Development of measuring tools for muscle strength and endurance arm for archery sport holding bow digitec test

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ABSTRACT

This study aims to produce a measuring instrument for arm muscle strength and endurance for "Archery Holding Bow Digitec Test". It creates a new breakthrough that the "Holding Bow Digitec Test" is a tool for measuring arm muscle strength and endurance with high validity and reliability for archery. This research is a type of research and development (R&D) research that uses the Borg & Gall development model which consists of 10 procedures. The subjects involved in this study amount to 33 subjects consisting of 18 male archers and 15 female archers. Data collection techniques use questionnaires, the delphi method, and measurement tests. Data analysis uses the percentage formula for the questionnaire. The validity test uses content validity which is analyzed using the Aiken's v formula and concurrent validity which is analyzed using product moment correlation. The reliability test used a test-retest approach which is analyzed using product moment correlation. The results of the study are a tool for measuring the strength and endurance of the arm muscles in archery called the "Holding Bow Digitec Test". The contribution of this research is to present a practical archery tool to measure arm strength and muscle power of adult archery athletes. It is the hope of the researcher that this research is continued with a large range of benefits in terms of subject, place and benefits, not only in one category but the tools developed can be used by categories of children and adolescents.

Keywords: Measuring instrument; strength; endurance; archery

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INTRODUCTION

The popularity of archery in Indonesia is motivated by the public's view that archery can train focus, concentration, and improve one's physical fitness (Humaid, 2014; Hung et al., 2021). Over the last 5 years, archery has grown very rapidly in Indonesia, both as a recreational sport and as an achievement, this can be proven by the number of archery clubs that have emerged and various kinds of championships both at the regional and national levels (Parena et al., 2017; Arisman & Okilanda, 2020). Archery itself is a static sport

that requires good physical conditions, namely strength and endurance, especially in the upper body muscles (Fahrizqi et al., 2021; Hardi et al., 2020). Archery is a sport that requires, and balance to form a good archery technique (Arkin & Budak, 2021;Taha et al., 2017). Archery is one of Indonesia's leading sports, because archery athletes from Indonesia are able to be competitive in prestigious events such as the World Cup Archery by winning medals at the event (Ichsanudin & Gumantan, 2020). In addition, archery is a sport that often donates medals at multi-event events such as the Sea Games, Asian Games, and made history as the first sport to win medals for Indonesia, namely the silver medal at the 1988 Seoul Olympics (Raharjo, 2014). This is an attraction that makes this sport popular in Indonesia (Komarudin et al., 2021).

By seeing this potential, the government continues to search and develop archery talents in Indonesia by creating a coaching platform such as the Development of Talented Athletes (PAB), Prima Pratama National Training Center, and also PPLP (Student Training Development Center) (Rumini & Rani, 2016). In this coaching, prospective talented archery athletes will be selected strictly, starting from their achievements, mental, and physical abilities (F. et al., 2014; Pluncevic-Gligoroska et al., 2010). These components are predictors of athlete success in the future (Putrawan et al., 2018; Burdukiewicz et al., 2016). An archer must develop certain muscles such as the arm and back muscles that aim to stabilize his aim and body position (Bostanci et al., 2019; Park, 2016). The coaching process must be supported by adequate facilities and infrastructure, a large field that has complete archery standards and equipment, and has special physical measurement tools for archery that are valid and reliable to support the process of coaching young archery athletes in Indonesia (Parena et al., 2017; Prastiwi & Suharjana, 2014).

However, the problem faced in coaching centers is that the selection and coaching process is still not specific and valid for measuring arm muscle strength and endurance in archery athletes (Hung et al., 2021; Komarudin et al., 2021). In particular, it is measuring the strength and endurance of the arm muscles in archery athletes, because at the training center the majority still use instruments that are not yet valid for archery, namely to measure arm muscle strength using a pull and push dynamometer, push ups and using a drawn hanging scale, for arm muscle endurance using the "holding bow test" this test is done by pulling the bow and holding it and counting how long the archer is able to hold it (Lu et al., 2021). The weakness of the pull and push dynamometer is that when measuring the strength of the arm muscles, the movements performed are not the same when the archer draws the bow, if using a hanging scale the tool is not yet capable (Bebetsos, 2015). Another potential problem in this study is the development of digital instrument for measuring arm muscle strength and endurance for adult archery athletes, especially in Indonesia, as well as the lack of manuals relating to archery measuring instruments.

