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DEVELOPMENT OF SPEED INFORMATION HARDWARE SOFTWARE (SHICEPATS) TO SUPPORT MOTOR LEARNING ASSESSMENT OF MADRASAH IBTIDAIYAH STUDENTS

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Abstract

In the context of Physical Education learning, objective and reliable speed assessment is essential not only for measuring students' physical abilities but also for informing instructional strategies, individualized feedback, and fair evaluation of learning outcomes. The absence of standardized and objective measurement tools can hinder teachers' ability to monitor student progress, design appropriate learning interventions, and motivate students effectively. From the background above, the following problem formulations can be taken: 1) What is the range of sports speed norms for students?, 2) What is the development model for sprint speed information hardware software (SHICEPATS) for tests and evaluations of state Islamic higher education students based on ESP8266 wireless?, 3) What is the feasibility of sprint speed information hardware software (SHICEPATS)?. The process that must be passed through in research and development by Borg and Gall. Feedback from the sports science validator highlighted several weaknesses in SHICEPATS, prompting important product improvements. One key suggestion was the creation of a comprehensive user manual to guide users through the device's operation. Based on input from IT experts regarding the control unit box, the researchers redesigned it to ensure a unique and distinctive appearance that distinguishes. The results of the small group trial showed that 38.10% were still unable to perform digital sprint tests and measurements because the operational method was not yet user friendly and there were still many displays that were confusing. The use of SHICEPATS in the large group trial has improved, the level of ease of performing measurement tests and reading results was 83.21%. In general, the level of ease of SHICEPATS design and ease of carrying was 91.97%, these results indicate that users find it much easier to process and understand the data generated by the device. The system is designed to calculate sprint speed using two strategically placed sensors.

Keywords: Sprint, Measurement, Physical Education, Elementary Education, Madrasah Ibtidaiyah.

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INTRODUCTION

The physical fitness of children in Indonesia is currently showing a declining trend. Changes in lifestyle, such as reduced opportunities for movement, increased sedentary activities, and the dominance of gadget use in children's daily lives, contribute to the decline in physical fitness. Lack of physical activity not only impacts physical condition but also has implications for children's long-term health, motor development, and readiness to learn in school. Additionally, an estimated 70% of children with obesity live with one risk factor for cardiovascular disease, and 39% of children have two or more risk factors (Fitriliani et.all, 2023: 104). In Indonesia, the development of fitness testing and measurement equipment is still underdeveloped. This may be because our country lacks sufficiently advanced technology and sports experts do not collaborate with technology experts. Consequently, there is no scientific solution to analyze the various problems that exist in sports (Dewanti and Hermawan, 2023: 157). The assessment of sports fitness components is a multifaceted field, with speed being a crucial parameter that demands precision and accuracy. However, many problems occur in its implementation. In the field of speed assessment on the field, the sprint test, a widely used method, has come under scrutiny due to issues that reduce its objectivity. First, the lack of objectivity of the sprint test is a concern. Speed measurement demands precision, but the test design may overlook important variables, resulting in incomplete assessments.

SHICEPATS is an innovative digital tool in this field, combining sports science and information technology to facilitate sprint speed assessment. The system is designed to calculate sprint speed using two strategically placed sensors. SHICEPATS' uniqueness lies in the integration of sensor technology and wireless data transfer, replacing traditional methods that relied heavily on cones and stopwatches. Previously, speed tests were conducted manually, which could lead to inconsistencies and errors. SHICEPATS modernizes this approach by combining sensors connected to a microcontroller housed in the main control unit, offering a highly efficient and automated alternative to manual testing.

This innovation is invaluable to coaches, educators, and test administrators because it simplifies the speed assessment process, making it easier and more precise. By automating speed testing, SHICEPATS ensures that test results are more reliable and free from human

error, increasing confidence in the accuracy and integrity of the scores. This technological approach eliminates the subjective elements often found in manual assessments, offering a more standardized testing experience. Furthermore, SHICEPATS promotes objectivity and fairness in assessments by providing consistent results that participants can trust. Because the tool is designed to eliminate bias or discrepancies commonly associated with manual testing, it embodies the principles of fairness and sportsmanship. Users have greater confidence in the results, as the device's automation minimizes the potential for inaccuracies or subjective influences in the testing process.The field of testing, measuring, and evaluating sports fitness components, especially speed, is expected to be integrated with information technology. The development of computer software and hardware is expected to revolutionize the accuracy, efficiency, and accessibility of speed assessment in sports, thereby contributing to improving student/athlete performance and a comprehensive understanding of sports fitness components, especially running/sprint speed. Based on this background, the authors formulate the problems: 1)) What is the range of sports speed norms?, 2) What is the development model for sprint speed information hardware software (SHICEPATS) for tests and evaluations of state Islamic higher education students based on ESP8266 wireless?, 3) What is the feasibility of sprint speed information hardware software (SHICEPATS)?

