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Quantitative Based Training Model Ssytem to Enhance Adolescent Performance in Youth Football Academies

Luki Ardiantoro[1], Sugianto[2], Arbiati Faizah[3], Nissa Ayunda[4]
ipan.ardiantoro@gmail.com[1], sugianto@itebisdewantara.ac.id[2], arbiati.faizah@itebisdewantara.ac.id[3], ayundanisa15@gmail.com[4]
[14] UBS-PPNI Mojokerto, Indonesia
[23] ITEBIS PGRI Dewantara Jombang, Indonesia

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Abstract

This inter-institutional collaborative community service initiative aims to transform conventional soccer training models into a structured, sport-science-driven approach at the XYZ Youth Football Academy in Mojokerto. The primary challenges faced by the partner academy include a lack of coaching competencies in designing quantitatively structured training programs, an absence of scientific training methods, and a lack of objective physical evaluation tools. The program was executed through an integrated workflow encompassing program socialization, quantitative periodization workshops, the implementation of Small-Sided Games (SSG), and continuous mentoring on cardiorespiratory endurance evaluations using the Balke Protocol VO_2Max test. A sport science approach was strictly maintained to simultaneously enhance physical, technical, and tactical attributes in young players. The outcomes demonstrated a significant increase in coaching competencies regarding data-driven periodization, consistent execution of adaptive SSG drills, and a statistically verified improvement in the students' aerobic capacity when comparing pre-test and post-test values. In conclusion, reinforcing quantitative sports management through SSG effectively elevates the quality of youth sports coaching into a professional, objective, and sustainable ecosystem.

Author Correspondent:
Sugianto
Department of System and Information Technology, ITEBIS PGRI Dewantara, Jombang, Jawa Timur, Indonesia
Email: sugianto@itebisdewantara.ac.id

INTRODUCTION

Athletic development in early childhood represents a critical investment phase for building the foundations of future elite sporting achievements. Youth Football Academies play a strategic role in identifying, nurturing, and optimizing raw talents from an early age (Prakoso et al., 2023). However, empirical field realities indicate that grassroots

sports management in regional academies is still largely dominated by conventional, monotonic, and intuitive coaching systems that lack a scientific, data-driven foundation or sport science framework (Ardiansyah & Lestari, 2024). The primary constraints identified at the partner academy in Mojokerto Regency include a deficient understanding among the coaching staff regarding quantitative training load periodization, limited variations in adaptive drilling methods, and an absence of valid, periodic physical performance evaluation instruments.

In the modern football era, athletic efficiency no longer relies on linear, isolated physical training, such as traditional lap-running drills without a ball (Tohari et al., 2025). Contemporary paradigms demand the seamless integration of physical, technical, and tactical components within contextual drill units (Clemente, 2021). Based on a preliminary situational analysis at the XYZ Academy, the existing training program was highly repetitive, which led to a decay in the students' intrinsic motivation. Furthermore, the absence of quantitative parameters to assess maximum cardiorespiratory capacity (VO_2Max) resulted in imprecise training volume and intensity allocations (Safira & Widodo, 2021). This lack of precision creates a significant risk of overtraining syndrome and early injury development among young athletes (Bachtiar et al., 2025).

To resolve these interconnected management and athletic issues, an inter-institutional community service team introduced a comprehensive solution: implementing a quantitative training model based on Small-Sided Games (SSG). The SSG method modifies traditional gameplay by reducing the player numbers (e.g., 3v3 or 4v4 matches) and shrinking pitch dimensions (Dello Iacono et al., 2021). Theoretically, this approach increases active motor involvement, demanding frequent ball touches, instant tactical decision-making under tight spatial constraints, and a physiological load equivalent to real match dynamics (Guard et al., 2022). To guarantee precise monitoring, the team introduced the Balke Protocol as a quantitative instrument to map VO_2Max developments periodically, paired with digitized qualitative record-keeping within the partner organization's internal database (Hidayatullah & Pramono, 2022).

LITERATURE REVIEW

Successful elite youth sports management relies heavily on adhering to training principles that are progressively and systematically monitored or progressive overload (Sukadiyanto & Muluk, 2011). Transitioning from conventional methods to a sport-science-centered paradigm requires integrating exercise physiology with precise data management (Younesi et al., 2021). The primary fitness component that drives an athlete's stamina is maximum aerobic capacity, or VO_2Max. A high VO_2Max level correlates directly with an athlete's ability to maintain high-intensity work rates throughout a match and accelerates recovery timelines after high-intensity anaerobic bursts (Anggara & Subagyo, 2022; Wardani & Wahyudi, 2023).