This prompted researchers to be interested in going directly to the location, in fact, the situation where the archery athlete is pulling the bow because there are differences, namely from the shape and weight of the tool, while the bow holding test had a weakness that it is not standardized how many pounds of bow capacity are used to measure arm muscle endurance, it is usually between the construction centers using bows that differ in the weight of the pull (Komarudin et al., 2020). The use of non-standard measuring instruments will cause the measurement process to be less than optimal. By utilizing advances in science and technology, a test tool that is more modern and has clear units will be able to measure validly and reliably the strength of the arm muscles and the endurance of the arm muscles of archery athletes (Park et al., 2013; Tsuzuki et al., 2021).

Knowing the strength and endurance of an archer's arm muscles will also determine the choice of the right bow with the archer (Hung et al., 2021; Qiu & Zhao, 2019). The most important thing in choosing a bow is that the bow is suitable for the athlete in question, this means that the bow weight should not be too heavy or too light for the archer (Roldán et al., 2020; Tu et al., 2020). So that the archer is able to draw the bow without expending excessive force and without tension and is able to do it repeatedly without changing the anatomical shape of the technique (Ahmad et al., 2014; Cohen et al., 2018). High precision when performing archery techniques between one arrow and another is important to get a high score (Akınoğlu et al., 2020). To be able to match the bow with the wearer, every trainer must be able to know the muscle strength and endurance of the athlete's arm (Arkin & Budak, 2021; Park et al., 2013; Tan et al., 2016).

 Researchers conduct interviews with PPLP archery trainers in Central Java that, in archery, a test tool for arm muscle strength and endurance was needed to measure the physical components of archery. If the strength

and endurance capacity of the archery athlete's arm muscles can be presented in the form of valid data, then it can be used as a support for the archery sports coaching process and can be used as an indicator of selecting a suitable archery tool for archers (Melo & Rubio, 2017; Shil'ko et al., 2015). Therefore, the match between the archer and the bow used so that the optimal performance can be obtained. From the preliminary research activities carried out by the researcher, distributing questionnaires to 12 respondents consisting of Archery Training Training Center trainers, Central Java PPLP, DIY PPLP, Bali Perpani trainers, DKI Jakarta trainers and Central Java archery trainers who are nationally certified and several are internationally certified by obtaining results. 10 people have a very positive opinion (83.33%), 2 people have a positive opinion (16.67%) accompanied by various kinds of input.

Previous researchers have discussed the development of measuring instruments for archery such as the development of tools to analyze archery accuracy (Yong et al., 2016), but as far as we know no one has developed these tools for muscle strength and endurance, but the focus of this research is based on the accuracy of an archery athlete's shot against the focus of the target. As for another relevant (Fajri & Prasetyo, 2015) who developed the Bow from Pralon for Archery Extracurricular Learning for Elementary School Students. The focus of this research is to provide an exercise mode for conscious school students to perform various basic archery techniques using modified tools. Another relevant research (Purnomo, 2014), by developing a tool for scouting archery talent for permanent employees at the Ministry of Youth and Sports of the Republic of Indonesia. The focus of this research is to present a tool that makes it easy to identify one's talent in the field of archery. Although the three previous researchers are relevant to the research, the three previous researchers have a difference with this research in that the focus of this research is to produce a measuring tool for arm muscle strength and endurance for archery athletes.

Based on these various problems, in the sport of archery, it is necessary to have an arm muscle strength and endurance test tool that can help the coach to determine the strength and endurance capacity of archery athletes' arm muscles. It should be noted that until now there is no measuring instrument that can produce accurate and valid data.

METHOD

This study uses research and development (R&D) methods (Sugiyono, 2015). This research is oriented to produce a product (Sugiyono, 2013). Research and development is generally based on a new product or a method developed from the limitations of previous researchers to make it simpler or more interesting and accountable (Flynn et al., 2020; Staley et al., 2019). This study uses Brog & Gall steps with a 10-step approach. However, the 10 steps above, then adjusted to the needs in carrying out research steps to develop a measuring instrument for measuring the strength and endurance of the archery arm muscles are packaged in Figure 1 below.
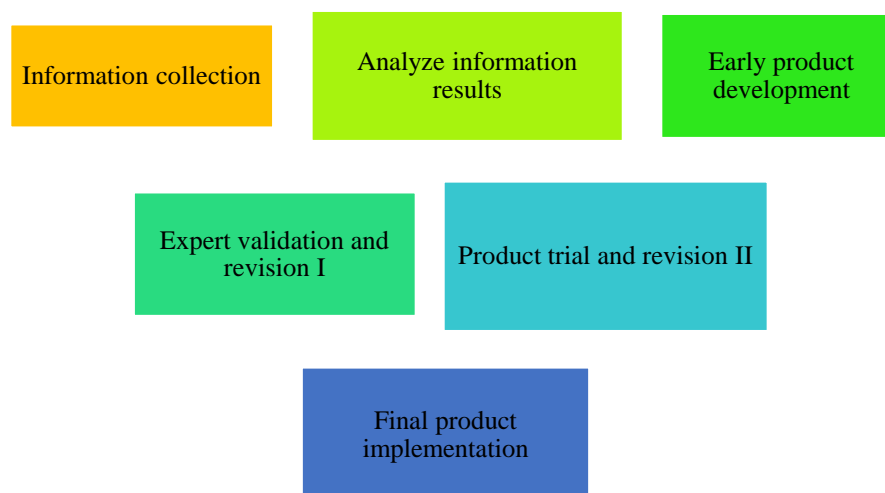
Information collection	Analyze information results	Early product development
	Expert validation and revision I	Product trial and revision II
	Final product implementation	