Saputra and Dewi (2023, 152) stated that several key factors contribute to an athlete's speed: 1) Genetics play a major role in determining a person's muscle fiber composition, body structure, and overall athleticism. Some individuals may be genetically predisposed to excel at speed-related activities. 2) The distribution of fast-twitch and slow-twitch muscle fibers in the body influences an athlete's speed. Fast-twitch fibers contract rapidly and produce greater force, making them important for explosive movements and sprinting. 3) Explosive muscle strength is a critical component of speed. The ability to generate force quickly, as seen in explosive movements such as jumping and sprinting, contributes to overall speed. 4) Biomechanics, Proper running mechanics and technique can significantly impact speed. Efficient stride length, stride frequency, and arm movement contribute to optimal running form.

METHODS

This research design uses a research and development design for positive innovation that refers to the theory of Borg and Gall with ten stages that must be passed. The entire research on making sprint speed information hardware software (SHICEPATS) for testing and evaluating students of state Islamic religious higher education based on ESP8266 wireless is carried out in ten steps. The following describes the scope of the research which includes concepts, variables, indicators and research instruments. The process that must be passed in development research goes through several stages including (1) Need assessment; (2) Planning; (3) Product development; (4) Expert Judgement; (5) First product revision; (6) Small

group experiment; (7) Second product revision; (8) Large group experiment; (9) Third product revision; (10) Dissemination and Implementation.

The expert validation consisted of eight experts: 1) four sports experts, and 2) four electronics or information and communication technology experts. The experts conducted observations and assessments using a questionnaire on the sprint speed information hardware software (SHICEPATS) for testing and evaluating students at a state Islamic higher education institution based on the ESP8266 wireless system. This input will serve as a reference for product improvements. Small group experiment is testing the product being developed. The experiment testees were PGMI students at PTKIN (UIN SATU Tulungagung), while the people who carried out the tests, measurements and evaluations (testors) lecturers of physical education, health and sports in each PGMI major. The small group trial is a trial of the developed product. The trial test subjects are PGMI students at the main PTKIN (UIN SATU Tulungagung). They carry out explosive power tests and measurements using SHICEPATS, and provide feedback using a questionnaire on SHICEPATS. The test subjects as large group experiment subjects were a group of PTKI students (UINMALIKI Malang and IAIN Kediri) majoring in PGMI who were not involved in the small group trials, while the testers were lecturers of physical education, health and sports in each PGMI major. The large group trial also serves as a trial of the developed product. The test subjects were a group of PTKIN (UINMALIKI Malang and IAIN Kediri) students majoring in PGMI who were not involved in the small group trial.

The research subjects used as respondents in the needs analysis activity regarding sprint speed information hardware software (SHICEPATS) for testing and evaluation of students of state Islamic religious higher education based on ESP8266 wireless are undergraduate students of PGMI UIN SATU Tulungagung aged 19 to 21 years who have taken physical education and sports courses and lecturers of physical education and sports. (1) Students in this study were taken by simple random sampling. The research subjects of students as respondents were undergraduate students of PGMI from 3 PTKIN (UIN SATU Tulungagung, UIN MALIKI Malang and IAIN Kediri) with the number of respondents being 40 students each determined by purposive sampling so that the total was 120 students.

RESULTS AND DISCUSSION

Needs analysis was conducted to understand the extent to which PGMI FTIK students of Sayyid Ali Rahmatullah State Islamic University of Tulungagung understand the concept of speed. The survey results showed that 26.89% of students felt they understood the concept of speed very well. This indicates that about a quarter of respondents have a strong and deep understanding of this concept. Most students, namely 47.06%, reported that they understood the concept of speed quite well. Although they do not fully understand this concept, they have a sufficient basis for applying it in their physical activities.

