Pegem Journal of Education and Instruction, Vol. 16, No. 1, 2026 (pp. 1299-1309)
RESEARCH ARTICLE WWW.PEGEGOG.NET

The Role of Modern Technological Applications in Sports Training and Training Load Monitoring

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Received: 21/07/2025 ; Accepted: 21/11/2025 ; Published: 18/01/2026

Abstract

The rapid development of modern technological applications has significantly transformed the field of sports training, particularly in the optimization of training processes and the monitoring of training load. This study examines the role of contemporary technologies—such as wearable devices, global positioning systems (GPS), performance analysis software, biomechanical sensors, and artificial intelligence—in enhancing training efficiency and improving athletic performance. These applications enable coaches and sports scientists to collect precise, real-time data related to physiological, biomechanical, and tactical variables, allowing for individualized training programs and accurate assessment of athletes' physical and functional states. Moreover, technological tools contribute to effective training load monitoring by balancing workload and recovery, reducing the risk of overtraining and sports injuries. The study highlights how integrating modern technological applications into sports training supports evidence-based decision-making, enhances performance outcomes, and promotes athlete health and sustainability.

Keywords: Modern technology; sports training; training load monitoring; performance analysis; wearable devices; athlete performance.

Introduction :

Scientific progress has played a significant role in enhancing athletic performance. The excellence and superiority demonstrated by developed countries are the result of the knowledge and information attained by professionals in this field, in addition to the experience gained through scientific application, training, research, and experimental studies, all of which have a substantial impact on athletic performance and its outcomes in sports competitions. The societal transformation brought about by information technology is, in essence, primarily an educational transformation. As the importance of natural and material resources declines, information emerges as the most important source of power. Consequently, technology-centered training becomes the decisive factor in shaping the future of sports (Hussein Ali, 2016, p. 7, Vol. 2, No. 1).

The main objective of training through information technology lies in reshaping the coach's mindset and directing it toward research, creativity, understanding, persuasion, problem-solving, and solution development. In this regard, Zaghloul argues that training using information technology does not merely involve the use of modern and advanced devices and tools; rather, it fundamentally represents a way of thinking aimed at establishing a structured training system based on the adoption of a specific methodological approach (Abdullah & Abdelrahman, 2022, Vol. 2, No. 3).

Moreover, modern technology provides precise tools for measuring training load, such as Global Positioning System (GPS) devices and force sensors, which assist coaches in assessing levels of fatigue and physiological stress among athletes. However, improper use of these technologies may lead to adverse outcomes, such as overtraining, which increases the risk of injuries and chronic fatigue (Zhang et al., 2025, p. 5).

Despite these numerous benefits, several challenges still hinder the use of technological applications in the sports field. Among the most prominent challenges are the accuracy and reliability of the data provided by these technologies, as variations in environmental conditions and individual differences among athletes may affect data validity (Zhang et al., 2025, p. 5). In addition, the level of acceptance of these technologies by coaches and athletes constitutes a crucial factor in the success of their integration into the training process. Some studies indicate resistance to adopting modern technological tools due to the need for prior training and the high cost of advanced equipment (Gabbett et al., 2017, p. 45).

Furthermore, issues related to privacy and data protection pose another challenge in the use of smart applications in sports training. These tools rely on collecting and analyzing sensitive athlete data, such as heart rate, physical exertion level, and neural response speed, which necessitates the establishment of strict mechanisms to protect this information from unauthorized use (Montgomery et al., 2020, p. 112).

Based on the above, despite the significant advancement in sports training technology and the availability of modern tools such as motion tracking systems, heart rate monitors, and physiological data analysis applications, many sports clubs and teams still face difficulties in

effectively integrating these tools into their training systems. Some football teams, despite possessing advanced technological equipment, have experienced recurrent muscle injuries related to excessive or imbalanced training loads. This indicates deficiencies in the scientific and systematic use of technology for monitoring and estimating training load. Accordingly, the researcher deemed it necessary to study the topic: **"The Reality of Using Modern Technological Applications in Sports Training and Their Contribution to the Success of the Training Process – Training Load Monitoring."**

Based on the above, the research problem of this study revolves around the following main question:

What is the reality of using modern technological applications in sports training, and to what extent do they contribute to the success of the training process and training load monitoring?

Sub-questions:

- What is the role of GPS devices in the success of the sports training process and their contribution to monitoring training loads?
- To what extent do video analysis technologies contribute to improving the quality of the sports training process and monitoring training loads?
- What are the obstacles to using modern technological applications in the success of the sports training process and training load monitoring?

Research Hypotheses:

General Hypothesis:

- Modern technological applications contribute to the success of the training process and the monitoring of training loads among football players.