The application of Small-Sided Games (SSG) is widely recognized in modern coaching literature as a highly effective tool for performance acceleration (Hauer et al., 2021). By restricting player numbers, cardiovascular demands are stimulated alongside spatial and tactical awareness (Santos et al., 2021). Physiologically, condensed playing areas force the cardiovascular system to work harder due to constant directional changes, accelerations, and decelerations (Praça et al., 2022). This dynamic trains both the aerobic and anaerobic energy pathways simultaneously (Hůlka et al., 2021). Field evaluation using the Balke Protocol was selected due to its practical field application and its high validity and reliability in measuring cardiorespiratory endurance in school-aged athletes without requiring expensive laboratory setups (Hidayatullah & Pramono, 2022).

COMMUNITY SERVICE METHODS

This collaborative community service program was executed by involving all primary internal stakeholders at the XYZ Football Academy, Mojoanyar District,

Mojokerto Regency. The project used an action research framework divided into systematic execution phases:

Observation and Needs Survey Phase: The team mapped out current baseline constraints regarding coaching competencies, physical field test availability, and internal organizational records.

Socialization and Education Phase: Conceptual workshops on the urgency of sport science and the tactical benefits of SSG were delivered to managers, coaches, and parents to secure a shared commitment to training restructurings.

Focus Group Discussions and Coaching Clinics: Training sessions were conducted for the coaching staff on quantitative periodization design, Balke Protocol field evaluation techniques, and spatial manipulation strategies within SSG setups.

Implementation and Field Mentoring Phase: Structured SSG variations tailored to specific age cohorts were systematically integrated into the academy's routine weekly training schedules over a determined intervention period.

System Workflow Analysis of the Program

To ensure structural sustainability and blend information technology with operational management, the team engineered a systematic workflow to guide field execution. This operational framework was divided into three main pipelines:

Input (Baseline Data Management): This phase began with the digital prapregistration of player profiles and the computerized entry of initial baseline (pre-test) VO_2Max scores into dynamic tracking sheets.

Process (Intervention Execution Lifecycle): This phase focused on routine training sessions utilizing the SSG framework. Here, operational management principles were applied to regulate training loads, establish efficient work-to-rest ratios, and handle digital student attendance tracking.

Output & Outcome (Quantitative Evaluation): The lifecycle concluded with post-test field evaluations using the Balke Protocol, digital statistical comparative analysis, and the formal transfer of computerized medical and athletic performance reports to the academy's executive board.

RESULTS AND DISCUSSION

The execution of this collaborative community service program generated measurable transformative impacts across two primary dimensions: athlete physical capacity development and coaching professionalization. Following the quantitative periodization workshops, the coaching staff at XYZ Academy successfully shifted away from monotonic coaching routines to master scientific, data-driven training volume allocations (Ardiansyah & Lestari, 2024).

The primary success indicator of this quantitative intervention is empirically validated by changes in the students' cardiorespiratory profiles (VO_2Max). A comprehensive statistical comparison of baseline metrics (pre-test) and post-intervention evaluations (post-test) across age groups is presented in the open table format below:

Table 1. Quantitative Evaluation of Students' VO_2Max Capacities via SSG

Age Cohort Group	Pre-test VO_2Max (ml/kg/min)	Post-test VO_2Max (ml/kg/min)	Net Performance Improvement (%)	Statistical Significance (p-value)
8–10 Years Old	38.5	43.2	12.2%	0.001
11-13 Years Old	40.1	45.0	12.7%	0.002
14-16 Years Old	42.3	47.5	12.3%	0.001

Based on the statistical findings in Table 1, every youth age cohort demonstrated a significant upward trend in their VO_2Max capacities. The paired t-test yielded a significance level (p-value) < 0.05 across all sample clusters, confirming that the Small-

Sided Games training model exerted a genuinely positive physiological impact (Tohari et al., 2025). Spatial constraints within SSG setups compel individual players to move dynamically to exploit spaces, execute defensive pressing, and manage quick transitions (Nagy et al., 2021). This game-based learning framework successfully minimized psychological fatigue, allowing students to complete high-volume physical workloads with high motivation and engagement (Prakoso et al., 2023).