Figure 1. Research Cycle

The place of this research is PPLP DIY. The duration in this study is one year, namely March 1, 2018-July 1, 2019. The subjects in this study were 33 archery athletes consisting of 18 male athletes and 15 female athletes with an average age of 20, 21, 22 and 23, as well as student occupation. Data collection techniques in this study include three stages, namely questionnaires, Delphi method, and measurement tests. Data analysis in this study uses the percentage formula for the questionnaire. The validity test uses content validity which is analyzed using the Aike''s v formula and concurrent validity which is analyzed using product moment correlation. Then the reliability test uses a test-retest approach which is analyzed using product moment correlation.

RESULTS AND DISCUSSION

The results of the preliminary study in the form of a needs analysis using an indirect questionnaire containing 14 questions, the questionnaire is distributed to the trainers directly and via email on June 5, 2017 consisting of; Archery training trainers, DIY archery PPLP trainers, DKI Jakarta perpani trainers, Klaten perpani trainers, Depok perpani trainers, Bali perpani trainers are then informed that 1). The form of the test used in archery has not been able to provide validly measured data, 2). The tests carried out still tend to be general and less specific, such as still using the handgrip dynamometer grip, push-ups, and side learning tests or holding one hand, 3). In Indonesia, there is no new innovation of arm muscle strength and endurance test equipment for archery, 4). Innovation of arm muscle strength and endurance test equipment will assist archery trainers in conducting tests and measurements, 5). Need to develop a test tool for arm muscle strength and endurance for archery, 6). As many as 83% of archery trainers responded very positively if a tool for measuring arm muscle strength and endurance was developed for archery, 7). As many as 17% of archery trainers responded positively when a tool for measuring arm muscle strength and endurance is developed for archery, starting from the beginning, the researcher wants to make a product in the sport of archery.

1. Planning of the Holding Bow Digitec Test Model Design Test

The initial model planning is based on the old model of arm muscle strength and endurance measurement tools and based on input from the archery trainer. The following is an image of the initial draft of the model below:
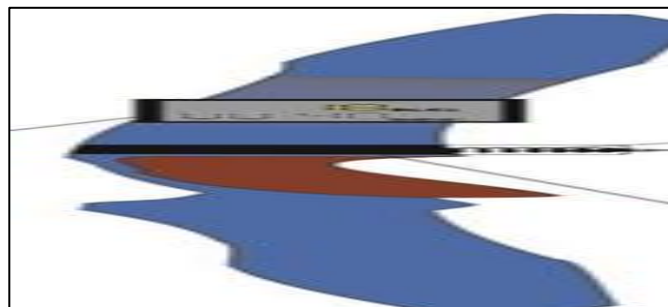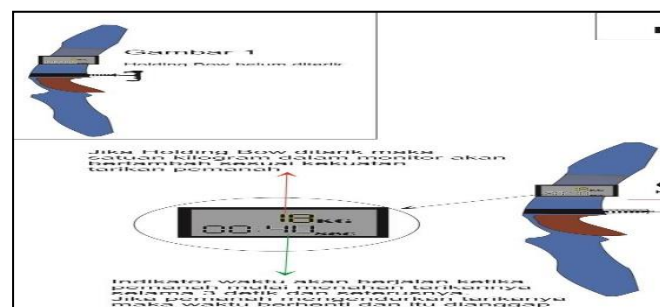

Figure 2. Initial model design

Figure 3. Initial Model Design

2. Description of Early Development

The product produced in this study is a tool for measuring arm muscle strength and endurance. Using a 24 inch riser made of wood, using a pull spring with a force of 80 kg which is read by the weight sensor and processed by the Micro Control AT-Mega 32 chip. This chip will receive data from the weight sensor and process it so that the measurement results can be displayed by the LCD. LCD uses OLED (Organic Light Emiting Diode), 16 x 2 Char with blue lettering color display. Here's a view of the product from the side and back.