Specific Hypotheses:

- The use of Global Positioning System (GPS) devices helps improve the success of the sports training process and training load monitoring among football players.
- Video analysis technologies contribute to the success of the sports training process and training load monitoring among football players.
- The use of modern technological applications in the success of the sports training process and training load monitoring faces technical and human-related obstacles.

Study Objectives:

- To identify the most prominent technological applications used in the field of sports training.
- To examine the extent to which these applications contribute to monitoring and regulating training loads.
- To analyze the impact of modern technology on athletes' physical performance and physiological adaptation.
- To highlight the challenges and difficulties faced by coaches and athletes in adopting and using these technologies.

1. Definition of Study Concepts and Terms

1.6.1 Modern Technological Applications in Sports Training

Conceptually:
Modern technological applications in sports training are defined as digital tools and advanced software used to develop and analyze athletes' performance. These applications include wearable devices such as heart rate monitors, video analysis systems, and smartphone applications that provide personalized training programs. They enable real-time data collection and analysis, allowing for more accurate training decisions (Daghash, 2021, p. 410).

Operationally:
In this study, modern technological applications refer to all digital tools and technologies used to improve the quality of sports training, whether through the collection of physiological data, performance analysis, or the provision of training plans based on accurate information.

1.6.2 The Training Process

Conceptually:
The training process is a set of activities and techniques aimed at developing athletes' physical and technical abilities through the application of scientific principles based on performance analysis and systematic training planning. This process includes goal setting, training session planning, exercise implementation, and monitoring progress to ensure maximum athletic benefit (Ben Toumi, 2024, p. 55).

Operationally:
The training process refers to all training activities and programs implemented using modern technological applications, with the aim of improving athletes' performance and monitoring the development of their physical capacities.

1.6.3 Training Loads

Conceptually:
Training loads represent the amount of physical and mental effort exerted by athletes during training sessions. They are determined based on several factors such as intensity, volume, and training density. Proper control of training loads contributes to physical development and reduces the risk of injuries caused by overtraining (Ben Toumi, 2024, p. 78).

Operationally:
Training loads refer to the level of effort exerted during training sessions, which is monitored using modern technologies to regulate intensity and density in accordance with athletes' abilities and to achieve optimal results.

2. 5.2 Research Methodology

The choice of research methodology depends on the nature of the study. Since the research topic directly determines the appropriate methodological approach, and given the nature of the subject, the researcher adopted the **descriptive-analytical method**, as it is the most suitable approach for addressing the objectives of this study.

3. 5.3 Study Variables

IndependentVariable:
According to the nature of the study, the independent variable is the use of modern technological applications.

DependentVariable:
Based on the nature of the study, the dependent variable is the success of the training process.

5.4 Population and Sample of the Study

5.4.1 Study Population

Based on the nature of the research topic, the study population includes coaches from the Wilaya League of Sétif for the 2024–2025 sports season, totaling (80) coaches.

5.4.2 Study Sample

Due to the nature of the research, the sample was selected from a group of coaches in the Wilaya of Sétif using **purposive sampling**. The selected sample consisted of (40) coaches.

5.5 Data Collection Methods (Research Instruments)

Research instruments refer to the methods through which the quality and validity of the research can be verified. Accordingly, the researcher relied on a **questionnaire** as the primary data collection tool. The questionnaire was designed to include directed questions addressed to sports team coaches in the Wilaya of Sétif and consisted of three main axes. Each axis included a set of statements evaluated using a three-point rating scale.

4. 5.6 Psychometric Properties of the Study Instruments (Validity, Reliability, Objectivity)

Table (01) presents the correlation, reliability, and validity coefficients obtained from the test–retest application of the questionnaire on the pilot sample:

Study Instrument	Axis	Correlation Coefficient	Reliability	Validity
Questionnaire	First Axis	0.94	0.94	0.96
	Second Axis	0.88	0.88	0.93
	Third Axis	0.90	0.90	0.94

5. Analysis

- The reliability coefficient of the questionnaire was calculated using Pearson's correlation coefficient between two consecutive applications (test–retest). The reliability value for the first axis reached (r = 0.94), indicating a very high level of internal consistency and reflecting a high degree of reliability and stability of the measurement tool used in this study.
- The reliability coefficient for the second axis was (r = 0.88), which also indicates a very high level of internal consistency and reflects strong reliability of the measurement instrument.
- The reliability coefficient for the third axis reached (r = 0.90), demonstrating a very high degree of internal consistency

and confirming the reliability and stability of the questionnaire.