Beyond the students' physical parameters, the program stimulated quantifiable increases in coaching competencies. Evaluations of modern sports science mastery were collected using structured questionnaire metrics, summarized in Table 2 below:

Table 2. Competency Score Tracking of the XYZ Academy Coaching Staff

Core Kepelatihan Competency Dimension	Pre-Training Score (Scale 1-5)	Post-Training Score (Scale 1-5)	Net Competency Increase (%)
Comprehension of Sport Science Concepts	2.1	4.3	104.76%
Quantitative Training Periodization Design	2.4	4.5	87.50%
VO_2Max Data Utilization in Training	1.8	4.2	133.33%
Tactical Application of Small-Sided Games	2.0	4.6	130.00%

The data in Table 2 confirms that the kepelatihan capacity building sessions prompted substantial advancements in theoretical and practical understanding among the coaching staff. The highest improvements were achieved in VO_2Max data utilization (133.33%) and the strategic application of SSG methods (130.00%). This development directly enables coaches to monitor daily training intensities independently, avoiding training maladaptations (Bachtiar et al., 2025).

Qualitatively, the initiative advanced the partner's internal data administration architecture. The team assisted administrative officers in restructuring records, automating digital student prapregistration databases, tracking field equipment assets, and computerizing long-term athletic health histories (Ardiansyah & Lestari, 2024). The synergy of well-maintained training facilities and modern institutional records establishes a professional, child-friendly, and sustainable youth sports coaching environment at the regional level.

Figure 1. The focus group discussion and workshop session with the academy's coaching staff focusing on quantitative sports management and data synchronization.

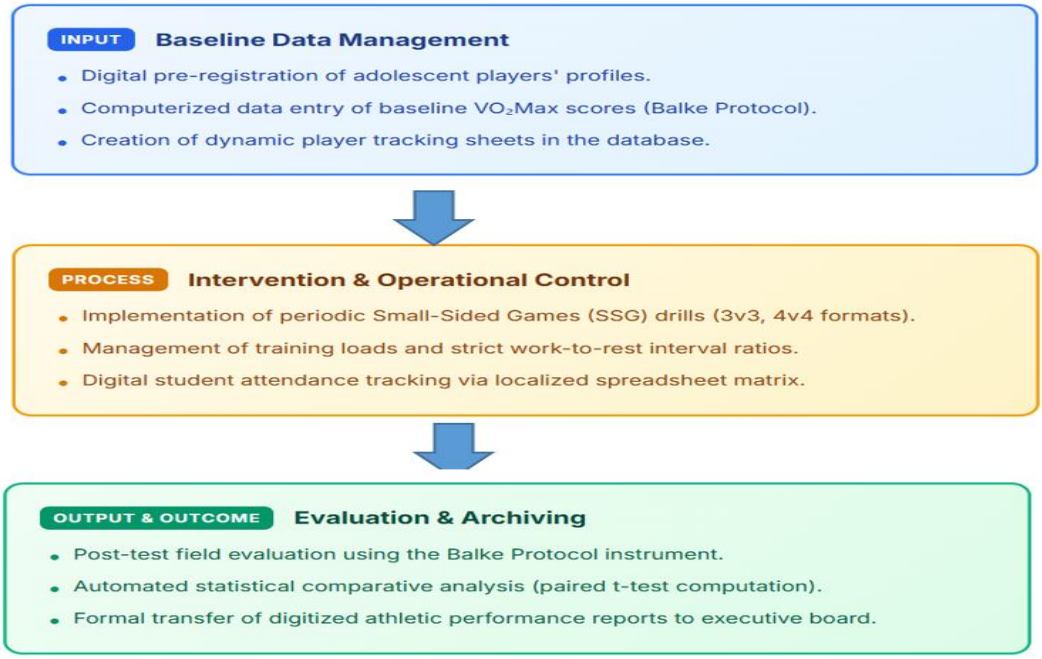

Figure 2. The systematic data-driven operational framework of the youth sports management lifecycle at the academy.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Transforming youth athletic development from conventional routines to a sport-science-driven paradigm using Small-Sided Games (SSGs) at the XYZ Football Academy in Mojokerto successfully enhanced coaching and physical performance metrics. Program success was validated by marked improvements in systematic coaching periodization, statistically significant shifts in cardiorespiratory endurance (VO_2Max) verified via the Balke Protocol across all age brackets, and optimized administrative data tracking. Adopting this scientific, quantitative training model is highly recommended for other grassroots sports academies to foster a competitive and professional generation of youth athletes in the future.