Figure 4. View of the Tool from the Side and Back

The product belonging to the researcher underwent two revisions, namely the first and second stage revisions. The input in the first revision is: Changed from a pull peer to a calibrated compression peer, the LCD has been changed to face forward to make it easier to monitor athletes. Then the results of the second stage of revision are: Need to add a support iron to connect the riser to the main measuring instrument, the data stored in the tool can be transferred to the software, an iron plate is added to connect the riser to the main tool. After passing the revision stage. Then the product will be validated by experts.

3. Expert Validation Results

After completing the initial product draft, in the form of a measuring instrument for arm muscle strength and endurance and a manual for using the tool. The draft that has been prepared is then validated by the expert through an assessment sheet according to the expertise of the validator. The experts needed by researchers are as follows: 1) Dr. Yudik Prasetyo, M.Kes. as a material expert; 2) Dr. Edy Supriyadi, MT as an electronics expert; 3) Dr. Or. Mansur, M.S. as a media expert. The results of the assessments of the three experts are presented through the table and pie chart below.

Table 1. Results of the Expert Assessment of Archery Materials (Dr. Yudik Prasetyo, M.Kes)

	Scoring Scale			
Material Expert Results on measuring instruments	**SS**	**S**	**TS**	**STS**
Total	12	7		
Presentation %	63.15%	36,85%		

Based on the results of the assessment related to the content of the product material in the table above, it can be concluded that from the aspect of archery material aspects, it is appropriate. The details of the assessment are as much as 63.15% of the content of the material is very appropriate and as much as 36.85% of the content of the material is appropriate. Then presented in the form of a pie chart below.
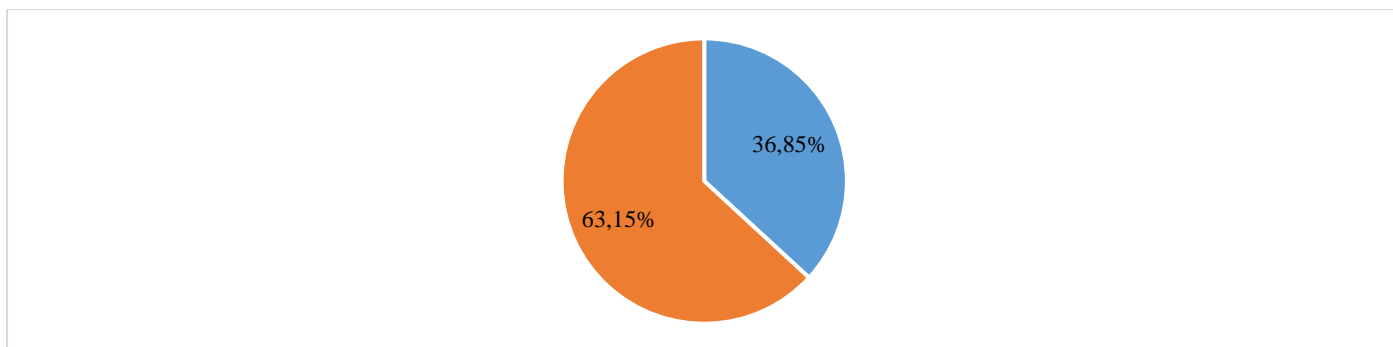
Figure 5. Diagram of ohe Results of Material Expert Validation on Tools

Table 2. The Results of the Assessment of Electronics Experts (Dr. Edy Supriyadi, MT.)

	Scoring Scale			
The results of the electrical expert on the tool	SS	S	TS	STS
Total	9	12		
Presentation %	57.15%	42,85%		

Based on the results of the assessment related to the tools developed in the table above, it can be concluded that in terms of the electronics aspect, it is compatible. The details of the assessment are as much as 42.85% very suitable and as much as 57.15% suitable. Then presented in the form of a pie chart below.
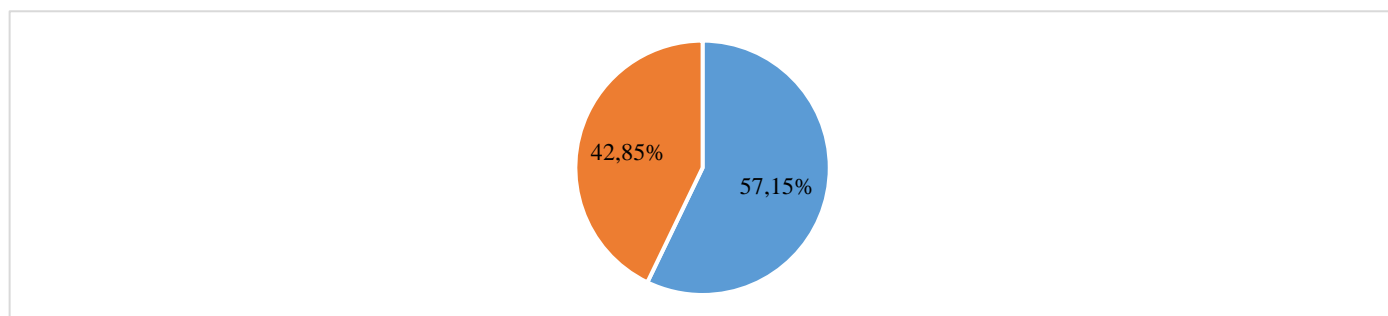