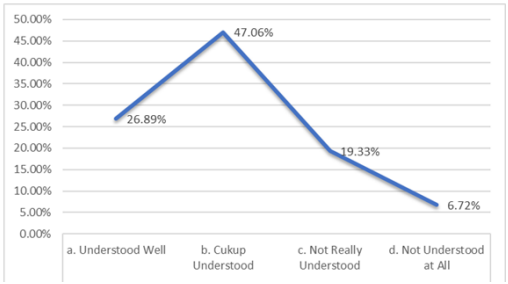

Figure 1. Level of Understanding of Speed

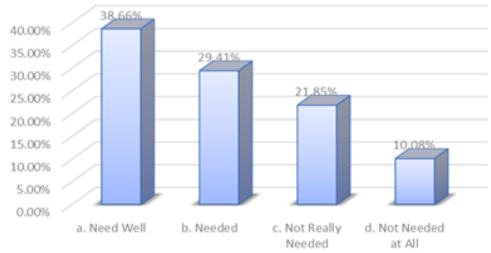

Figure 2. Analysis of technology needs in Speed Test and Measurement

Survey of Technology Needs in Speed Testing and Measurement to identify how much students need the use of technology to improve the objectivity and efficiency of speed measurement in physical education and sports activities. The survey results showed that 38.66% of students felt they really needed technology in speed testing and measurement. This percentage shows that almost two-fifths of respondents are very aware of the benefits that technology can provide in improving the accuracy, efficiency, and objectivity of speed measurement. Technologies such as wireless devices and digital sensors can help eliminate human error and provide more accurate and consistent data. In addition, 29.41% of students stated that they need technology in speed measurement.

The next step in RnD based on the results of the needs analysis was then discussed by the development research team. The discussion was carried out in order to compile a software script for sprint speed information hardware (SHICEPATS) for testing and evaluation of state Islamic religious higher education students based on ESP8266 wireless as well as compiling context diagrams, Data Flow Diagram Level 2, Flowcharts, Soft File Printed Circuit Board/PCB.The context diagram has only one process, namely the SHICEPATS software and hardware process. Entities in the Context Diagram include Administrators, Testers, Lecturers, and Testi or Students. Each entity interacts with the system to perform various functions according to their roles.

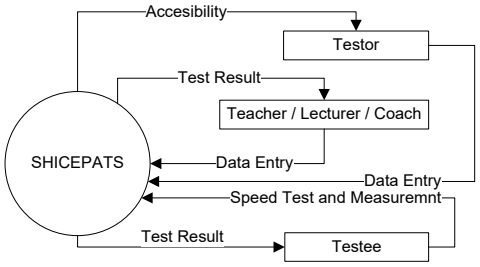

Figure 3. Context Diagram

Flowcharts act as an effective communication tool. By using a flowchart, it will be easier to understand and discuss each step in the process, ensuring a common understanding. Finally, this flowchart functions as a complete and structured document.

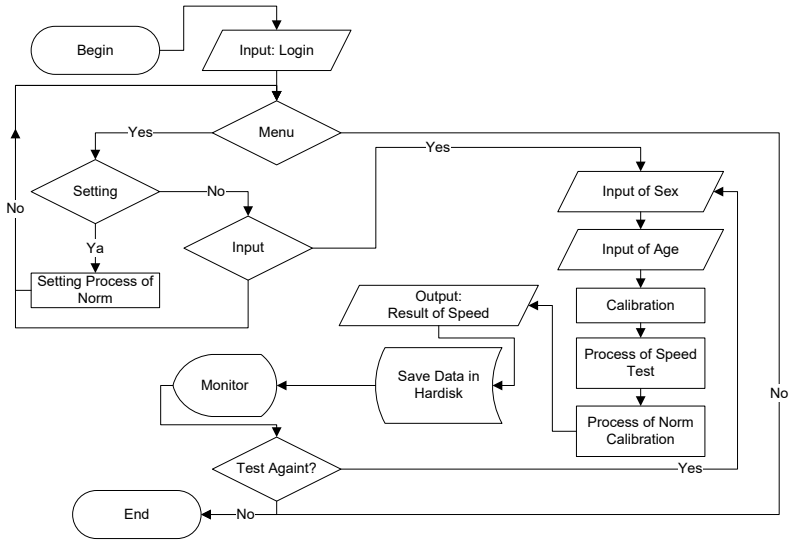

Figure 4. Flowchart of SHICEPATS

The physical PCB manufacturing process begins with creating a PCB schematic drawing using the Protel application, then printing it. After the schematic drawing is finished and printed, the next stage is the printing and dissolving process. The next step is to attach the printed layout to the PCB. This print must be printed on transparent plastic film paper or photo paper, then attached to the PCB using an iron at the hottest temperature so that the layout sticks perfectly. The next stage is drilling on the PCB to make holes for the legs of the electronic components. Component installation is done by soldering using hot tin. This soldering process ensures that the components are properly and firmly attached to the PCB.

