ACTIVE

Implementation Measurement of Physical Test Results for Branch of Badminton Using Application

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Abstract

The objective of the study is to assess the physical condition of students at State Elementary School 216 Palembang using a dedicated application. The research employs a quantitative descriptive method. The results from measuring physical test outcomes through the application indicate that 5 students fall into the good category, constituting 20.8%, 18 students are in the sufficient category, representing 75%, and 1 student is in the less category, accounting for 4.2%. Hence, the overall physical condition of students at State Elementary School 216 Palembang is deemed sufficient. According to a study by Wiyanto (2020), the development of norms and physical condition tests for badminton players aged 10-12 years is valid, reliable, and effective, making it a recommended measurement tool for assessing physical condition in badminton. The findings underscore the importance for students and athletes to cultivate a sense of awareness for continuous improvement and maintenance of their physical well-being, aiming for better performance and optimal achievements. The application facilitates the process of measuring physical test results for teachers, coaches, and athletes, offering a more effective and efficient way to monitor the physical condition of students and athletes.

How to Cite

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INTRODUCTION

Sports Badminton is one of the sports widely enjoyed by individuals of various age groups, ranging from early childhood, adolescence, and adulthood to veterans. The game involves the use of a racket and shuttlecock, with the objective of landing the shuttlecock on the opponent's side of the court over the net. In badminton, the mastery of basic techniques is a crucial factor for players, enabling them to execute shots that score points and disrupt the opponent's defense. To acquire proficient basic technique skills, a player needs to be supported by good physical conditions and adhere to a structured training program.

Badminton is a sport that continuously evolves, particularly with the advancements in technology in the current era. The widespread use of technology has become indispensable for everyone. The rapid progress in science and technology has simplified and expedited various aspects of life. Sports, including badminton, are no exception to the integration of science and technology, notably computers. Different areas of scientific and technological development play a pivotal role, giving rise to new applications widely utilized by the public for various activities, such as physical tests and measurements.

Several instances of technological developments can be observed in the research and development of physical test result processing. Various applications have been created to manage the outcomes of physical tests in sports. This is evident in the research conducted by Hartati et al. (2020) with the title "Development of Physical Test Applications Basketball Sports Model in Regional Student Education and Training Center." The study yielded a visual basic 6.0 application.

Another study by Gumantan Aditya et al. (2020) titled "Development of Physical Fitness Measurement Application Based on Android" resulted in software in the form of an Android-based physical fitness measurement application. Similarly, research conducted by Putra & Imam Solikin (2020) with the title "Implementation of Physical Condition Measurement Application for Soccer Players Based on Web Mobile" produced a web mobile-based application for measuring physical condition.

A study conducted by Putro et al. (2018) titled "Cardiovascular Endurance Fitness Program Application Based on Android" resulted in the development of an Android application as a tool for cardiovascular endurance fitness programs. Similarly, Gumelar et al. (2017) conducted research with the title "Development of Aerobic Capacity Software Using Bleep Test Based on Android Application." This study produced a software product, an Android application-based instrument for measuring the Bleep Test.

Based on observations, assessing the physical condition of students is done through tests and measurements. One of the tests conducted is a physical test designed for students to monitor their physical progress, enabling them to excel at the provincial, national, and international levels. However, the technological advancements that could aid and streamline these tasks have not been utilized by teachers. Practical technology could greatly benefit the teaching process, especially in the measurement of students' physical tests, enhancing the achievement of performance. This process ideally should involve a sports technology approach, considering that sports technology is a tool that can ensure accuracy in creating physical conditions for students.

Traditionally, physical test measurements have not involved applications and are often calculated manually. The manual recording of identities, physical test measurements, and the processing of physical test results can be time-consuming due to limited access, facilities, test criteria, and manual execution of physical test components. This manual process may lead to errors or inaccuracies in recording athletes' physical test results. The test results serve as a data source for teachers regarding students' physical conditions during testing and measurements. This data also serves as a reference for improving students' physical conditions. Given these circumstances, there is a need for the implementation of an application for measuring physical test results to facilitate teachers and students in achieving optimal performance with maximum physical condition.

Based on the aforementioned background, the researcher intends to conduct a study to address and resolve the issues outlined above with the title "Implementation of an Application for Measuring Physical Test Results in the Sport of Badminton at State Elementary School 216 Palembang."