Figure 6. Diagram of the Results of the Electrical Expert's Validation of the Tool

Table 3. Results of Media Expert Assessment (Dr.Or. Mansur, MS.)

	Scoring scale			
Material Expert Results on measuring instruments	SS	S	TS	STS
Total	8	9		
Scoring scale %	47,05%	42,85%		

Based on the results of the assessment related to the tools developed in the table above, it can be concluded that from the aspect of media experts, it is appropriate. The details of the assessment are as much as 47.05% very suitable and as much as 52.95% suitable. Then presented in the form of a pie chart below:
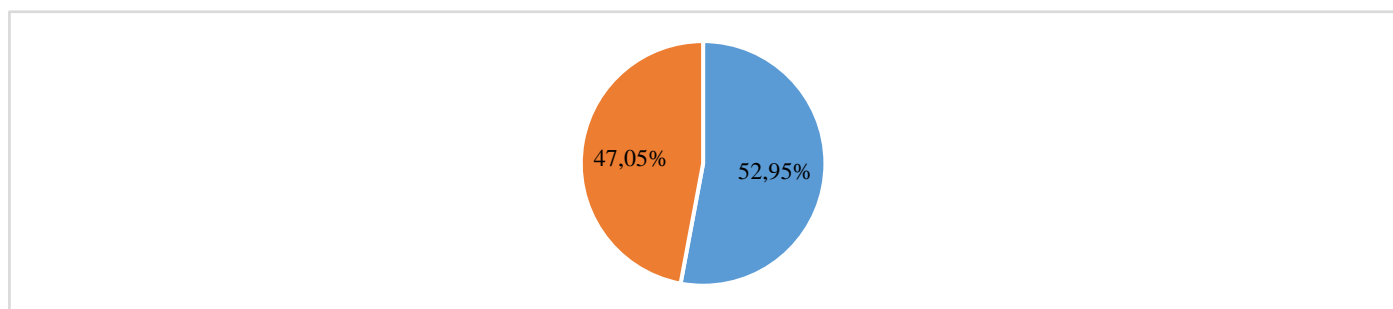

Figure 7. Media expert assessment results (Dr.Or. Mansur, MS.)

4. Product Trial Results

Product testing is carried out after revising the inputs given by the validator to the product being developed. The results of product trials consist of small-scale trials and large-scale trials. The following describes the details of the results of small-scale trials and large-scale trials.

1) Small-Scale Trial Results

Small-scale product trials aim to test the feasibility of using the product and get input from a limited number of users. The small-scale product trial involved 10 UNY Archery UKM Athletes. The results of the trainer's assessment of the attached products are calculated using the percentage formula. The results of small-scale product trials can be seen in the following table:

Table 4. The Results of the Assessment of Small Group Test Measuring Instruments

The Results of the Assessment of the Small Group Trial Measuring Instrument	Scoring Scale			
	SS	S	TS	STS
Amount	122	87	1	
Total	210			
Presentation %	58%	41,6%	0,4%	

Based on the results of the implementation of small-scale measuring instruments that contain tests of arm muscle strength and arm muscle endurance in the table above shows the total value of scale 4 (very appropriate) amount to 122 with a percentage of 58%, while the overall value of scale 3 (appropriate) amount to 87 with a percentage of 41.6%, and the overall value of a scale of 2 (not appropriate) amount to 1 with a percentage of 0.4%. This shows that the measuring instrument product has a suitability of 99.6%, meaning that the product is included in the very good category. Furthermore, it can be concluded that the measuring instrument product contains a test of arm muscle strength and endurance that is suitable for the needs of archery athletes. Then presented in the form of a circle below.
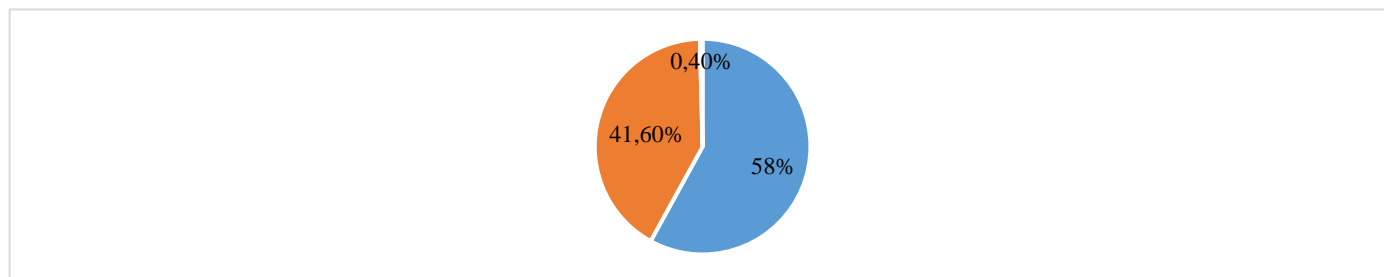