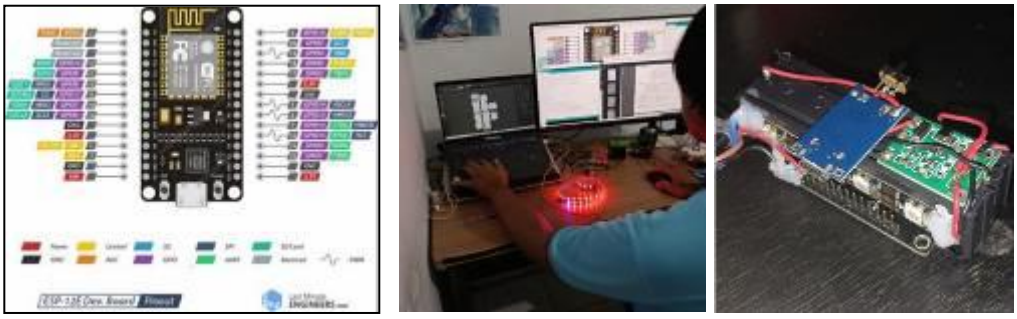

Figure 5. SICEPAT PCB and Schematic Manufacturing Process

The finished SHICEPATS hardware cannot function without software that acts as the brain to execute its commands. Therefore, coding is needed using a programming language so that the computer or hardware can process data according to the user's wishes. In this study, the programming language used is assembly language. Assembly language is a low-level computer programming language that provides instructions to machines and can be read by humans.

The final results of the SHICEPATS product in detail, including the names and terms for both the Master Control Unit (MCU) and the sensors on the device, can be seen in the following Figure 8. The initial user interface of the sender and receiver sensor microcontroller was made using a box with dimensions of 10 cm long, 5 cm wide, and 8 cm high, the sensor box is equipped with an antenna to send data to the master control. However, based on expert input, there were improvements by using modified acrylic according to needs and more aesthetic. In the early stages of making the SHICEPATS product, the support used wood equipped with a sensor. However, the use of wood as a support material turned out to be very susceptible to damage, either due to humidity factors, insect attacks, or physical impacts. Wood can break or crack easily, and this causes problems in maintaining the stability and accuracy of the sensor. Therefore, based on expert judgment input, as a solution to this problem, the wood material was replaced with iron which is stronger and more durable, so researchers used a camera tripod. Therefore, in order to improve the efficiency and effectiveness of use, it was decided to use a tripod as a support for the transmitter and receiver sensors. Tripods have many advantages compared to ordinary support poles.

