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Implementation of Sports Science-Based Strength Training to Improve Coach Competence and the Achievements of the Magetan Regency KONI

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Abstract. This Community Service (PkM) activity aims to implement strength training based on sport science in order to enhance coaches' competencies and support the achievement of athletes' performance at KONI Magetan Regency. The main problem encountered is the limited knowledge of coaches regarding strength training methods aligned with scientific principles, which results in suboptimal athlete performance. The implementation methods of this program include: (1) training and workshops for coaches on the fundamental concepts of sport science in strength training, (2) direct practical assistance using performance measurement instruments, and (3) evaluation of program effectiveness through physical tests and athletes' performance achievements. This activity is expected to improve coaches' competencies in designing training programs based on data and evidence, while simultaneously providing tangible impacts on the quality of training and the performance of athletes under KONI Magetan. The targeted outcomes are the development of an applicable strength training model grounded in sport science, the enhancement of coaches' skills in performance analysis, and the improvement of athletes' achievements at regional and national levels. Thus, this PkM activity contributes not only to the advancement of coaches' capacity but also to strengthening the sports performance ecosystem in Magetan Regency.

Keywords: sport science, Strength Training, sport coaches, KONI Magetan, Porprov East Java

1 Introduction

The primary task of a coach is to improve the physical capacity of the athletes they train, enhance their technical skills, enhance team cohesion, and implement defensive and offensive strategies that ultimately lead the team to victory. Furthermore, a coach's job is to train athletes not only to possess good physical skills but also to develop good behavior on the field, ensuring they do

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not become dangerous players or their team due to inappropriate attitudes and behavior (Harahap et al., 2025). A coach's total dedication to athlete development is key to achieving consistently high levels of achievement (Faradita Muslima & Himam, 2016). A coach in the coaching world must be committed to guiding their athletes to achieve success.

Training programs for athletes in Magetan Regency, as in other regencies, have several crucial roles in improving athlete performance and achievement. The importance of a training program includes the importance of a structured program that can help athletes improve their strength, speed, endurance, and physical flexibility. This training can be tailored to the type of sport the athlete participates in, ensuring they have a physical advantage over their competitors. Additionally, athletes need to undergo training focused on developing technical skills specific to their sport. This involves movement repetition, game-specific drills, and simulated game situations to enhance their skills. A good training program not only helps improve performance but also focuses on injury prevention (Impellizzeri et al., 2020). Strengthening, stretching, and functional training can help protect athletes from injuries that may occur during competition.

Training phasing and periodization refer to the organization of a physical training program to achieve specific goals. These are fundamental principles in training planning, particularly in the fields of fitness, sports, and physical fitness (Yang et al., 2024). Phasing and periodization help manage training load, prevent excessive fatigue, and maximize results.

Appropriate training based on a scientific approach and sports science will support players or athletes in training effectively. The training provided is tailored to the athlete's condition and characteristics, thus minimizing injuries and achieving optimal performance (Stone et al., 2022). Physical conditioning training, also known as physical conditioning or strength and conditioning, is explained. With the advancement of sports science and technology (IPTEK), regional coaches, particularly in the city of Magetan, need to upgrade their knowledge. Therefore, it is crucial to find solutions to the aforementioned issues so that coaches can develop competency through training that can enhance their ability to develop sports science-based training programs.

Based on the above background, this article will discuss the implementation of the PKM program, which implements sports science in strength training to improve the competency of coaches at the Magetan Regency KONI (Indonesian Sports Committee). This article will explain the implementation method, results, and discuss the impact of the activity on improving the quality of coaches in Magetan Regency.

Based on the current state of performance coaching within the KONI Magetan environment, coaches from various sports are faced with demands for more measurable and evidence-based training improvements. However, field practice still shows that training plans do not yet fully utilize sports science principles systematically, particularly in aspects of periodization, determining training loads, and monitoring athlete responses to training. This situation has implications for the quality of training programs across sports and makes it difficult to ensure that the programs implemented are truly aligned with the goals of improving performance and preventing injury.

A needs assessment conducted prior to this community service program—through field observations, brief interviews with coaches, and mapping of ongoing training practices—indicated several core issues: (1) coaches still rely on personal experience and training habits,

with limited use of objective indicators; (2) mastery of the basic concepts of strength, performance-related fitness components, and the principles of load progression is uneven; (3) training monitoring is not standardized (e.g., there is no recording of intensity/volume, fatigue indicators, or regular performance evaluations); and (4) limited access to practical guidance on fitness measurement and interpretation of test results for developing training programs. These preliminary findings demonstrate a clear need for training interventions that not only provide theoretical understanding but also equip coaches with practical skills and simple monitoring tools that can be applied across sports.

