International Journal of Education, Vocational and Social Science
https://e-journal.citakonsulfindo.or.id/index.php/IJEVSS
E-ISSN : 2963 4954
IJEVSS

Development Of A Footwork Training Model To Improve Badminton Skills In Extracurricular Students At SMK PGRI 2 NGANJUK

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Abstract

The demands of physical activity of Vocational High School (SMK) students after daily vocational practicum often trigger chronic physical fatigue which negatively impacts on decreased motor performance and agility in badminton extracurricular activities. Therefore, it is necessary to innovate training models that are adaptive, biomechanically safe, and efficient in terms of time. This study aims to: (1) test validity and feasibility, (2) measure practicality, and (3) test the effectiveness of the integrated circuit-based *"Footwork Masterclass" Exercise Book Module* for vocational school students. This study uses *the Research and Development* (R&D) method by adapting the Borg & Gall development model. The research subjects consisted of 15 students in a small-scale limited trial and 34 students who were extracurricular members of badminton at SMK PGRI 2 Nganjuk in a large-scale field trial (using *the One-Group Pretest-Posttest Design*). The data collection instruments included expert validation questionnaires (materials and media), student practicality questionnaires, and standardized physical tests *Modified Shadow Footwork Test* (12 corner touches). The data analysis technique used percentage analysis, Shapiro-Wilk normality test, *Paired Sample t-test*, *Normalized Gain* (), and N-Gain*Effect Size* (Cohen's). It can be concluded that the integrated circuit-based d*"Footwork Masterclass" Exercise Book Module* has proven to be valid, very practical, and effective in significantly

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improving the *footwork skills* of vocational school students in a significant, measurable, and safe manner without triggering excessive physical fatigue (*overtraining*).

Keywords: sack racing game, knuckle game, gross motor skills, traditional game, elementary school.

INTRODUCTION

Sports activities in the school environment, especially through extracurricular badminton, are actually not just a place to pursue physical achievements, but a humanist vehicle for students to actualize themselves, channel talents, and build confidence. In the game of badminton, mastery of *footwork* is the main foundation that allows a student to move efficiently, balanced, and quickly on the court to achieve the ideal hitting position. Theoretically, *footwork* that includes split *steps*, left-right swipes (*chassé*), long steps (*lunges*), and backward movements, is the main key in responding to the direction of come. The importance of structuring foot movements is supported by Soniawan's (2018) research which confirms that *structured footwork* training can increase agility by up to 25% in beginner athletes.

The ideal hope is that the extracurricular training process will be able to present a fun and effective method (*joy of play*), so that students are not only skilled, but also avoid mental fatigue and physical injury.

However, the reality on the ground shows that there is a deep *gap* between these ideal expectations and the reality experienced by extracurricular students at SMK PGRI 2 Nganjuk. Based on **preliminary studies and preliminary diagnostic tests** conducted by the researcher using the Footwork Skills Evaluation Sheet instrument (covering 5 quantitative indicators: *Ready Stance & Split Step, Front Agility, Back Agility, Body Balance/Center of Gravity*, and *Recovery Speed*), quantitative data was obtained that **70% of extracurricular students obtained a Final Grade below the standard graduation criteria ()**< 70. This problem is very crucial because it concerns the psychological and physical condition of Vocational High School (SMK) students who have to divide their energy between the heavy load of vocational practicum and extracurricular activities in the afternoon. Practice methods

The conventional methods applied so far tend to be rigid, monotonous, mechanical, and do not have a clear training dose measurement, thus triggering mental fatigue, decreased motivation, and slow foot movements on the court. The domino impact of weak *footwork* is in

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line with Adzinar Rasyid's study which found a direct relationship between the quality of foot movement and the level of stroke accuracy. This phenomenon is also reflected in the data of the 2025 Nganjuk Badminton Championship, where the dominance of the champion is still occupied by public schools, indicating the need for a more adaptive and structured training approach for vocational school students.

