efforts to make revisions at a later stage. The results obtained in the field after conducting Phase I trials were that the Android-based shoulder and wrist test tool used worked quite well and the results were read perfectly by the distance calculation sensor (cm) connected to the IOP system on Android. 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 questionnaires, by grouping them into 2 aspects, namely, clarity of material, material aspects so that a total of 22 questions, the results of athletes' answers are grouped into 5 categories, namely SS (Strongly Agree), S (Agree), SD (Moderate), TS (Disagree), STS (Strongly Disagree) with an assessment of 5,4,3,2,1. The results of the stage 1 trial on these athletes were outlined through the presentation formula for the number of answers/maximum score x 100% with the following results. Of the 15 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 Very Eligible criteria. During the Phase I trial, the researchers found findings in the field on the Android-based shoulder and wrist test kit which the researchers listed in Table 1.

**Table 1.** Research Findings

No	Research Findings
1	During the shoulder and wrist test, the tester often raises his head
2	During the shoulder and wrist test, the tester often lifts/bends his hand to hold the tool
3	During the shoulder and wrist test, the tester often does not straighten his arm so that the shoulder muscles are slightly bent
4	The tester is still not used to doing shoulder and wrist tests
5	Testers are still often helped by other people not to raise their heads
6	The handle of the shoulder and wrist test kit is still made of aluminum and the surface is not flat and a bit sharp

### Phase II Product Trial

Phase II trials were carried out on 30 North Sumatra Pre Pon athletes including the Taekwondo sport, this aims to provide input and an assessment of the results of trials conducted on samples to see the level of usefulness of the tool and the effectiveness of the Android-based shoulder and wrist test kit, so that meet the criteria feasible theoretically and empirically. The data obtained is then used as a basis for efforts to improve the final product of the Android-based shoulder and wrist test kit. The results obtained in the field after carrying out the Phase II trial were the work of the android-based shoulder and wrist test kit whether it was feasible to use and met the criteria referred to in the android-based shoulder and wrist test kit. From the results of the trials conducted, it can be seen and classified in the form of a questionnaire, by grouping them into 2 aspects namely, clarity of material, material aspects so that a total of 22 questions, the results of athlete answers are grouped into 5 categories, namely SS (Strongly Agree), S (Strongly Agree), S (Agree), SD (Moderate), TS (Disagree), STS (Strongly Disagree) with an assessment of 5,4,3,2,1. The results of the

second stage of the trial on these athletes were outlined through the presentation formula for the number of answers/maximum score x 100% with the following results. Of the 30 samples of the Phase II trial with a total score of 2,743 divided by a maximum score of 3,000 x 100%, it resulted in a presentation of 91% with Very Eligible criteria.

### The Final Product

From the results of the assessment and the results of the stage 2 product trial above, it became the material for improving the final product of the Android-based shoulder and wrist test kit that the researchers developed. In the efficiency of preparation for carrying out the android-based shoulder and wrist test kit, the researcher went through several processes to perfect the research, while the stages of the process were passed, namely (1) Defining the problem and gathering information as a rationale for creating a development research concept, (2) Determining what form of development which will become an object of research, (3) Conduct a research development in collaboration with a team of experts, (4) Revise the design of the developed test and measurement tool, (5) Initial product of the Android-based shoulder and wrist test kit, (6) Phase I trial, (7) Revision of phase I trial to experts, (8) Phase II trial and assessment by experts, (9) Final product. Furthermore, due to the limitations of the researchers, the research carried out only reached the Phase II trial stage and was assessed by experts, at which stage the experts consisting of test and measurement experts, IT experts, and sports academic experts revised and validated the test kits and digital-based vertical jump measurement with the Very Eligible category. From the stages of the process to an android-based shoulder and wrist test kit which can later be used by coaches and athletes, especially in the province of

North Sumatra and add to the treasury of test and measurement tools within the Unimed Faculty of Sports Science. Comparison between the results of the phase I trial and the results of the phase II trial can be seen in the graphic as follows:



Figure 2. Phase I & Phase II Trial Graph

The final product that has gone through a series of development paths so that it becomes an Android-based shoulder and wrist test kit product is as follows:



Figure 3. Android-Based Shoulder And Wrist Test Tool (Trial)

Procedures for Implementing the Android-Based Shoulder and Wrist Test Tool:

Objective : To measure the flexibility of the shoulders and arms

Equipment : Test tool and measurement of shoulder and arm flexibility based android Implementation

1. Raise the stick as high as possible
2. The nose remains on the floor
3. Measure the vertical distance the cane is from the floor in inches
4. Repeat the test three times and record the best distance

## DISCUSSION

### Product Result Discussion

The test equipment and measurement of shoulder and wrist flexibility that the researchers observed during the PELATDA KONI North Sumatra athlete's physical test which was carried out at GSG (Multipurpose Sport Center) Jl Williem Iskandar, shows that the test to measure shoulder muscle flexibility still uses a manual method. , meaning that the test kits are still using the manual method, meaning that the test kits and measurements are still using the conventional method. Based on the results of the analysis carried out by the researcher, it appears that the validity of the shoulder and wrist test and measurement tools which have been the instrument used in carrying out tests and measurements of shoulder flexibility is doubtful with a number of points that the researchers have described previously, preferably in this digitalization era. 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 shoulder and wrist tests and measurements so that the tests and measurements of the shoulder and wrist are more precise and their validity is beyond doubt because their utilization using technological media is expected to be able to erode doubts that have existed so far. In addition, the use of a wooden meter as a reference in measuring the distance measurements taken by athletes is not quite right, especially in the modern era and increasingly advanced technological

waves, causing the level of relevance to be something that should be focused on, applying science and technology in the world of sports causes efficiency and the effectiveness of test and measurement tools is even more valid because changes in tests supervised by humans have turned into test kits designed using technology that need to be designed and become a focus in research that researchers will design.