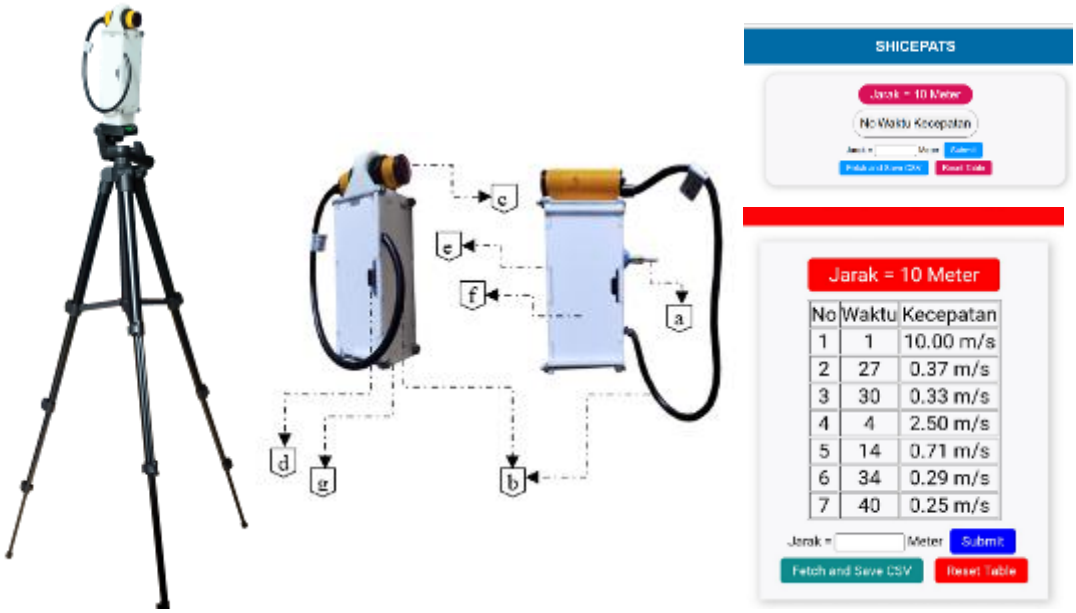

Figure 6. SHICEPATS User Interface

These expert validations provide robust evidence that SHICEPATS is both pedagogically appropriate and technically reliable for educational use. Expert validation is very important to ensure that the SHICEPATS product we produce can be improved and enhanced based on input from experts. This process allows us to identify and fix weaknesses in the product before proceeding to the next stage. There are two types of expert validation that must be carried out for the SHICEPATS product. The first is validation by experts in the field of Sports Science or Physical Education and Health. Experts in this field will evaluate the product from a sports perspective, including how the product can be used in the context of physical exercise, health, and physical education. The second type of expert validation is

validation by experts in the field of Information and Computer Technology. Experts in this field will assess the product from a technological perspective. They will evaluate technical aspects such as software, hardware, algorithms used, and user interfaces.

The insights provided by sports science experts are invaluable in further refining the product. One of the main suggestions from the experts was 1) the need for a manual book to make the device easier to use, they emphasized that having a clear and comprehensive manual would significantly improve the user experience and efficiency when operating SHICEPATS. 2) Another important point raised was regarding the sprint distance, the experts recommended that the device be adapted to various sprint distances, not limited to just 10 meters, the sports science experts expressed their overall appreciation for the creation of a digital sports device focused on speed measurement. They recognized its potential to improve the precision and reliability of speed assessment in the field of sports.

Expert validation from the Information and Electronic Technology field also provided constructive feedback for the software and hardware components of SHICEPATS. Their input focused on the functionality and design of the device. 1) One suggestion was to improve the aesthetics and uniqueness of the parent box, the experts recommended that the appearance should not resemble the general manufacturer's design but have a distinctive appearance that distinguishes it. 2) Another recommendation was to add a connector for the battery charger, this would allow the box to remain closed during charging, reducing wear and tear from frequent opening and closing. 3) Experts also suggested that the data stored in the host unit can be exported in formats such as CSV or Excel, which will facilitate the analysis and reporting of speed test results. 4) In addition, they suggested including LEDs as start and end indicators. This feature will make it easier for operators to operate the SHICEPATS device during the test, thus ensuring smoother operation. 4) For the placement of the SHICEPATS MCU device, experts suggested not to rely solely on a tripod, they recommended designing additional support pads that can be mounted on the tripod for greater stability and flexibility.

One of the main suggestions was to create a comprehensive manual to guide users in operating the device. In response, the researchers developed a Manual, available in both print and digital (PDF) formats, that serves as a detailed user guide. The manual provides step-by-step instructions for setting up, operating, and performing speed tests using SHICEPATS, making the device easier to use and more accessible. The researchers have improved by creating a manual book. The inclusion of this manual offers several key benefits. Overall, the addition of a detailed manual is a significant improvement to the SHICEPATS tool. This manual not only responds to validator feedback but also improves the overall usability and functionality of the product. Based on feedback from IT experts regarding the SHICEPATS control unit box, the researchers redesigned the box to ensure a unique and distinctive look that sets it apart from the typical factory design. The original box had a standard look, which did not reflect the uniqueness of the SHICEPATS device. To address this, the researchers created a design that was not only functional but also visually appealing, giving the main control unit a more distinctive and professional look. By using acrylic, the researchers were able to create a custom-shaped box that enhances aesthetics while ensuring that all components are securely attached and function efficiently.

The second improvement recommendation from the IT experts for SHICEPATS was to add a connector for the battery charger. This improvement would allow the main control unit box to remain closed during charging, providing significant benefits to the overall functionality and durability of the tool. By including a dedicated connector, the user would no longer need to open the box frequently, which helps protect the internal components from potential damage or exposure to external elements. The ability to keep the box closed during charging greatly reduces wear and tear on the box and its locking mechanism. The SHICEPATS software and hardware have undergone significant improvements based on a second round of feedback from sports science experts. One key recommendation was that the tool be adaptable for various sprint distances, and no longer be limited to just 10 meters. This feedback highlighted the need for greater acceleration and velocity in measuring different sprint lengths, which would make the tool more adaptable to a variety of athletic training and testing scenarios. In response, the researchers enhanced the software to include a feature that allows users to customize sprint distances to suit their specific needs.