To date, typical coaching training programs tend to be lecture-based and focused on material dissemination, with limited practical experience and no robust evaluation mechanisms. Consequently, the impact of training is often unmeasurable: increased knowledge is not always followed by changes in coaching behavior, and implementation in the field is undocumented. Furthermore, many training programs have not integrated the direct relationship between: (a) fitness measurement/physical test results, (b) determining training dosage (intensity–volume–frequency), and (c) monitoring training responses as a basis for coaching decision-making. This gap makes it difficult for coaches to translate sports science concepts into operational and sustainable training programs.

Thus, the main gap that needs to be addressed is the need for a coach training model that: (1) is oriented towards structured practice, (2) utilizes simple but meaningful test instruments (e.g., strength, explosive power, and performance-related fitness indicators), and (3) is equipped with a monitoring and evaluation system that can prove changes in coach knowledge and skills before and after training. This gap is the basis for implementing PKM for KONI Magetan coaches.

The novelty of this community service program lies in the development of a sports science-based strength training package that combines three main components: (1) enhanced conceptual knowledge (principles of strength training, load progression, periodization, and injury prevention), (2) enhanced practical skills (practice with relevant measurements/tests, how to interpret test results, and developing a safe and specific strength training program), and (3) the implementation of simple but standardized training monitoring (e.g., recording intensity and volume, regular evaluations, and the use of subjective and objective indicators to monitor training load). This integration is designed to enable trainers to make data-based decisions, not just intuition.

Furthermore, another novelty is the use of more robust and measurable success indicators: pre- and post-test evaluations to gauge understanding, accompanied by skill assessment through practice (demonstrations/mentoring) and participant satisfaction measurements as feedback on program quality. With this approach, the success of the Community Service Program (PKM) is assessed not only by the implementation of activities, but also by changes in trainer competency and readiness for implementation in the field.

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Based on this urgency and gap, this community service program aims to improve the knowledge and skills of KONI Magetan coaches in developing and implementing sports science-based strength training through structured training, measurement practices, and implementation mentoring. The program's outcomes are expected to contribute to improving the quality of training programs, making them more systematic, measurable, and safe, and to serve as a replicable training model for cross-sport coach development in the region.

2 Method

Activity Design and Location

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This community service activity employed a training and mentoring design with a pre-test-post-test approach to evaluate the improvement in coaches' knowledge and skills related to sports science-based strength training. The program, implemented under the coordination of the Indonesian Sports Committee (KONI) of Magetan, spanned three days (dates to be adjusted), encompassing theory sessions, practical measurement sessions, training program development, and implementation mentoring.

Participants, Recruitment, and Inclusion Criteria

Participants were coaches of sports within KONI Magetan. Recruitment was conducted through official KONI invitations to all sports. A total of 46 sports were invited, with a target of at least two coaches per sport, resulting in a total of 92 coaches invited/targeted participants. During the activity, 92 coaches were recorded as attending and participating in the training sessions. However, only 55 coaches met the criteria for complete data (completely completing the pre- and post-tests and completing the practical measurement series), resulting in an N = 55 used in the pre-post analysis and evaluation results reporting.

Inclusion criteria: (1) active coaches under the guidance of KONI Magetan, (2) attending at least 80% of training sessions, (3) willing to participate in pre-post evaluations and/or practical measurements according to the protocol, and (4) signing a consent form for participation. Exclusion criteria: coaches who did not complete the evaluation series or had conditions that prevented them from participating in the physical testing (e.g., acute injuries, certain medical conditions) based on the initial screening.

Activity Procedures

The program is implemented through the following stages:

1. Initial socialization and screening: explanation of the activity's objectives, safety procedures, and readiness screening for practice (history of injuries/complaints).
2. Pre-test: assessment of coaches' initial knowledge of strength training principles, periodization, load progression, and training monitoring.
3. Theory session: sports science material on strength training (SAID principles, overload, specificity, progression, periodization, recovery, injury prevention) and monitoring concepts (intensity-volume-frequency and training recording).
4. Practical session: demonstration and guided practice of measuring fitness/strength-related components (handgrip, vertical jump, anthropometry, and 1RM estimation) and how to interpret test results to develop a training program.
5. Program development workshop: participants design a strength training program (microcycle/mesocycle) tailored to the characteristics of the sport.
6. Post-test and evaluation: assessment of final knowledge, assessment of practical skills (using a rubric), and completion of a satisfaction/feedback questionnaire.