METHODS

This research adopts a descriptive research design with a quantitative approach. According to Sugiyono (2017), quantitative descriptive research aims to describe a phenomenon, event, phenomenon, or incident that occurs factually, systematically, and accurately. Phenomena can take the form of shapes, activities, relationships, characteristics, as well as similarities and diffe-

rences among phenomena. The subjects in this study are fifth-grade students at State Elementary School 216 Palembang. Data collection techniques in this research include:

Questionnaire Technique

The questionnaire technique is employed to collect data in the form of assessments of the results of physical tests in the sport of badminton, to be filled out by students at State Elementary School 216 Palembang.

Test Assessment Technique

The test technique is utilized to gather data on the achievement of results in the physical tests for the sport of badminton.

Research instruments are measurement tools used to collect data. According to Maksum (2018), variables are concepts that have diversity and are the central focus of study in research. In this study, the physical test selected by the researcher as an instrument to obtain badminton physical test data consists of.

30-Meter Sprint Test

This test aims to measure speed. The equipment used includes a running track, cones, and a stopwatch. The test implementation procedure is as follows:

a. Participants stand behind the starting line, and when the "ready" command is given, they are ready to run from a standing start. When the "go" command is given, participants run as fast as possible, covering a distance of 30 meters until they pass the finish line.

b. Sprint speed is measured from the "go" command. Timing is recorded up to tenths of a second (0.1 seconds), and if possible, it is recorded up to hundredths of a second (0.01 seconds).

c. The test is conducted twice. Participants perform the next test after a minimum interval of one runner.

d. The best sprint speed is calculated, and participants are considered unsuccessful if they cross or step over the track.

Table 1. Norms for the 30-Meter Sprint Test for Ages 10-12 Years

Category	Score	Man (Second)	Woman (Second)
Excellent	5	6.7	6.7
Good	4	6.4-6.9	6.8-7.5
Adquate	3	7.0-7.7	7.6-8.3
Inadequate	2	7.8-8.8	7.8-8.8
Very Poor	1	8.9	8.9

(Source: Abdul Narlan & Dicky Tri Juniar, 2020)

60-Second Push-Up Test

This test is designed to measure the strength and endurance of the arm muscles. The equipment used includes a stopwatch and a mat. The test procedure is as follows:

a. The participant starts in a position parallel to the surface with elbows forming a 90-degree angle.

b. Upon the cue "go," the participant raises their body as much as possible with arms fully extended.

c. Afterward, the body returns to the initial position and is repeated for 60 seconds.

d. For males, the support point is the toes.

e. For females, the support is provided by both knees, with the legs crossed.

Table 2. Norms for the Push Test for Ages 10-12 Years

Category	Score	Man (Second)	Woman (Second)
Excellent	5	>23	>20
Good	4	18-22	14-19
Adquate	3	12-17	7-13
Inadequate	2	4-11	2-6
Very Poor	1	0-3	0-1

(Source: Nurhasan, 2017)

Shuttle Run Test

This test aims to measure agility. The equipment used includes cones or markers for the start line (4 of them), a stopwatch or timer, and a flat non-slip surface with two lines spaced 10 meters apart or as specified. The test implementation procedure is as follows:

a. Participants start from a standing position on the starting line.

b. After the "go" command, participants immediately run towards the first line. After both feet cross the first line, they quickly turn and head towards the middle line.

c. Participants run again from the middle line towards the second line and back to the middle line, counted as one round.

d. Repeat this process four times, covering a total distance of 40 meters.

Table 3. Norms for the Shuttle Run Test for Ages 10-12 Years

Category	Score	Man (Second)	Woman (Second)
Excellent	5	<11.1	<11.7
Good	4	11.1-11.6	11.7-12.2
Adquate	3	11.7-12.0	12.3-13.7
Inadequate	2	712.1-12.4	12.8-13.2
Very Poor	1	>12	> 13.3

(Source: Napfa Scorechart)

Vertical Jump Test

This test aims to measure the explosive power of the leg muscles. The equipment used includes a wall with a minimum height of 365 cm, chalk powder, and a measuring tape. The test implementation procedure is as follows: Students stand sideways to the wall, both feet close together, the soles of the feet fully touching the floor, and chalk powder applied to the fingertips of the hand closest to the wall.

    a. With one hand, the student reaches upward as high as possible, keeping the feet firmly on the floor. Record the height reached at the trace of the middle fingertips.

    b. The student jumps upward as high as possible, attempting to touch the wall. Perform three jumps at the trace of the middle fingertips.

    c. The starting position for the jump involves the soles of the feet remaining on the floor, knees bent, and the hand straight slightly behind the body.

    d. No stepping forward is allowed during the upward jump.

    e. Measure the difference between the jump height and the reaching height.

    f. The student's score is the greatest difference and the height reached from the three jumps performed.

