

The Contribution of Modern Technologies to Enhancing Physical Performance in Football from the Perspective of Coaches - A Field Study of Coaches in Annaba Province

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Abstract:

This study aimed to analyze the contribution of modern technologies to enhancing physical performance from the perspective of coaches in the Annaba province, through the use of advanced digital tools such as GPS, VBT, InBody, and Polar Pro. Adopting a descriptive approach, a questionnaire was distributed to a purposive sample of 11 coaches. The results showed that 72.7% of the coaches are theoretically aware of the importance of these tools, yet 63.6% suffer from a lack of practical skills. Additionally, significant financial and technical barriers exist, with 81.8% indicating a lack of financial support. The study concludes that the success of technology in improving physical performance depends on the integration of practical training and the provision of technical infrastructure. This calls for serious institutional intervention to support training and equipment within Algerian football clubs.

KEY WORDS : Modern Technologies; Physical Output ; Football Coach

المخلص:

هدفت هذه الدراسة إلى تحليل مدى إسهام التكنولوجيات الحديثة في تحسين المردود البدني من منظور مدربي ولاية عنابة، باستخدام أدوات رقمية متقدمة مثل (GPS)، (VBT)، (InBody و Polar Pro). وباعتماد المنهج الوصفي، تم توزيع استبيان على عينة قصدية من 11 مدربا، حيث أظهرت النتائج أن 72.7% من المدربين يدركون أهمية هذه الأدوات نظريا، إلا أن 63.6% يعانون من نقص في المهارات التطبيقية، فضلا عن وجود عوائق مادية وتقنية كبيرة (81.8% أشاروا لغياب الدعم المالي). تؤكد الدراسة أن نجاح التكنولوجيا في تحسين الأداء البدني مرهون بتكامل التكوين العملي وتوفير البنية التحتية التقنية، ما يستدعي تدخلا مؤسسيا جادا لدعم التكوين والتجهيز داخل الأندية الجزائرية.

الكلمات المفتاحية: التكنولوجيات الحديثة ؛ المردود البدني ؛ مدرب كرة القدم

1-Introduction:

Digital technologies have brought about a radical transformation in the football training system. Advanced tracking systems, such as GPS, have enabled real-time monitoring of motor performance, providing immediate feedback that allows for technical adjustments during the training session itself (Weakley et al., 2023, p. 208). Furthermore, artificial intelligence solutions have offered practical applications ready for direct implementation, particularly in regulating training load intensity in real-time based on precise physiological indicators. This helps prevent overtraining and improves physical performance (Al-Badri, 2024, p. 37). These tools have replaced traditional observational methods, becoming a cornerstone for data-driven decision-making. Body composition analyzers using bioelectrical impedance analysis (BIA) technology, such as InBody, are among the most prominent digital solutions for monitoring changes in muscle mass and fat, offering accurate assessments of physical condition (Kyle et al., 2004, p. 1440). Cardiovascular monitoring systems like Polar Pro are also essential for tracking physiological responses during physical exertion (Giles et al., 2016, p. 568). Meanwhile, the MyJump app is scientifically validated for accurately measuring vertical jump performance (Balsalobre-Fernández et al., 2015, p. 1577). In terms of advanced technologies, the GymAware Cloud Pro device demonstrates high efficiency in monitoring strength and speed variables in real-time using Velocity-Based Training (VBT) technology. Studies confirm that "VBT systems surpass traditional methods in estimating strength and monitoring fatigue" (Orange et al., 2020, p. 559). Experimental data also show improvements of 10.1% in jump performance and a 15.2% increase in maximum strength over a six-week period (Pareja-Blanco et al., 2017, p. 1042). However, the successful application of these technologies requires a deep understanding of their operational mechanisms and data interpretation, as "effective use of technology necessitates precise scientific awareness of physiological functions" (Abdel Aati, 2017, p. 92). Despite global advancements, the use of these technologies in the Algerian context remains limited-particularly among coaches working with youth categories and in local leagues-due to constraints related to training, resources, and digital literacy. Based on this reality, the present study raises a central question: To

what extent are football coaches in Algeria aware of the importance of these tools, and how effective is their use in enhancing physical performance?

General Hypothesis:

To what extent do modern technologies contribute to improving physical performance from the perspective of football coaches in Annaba Province?