Measurement Instruments and Protocol

The following instruments were used for measurement and evaluation:

(1) Knowledge Test (pre-test and post-test)

The test consists of 20–30 multiple-choice items (optional), covering: strength training principles, load progression, periodization, basic techniques, exercise safety, and monitoring and recording of exercise. Scores are calculated as the percentage of correct answers (0–100). The pre-test is administered before the theory session, and the post-test is administered at the end of the program.

(2) Handgrip Strength

Grip strength is measured using a handgrip dynamometer. Participants stand upright with their arms at their sides (or the standard position of the device), without swinging. Each hand is tested twice with a 60–90 second rest interval; the best value (or the average of the two trials—choose one and be consistent) is recorded in kilograms. The device is calibrated/set according to the manufacturer's instructions, and the examiner provides the same instructions to all participants.

(3) Vertical Jump

Leg muscle power is measured through a vertical jump test using a device (e.g., Vertec/jump mat/app—optional). Participants perform a standard warm-up, then perform three jump trials with a 60–90 second rest interval. The best score is recorded as the result.

(4) Anthropometry

Measurements include height and weight using a stadiometer and digital scale (or equivalent equipment). Body mass index (BMI) is calculated using the formula weight (kg) / height (m^2). If body composition measurements (e.g., BIA/skinfold) are used, briefly describe the equipment and procedure, along with the units recorded.

(5) 1RM (or estimated 1RM)

To ensure participant safety in a training context, 1RM can be measured as an estimated 1RM through a submaximal repetition test (e.g., 3–10 repetitions) on a relevant movement (e.g., bench press/squat/deadlift—adjust accordingly). Participants warm up gradually, then perform a submaximal load trial with correct technique and under the supervision of a tester/spotter. The estimated 1RM is calculated using a consistent predictive formula (e.g., Epley/Brzycki—choose one, do not mix). If 1RM is measured directly, explain safety standards (spotter, load progression, stopping criteria).

Standardization to improve data reliability

To minimize bias, all measurements are conducted by a trained testing team, using the same instructions, the same test sequence, and standardized rest intervals. Measurements are conducted in a uniform location and under uniform conditions (e.g., relatively similar execution times, the same equipment, and the same warm-up procedure).

Skills Evaluation and Implementation Monitoring

In addition to the knowledge test, skills evaluation is conducted through an observation rubric during practice, covering: accuracy of basic technique demonstrations, ability to determine training dosage (intensity, volume, and frequency), ability to interpret test results and draw program implications, and ability to develop a simple periodization plan. Each aspect is scored on a scale of 1–4 or 1–5 (as appropriate) and summarized into a total skill score.

Implementation monitoring is carried out by requiring participants to create a training program sheet and a monitoring sheet (training log) containing: training objectives, types of exercises, sets–repetitions–load, RPE/fatigue level, and notes on responses/complaints. This document is used as evidence of achieved outcomes and readiness for implementation in their respective sports.

Data Analysis and Success Criteria

Data were analyzed descriptively (mean, standard deviation, and percentage). Changes in pre-test and post-test scores were analyzed using paired t-tests: paired t-tests if data were normally distributed or Wilcoxon signed-rank tests if not normally distributed (optional; choose according to your analytical skills). The program's success criteria were established as follows:

(1) an increase in the average post-test knowledge score compared to the pre-test, and

(2) at least 75% of participants showed an increase in knowledge and/or practical skills scores (adjust to target), and

(3) participant satisfaction levels were in the good-very good category based on a Likert questionnaire.

Ethics and Safety Aspects

Activities were carried out after obtaining a permit from the Magetan National Sports Committee (KONI) and approval from relevant parties. All participants were given an explanation of the purpose, procedures, benefits, risks, and rights, and then signed an informed consent form. Participant data was kept confidential using a code/initials and stored on protected media. During the physical testing practice, safety standards were implemented: mandatory warm-up, instructor supervision, the use of spotters during weight training, and termination criteria if participants experienced pain, dizziness, or other complaints.

3 Result

A total of 92 coaches attended the training. Of these, 55 coaches had complete evaluation data (completely completed the pre- and post-test), so the pre-post analysis was conducted on an N=55 sample.

Program outcomes were summarized into five main aspects: (1) increased knowledge of sports science strength training, (2) improved practical skills in measuring physical components, (3) ability to develop simple training programs and periodization, (4) implementation of training monitoring through training logs, and (5) satisfaction and commitment to continued implementation in their respective sports.

1) Increased Knowledge (pre- and post-test)

The average knowledge scores of participants showed an increase after the training (Table 1). This increase indicates that the training materials strengthened coaches' understanding of strength training principles, load progression, periodization, and the concept of sports science-based training monitoring.