Figure 8. Diagram of the Assessment of the Feasibility tf Small-Scale Test Measuring Instruments

2) Large-Scale Trial

Large-scale trials aim to test the product in a wider scope. Large-scale trials in this study are conducted on athletes from UKM Archery UNY and athletes from Perpani Klaten. The results of the trainer's assessment of the attached products are calculated using the percentage formula. The results of large-scale product trials can be seen in the following table:

Table 6. Assessment Results of Large Group Test Measuring Instruments

The Results of the Assessment of the Large Group Trial Measuring Instrument	Scoring Scale			
	SS	S	TS	STS
Amount	235	185		
Total	420			
Presentation %	55%	45%		

Based on the results of the implementation of large-scale measuring instrument trials containing tests of arm muscle strength and arm muscle endurance in the table above shows the total value of scale 4 (very appropriate) amount to 235 with a percentage of 55%, while the overall value of scale 3 (appropriate) amount to 185 with a percentage of 45%, this shows that the measuring instrument product has a suitability of 100%, meaning that the product is included in the very good category. Then the results of large-scale trials are presented in the form of a circle below.
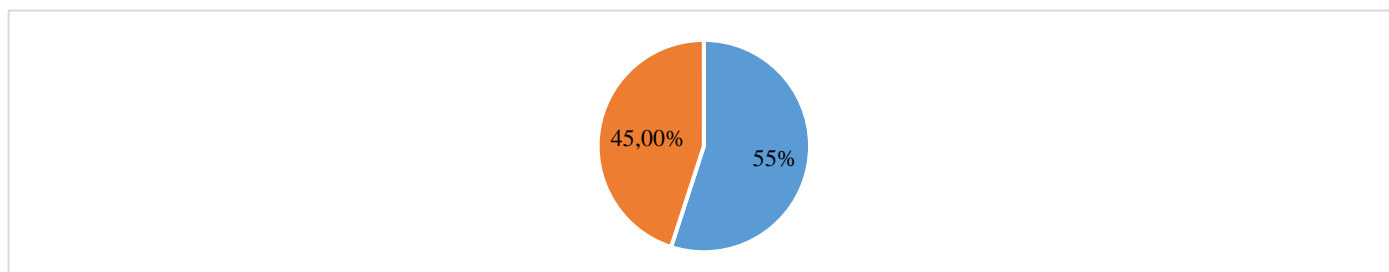

Figure 9. Diagram of the Assessment of the Feasibility of Large-Scale Test Measuring Instruments

5. Effectiveness Test

Product effectiveness test aims to determine the extent to which the product can achieve its goals. The effectiveness test was carried out by archery athletes from the Archery UKM of UNY and Perpani, Klaten Regency. There are 18 male athletes and 15 female athletes. The measurement results are presented in the table below.

Table 7. Measurement Data Using Manual and Digital Tools

	Digital		Manual	
	Strength	Endurance	Strength	Endurance
Highest	25	24	25.4	24.4
Lowest	14	15	14.5	15.2
Total Value	600	668	611,9	676
Average Score	18,18	20,34	18,54	20,48

The data in the table shows that there are similarities between the average digital and manual results on tests of arm muscle strength and endurance. This shows that the digital arm muscle strength and endurance test results from the development of the manual arm muscle strength and endurance test are both in the good category. After passing the effectiveness test, this research will pass several homogeneity, normality and correlation tests.

a. Homogeneity Test

In the homogeneity test process, there are two factors, namely strength and durability tests. The test results of these two factors can be presented in the table below.

Table 8. Strength Test Results

	Levene Statistic	df1	df2	Sig.
	,635	1	64	,429

Based on the results of the analysis above, the significance value is 0.429. In accordance with the basis of decision making if the significance value> 0.05 then the data is homogeneous.