✓ Sub-Problems:

1. To what extent are football coaches aware of the importance of modern technologies in enhancing physical performance?
2. Does the use of modern technologies actually contribute to improving physical performance according to the coaches' perspective?

2- General objective of the study:

This study aims to:

- ✓ Explore the awareness of football coaches regarding the importance of modern technologies in physical training.
- ✓ Identify the role of these technologies in improving physical performance and reducing injuries.
- ✓ Determine the most commonly used technological tools for regulating training loads and assessing performance.
- ✓ Provide scientific recommendations to support the integration of technology into training programs.

3- Procedural definition of the concepts mentioned in the research:

- **Modern Technologies:** Modern technologies in sports training are integrated systems that rely on digital devices and software to monitor and analyze biometric data (such as strength and speed) in order to enhance athletic performance. (Haugen et al., 2018, p. 5)

The researcher concludes In this study, the term refers to the devices and software used by football coaches to regulate training loads and improve the players' physical performance.

- **Physical Output:** Physical output is the athlete's ability to produce effective physical effort, measured through indicators such as strength, endurance, speed, and flexibility. (Cormie et al., 2011, p. 321)

The researcher concludes In this study, physical output is assessed based on the observable physical improvement in players as perceived by coaches, using either measurement tools or direct observation.

- **Football Coach:** A qualified specialist responsible for designing training programs, developing physical and tactical performance, and managing injury prevention processes. (Gabbett, 2016, p. 275)

The researcher concludes In this study, it refers to the coach who is directly in charge of football players on the field and participates in the research by completing a questionnaire that reflects their awareness of modern technology.

4- The methodological procedures used in the study:

4-1 Method and tools:

In this study, the researcher adopts the descriptive method, as it is the most suitable for the nature of the subject. This method aims to describe phenomena as they exist in reality and analyze them in order to reach accurate and objective conclusions. Some scholars define it as a research approach that examines phenomena in their natural context by describing, analyzing, and interpreting them methodically to understand their reality and derive their implications. (Obeidat et al., 2010, p. 107; Creswell, 2018, p. 182)

This method is appropriate for studying the topic “The Contribution of Modern Technologies to Improving Physical Output from the Perspective of Football Coaches”, as it allows for the collection of field data from coaches and the analysis of their opinions and attitudes using appropriate research tools. This contributes to understanding their awareness of applying modern technology in training and its relation to players' physical output.

Study Population:

The study population is defined as all individuals or elements that share common characteristics related to the research problem and to whom the results are intended to be generalized.

(Obeidat et al., 2010, p. 121)

Accordingly, the population of this study includes all football coaches active in the Wilaya of Annaba during the 2024 sports season, due to their direct involvement in physical training processes and the potential use of modern technologies in their work.

Study Variables:

✓ **Independent Variable:** Modern technologies used in training (such as tracking devices, performance analysis tools, and load monitoring systems).

✓ **Dependent Variable:** The physical output of football players, considered as a result of utilizing these technologies.

Study Tool:

When adopting the descriptive method as a research approach, the most important tool for collecting data from the surveyed population is what some experts refer to as the questionnaire form. It is defined as a systematic instrument (such as a questionnaire or interview) designed to gather data by measuring the opinions, knowledge, or attitudes of respondents, while ensuring the properties of validity and reliability. (Obeidat et al., 2004, p. 160; Creswell, 2018, p. 189)

A. Stages of Its Preparation:

- ✓ Defining the objectives of the tool based on the hypotheses.
- ✓ Formulating the questions in language understandable to coaches.
- ✓ Organizing the questions into two main sections.
- ✓ Choosing a closed-ended response format (Yes / No / Slightly).
- ✓ Validating the tool through expert review in the field.
- ✓ Administering the questionnaire directly to the study sample.

B. Relevance to the Study:

The questionnaire serves the research objectives by measuring coaches' awareness of using technology and its impact on physical performance.

C. Link to Hypotheses:

- ✓ The first section corresponds to the first hypothesis (awareness).

✓ The second section corresponds to the second hypothesis (impact). Combining the results from both sections contributes to testing the general hypothesis.