To overcome this series of problems, concrete and innovative problem solving (*solutions*) is needed in the form of the development of the *Footwork Masterclass* Training Guide Module. This research not only offers a variety of movements, but also an integrated training system that transforms *stiff leg drills* into measurable, interactive, and biomechanically safe activities. The novelty of this product lies in the presentation of 4 variations of structured models (*Hexagonal Cone Reaction, Agility Ladder Multi-Step, Shadow Visual Cue*, and *Multi-Shuttle Interval*), the preparation of a training dosage table that distinguishes the Beginner vs Advanced levels, the integration of *QR-Code technology* for interactive demonstration videos, as well as biomechanics safety guidelines to prevent knee and ankle joint injuries.

Broadly speaking, this research was conducted in order to produce a final product in the form of guide modules and *footwork* training media that are valid, practical, and effective. The main goal is to humanize the training process; restore students' confidence when stepping on the field, significantly improve *footwork* skills, and help extracurricular students of SMK PGRI 2 Nganjuk achieve optimal sports achievements with a feeling of pride and happiness.

RESEARCH METHODS

This research uses *the Research and Development* (R&D) method with the Borg and Gall development model. The product developed is a circuit-based *Footwork Masterclass* Training Book Module that is integrated with *QR-Code* demonstration videos and training dosage guidelines for badminton extracurricular students at SMK PGRI 2 Nganjuk. The research was carried out for four months, namely February-May 2026. The research used a qualitative and quantitative approach.

The qualitative approach is used at the stages of needs analysis, observation, interview, and product evaluation and revision. The quantitative approach is used to analyze the results of product validation, practicality, and effectiveness through the design of *One-Group Pretest-Posttest*. The research subjects consist of material/coaching experts, media experts, coaches, and badminton extracurricular students. Product validation involves experts to assess the feasibility

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of materials, media, safety, and readability of instructions. Limited trials involve 10–15 students to find out the initial practicality, while field trials are conducted on extracurricular students as the subjects of effectiveness testing.

Data collection was carried out through interviews, observations, validation questionnaires, student and coach response questionnaires, and *footwork performance tests*. The effectiveness instrument used the Shadow *Footwork Test* with a digital stopwatch to obtain movement completion time. Validation and practicality data were analyzed descriptively using the percentage of scores. The effectiveness of the product was analyzed through the Shapiro-Wilk normality test and *the paired sample t-test* at a significance level of 0.05. The amount of improvement in students' abilities was analyzed using *Normalized Gain* (N-Gain), with the categories of high ($g \geq 0.70$), medium ($0.30 \leq g < 0.70$), and low ($g < 0.30$).

RESULTS

After the student simulates all four posts of the exercise circuit (*Hexagonal Cone*, *Agility Ladder*, *Shadow Visual Cue*, and *Multi-Shuttle Interval*), they were asked to fill out the Student Practicality Response Questionnaire (KP-01 Instrument) which consisted of 7 statements with a Likert Scale of 1:4. The tabulation of response data from 15 students is presented in the Table below

Table 1.1 Tabulation of Student Response Data on Limited Trials (Small Scale)

Yes	Name	Classes	Item Score							Total Score (∑X)
			1	2	3	4	5	6	7	
1	AISYAH NAILA AZZAHRA	X.1	3	4	3	4	3	3	4	24
2	ANDINI RISQIANI LARASATI PUTRI W	XI.AK.1	4	3	4	3	4	4	3	25
3	ANDINI RISQIANI LARASATI PUTRI W	XI AK 1	3	3	3	4	3	3	3	22
4	APRILIA DWI AYU AZZARA	XI AK 1	4	4	4	3	4	3	4	26
5	APRILIA SANBILLA PUTRI	X.1	3	3	4	4	3	4	3	24

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6	AULIA NURZAHZIROH	XI AK 1	4	4	3	3	4	4	4	26
7	BELLA MEY LINDA	XI AK 1	3	3	3	3	3	3	3	21
8	BINTI NOR KAZANAH	XI.AK.1	4	4	4	4	3	4	4	27
9	BINTI NUR KASANAH	XI AK 1	3	3	4	3	4	3	3	23
10	DANIA SEPTI WULANDARI	XI AK 1	4	4	3	4	4	4	4	27
11	DESTA ANIS ATUL CHASANAH	XI AK 1	4	3	4	4	3	3	4	25
12	DEVI ASNA AMALIA	XI.AK.1	3	4	3	3	4	4	3	24
13	DWI CONTIKA PUTRI	XI.AK.1	4	4	4	3	4	3	4	26
14	DWIGHT HARDIKA	XI AK 1	3	3	3	4	3	4	3	23
15	FADILLA PUTRI A	XI.AK.1	4	3	4	4	3	3	4	25
∑	TOTAL		53	52	53	53	52	52	53	368