Table 9. Strength Test Results

	Levene Statistic	df1	df2	Sig.
	,009	1	64	,924

Based on the results of the analysis above, the significance value is 0.924. In accordance with the basis of decision making if the significance value > 0.05 then the data is homogeneous.

b. Normality test

In the normality test process, there are two factors, namely the digital strength test and digital endurance test. The test results of these two factors can be presented in the table below.

Table 10. Digital Power

		Test 1	Test 2
N		33	33
Normal Parameters[a,b]	Mean	17,9394	17,9394
	Std. Deviation	2,79441	3,07143
	Absolute	,231	,153
Most Extreme Differences	Positive	,231	,153
	Negative	-,086	-,090
Kolmogorov-Smirnov Z		1,327	,878
Asymp. Sig. (2-tailed)		,059	,424

a. Test distribution is Normal.
b. Calculated from data.

Table 11. Digital Endurance

		Test 1	Test 2
N		33	33
Normal Parameters[a,b]	Mean Std. Deviation	19,9394	19,9091
		2,43592	2,36331
	Absolute	,126	,145
Most Extreme Differences	Positive	,126	,093
	Negative	-,116	-,145
Kolmogorov-Smirnov Z		,726	,834
Asymp. Sig. (2-tailed)		,667	,490

a. Test distribution is Normal.
b. Calculated from data.

Based on the normality test, the value of Sig. (2-tailed) is 0.667 and manual is 0.490. based on these data, p > 0.005 means normal data.

c. Correlations

In the process of testing the normality of two factors, namely the strength correlation test and the endurance correlation test. The test results of these two factors can be presented in the table below.

Table 12. Paired Samples Correlations Strength

		N	Correlation	Sig.
Pair 1	Digital & Manual	33	,939	,000

Based on the normality test, it is known that the significance value is 0.330 > 0.005, then the data can be concluded to be normally distributed. So it can be used to test paired samples correlation.

Table 13. Paired Samples Correlations Endurance

		N	Correlation	Sig.
Pair 1	Digital & Manual	33	,974	,000

The results of the product moment correlation test between the digital power and manual strength variables, the correlation test produces a sig value of 0.000. In accordance with the decision making on the correlation test, if the sig. value is less than 0.005 then there is a relationship between the variables being tested. Since

the sig. value is 0.000 < 0.005, there is a relationship between digital power and manual power. The results of the product moment correlation test between digital and manual endurance variables, the correlation test produces a sig value of 0.000. In accordance with the decision making on the correlation test, if the sig. value is less than 0.005 then there is a relationship between the variables being tested. Since the sig. value is 0.000 < 0.005, there is a relationship between digital durability and manual durability. This tool is a new technology that is easy to use, more accurate measurement results only require one person. The measurement data is also presented in digital form and stored in the device's memory and can be transferred to a computer. Therefore, this tool is effective for measuring arm muscle strength and endurance in archery.

The initial development of the Holding Bow Digitec Test tool is designed and modified to measure muscle strength and muscle endurance of archery athletes. Holding Bow Digitec Test is a measurement tool for new innovations in the field of sports. The steps of this development research are based on theory Brog and Gall (2007) then become a study in the development procedure that will be carried out. The procedure for developing this research is adopted from the research and development stages of Borg & Gall. This development research is modified into two stages, namely the preliminary stage and the development stage. The preliminary stage includes conducting a literature review, relevant research, observation, and preliminary studies. The development stage includes developing initial products, expert validation, small-scale trials, large-scale trials, and validity and reliability tests.

Before conducting the research, the researcher distributes a questionnaire to the national trainers totaling 10 trainers and asked for input on the product to be developed. input is received, the researcher makes an initial design of the tool developed with the help of practitioners who are experts in the field of electronics. The initial design of the finished tool, before proceeding to expert validation, the researcher asked for input from the national archery trainer both from the design and construction of the tool and then discussed it with the supervisor. The results of the input of trainers and supervisors obtained several product revisions for product perfection. As for the input of the trainers and supervisors, the changed part is that the LCD of the tool does not face backwards because it can affect the measurement process, therefore the LCD is changed to face forward. The type of peer has also changed, from a pull peer to a push peer. Because the tensile peer has a low pressure mass, the peer uses a pressure peer type that has been calibrated using a special peer calibration tool at the DIY Technical Training Agency. To add to the Holding Bow Digitec Test function, the tool is equipped with memory that can store as much as 200 data and a USB port is added for the process of transferring data to the computer.