- The scientific foundations of the tool Scientific Foundations of the Research Tool:

The construction of the research tool was based on scientific principles to ensure its validity and reliability, as follows:

1. Content Validity:

✓ This refers to the extent to which the items of the research tool comprehensively and objectively represent the targeted knowledge domain. It is verified through expert judgment and by ensuring that all dimensions of the measured phenomenon are covered.
(Oudeh, 2018, p. 150)

✓ **Application in the Study:** The questionnaire was developed based on the study's key themes related to coaches' awareness of using modern technologies and their impact on physical output. The tool was reviewed by a panel of specialized experts, which enhances its content validity.

2. Reliability:

✓ Reliability refers to the degree of consistency in the results of the tool when applied under similar conditions. It is measured using statistical coefficients (such as Cronbach's Alpha), which ensure the tool's stability over time or among different raters.
(Hamdi Shakir, 2006, p. 09)

✓ **Application in the Study:** The questionnaire was redistributed to the same sample after 20 days. The results showed a noticeable consistency, indicating that the tool possesses a high degree of reliability.

Statistical Tools:

Two statistical methods were used in this study to analyze the data:

1. Descriptive Processing:

This involves analyzing data through frequency tables and percentages to describe the characteristics of the sample.

(Al-Omran, 2021, p. 55)

Percentages were used to categorize and analyze the responses of the sample, which helped clarify the general trends in their opinions.

✓ General formula for percentage:

- $\text{Percentage (\%)} = (\text{Frequency} \div \text{Sample Size}) \times 100$

2. Statistical Processing:

This refers to the use of statistical tests (such as Chi-Square) to analyze the relationships between variables.

(Pallant, 2020, p. 240)

The researcher used the Chi-Square test (χ^2) to measure whether there is a statistically significant relationship between two categorical variables.

✓ General formula for the Chi-Square test:

- $X^2 = \sum [(O - E)^2 \div E]$

Where:

- X^2 = Chi-Square value
- O = Observed frequency
- E = Expected frequency

If there is no relationship between the variables, this test helps determine whether the differences or relationships observed are due to chance or are statistically significant.

4-2 Presentation and Analysis of Results:

- **First Axis:** (Coaches' awareness of the importance of modern technologies in regulating training loads and improving physical performance).

✓ Question 1: Do you think that the use of modern technologies contributes to improving players' physical performance?

Table N°1 : It highlights the extent of the use of modern technologies and their contribution to improving the physical performance of players

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	7	1	3	11	6.18	5.99	2	0.045	Significant

✓ Analysis and Discussion of the Results in Table No. 01:

The questionnaire results revealed that 63.6% of the coaches (7 out of 11) believe that the use of modern technologies contributes to improving physical performance. Meanwhile, 27.3% consider their effect to be limited, and 9.1% completely disagreed. The Chi-square test showed statistically significant differences ($\chi^2 = 6.18 > 5.99$, $p < 0.05$), reflecting a clear positive awareness among the sample towards the importance of these technologies in regulating training loads.

This trend is supported by a recent field study which demonstrated that coaches' reliance on digital devices such as GPS Pro led to a 37% improvement in managing physical loads, indicating the effectiveness of these tools in enhancing physical performance (Coutts & Duffield, 2010, p. 133). These findings support the first sub-hypothesis, which assumes an increasing awareness among coaches of the importance of modern technologies in improving players' physical output.

✓ Question 2: Do you have general knowledge of how to use modern technological devices in training?

Table N°2 : It highlights the level of general knowledge about how to use modern technological devices in training

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Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	2	6	3	11	3.54	5.99	2	0.170	Not significant

✓ Analysis and Discussion of the Results in Table 02:
 The results revealed that 54.5% of the coaches (6 out of 11) lack sufficient knowledge in using technological devices, while 18.2% (2 out of 11) reported having general knowledge, and 27.3% (3 out of 11) had limited knowledge. This distribution showed no statistical significance ($\chi^2 = 3.54$, $p > 0.05$). This deficiency can be attributed to the scarcity of practical training programs. A field study confirms that 72% of coaches in local leagues rely on traditional experience rather than technological tools (Gabbett, 2016, p.276). These findings support the first sub-hypothesis, which suggests that the main challenge in using technology to regulate training loads lies in the lack of applied awareness, rather than the technical effectiveness of the tools.

✓ Question 3: Have you previously benefited from workshops or training sessions on how to use these devices?