To determine the improvement of students' *footwork* ability after using the developed product, measurements were carried out through *pre-test* and *post-test*. Measurements were taken on 34 students using travel time as an indicator of *footwork ability*. The results of the measurement are presented in the following Table 1.2.

Table 1 1 Pre-test and Post-test Score Data on Student Footwork Ability (N=34)

Yes	Name	Classes	Pre-test score (Seconds)	Post-test score (Seconds)	Difference / Delta (D)	Difference Square (D2)
1	AISYAH NAILA AZZAHRA	X.1	16,55	12,15	4,40	19,36
2	APRILIA SANBILLA PUTRI	X.1	16,80	12,50	4,30	18,49
3	KUSUMASTUTI NAJELA CHAHYANI	X.1	16,30	11,80	4,50	20,25
4	LAISA TARA KISSELA	X.1	16,10	11,90	4,20	17,64
5	NENSIA NINDI LESTARI	X.2	17,20	12,60	4,60	21,16

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6	RYSTA ALYA ARBIANTI	X.2	16,45	12,05	4,40	19,36
7	SAFIRA EKA KARTIKASARI	X.2	16,95	12,65	4,30	18,49
8	SHYNTA DWI ARIANTI	X.2	16,25	11,75	4,50	20,25
9	TANIA PUTRI ARIWIBOWO	X.2	15,90	11,70	4,20	17,64
10	VITA AURA CHESILLIA	X.2	17,05	12,45	4,60	21,16
11	VIONA FARISA ANDINI	XI.LP.1	16,60	12,20	4,40	19,36
12	Viona Farisa Andini	XI.LP.1	16,85	12,55	4,30	18,49
13	ANDINI RISQIANI LARASATI PUTRI W	XI.AK.1	16,40	11,90	4,50	20,25
14	BINTI NOR KAZANAH	XI.AK.1	16,50	12,10	4,40	19,36
15	DEVI ASNA AMALIA	XI.AK.1	17,15	12,85	4,30	18,49
16	DWI CONTIKA PUTRI	XI.AK.1	16,20	11,70	4,50	20,25
17	FADILLA PUTRI AULIA	XI.AK.1	16,65	12,25	4,40	19,36
18	GHOFATUL SHAFA NUR LAILIYAH	XI.AK.1	16,90	12,60	4,30	18,49
19	GITA KEY LAYLA PRAISES SAMITA	XI.AK.1	16,35	11,85	4,50	20,25
20	PERMATASARI VAT	XI AK 1	16,55	12,15	4,40	19,36
21	DANIA SEPTI WULANDARI	XI AK 1	17,00	12,70	4,30	18,49
22	FADILLA PUTRI AULIA	XI AK 1	16,45	11,95	4,50	20,25

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23	ANDINI RISQIANI LARASATI PUTRI W	XI AK 1	16,70	12,30	4,40	19,36
24	DESTA ANIS ATUL CHASANAH	XI AK 1	17,10	12,80	4,30	18,49
25	APRILIA DWI AYU AZZARA	XI AK 1	16,15	11,65	4,50	20,25
26	DWIGHT HARDIKA	XI AK 1	16,40	12,00	4,40	19,36
27	AULIA NURZAHZIROH	XI AK 1	16,80	12,50	4,30	18,49
28	BINTI NUR KASANAH	XI AK 1	16,30	11,80	4,50	20,25
29	BELLA MEY LINDA	XI AK 1	16,65	12,25	4,40	19,36
30	RENA ZUNITA PUTRI	XI AK 2	15,85	11,65	4,20	17,64
31	WULANDARI	XI AK 2	17,15	12,55	4,60	21,16
32	OCKTA DWI RETNANINGTYAS	XI AK 2	16,05	11,85	4,20	17,64
33	THARIQA SALSABILA	XI AK 2	16,95	12,35	4,60	21,16
34	THE STORY	XI AK 2	16,50	12,10	4,40	19,36
∑	TOTAL		561,00	411,40	149,60	658,72
	AVERAGE		16,50	12,10	4,40	-

Before the hypothesis test was carried out, the score difference data *Pre-test* and *Post-test* Abilities *footwork* The normality test was first tested. The normality test was carried out using the Shapiro-Wilk method with the help of SPSS 27 on 34 students. The results of the normality test are presented in Table 1.3.