Table 4. Norms for the Vertical Jump Test for Ages 10-12 Years

Category	Score	Man	Woman
Excellent	5	>46 cm	>42 cm
Good	4	38-45 cm	34-42 cm
Adquate	3	31-37 cm	28-33 cm
Inadequate	2	24-30 cm	21-27 cm
Very Poor	1	<24 cm	<21 cm

(Source: Abdul Narlan & Dicky Tri Juniar, 2020)

Bleep Test

This test aims to measure cardiovascular endurance. The equipment used includes a stopwatch, measuring tape, a track with a minimum length of 25 meters, cones, and a sound system. The test implementation procedure is as follows:

    a. Prepare a running area with a distance of 20 meters and an additional 2.5 meters at each end of the test area. The test area is divided into several running tracks with a minimum distance of 1 meter for each participant marked with cones. Upon the command "on your mark, get ready, start," participants begin running on the designated track while maintaining a speed corresponding to the audio rhythm.

    b. Participants run from the starting line to the finish line with the condition that one foot touches the finish line before the "ting" sound. When the "ting" sound occurs, participants must turn around and run back to the other end of the finish line. If a participant reaches the line before the "ting" sound, they must wait at the line until they hear the "ting" sound before running back to the other end.

    c. When the level change announcement is made, participants continue running to the other end of the line while increasing their speed according to the audio rhythm.

    d. Participants continue running back and forth from the starting line to the finish line until they complete the test or they have failed/taken too long to cross the finish line twice.

Table 5. Bleep Test Norms

Category	Score	Man	Woman
Excellent	5	>51	>48
Good	4	45-50	42-47
Adquate	3	40-44	36-41
Inadequate	2	35-39	33-35
Very Poor	1	<34	<32

(Source: Nurhasan, 2013)

Data analysis technique refers to a method used to manage data in order to draw accurate conclusions. In this research, the chosen technique is quantitative descriptive data analysis. The data obtained from each measurement represents raw data from the results obtained by students. The normality test aims to demonstrate that the sample data originates from a normally distributed population. In this study, the Shapiro-Wilk test is employed for normality testing, with the following criteria:

Significance level (α): 0.05

If the p-value > α, then the sample is derived from a normally distributed population.

If the p-value < α, then the sample does not originate from a normally distributed population.

The normality test is conducted using computer software such as SPSS, and the percentage is calculated using the formula:

$$P = N/F \times 100\%$$

Source: Anas Sudijono (2011: 43)

Information:

P: persentase

F: frequency

N: number of cases

Once all the data has been gathered, the subsequent step involves analyzing the data to draw conclusions. The technique for calculating the results of the physical fitness tests aligns with the following **Table 6.**

Table 6. Physical Fitness Test Norms

Category	Score	Man	Woman
Excellent	5	>51	>48
Good	4	45-50	42-47
Adquate	3	40-44	36-41
Inadequate	2	35-39	33-35
Very Poor	1	<34	<32

Source: Nurhasan, (2013).

RESULTS AND DISCUSSION

The study collected data through physical examinations and measurements of various badminton sports components, including the 30-meter sprint, shuttle run, vertical jump, and pacer, administered to students at State Elementary School 216 Palembang. The results of the tests were entered into a physical test measurement application to categorize the students' physical conditions, assessing whether they fall into the categories of excellent, good, fair, poor, or very poor physical condition. The subsequent presentation illustrates the results of the physical test measurements obtained using the application. The results are then totaled based on the outcomes obtained from the tests, which will subsequently be presented as a percentage and categorized according to the applicable norms. The following information can be observed in the **Table 7.**

Table 7. Frequency Distribution of Students' Physical Test Data

Category	Score	Frequency	Percentase
Excellent	5	0	0%
Good	4	5	20,8%
Adquate	3	18	75%
Inadequate	2	1	4,2%
Very Poor	1	0	0%
Total		24	100%

Source: SPSS 28

The results from the above **Table 7** provide physical test scores with respective categories assessed directly by the researcher for 24 students using the reference norms for the 30-meter run, 60-second push-up, shuttle run, vertical jump, and bleep test. The breakdown is as follows: for the excellent category, there were 0 students with a percentage of 0%. In the good category, there were 5 students with a frequency of 20.8%. The fair category included 18 students with a frequency of 75%. In the poor category, there was 1 student with a frequency of 4.2%. For the very poor category, there were 0 students with a percentage of 100%.