Table N°3 : It highlights the extent of the benefit gained from internships or training programs on how to use these devices

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	2	7	2	11	5.55	5.99	2	0.062	Not significant

✓ Analysis and Discussion of the Results in Table 03:

The results showed that 63.6% of the coaches (7 out of 11) had not received any training in the use of technological devices, while 18.2% (2 out of 11) had received sufficient training and another 18.2% (2 out of 11) had limited training. This distribution was not statistically significant ($\chi^2 = 5.55$, $p > 0.05$), and aligns with findings from a field study indicating that 75% of Algerian clubs do not conduct training programs on sports technology (Boubekeur & Hassaine, 2021, p. e79).

This result explains the lack of practical awareness reflected in the responses to Questions 01 and 02, and strongly supports the first sub-hypothesis, which emphasizes the correlation between practical training and understanding how to implement technology effectively.

✓ **Question 4:** Have you ever used technological devices to monitor the development of physical performance during the sports season?

Table N°4 : It highlights the extent of the use of technological devices to monitor the development of physical performance throughout the sports season

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	2	7	2	11	5.18	5.99	2	0.075	Not significant

✓ **Analysis and Discussion of the Results in Table 04:**

The results revealed that 63.6% of the coaches (7 out of 11) had not used technological devices to monitor the development of physical performance during the sports season, while 18.2% (2 out of 11) reported using them and 18.2% (2 out of 11) indicated limited use. This distribution was not statistically significant ($\chi^2 = 5.18$, $p > 0.05$). This weakness is attributed to a lack of material resources and the absence of practical training. A field study confirms that 68% of

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Algerian clubs do not provide access to advanced devices such as GPS Pro or InBody due to budget constraints (Rabahi et al., 2023, p. 148).

These findings support the first sub-hypothesis, suggesting that the main barrier to employing technology in load management is the lack of practical awareness, rather than the technological tools themselves.

✓ **Question Five:** Do you think technologies such as GPS Pro or Beeper Pro help in regulating training loads?

Table N°5 : It indicates whether technologies such as GPS Pro or Beeper Pro help in managing training loads

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	2	8	1	11	6.18	5.99	2	0.045	significant

✓ **Analysis and Discussion of the Results in Table 05:**
The results revealed that 72.7% of coaches (8 out of 11) do not believe that tracking devices such as GPS Pro or Beeper Pro effectively contribute to regulating training loads, while 18.2% (2 out of 11) supported their use, and 9.1% (1 out of 11) expressed limited agreement. This distribution was statistically significant ($\chi^2 = 6.18$, $p < 0.05$).

This skepticism is attributed to a lack of practical training in using these technologies. A field study published in the *Journal of Excellence* indicates that 72% of Algerian coaches had not received adequate training on technological measurement tools, which limits their ability to employ them effectively (Lebbad & Maamer, 2021, p. 150).

These findings support the first sub-hypothesis, confirming that coaches' awareness of the importance of technology does not translate

into practical application without a supportive environment (technical training, technical support, material resources).

● **Axis Two: The Impact of Employing Modern Technological Devices on Enhancing the Physical Capabilities of Football Players.**

✓ **Question Six:** Has the use of devices such as InBody or Z-Metrix helped you accurately assess the players' physical indicators?

Table N°6 : It highlights the extent to which devices like InBody or Z-Metrix are used to accurately assess players' body composition indicators

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	2	8	1	11	9.63	5.99	2	0.045	significant

✓ **Analysis and Discussion of Table No. 06:**

The results revealed that the majority of coaches (8 out of 11) had not effectively benefited from devices such as InBody or Z-Metrix in assessing players' physical indicators, while two answered "a little" and only one responded "yes." The Chi-square test indicated statistically significant differences ($\chi^2 = 9.63 > 5.99$, $p < 0.05$), reflecting a clear inconsistency in the use of these devices within the study population. This can be attributed to weak training or disparities in technical resources among clubs, highlighting a reality in which these technologies are still not effectively implemented. This result aligns with the second hypothesis of the study, which assumes a positive impact of using modern technology on physical capabilities. It is further supported by a field study that utilized the InBody 230 device, which demonstrated its effectiveness in improving body composition through precise programs-helping to reduce fat percentage and increase muscle mass in athletes (Fedlaoui, 2021, pp. 33–46).

✓ **Question 7:** Has using devices such as Gymaware Cloud Pro or Kit Vitesse 2 helped you improve strength or speed?