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Table 1 2 Shapiro-Wilk Normality Test Results Footwork Score Difference (n=34)

Variable	Statistics (W)	Degree of Freedom (df)	Significance (Sig.)	Remarks
Footwork Time Difference ()D	0,952	34	0,145	Normally Distributed () Sig. $>$ 0,05

Source: Primary data processed via SPSS 27 (2026).

After going through the validation process and several stages of revision, the final product *of the Masterclass Footwork Circuit was* obtained. The product consists of a physical guide module, digital video media, and a four-post circuit training system. The final specifications of the refined product are presented in Table 1.4

Table 1 3 Module Development Product Revision Summary Matrix

Evaluation Stages	Focus of Findings/Key Constraints	Change/Improvement Results	Philosophical & Practical Reasons
Expert Judgment	1. Risk of knee injury in Range instructions Post 3 (*Lunge*). *2. QR Code* difficult to scan with a cell phone camera.	1. Addition of a clause to protect the biomechanics of knee flexion & heel luminescence.≈ 90° 2. Enlargement of *the dimensions of the QR-Code* () and the addition of frame contrast.3 cm × 3 cm	Protects adolescent joints from overload and facilitates readability media on smartphones with low specifications.
Test	Pos 3 cone *spacing* and Pos 4 rubber pull load	Dynamic cone *spacing* reduction () and load tolerance	Accommodate students' variations in physical

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Try Limited *(Small Scale,* $)n = 15$	Overwhelming students Posture short (). < 160 cm	modification$15 - 20$ cm *resistance band* (). $15 - 20$ lbs	anthropometry so that exercises are inclusive, ergonomic, and safe for the lower back.
Field Trials *(Wide Scale,* $)n = 34$	Passive queue stacking between Posts causes a decrease in Body temperature (*premature cooling down*).	Implementation of circuit current management *of Wave Start* system (waved departure pause). 15 detik	Maximize the efficiency of 90 minutes of extracurricular time and maintain the consistency of students' pulse in the optimal exercise zone.

Source: Synthesis of R&D research revision data (2026).

After going through the validation stages, limited trials, and field trials, *the Footwork Masterclass Circuit product* is refined into the final product. The product consists of a physical guide module, digital video media, and a four-post circuit training system. The final specifications of the product and its operational functions are presented in Table 1.6

Table 1.6 Final Product Specifications of Masterclass Footwork Circuit

Product Components	Final Specifications & Characteristics	Ergonomic Value & Operational Function
Manual Module (Physical)	Print A5 size, *Art Paper* material 120 gsm (Anti-water and sweat), 24 Pages. Equipped with *Rate of Perceived Exertion* (RPE) scale.	Durable and durable for use in the environment indoor/outdoor *field*; guide students to recognize their body fatigue levels honestly and independently.
Digital Media (Video)	Full HD 1080p resolution at 60 fps (*Slow-motion*), accessed via *high-*	Presents visual-learner-friendly *kinetic visualizations of motion*,