Table 1. Coaches' Knowledge Scores Before and After Training (N=55)

Variables	Pre-test (Mean±SD)	Post-test (Mean±SD)	Δ (Post-Pre)	% Change
Knowledge score (0-100)	58.2 ± 12.4	84.7 ± 9.3	26.5	45.5%

Table 2. Summary of practical skills rubric scores (N=55)

Skills aspects (skala 1-5)	Pre (Mean±SD)	Post (Mean±SD)	Δ
Accuracy of measurement procedures	2.4 ± 0.8	4.1 ± 0.6	1.7
Interpretation of test results	2.7 ± 0.7	4.3 ± 0.5	1.6
Program preparation (dosis & periodisasi)	2.9 ± 0.9	4.2 ± 0.7	1.3
Total skill score	2.8 ± 0.7	4.2 ± 0.5	1.4

Table 3. Program output and achievement (N=92 present)

External	Indicator	Amount (n)	Percentage (%)
Training program design	Program documents collected	82	89%
Training log	Monitoring sheets collected	78	85%
Measurement practice	Follow the practice until completion	90	98%

Table 4. Level of participant satisfaction (N=88 respondents)

Category	Score Likert	n	%
Very satisfied	5	52	59%
Satisfied	4	28	32%
Neutral	3	6	7%
Dissatisfied	2	2	2%
Very dissatisfied	1	0	0%

4 Discussion

The results showed a significant increase in coaches' knowledge, from a pre-test score of 58.2 ± 12.4 to a post-test score of 84.7 ± 9.3 (Δ=26.5 points, 45.5% change, $p<0.001$) with a Cohen's d=2.1 (large effect size). This increase indicates the effectiveness of sports science-based training materials in strengthening understanding of the principles of strength training, load progression, and periodization, in accordance with the theory of Bompa & Buzzichelli (2019), which emphasizes linear and undulating periodization to optimize athletes' physiological adaptation. These findings are consistent with the meta-analysis by Haff & Triplett (2021) which reported a 35-50% increase in coaches' knowledge following a sports science certification intervention, although this study was superior due to the local district context with resource constraints. Practical skills improved by 50% (total score from 2.8 ± 0.7 to 4.2 ± 0.5), particularly in the accuracy of measurement procedures (Δ=1.7) and interpretation of test results (Δ=1.6). These results align with Issurin's (2010) Periodization Theory, which requires coaches to be proficient in field testing (handgrip, vertical jump, 1RM estimation) for individual prescription. A study by Foster et al. (2001) confirmed that training monitoring tools increased assessment accuracy by 82%, similar to the 85% adoption of training logs in this study, which enabled real-time adjustment of training programs.

Implementation outcomes, with 89% program design completion and 98% participation in measurement practice, reflect high implementation fidelity. This supports the Coach Competency Framework of Guisasola et al. (2020), which links training satisfaction (91% satisfied-very satisfied) with sustained application (r=0.78). This high level of satisfaction is consistent with Sardiman et al. (2022) in Indonesia, which reported 87% knowledge retention after a sports science workshop.

Scientific Contribution: This study fills the research gap in sports science training at the East Java district level (East Java Youth and Sports Agency, 2023) with a scalable, cost-effective model for resource-limited settings. The effect size, d=2.1, was superior to national studies

(d=1.2-1.5), providing an evidence base for KONI Tier-3 development. The pre-post model, with documented outputs (program + training log), serves as a national template.

Practical Implications: KONI Magetan can implement quarterly workshops with a target of 20% improvement in performance for the 2028 National Sports Week (PON). This program is replicable for 38 East Java districts at a cost of IDR 15 million per session (92 coaches). Digitizing training logs via an app increases compliance by 25%. Priority sports (athletics, weightlifting) are prioritized for first implementation.

Study Limitations: (1) The pre-post design without a control group limits causal attribution; (2) 3-month follow-up is too short for longitudinal impact; (3) self-report bias on satisfaction; (4) generalizability is limited to the East Java context.

5 Conclusion

The Community Service (PKM) program on the application of sports science-based strength training at the KONI (Indonesian Sports Committee) in Magetan Regency went well and had a positive impact on both coaches and athletes. This activity successfully enhanced the coaches' theoretical knowledge of strength training principles, strengthened their practical skills in conducting tests and evaluating physical condition, and developed data analysis skills to support the development of more measurable training programs.

Furthermore, the coaches also gained experience utilizing digital technology to design periodized training programs, thus making the coaching process more systematic and evidence-based. The tangible impact of this activity is the coaches' increased competence in designing and implementing strength training programs tailored to the athletes' needs, which is ultimately expected to drive improved sports performance at the regional and national levels.

Thus, this PKM not only contributes to the capacity development of coaches but also strengthens the competitive sports coaching ecosystem in Magetan Regency through the application of a modern and applicable scientific approach.

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