This update allows lecturers, teachers, and coaches to set the distance for each test, providing a more personalized approach to speed testing. By adding this feature, SHICEPATS has become a more practical and valuable tool for coaches and educators (teachers and lecturers). It allows them to tailor speed tests to meet the specific requirements of their athletes, ensuring more accurate and relevant performance assessments. These improvements not only broaden the tool's applicability but also ensure its effective use across a wide range of sports and competitive environments.

The second improvement recommendation from the Information Technology experts for SHICEPATS is the addition of a connector for the battery charger. This improvement would allow the main control unit box to remain closed during charging, significantly improving the overall functionality and durability of the device. By including a dedicated connector, teachers, lecturers, and trainers as users would no longer need to frequently open the box, which would help protect the internal components from potential damage or exposure to external elements.

A small group field trial was conducted at Sayyid Ali Rahmatullah State Islamic University (UIN SATU) to evaluate the use of SHICEPATS Software and Hardware in speed testing and measurement. The trial sample consisted of third-semester students from the Elementary Madrasah Teacher Education (PGMI) study program, Faculty of Tarbiyah and Teacher Training (FTIK), who had successfully completed the Physical Education and Health Course. The first input on the small group trial was that the SHICEPATS power button should be clearly marked with the labels "on" and "off" to improve its usability and prevent confusion during operation, with clearly labeled buttons, users such as students or instructors can control the device efficiently without unnecessary delays or confusion. The second input was that the SHICEPATS system found several electronic components that were loose or protruding from their proper positions because they were not properly installed in the MCU box. The third input in this small group trial was to include additional LED indicators into the SHICEPATS system for the start and finish functions of the speed test which would significantly improve its usability and functionality.

In the Small Group Trial, data was obtained that provided insight into various aspects of SHICEPATS usability. Only 42.86% of respondents reported that assembling the device was easy, indicating that more than half of users faced difficulties in setup. This may indicate the need for improvements in the assembly instructions or hardware design to improve usability in this area. Regarding operation, 59.52% of respondents stated that they found SHICEPATS easy to use, likening the experience to using the power button on other common devices. This suggests that the basic operational design of the device is relatively intuitive and familiar to many users, which is a positive aspect of its usability. However, only 38.10% of respondents found reading sensor data on SHICEPATS easy, and 35.71% of respondents found it easy to perform speed testing and measurements. These low percentages suggest that the data reading and testing features may require improvements in accessibility or clarity for better user understanding.

Large group trials were conducted at UIN Maliki and IAIN Kediri. The large group trial demonstrated improved performance with the SHICEPATS software and hardware. The data showed that respondents had improved their skills in operating the SHICEPATS, achieving a high level of competence. This reflects positively on the learning curve, especially as users in the larger trial appeared to be managing operations with increased confidence and proficiency.

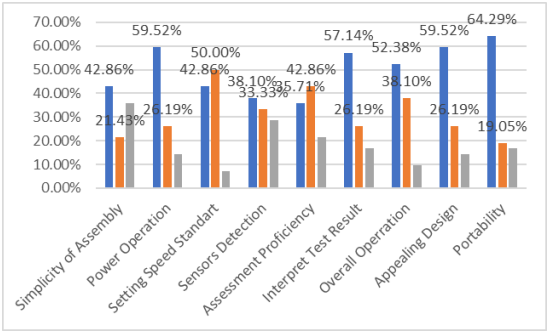

Figure 7. Results of Small Group Experiment Questionnaire

Sprint time data for male students at UIN Maliki ranged from 2.87 seconds to 4.82 seconds, with a very fast time of 2.87 seconds, indicating high speed potential in this group. The average sprint time for male students at UIN Maliki ranged from 3.91 seconds, indicating generally consistent performance with minimal variation in speed. The mean time was around 3.78 seconds, which closely matched the mean, indicating a symmetrical distribution of times. However, female students at UIN Maliki showed slower average sprint times compared to their male counterparts, with times ranging from 4.10 seconds to 5.21 seconds. The mean time for this group was around 4.75 seconds, with most times ranging between 4.5 and 4.9 seconds. These data suggest that although female students at UIN Maliki generally show slower speeds than male students, there is potential for improvement through targeted training.