Based on the research results on the measurement of physical test outcomes using an application, there is a need for a discussion regarding the implementation of the physical test measurement application in the sport of badminton. The application's implementation in measuring the physical test outcomes in badminton assists teachers or coaches in determining and organizing the physical test results that have been conducted. The presence of information technology can support sports information activities, including the development of hardware, software, networks, and databases related to sports.

According to Saputro (2020), technology is essentially created to simplify human tasks. Regarding the application of physical test measurement, research by Fadli, (2016) suggests that the benefits obtained from the use of technology are created and used by humans to ease life. This research is further supported by statements from Saputro, Wijaya, et al. (2020) that the procurement of physical test result management software is intended to enable coaches to manage physical test results effectively and efficiently.

The findings of research conducted by Ichwanun NH (2017) state that the use of applications positively impacts the effectiveness and efficiency of providing appropriate training loads to athletes based on their individual capacities, avoiding negative effects of overtraining. Physical fitness tests serve as the foundation for students at State Elementary School 216 Palembang to execute each training session effectively and smoothly, as well as to enhance their performance during competitions. A good level of physical condition is expected to enable students to perform well in competitions, thus achieving optimal results. This aligns with the opinion expressed by Bouchard, C., Blair, S. N., & Haskell, (2017), Blair, and Haskell in Erwinanto (2017) that "physical fitness is a set of attributes that people have or achieve that relate to the ability to perform physical work," indicating that physical fitness is an integral aspect related to one's capability to engage in physical activities.

According to Himawan & Permadi (2021), badminton is a sport that requires good physical

condition, demanding players to actively engage in various movements such as running, jumping, quick direction changes, and striking. Therefore, players are expected to possess good physical fitness, concentration, intelligence, precision, and teamwork. Strategies and tactics are challenging to implement without good physical and technical abilities (Subarkah & Marani, 2020). Given the multitude of movements in badminton, various physical components are essential to support each action in the sport. Some crucial physical components supporting motion activities in badminton include speed, arm muscle strength, agility, explosive power, and endurance. In line with the research objectives and findings, the physical condition was measured in various tests, including the 30-meter run, 60-second push-up, shuttle run, vertical jump, and bleep test.

The speed component was assessed through the 30-meter run test, and the results from students at State Elementary School 216 Palembang showed an average rating in the fair category with a percentage of 37.5%. Male students achieved percentages of excellent 31.5%, good 6.25%, fair 37.5%, poor 6.25%, and very poor 18.75%. Female students obtained percentages of good 25%, fair 37.5%, poor 37.5%, and excellent and very poor categories with a percentage of 0%. The 30-meter run test results were relatively low, indicating a lack of physical activity among individuals. Considering the crucial role of running speed in badminton, it is necessary to improve the running speed of students at State Elementary School 216 Palembang to enhance the quality of their gameplay. Speed is vital for badminton players to execute continuous and timely movements as quickly as possible (Muin et al., 2019).

The component of arm muscle strength is measured by the 60-second push-up test, and the results from students at State Elementary School 216 Palembang indicate an average rating in the fair category with a percentage of 50%. Male students achieved percentages of fair 25%, poor 56.25%, very poor 18.75%, and excellent and good categories with a percentage of 0%. Female students obtained percentages of fair 100%, and excellent, good, poor, and very poor categories with a percentage of 0%. Given the crucial role of arm muscle strength in badminton, it is necessary to further enhance the arm muscle strength of students at State Elementary School 216 Palembang to achieve better quality. Strong arm muscles are vital for badminton players to execute various movements. Thus, all athletes are required to have good arm muscle strength to op-

timize endurance during hand movements. Due to the vital role of arm muscle strength for all athletes, it needs to be developed to attain better quality (Rohmah & Purnomo, 2022).