Table N°7 : It highlights the extent to which devices like Gymaware Cloud Pro or Kit Vitesse 2 are used in developing strength or speed

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	1	8	2	11	7.81	5.99	2	0.020	significant

✓ **Analysis and Discussion of Table No. 07:**

The coaches' responses regarding the contribution of technological devices to the development of strength and speed revealed that 72.7% of the sample (8 out of 11 coaches) did not observe an actual improvement in physical performance. In contrast, only 9.1% (1 coach) reported a direct positive impact, while 18.2% (2 coaches) acknowledged limited benefits. The Chi-square test showed statistically significant differences ($\chi^2 = 7.81 > 5.99$, at $\alpha = 0.05$), indicating that the variation in opinions was not random. Despite the statistical significance, the majority of coaches were unable to effectively utilize these devices, suggesting that the issue lies not in the efficacy of the equipment itself, but in the lack of technical competence and practical training among users. This conclusion is supported by a field study, which found that 70% of coaches suffer from inadequate practical training in interpreting data from technological devices, which diminishes their effectiveness in improving physical attributes such as strength and speed (Mahfoudhi, 2023, p. 78). These findings reinforce the second hypothesis of the second axis, which posits that the limited impact of technology on enhancing physical abilities is due to the lack of effective field implementation.

✓ **Question Eight:**

Does your club provide you with the financial resources to acquire these devices?

Table N°8 : It highlights the extent of the club's commitment to providing the financial resources to acquire these devices

Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	0	9	2	11	12.23	9.21	2	0.01	significant

✓ **Analysis and Discussion of Table No. 08:**

The results of the Chi-square test ($\chi^2 = 12.23$, $df = 2$, $p < 0.01$) revealed statistically significant differences in the distribution of coaches' responses. The calculated value (12.23) exceeded the critical value (9.21) at the 0.01 significance level, indicating that the predominance of the answer "No" (9 out of 11 coaches) reflects a clear institutional financial incapacity to provide sports technology. This financial obstacle constitutes a fundamental barrier that hinders the application of the second sub-hypothesis (i.e., employing technology to enhance physical capacities), despite the coaches' awareness of its effectiveness as demonstrated in the second axis. These findings align with previous conclusions asserting that "insufficient funding accounts for 48.4% of the total obstacles to employing technology in Algerian institutions." (Al-Mukhlafi, 2017, p. 208).

✓ **Question Nine:** Do you face technical or material difficulties that prevent the regular use of technology in training?

Table N°9 : It highlights the extent to which technical or financial difficulties hinder the regular use of technology in training

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Answers	Yes	No	A little	Total	Calculated Chi-square (χ^2)	Tabulated Chi-square (χ^2)	Degrees of Freedom	Level of Significance	Statistical Significance
Frequencies	8	0	3	11	8.97	5.99	2	0.05	significant

✓ Analysis and Discussion of Table No. 09 Results:
The results of the Chi-square test ($\chi^2 = 8.97$, $df = 2$, $p < 0.05$) revealed a non-random distribution of coaches' responses, with 73% (8 out of 11) affirming that they face technical and/or material obstacles that hinder the use of technology in training. This reflects a systematic challenge in applying the second sub-hypothesis (utilizing technology to enhance physical performance), as these structural obstacles-particularly weak infrastructure-impede the realization of the expected positive impact on players' physical performance, as addressed in Axis II. These findings are consistent with the statement that "37% of global studies identified the lack of digital infrastructure and technical support as a major barrier to the application of technology in resource-limited environments". (Erduran et al., 2025, p. 878)

Conclusion:

The study revealed that activating the enhancing role of modern technologies in improving football players' physical performance-despite coaches' acknowledgment of their theoretical importance-depends on the integration of two critical factors:

1. Developing the practical dimension through the training of human resources in analyzing digital indicators and making data-driven decisions.
2. Providing material and technical infrastructure by funding specialized devices and ensuring sustainable technical support.

This necessitates a strategic partnership between football clubs and relevant authorities to transform technological capabilities into an

effective operational pillar within the training system. This conclusion applies to all Algerian football clubs without exception, and is not limited to teams or clubs in the city of Annaba. It reflects the practical reality on the ground, as well as findings confirmed by several studies conducted by fellow researchers across Algeria.

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