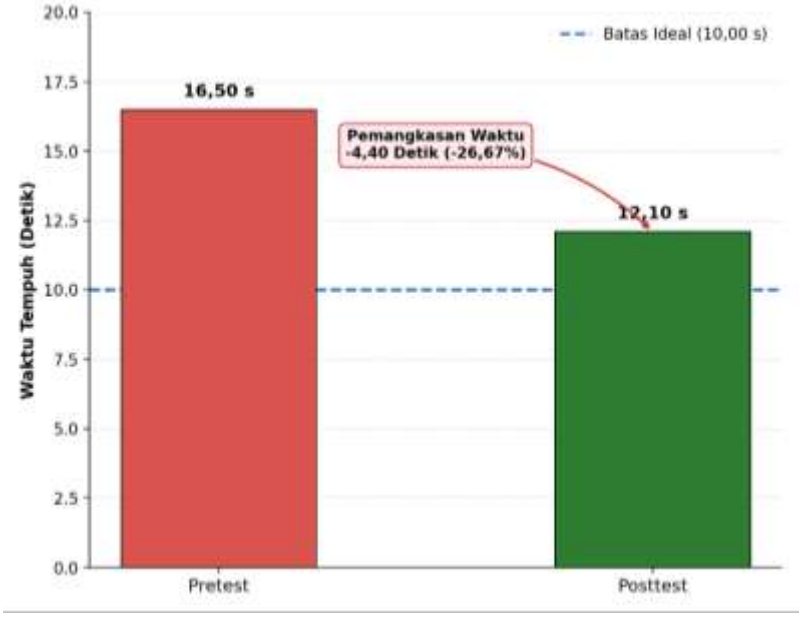
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	resolution QR-Code 3 cm × 3 cmon every post page.	reducing reliance on repetitive trainer oral instruction.
Circuit System (4 Posts)	Post 1 (*Split Step*), Post 2 (*Side Step*), Post 3 (*Lunge Precision*), Post 4 (*Back Pedal*). Using Wave *Start System* current management (pause). 15 detik	Prevents *idle time buildup*; the volume of exercises becomes dense and efficient, complete before students experience chronic fatigue.

Source: Formulation of final product specifications R&D (2026).

The results of the time records of 34 vocational students who were the subjects of the field trial are represented through a comparative histogram in Graph 1.7:

Graph 1.7 Average Travel Time Comparison Histogram *Shadow Footwork* (Seconds)



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The histogram above explicitly shows a "leap in quality" in student movement performance. The height of the graph bar shrinks drastically from . The shrinkage of this amount of time duration means very positive, indicating that students' foot movements become much more responsive, agile, and efficient. The achievement 16,50 detik12,10 detik4,40 detik *of this posttest* also shows that the agility performance of students' feet is getting closer to the ideal time limit for adolescent athletics (). This is a very extraordinary achievement considering that the research subjects are vocational school students who also bear the physical burden and fatigue from daily vocational practicum activities.10,00 detik

DISCUSSION

The results of the study show that the Exercise Book Module *Footwork Masterclass* QR-Code-based integrated circuit can be used as a training medium *footwork* for extracurricular students of badminton SMK PGRI 2 Nganjuk. The product combines four training posts, namely *Split Step*, *Side Step*, *Precision lunge*, and *Back Pedal*, which is equipped with printed modules, demonstration videos, and training dosage guidelines. The integration of print and digital media provides movement guides that are easier to understand and can be used independently by students in the field. The results of the trial were limited to 15 students showing a percentage of practicality of 87.62% and were included in the category of very practical. The findings showed that the module could be used easily in exercise activities. During the trial, it was also found that there was a difference in ability based on the student's posture, especially in exercises *Squirt*. Therefore, the cone spacing is adjusted proportionally so that the exercise is more in line with the physical characteristics of the student

In a field trial of 34 students, the average time *Shadow Footwork Test* decreased from 16.50 seconds on *Pretest* to 12.10 seconds on *Posttest*, with an increase of 4.40 seconds. The decrease in time indicates an increase in ability *footwork* after the students participated in 12 training sessions. The series of exercises at the four posts provided a variation of movement towards the front, side, and back so that students received more structured and diverse exercises. The results of the normality test showed a significance value of 0.145 > 0.05 so that the data met the assumption of normality. Furthermore, the results of the normality test showed a significance value of 0.145 0.05 so that the data met the assumption of normality. Furthermore, the results of the normality test showed a significance value of 0.145 0.05 so that the data met the assumption of normality. Furthermore, the results of the normality test *Paired Sample T-Test*

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shows a significance value of 0.000 < 0.05. Thus, there is a significant difference between the ability *footwork* before and after the implementation of the Module *Footwork Masterclass*. These results provide empirical evidence that the application of the developed exercises is followed by an improvement in ability *footwork* students.