The agility component is measured by the shuttle run test, and the results from students at State Elementary School 216 Palembang show an average rating in the excellent category with a percentage of 54.2%. Male students achieved percentages of excellent 81.25%, fair 12.5%, poor 6.25%, and excellent, fair, and very poor categories with a percentage of 0%. Female students obtained percentages of good 25%, fair 37.5%, poor 37.5%, and excellent and very poor categories with a percentage of 0%. The shuttle run test results were relatively high, indicating that each individual performed the physical test maximally. Given the importance of agility for badminton players, the agility of students at State Elementary School 216 Palembang needs to be maintained. Agility in badminton is crucial for quick and precise changes of direction without losing balance. In badminton, athletes need to swiftly change their movements depending on the shuttlecock coming from the opponent (Dita et al., 2022).

The explosive power component is measured by the vertical jump test, and the results from students State Elementary School 216 Palembang show an average rating in the excellent category with a percentage of 91.7%. Male students achieved percentages of excellent 87.5%, fair 12.5%, and excellent, poor, and very poor categories with a percentage of 0%. Female students obtained percentages of excellent 100%, and excellent, fair, poor, and very poor categories with a percentage of 0%. The vertical jump test results were relatively high, reflecting the competitive nature of each individual during the test. Given the crucial role of explosive power for badminton players, the explosive power of students at State Elementary School 216 Palembang needs to be maintained to achieve better gameplay quality. Explosive power significantly contributes to the strength of a jump smash in badminton (Suwarman, 2013).

The findings of this study are consistent with previous research conducted by (Arif & Wiriawan, 2022) indicating that the explosive power level of badminton athletes at PORPROV Situbondo in 2022 is in excellent condition. This is crucial in badminton as players need good explosive power to endure during the play-on phase to score points. The endurance component is measured by the bleep test, and the results from students at State Elementary School 216 Palembang indicate an average rating in the very poor category with a percentage of 83.3%. Male students

obtained a percentage of very poor 100%, and excellent, good, fair, and poor categories with a percentage of 0%. Female students obtained a percentage of very poor 100%, and excellent, good, fair, and poor categories with a percentage of 0%. The bleep test results were very low, possibly due to students' lack of physical activity or fear of fatigue. Given the crucial role of endurance for badminton players, the endurance of students at State Elementary School 216 Palembang needs to be improved to enable them to play at their full technical capacity until the end of a match. Endurance determines how far someone can run; the higher the level of cardiovascular endurance, the greater the distance that can be covered (Fitrianto, 2016).

Based on all the data and analysis conducted by the researcher, it is evident that the physical condition of students at State Elementary School 216 Palembang in the 10-12 age group averages in the fair category with a percentage of 50%. Some components of physical fitness that need improvement include speed, arm muscle strength, and endurance. The low scores in speed, arm muscle strength, and endurance can be influenced by the lack of sleep and rest before the test. Adequate rest is crucial for the body's recovery after a day of activities, and fatigue and insufficient rest can hinder optimal performance during the test. Badminton players with good physical fitness, marked by good aerobic capacity, are essential for performing maximum technical movements. "Endurance and speed depended on body mass index both in male and female school badminton players," indicating that endurance and speed are related to body mass index (Cinthuja et al., 2015).

According to Mubarak, H., Rahayu, S & Hidayah, (2015), aerobic capacity reflects a person's effectiveness in obtaining and utilizing oxygen in muscles for energy production. Good physical condition allows students or athletes to execute badminton techniques with maximum efficiency. The results of this study align with previous research conducted by (Erwin Hidayat, 2023), indicating that the average physical condition of male badminton athletes from PB Gemilang Surabaya in 2023 is in fair condition. This is known because out of the seven physical fitness components, some are in the moderate to good category. Looking at the FIT (Frequency, Intensity, Time), the frequency of training performed once a week does not allow the effective application of the physical training program, as there is too much technical training every day. Further-

more, there is no dosage indicating the difficulty level of training intensity, making it impossible to determine the level of fatigue that may occur, whether it is quick or slow. Additionally, the time or duration of one training session does not meet the ideal range of 60-120 minutes. Progression in training intensity is also not entirely good, as many players engage in physical training outside of regular practice hours. Therefore, the physical fitness training program lacks standardized metrics from the coach, preventing the coach from assessing the players' physical condition adequately.