Then to strengthen the background of the research to be carried out, the researcher conducted a preliminary study by looking for scientific principles based on the studies that had been carried out regarding the development of shoulder and wrist devices that had been developed by other researchers. In the researcher's preliminary study through a journal review conducted by the researcher, it was not seen that there had been any development of the shoulder and wrist device found by the researcher, but from several journals collected by the researcher it was seen that the test tool developed to measure flexibility was the sit and reach tool, which is a tool that developed to measure the flexibility of the back muscles. In the preliminary study of researchers through journal studies conducted by researchers, it was seen that there was a development of a shoulder and wrist tool that was found by researchers, from a literature study through the journal Mesnan (2022) developed a shoulder flexibility test instrument that was designed based on technology which functioned to see the level of flexibility of abilities shoulder muscles. As is the case with research conducted by Anton Komaini (2018) explaining that the development of sensor technology-based static flexibility test and measurement tools produces sensor-based static flexibility test and measurement tools that have a high level of validity and reliability. The results of expert validation obtained an assessment percentage of 97.5%. This can

be interpreted that the sensor-based flexibility measuring instrument has a good/decent category. The results of calculating reliability using test and retest techniques, obtained an r value of 0.894 for small-scale trials and 0.882 for large-scale trials. From the results of research conducted by Anton Komaini (2018) it can be seen that test and measurement tools for flexibility are very necessary for athletes because by developing technology-based test and measurement tools for flexibility, the level of the test itself has a high level of validity. From the description that has been carried out by researchers through observation and preliminary studies. The researcher is interested in conducting a needs analysis to see how far the tool can be needed by the user through calculating quantitative data which is explained through a needs analysis questionnaire, while the user here is intended to be a user with a total of 10 people including strength and conditioning trainers (SC) Pelatda KONI SUMUT from 5 sports, namely sports that use shoulder and wrist test kits and measurements including Bolling, Taekwondo, Bodybuilding, Roller Skating, Archery and 5 athletes as testers who often carry out shoulder and wrist tests and measurements. From these results it is known through the following percentages: 100% of athletes and coaches know the shoulder and wrist test and measurement tools, 70% of athletes and coaches say that the shoulder and wrist test and measurement tools are ineffective and their level of validity is questionable, 100% of athletes and coaches never seen and carried out tests and measurements using technology, 100% of athletes and coaches needed a digital-based shoulder and wrist test and measurement tool to measure shoulder muscle flexibility, 100% of athletes and coaches wanted to get a digital-based shoulder and wrist test and measurement tool.

From the results of observation studies, preliminary studies and needs analysis that have been carried out by researchers, the researchers are interested in developing an android-based shoulder and wrist test and measurement tool to measure shoulder muscle flexibility, 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 frame of mind, the researcher wanted to make a shoulder and wrist test kit where the implementation is like a manual shoulder and wrist test kit but the difference is how to measure it directly digitally where the tool designed results directly out through the monitor without having to look far away achievement with the help of a tester. While what is said to be effective is that the tool to be designed by the researchers does not use a wooden tape measure or PVC pipe as a shoulder and wrist test and measurement tool that is portable or can be carried anywhere, besides that the tester also does not have to hold a wooden tape measure as a distance measuring device, the achievement obtained is the highest achievement result. So from the results of the discussion/analysis and problem solving above carried out by the researcher, the researcher is interested in conducting research with the title "Development of an Android-Based Shoulder and Wrist Test Tool" where the tool is expected to be able to answer the problems that have been expressed by researchers and it is hoped The tool that will be developed is capable of advancing technology, especially in the treasury of Android-based shoulder and wrist test kits as well as being a trigger for sports people, especially at Medan State University in developing test and measurement tools using technology that is appropriate to their respective functions.

## CONCLUSION

The results of the research that has been done, the researchers concluded that this android-based shoulder and wrist test and measurement tool is suitable for use in carrying out android-based shoulder and wrist tests and measurements. With the development of the android-based shoulder and wrist test and measurement tool that the researchers developed, stakeholders in the sports sector can more easily see the android-based shoulder and wrist tests and measurements of athletes and can also be used as evaluation material, especially in improving the flexibility of the athlete's shoulders and arms. This development research produced an android-based shoulder and wrist measurement and test tool product, which is expected to work effectively and efficiently so that it can be an attraction for athletes and coaches in activities to determine the flexibility of athletes' shoulders and shoulders as well as for further researchers. This test tool is expected to provide convenience in the implementation of measuring the flexibility of the shoulder and arm muscles of athletes as well as accuracy in seeing the results of the athlete's ability to flex. In carrying out tests and measurements the data will go directly to the IOP device in the Android system.

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