Analysis *N-Gain* resulting in a value of 0.68 which is in the medium category. These results show that the product provides a fairly good improvement in ability, although it has not yet reached the high category. The value also shows that the development of exercises needs to consider the balance between improved performance and the ability of students to accept the training load.

Another advantage of the product lies in the QR-Code integration, which allows students to access the demonstration video directly. The *slow motion* feature, multiple shooting angles, *voice-over*, and *subtitles* help students understand the stages of movement that are difficult to explain through text alone. In addition, the implementation of *progressive load* and *the Wave Start system* help to regulate the dosage and flow of the exercises so that activities can take place more structured and efficient.

Overall, the results of the study show that the *Footwork Masterclass* has excellent practicality and can support the improvement of capabilities *footwork* students. This product has advantages in systematic exercise structure, visual media support, exercise variety, and flexibility of adjustment to student conditions. However, the research is still limited to one school and uses a single-group design *Pretest-Posttest*. Further research may involve a wider sample and control group to obtain stronger evidence of effectiveness.

CONCLUSION

Based on the formulation of the problem set out in Chapter I, the results of empirical data analysis, as well as the discussion of the development of *Exercise Book Module "Footwork Masterclass"* based on integrated circuits at SMK PGRI 2 Nganjuk, three main conclusions can be drawn as follows: (1) **Product Validity and Feasibility** Product development in the form of a circuit training system supported by A5 size printed physical module (material *Art Paper* 120 gsm) and kinetic demonstration video based *QR-Code* declared Very Valid and Suitable for Use. Assessments from coaching material experts and learning media experts prove that the movement design at 4 circuit posts (*Split Step*, *Side Steps*, *Lunge Precision*, and *Back Pedal*) has met the requirements for the safety of adolescent body biomechanics (such as knee flexion

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protection), ergonomic, and in accordance with the rules of self-learning media.$\approx 90°$**(2) Product Practicality** Products *Exercise Book Module "Footwork Masterclass"* proved to be Very Practical with a percentage level of practicality achieved in a limited trial (). Visual, communicative, and structured instructional design successfully reduced cognitive load ($87{,}62\% n = 15$*Cognitive Load*) vocational post-practicum vocational vocational school students. Students can understand the mechanics and flow of training circuits independently without relying on repetitive oral instruction from trainers in the field. **(3) Product Effectiveness** Circuit training model interventions have a very significant and positive influence on the increase in agility and speed *footwork* students. Proof of this effectiveness is demonstrated by the following statistical indicators: **(a)** Hypothesis Test (*Paired Sample t-test*) A value with a significance value is obtained, which means rejected and accepted.$t_{\text{hitung}}(213{,}80) > t_{\text{tabel}}(2{,}034) p = 0{,}000 < 0{,}05 H_0 H_a$**(b)** Rate of Improvement (*N-Gain*) A coefficient of magnitude is obtained that is included in the Medium / Moderate Category (). This achievement shows the optimal meeting point between improving physical performance and maintaining the physiological condition of students in order to avoid N-Gain$0{,}68 0{,}30 \leq g < 0{,}70$*Overtraining*. **(c)** Reduction in Travel Time There is a reduction in the average travel time of the test *Shadow Footwork* by (increased by $4{,}40$ detik$16{,}50$ detik*Pretest* be on $12{,}10$ detik*Posttest*). **(d)** Impact Amount (*Effect Size*) Cohen's value is obtained which is classified as Very Large Impact ($d = 36{,}67$*Large Effect*) with a very tight standard deviation value (). This proves that the improvement of skills $S_D = 0{,}120$ detik*footwork* occurs homogeneously, evenly, and consistently across all research subjects ()$n = 34$

IMPLICATIONS

1. **Practical Implications**
   a) For Extracurricular Teachers/Trainers
      It is recommended to adopt a *Wave Start* circuit management system and integrate the 15 detik*existing Rate of Perceived Exertion* (RPE) control sheet in the module so that the duration of the 90-minute exercise runs efficiently and the student's training load remains controlled.
   b) For Students
      It is recommended to use *the QR-Code media* independently before the training session begins to learn the biomechanics of movement visually, so that when in the field the focus can be fully shifted to physical execution.

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