According to Uswan Firmansyah (2013), badminton is a sport with prolonged and demanding physical activity, requiring consistent physical performance from players to endure throughout a game. To consistently perform well during matches, every player must maintain optimal physical condition, increasing their chances of winning. Hence, it is crucial for both teachers and students to regularly conduct physical fitness measurements and engage in exercises related to these fitness components to ensure good physical fitness in the future. This is especially important in badminton, where physical fitness is vital for optimal performance.

CONCLUSION

Based on the research, the physical fitness test results for badminton involved a testing and measurement process with four dominant components: the 30-meter sprint test to measure speed, the 60-second push-up test for assessing arm muscle strength, the shuttle run test for agility measurement, the vertical jump test for gauging leg muscle power, and the bleep test for evaluating endurance. The results of these measurements were input into a web-based application designed for assessing badminton physical fitness test outcomes, facilitating the collection of student physical test results. Since these test results serve as a data source and information for teachers regarding the students' physical condition during the tests and measurements, the application-assessed physical fitness test results from a total of 24 students were categorized using the reference norms. The breakdown for the categories is as follows: excellent 0%, good 20.8%, sufficient 75%, insufficient 4.2%, and very insufficient 0%. Consequently, it can be concluded that the physical condition of students at State Elementary School 216 Palembang falls into the sufficient category.

REFERENCES

Anas, S. (2011). Pengantar evaluasi pendidikan. Jakarta: Rajawali Pers.

Arif, M. F., & Wiriawan, O. (2022). Analisis Kondisi Fisik Atlet Bulutangkis Putra Porprov Situbondo Tahun 2022. Jurnal Prestasi Olahraga, 5(8), 70–80.

Bouchard, C., Blair, S. N., & Haskell, W. L. (2017). Physical Activity and Health. https://us.humankinetics.com/products/physical-activity-and-health-2ndedition

Cinthuja, P., Jayakody, J. A. O. A., Perera, M. P. M., Weerarathna, W. V. D. N., Nirosha, S. E., Indeewari, D. K. D. C., Kaethieswaran, T., & Adikari, S. B. (2015). Physical fitness factors of school badminton players in Kandy district. European. European Journal of Sports and Exercise Science, 4(2), 14–25. http://scholarsresearchlibrary.com/archive.html

Dita, A. U., Isyani, I., & Taufik, K. (2022). Analisis unsur kondisi fisik dominan atlit bulutangkis PB. Satria Dompu Tahun 2021. Gelora: Jurnal Pendidikan Olahraga Dan Kesehatan IKIP Mataram, 8(2), 27–39.

Erwinanto, D. (2017). Hubungan Antara Tingkat Aktivitas Fisik Dengan Kebugaran Jasmani Siswa Smk Muhammadiyah 1 Wates. Pendidikan Jasmani Kesehatan Dan Rekreasi, 5(5).

Fadli, Z. (2016). Hubungan Teknologi Informasi Dan Komunikasi Dalam Menunjang Kinerja Koni Provinsi Dan Induk-Induk Organisasi Cabang Olahraga Sumatera Utara. Jurnal Ilmu Keolahragaan, 15(1), 26–37.

Firmansyah, U. (2013). Keterampilan Bermain Bulutangkis Ditinjau Dari Unsur Fisik Dominan Dalam Bulutangkis Pada Pemain Tunggal Anak Putra Persatuan Bulutangkis Purnama Surakarta. Universitas Sebelas Maret, 4(26), 185–197.

Fitrianto, E. J. (2016). Profil Hasil Tes Pengukuran Vo2Max Metode Laboratorium Dan Metode Multi Stage Fitness Test/Bleep Test. Prosiding Seminar Dan Lokakarya Fakultas Ilmu Keolahragaan Universitas Negeri Jakarta, 1(01), 178–183.

Gumantan, A. (2020). Pengembangan Aplikasi Pengukuran Tes kebugaran Jasmani Berbasis Android. Jurnal Ilmu Keolahragaan, 19(2), 196–205.

Gumelar, M. I., Ray, H. R. D., & Ugelta, S. (2017). Pengembangan Software Aerobic Capacity Dengan Menggunakan Bleep Test Berbasis Aplikasi Android. Jurnal Terapan Ilmu Keolahragaan, 2(1), 25–28.