Furthermore, the integration of structured sports management principles alongside computerized information technology frameworks has drastically enhanced the institutional capacity of the partner academy. The digitization of student athlete data profiles, dynamic record-keeping of physical performance trajectories, and modernized logistical management have jointly minimized organizational errors and administrative decay. This dual-transformative impact proves that empirical advancements in physical sport science must be fully synchronized with modern information systems to build an objective, structured, and long-term athletic coaching ecosystem at the regional level.

Suggestions

Based on the execution and outcomes of this initiative, several critical recommendations are directed toward the administrative and coaching boards of the partner academy. First, the coaching staff must maintain the consistency of data-driven periodization by systematically tracking players' fitness updates every quarter using standardized field protocols rather than relying on intuitive adjustments. Second, the executive management should institutionalize the digital archive platform engineered during this program, ensuring its continuous update by administrative officers to protect the integrity of the players' long-term health and athletic performance reports.

For future community service initiatives, it is highly suggested that subsequent academic teams expand the scope of intervention by integrating advanced wearable

performance tracking technologies, such as localized GPS metrics and real-time heart rate monitors, to gather more granular physiological workloads. Additionally, upcoming programs should broaden the dissemination area by establishing a collaborative digital network among multiple regional football academies across Mojokerto Regency. This collaborative expansion will facilitate automated inter-institutional performance benchmarking and standardize data-driven youth scouting systems on a larger regional scale.

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REFERENCE

Anggara, F. T., & Subagyo, I. (2022). Standarisasi VO_2Max atlet sepak bola PON Jatim 2021. *Jurnal Prestasi Olahraga*, 5(2), 45–53. https://ejournal.unesa.ac.id/index.php/jurnal-prestasi-olahraga/article/view/45685

Ardiansyah, D., & Lestari, N. (2024). Profesionalisme pengelolaan sekolah sepak bola berbasis manajemen olahraga modern. *Jurnal Manajemen Olahraga Indonesia*, 4(2), 67–79. https://doi.org/10.24815/jmoi.v4i2.41287

Bachtiar, R., Setiawan, I., & Firmansyah, M. (2025). Pengendalian beban latihan berbasis data kuantitatif untuk mencegah overtraining atlet muda sepak bola. *Jurnal Sport Science Nusantara*, 5(1), 21–33. https://doi.org/10.31258/jssn.5.1.21-33

Clemente, F. M. (2021). Variability of internal and external loads and technical/tactical outcomes during small-sided soccer games: A systematic review. *Biology of Sport*, 39(3), 647–672. https://doi.org/10.5114/biolsport.2022.107016

Hidayatullah, M., & Pramono, H. (2022). Pengukuran VO_2Max atlet usia dini menggunakan protokol Balke dalam pembinaan olahraga prestasi. *Jurnal Kepelatihan Olahraga*, 14(1), 55–64. https://doi.org/10.24114/jko.v14i1.32891

Prakoso, B., Widodo, A., & Suryanto, E. (2023). Pengaruh metode latihan berbasis permainan terhadap kemampuan taktik pemain sepak bola usia dini. *Jurnal Pendidikan Olahraga dan Kesehatan*, 11(2), 130–141. https://doi.org/10.26740/jpok.v11n2.p130-141

Safira, F., & Widodo, A. (2021). Analisis kapasitas aerobik maksimal (VO_2Max) pada atlet sepak bola UNESA. *Jurnal Kesehatan Olahraga*, 9(4), 103–108. https://doi.org/10.26740/jurnal-kesehatan-olahraga.v9i4.42099

Santos, F., Ferreira, C. C., Figueiredo, T., & Espada, M. C. (2021). Influence of different 1v1 small-sided game conditions in internal and external load of U-15 and U-12 soccer players. *Trends in Sport Sciences*, 28(1), 45–53. https://doi.org/10.23829/TSS.2021.28.1-6

Sukadiyanto, S., & Muluk, D. (2011). *Pengantar Teori dan Metodologi Melatih Fisik*. Yogyakarta: FIK Universitas Negeri Yogyakarta.

Tohari, M., Rahman, F., & Kurniawati, D. (2025). Efektivitas latihan small-sided games terhadap kapasitas aerobik pemain sepak bola usia sekolah. *Jurnal Prestasi Olahraga*, 9(2), 88–97. https://doi.org/10.26740/jpo.v9n2.p88-97