Male students at IAIN Kediri recorded sprint times ranging from 3.41 to 4.88 seconds. The average sprint time for this group was about 4.05 seconds, slightly slower than

the average for males at UIN Maliki. However, several times were close to 3.5 seconds, indicating that some students had strong sprinting abilities. The average time for male students at IAIN Kediri was about 3.98 seconds, close to the average, indicating a relatively even distribution. Female students at IAIN Kediri showed times ranging from 3.00 to 4.91 seconds, indicating a wider range than their counterparts at UIN Maliki. The average sprint time was about 4.42 seconds, with several participants reaching speeds approaching 3 seconds, indicating high variability within the group. In particular, the average time was about 4.35 seconds.

In the context of Physical Education learning at PGMI, the data is relevant as a basis for data-driven learning, particularly in physical fitness and basic movement skills. PGMI teacher candidates can utilize accurate and consistent measurement results to understand differences in speed abilities among students, so that Physical Education learning at Islamic elementary schools can be designed to be more adaptive and oriented to student needs. For Physical Education learning at PGMI, SHICEPATS has the potential to be a tool for objective learning evaluation, assisting teacher candidates in developing evidence-based assessment skills, and supporting the implementation of Physical Education learning that is more scientific, measurable, and oriented towards student development at Islamic elementary schools.

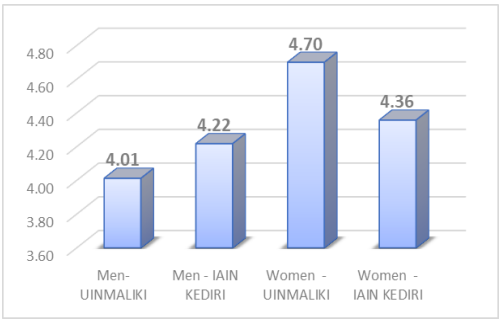

Figure 8. Speed Data on Large Group Trials

Specifically, ease of assembly for the SHICEPATS in the large group trial reached 73.72%. This improvement suggests that initial difficulties in setup may have been overcome, either through better instructions or increased familiarity with the assembly process. Users found this stage of the interaction smoother and easier to understand compared to the small group results. Additionally, components related to turning on and operating the SHICEPATS achieved a high success rate of 90.51%. This significant improvement suggests that users felt much more comfortable and able to manage the core functions of the device, likely due to better preparation and a good understanding of the provided user manual.

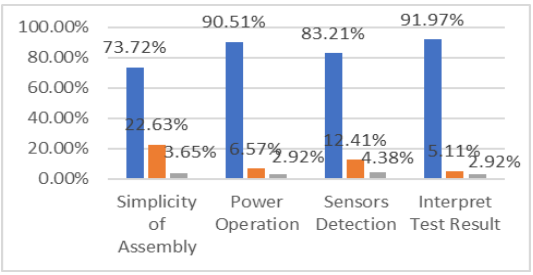

Figure 11. Results of Large Group Experiment Questionnaire

Regarding sensor detection, 83.21% of respondents reported ease in this aspect, which represents a significant improvement from the smaller group results. In addition, the ability to interpret the test criteria and results from SHICEPATS scored an impressive 91.97%, indicating that users found it much easier to process and understand the data generated by the device. The overall improvement in user ability across these areas can be attributed to the thorough preparation provided prior to the test. All test subjects read the user manual and received detailed guidance from the tester on how to assemble, operate, and perform speed tests with SHICEPATS, including how to interpret speed test results. This preparation likely played a significant role in increasing user confidence and operational success during the large-group test.

Figure 9. Documentation of large group experiment in IAIN Kediri

Specifically, the ease of assembly for SHICEPATS in the large group trial reached 73.72%. This improvement suggests that initial difficulties in setup may have been overcome, either through better instructions or increased familiarity with the assembly process. In physical education (PE) learning at PGMI, ease of assembly is essential because prospective elementary school teachers need to prepare learning tools quickly and independently amidst limited learning time. These data demonstrate that SHICEPATS meets the criteria for practical validity as a learning and evaluation tool. Regarding sensor detection, 83.21% of respondents reported ease in this aspect, which is a significant improvement from the results of the smaller group. Detection rate further supports SHICEPATS's high functional reliability. In the context of PGMI Physical Education (PE) learning, responsive and accurate sensors are