Hartati, Aryanti, S., & Victorian, A. R. (2020). Development of Physical Test Applications Basketball Sports Model in Regional Student Education and Training Center. International Conference on Progressive Education (ICOPE 2019), 176–178.

Hidayat., E. (2023). Analisis Kondisi Fisik Atlet Bulutangkis Putra Pb. Gemilang Surabaya Tahun 2023. Jurnal Prestasi Olahraga, 5(8), 70–80. https://ejournal.unesa.ac.id/index.php/jurnal-prestasi-olahraga/article/view/52968%0Ahttps://ejournal.unesa.ac.id/index.php/jurnal-prestasi-olahraga/article/view/52968/42579

Himawan, M. R., & Permadi, A. G. (2021). Analisis Unsur Kondisi Fisik Dominan Atlit Bulutangkis Pb. Satria Dompu Tahun 2019. JISIP (Jurnal Ilmu Sosial Dan Pendidikan), 8(3). https://doi.org/10.58258/jisip.v3i3.871

Ichwanun NH, B. (2017). Pengembangan program aplikasi VO2Max dan database menggunakan delphi 7.1 untuk atlet Pelatihan Cabang (PelatCab) di Persatuan Bulutangkis Seluruh Indonesia (PBSI) Kota Malang. Universitas Negeri Malang.

Mubarak, H., Rahayu, S & Hidayah, T. (2015). Analisis Profil Tingkat Kesegaran Jasmani Pemain Futsal Anker FC. Journal of Sport Sciences and Fitness, 4(3).

Muin, M., Nur, A., & Akhmady, A. L. (2019). Analisis Kondisi Fisik Atlit Pomnas Cabang Olahraga Bulutangkis Maluku Utara Tahun 2019. JUPE: Jurnal Pendidikan Mandala, 4(5).

Narlan, A., & Juniar, D. T. (2020). Pengukuran Dan Evaluasi Olahraga (Prosedur Pelaksanaan Tes Dan Pengukuran Dalam Olahraga Pendidikan Dan Prestasi). Deepublish.

Nurhasan. (2013). Tes dan Pengukuran Keolahragaan. Bandung: FPOK UPI.

Putra, M. S., & I. S. (2020). Implementasi Aplikasi Pengukuran Kondisi Fisik Pemain Sepak Bola Berbasis Web Mobile. IT Journal Research and Development, 5(2). https://doi.org/10.25299/itjrd.2021.vol5(2).5281

Putro, A. A., Suherman, A., & Sultoni, K. (2018). Aplikasi Program Kebugaran Daya Tahan Kardiovakular Berbasis Android. Jurnal Terapan Ilmu Keolahragaan, 3(1), 1.

Rohmah, A. F., & Purnomo, M. (2022). Analisis Kondisi Fisik Dan Teknik Dasar Atlet Bulu Tangkis Kategori Putra Di Kota Surabaya. Jurnal Prestasi Olahraga, 5(3), 21–28.

Saputro, D. P., Adila, F., Wedi, S., & Putra, P. A. (2020). Aplikasi olahraga: Digitalisasi manajemen tes fisik olahraga. Tadulako Journal Sport Sciences And Physical Education, 8(2), 1–13.

Subarkah, A., & Marani, I. N. (2020). Analisis Teknik Dasar Pukulan Dalam Permainan Bulutangkis. Jurnal MensSana, 5(2), 106–114.

Sugiyono. (2017). Metode Penelitian Bisnis: Pendekatan Kuantitatif, Kualitatif, Kombinasi, dan R&D. Penerbit CV. Alfabeta: Bandung. https://scholar.google.com/scholar?q=related:lnOPOjRwl0cJ:scholar.google.com/&scioq=Metode+Penelitian+Bisnis:+Pendekatan+Kuantitatif,+Kualitatif,+Kombinasi,+dan+R%26D&hl=id&as_sdt=0,5

Suwarman, D. (2013). Kontribusi Daya Ledak Otot Tungkai Terhadap Kekuatan Jump Smash Pada Permainan Bulu Tangkis di Pb. Mandiri Putra Pekanbaru.

Wiyanto, A. (2020). (2020). Norma Dan Tes kondisi Fisik Pebulutangkis Usia 10-12 Tahun. Universitas Negeri Semarang.