Based on the results of the research above, this digital bow holding test device results in an increase in the strength and endurance of archery athletes' arm muscles, but the increase in archery results is not better than the pull and push dynamometer because the digitec bow holding test device can not be used in the juvenile category. Based on research by Prasetyo and Siswantoyo (2022) the holding bow digitec test is a better tool for athletes to determine the ability of arm strength and muscles. Product development is carried out by researchers to create archery tools that are practical, effective and efficient for archery athletes (Proffitt et al., 2016). This is in line with the statement of Bolotin and Bakayev (2017) which explains that product development in the field of archery has a positive impact on junior and senior archery athletes. With the development of a tool in the form of a holding bow digitec test, it will affect the quality of maximum arm muscle strength and endurance for an archery athlete (Kutukcu et al., 2018 ; Bouhlel et al., 2010).

In line with Zhang et al. (2016) arm muscle strength and endurance in archery are important components for holding bows and arrows, especially bows, with good stability making it easier for archery athletes to aim at an object so that it sticks to the target point. desired. This product provides an athlete with effective and efficient results in performing various archery techniques in that sport (Tymchik & Goloborodko, 2021). Similar to Davis et al. (2020) states that archery athletes also involve all components that support in getting the expected results in a competition other than muscle strength and endurance. For example, accuracy in making decisions and concentration. Because the result of a match does not only involve strength and endurance but also involves other components (Philpott et al., 2019). Therefore, arm muscle strength and endurance are needed not only to maintain good archery accuracy/get results maximum, but to prevent the athlete from becoming easily fatigued in bearing the weight of the bow.

Holding Bow Digitec Test is a new innovation measuring instrument that is more effective and easier in the process of measuring arm muscle strength and endurance. Holding Bow Digitec Test is a new innovation measuring instrument that is more effective and easier in the process of measuring arm muscle strength and endurance. As for

other studies that are relevant to this study (Bedir & Erhan, 2021; Gunawan et al., 2020), both studies clearly state that the development of a tool to measure the strength and endurance of the arm muscles of archery athletes digitally has a positive impact on targets. shooting, other relevant research is (Eidelman, 2012; Praningki et al., 2019). These two studies also say that the level of effectiveness of the use of component or biomotor measuring instruments of an archery athlete is very large and has a degree of ease in knowing the results of an athlete's biomotor measurement in general, in particular archery athlete. Limitations in this study relate to the research subject and the environment in which the research was conducted. The limitations of this development research include: the limitations of theoretical studies on archery, where data collection is carried out in different places so that researchers find it difficult to control each research environment, tests are carried out at different times, the conditions of athletes during testing are different, only tests on limited samples, and equipment. The gauge is intended for adult archery athletes only.

An archery athlete must have good arm muscle strength and endurance, because it will affect the technique of holding the bow and releasing arrows that are consistent and accurate to the target shot. Based on the research of Kim et al. (2015) to get accurate shots, an archery athlete has high concentration and good muscle strength and endurance. In archery, besides having the correct archery technique, it is also necessary to have strong arm muscle strength and endurance. In line with the research of Taha et al. (2017) an athlete must improve the quality of the biomtor components including the strength and endurance of the arm muscles, according to Hidayat et al. (2016) an athlete doing archery towards the target, must be in a state that the muscles are ready to cooperate with other elements to release arrows and maintain shot accuracy, this will result in shot stability. Other factors that support the success of archery are maintaining balance, controlling emotions, increasing self-confidence, being able to read the direction of the wind well and always being calm (Turna, 2020). Based on research by Spratford and Campbell (2017) because if an archery athlete does not have good concentration, good strength and endurance will cause instability in the athlete, therefore the results obtained by an athlete are far from the expectations and desired goals.

CONCLUSION

It can be concluded that this study has produced a good tool for measuring arm muscle strength and endurance for archery. Arm muscle strength is measured in units (Kg), arm muscle endurance is measured in seconds. Based on the effectiveness test to determine the validity and reliability of the measuring instrument, it is known that the strength measuring instrument has very good and significant validity in the products produced in this study. The validity of the endurance, strength, and endurance of the arm muscles is concluded to be significant. Meanwhile, the strength constraint analyzed using Cronbach's alpha is significant. Arm muscle endurance has a reliability that is significant Cronbach's alpha value. So it can be concluded that the test of arm muscle strength and endurance has reliability.

Based on the limitations of product dissemination development has not been carried out due to limited research time. For further development, this tool can be developed again so that it can be used by athletes of various ages by adjusting several components as needed, as well as looking for test norms that have been carried out. The contribution in this research is to make it easier for archery athletes to find out their personal abilities in a fairly short time. Through this measuring instrument, the researcher hopes that this tool can be used as much as possible in order to determine the ability of archery athletes, especially the strength of the arm muscles.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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