crucial to ensure that every student's physical activity is objectively recorded. This supports the implementation of performance-based assessment, which requires consistent and reliable measurement results, enabling teachers to provide appropriate feedback to students. Furthermore, the ability to interpret the test criteria and results of SHICEPATS scored an impressive 91.97%, indicating that users found it much easier to process and understand the data generated by the device. These findings serve as strong evidence for the instructional validity of SHICEPATS, as the data generated is not only accurate but also easily understood by educational users. For PGMI students as prospective physical education teachers, ease of data interpretation is crucial to support the process of learning reflection, pedagogical decision-making, and the development of follow-up learning activities tailored to the ability levels of elementary school students.

Figure 10. Documentation of large group experiment in UIN MALIKI Malang

Research novelty refers to the unique contribution or new insights that a study provides to scientific knowledge or the fields of sports science and informatics engineering. SHICEPATS is an innovative digital tool in this field, combining sports science and informatics engineering to facilitate the assessment of sprint speed. The system is designed to calculate sprint speed by passing through two strategically placed sensors. These sensors detect the speed metrics and convey them to a main control unit, which then processes and displays the data on connected devices, including computers and handheld gaming devices (HGPs) via wireless communication. The uniqueness of SHICEPATS lies in the integration of sensor technology and wireless data transfer, replacing the traditional method that relies heavily on cones and stopwatches.

CONCLUSION

Speed Information Software and Hardware (SHICEPATS) was developed as a learning innovation that directly contributes to improving Physical Education learning strategies and teacher competency at the Madrasah Ibtidaiyah (Islamic elementary school) level. This study has several limitations that need to be openly disclosed as part of academic integrity. The trial subjects were still limited to PGMI students who served as representatives

of prospective teachers, so the research findings do not fully describe the implementation of SHICEPATS in Madrasah Ibtidaiyah students as the primary users. Furthermore, this study has not examined the adoption and sustainability aspects of SHICEPATS use in the long term, so its impact on Physical Education learning and improvement of student learning outcomes cannot be fully measured. SHICEPATS offers an efficient, objective, and automated speed measurement approach, supporting a more scientific and data-driven Physical Education (PE) learning process. This system utilizes ESP8266-based receiver and transmitter sensors that can provide real-time measurement results via laptops or mobile devices, allowing speed data to be immediately accessed and utilized by teachers, students, and other educational stakeholders.

Compared to conventional speed measurement methods that require more than one examiner and are prone to subjective error, SHICEPATS simplifies the measurement process by involving only one operator. This efficiency has a positive impact on PE learning in Madrasah Ibtidaiyah, as teachers can focus more on classroom management, observing student movement activities, and providing appropriate learning feedback. User feedback findings indicate that 38.66% of respondents considered an automated speed measurement system important in determining individual ability levels, while 69.75% expressed readiness to use an automated measurement device if available. This data reflects the real need for technology like SHICEPATS to support modern and accurate Physical Education (PE) learning. The results of small and large group trials showed consistent performance patterns based on gender, with male participants generally having faster speeds than female participants. This difference can be explained physiologically, such as differences in muscle fiber composition and quality, as well as greater explosive leg muscle strength in males. These findings align with physical development theory and provide contextual material that teachers can utilize in PE lessons at Islamic elementary schools (Madrasah Ibtidaiyah) to explain the concept of individual differences scientifically and educationally. The effectiveness of SHICEPATS is also reflected in high user ratings across various aspects of the system. Ease of assembly, activation, and operation scored 73.72%, while ease of turning on and operating the device achieved 90.51%. Furthermore, sensor detection capability was assessed at 83.21%, and clarity of criteria and test results scored very high at 91.97%. These achievements demonstrate that SHICEPATS is capable of presenting clear, easy-to-understand, and relevant information for learning, thus contributing to improving the competence of MI Physical Education teachers, particularly in aspects of assessment, utilization of learning technology, and data-based decision-making.

SHICEPATS offers innovation through the cross-disciplinary integration of sports science and information engineering in a single automated running speed assessment system. Unlike previous research that relied on manual methods using cones and stopwatches, SHICEPATS develops a new approach by utilizing two strategically placed sensors to

accurately detect run times. The data obtained is then processed by a microcontroller-based control unit and transmitted wirelessly to digital devices, such as computers and handheld devices, so that the measurement results can be displayed in real time.

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