6. Conclusion

It can be concluded that the questionnaire demonstrates a very high level of reliability. This indicates that the research instrument is capable of measuring the targeted variables in a consistent and reliable manner, which enhances the credibility of the collected data and strengthens the scientific rigor of the study's results and statistical analyses.

Statistical Treatment

To achieve the objectives of this study and answer its research questions, a set of statistical methods appropriate to the nature of the data and study variables was used through the **SPSS** software. The following statistical procedures were applied:

- **Percentages(%):**
  These were used to analyze descriptive data and determine the frequencies of the respondents' answers, providing an initial understanding of their tendencies toward the studied variables.
- **Pearson Correlation Coefficient:**

  This coefficient was used to measure the reliability of the research instrument by applying it twice (test–retest method) to determine the consistency of participants' responses over time. Pearson's coefficient was appropriate in this case since the data were quantitative and normally distributed.

Results of the First Question

Question	Frequencies and Percentages	Yes	No	Sometimes
Do you use GPS devices during sports training?	Frequency	20	10	0
	Percentage (%)	50	25	25

7. Results of the Second Question

Question	Frequencies and Percentages	To a large extent	To a moderate extent	To a low extent
To what extent do you believe that GPS devices help in tracking and analyzing training loads?	Frequency	32	8	0
	Percentage (%)	80	20	0

8. Results of the Third Question

Question	Frequencies and Percentages	Yes	No	Sometimes
Do you believe that GPS data provide accurate information about sports performance?	Frequency	30	0	10
	Percentage (%)	75	0	25

9. General Conclusion of the First Hypothesis

The results of the questionnaire revealed that the majority of coaches are aware of the increasing importance of using GPS devices in sports training, as high approval rates were recorded across most questionnaire items. This reflects a strong conviction among the study sample regarding the role of this technology in developing athletic performance and enhancing the efficiency of the training process. In terms of prevalence and actual use, a considerable proportion of coaches reported regular use of GPS devices, while the remaining proportion attributed non-use either to the unavailability of the devices or to the need for further training and qualification to use them effectively.

Regarding the effectiveness of GPS in tracking and analyzing training loads, the responses were strongly supportive, indicating coaches' awareness of the accuracy of the data provided by these devices in monitoring performance. Concerning physical evaluation and injury prevention, the majority of responses confirmed that GPS use contributes directly to reducing the risks associated with excessive training loads and improving the accuracy of physical assessments, thereby reinforcing the importance of GPS as a valuable tool for prevention and training planning.

The results also showed broad agreement that individualizing training loads and improving training effectiveness are better achieved through the use of GPS compared to traditional methods. However, a significant number of coaches pointed out that this technology is not suitable for all types of sports, as its applicability depends on the nature of the sport and the specific skills required.

Furthermore, a large proportion of participants agreed that understanding and analyzing GPS data requires specialized training, highlighting the need for sports institutions to better qualify technical staff in this field. Finally, three main factors were identified as obstacles to the widespread use of this technology: high cost, lack of training on its use, and occasional data inaccuracy. These findings call for intervention by relevant authorities to reduce these barriers and facilitate the integration of technology into the sports training

10. General Conclusion of the Second Hypothesis

Analysis of coaches' responses to the questions in this section reveals a widespread appreciation for the importance of video analysis technologies in the training process. The results showed that the majority of coaches believe these technologies significantly contribute to improving athletic performance, identifying and correcting movement errors, and providing accurate information regarding training loads and athletes' technical levels.

The responses also indicated that coaches consider video analysis capable of adapting training strategies according to each athlete's abilities and contributing to injury reduction by improving movement technique. Despite acknowledging the effectiveness of these technologies, most coaches emphasized the need for specialists to analyze and interpret the resulting data, noting that video analysis provides more precise information than conventional observation.

Regarding challenges, the main obstacles identified were high cost and the requirement for advanced analytical skills, which may limit the widespread adoption of this technology. Nevertheless, the majority of coaches agreed that video analysis should be an essential component of every training program, reflecting their strong belief in its positive impact on supporting the training process.

11. General Conclusion of the Third Hypothesis

Analysis of coaches' responses to the questions in this section reveals a strong awareness of the importance of modern technology in sports training. However, this awareness is challenged by several obstacles that hinder its full utilization. Most coaches indicated facing real difficulties, primarily related to the high cost of these applications, limited technological skills among some users, as well as technical issues such as poor internet connectivity or device incompatibility.

Coaches also expressed a clear need for more user-friendly and suitable applications and emphasized the necessity of providing specialized training for both coaches and athletes to use these technologies efficiently. Based on their responses, it can be concluded that overcoming these obstacles requires practical interventions, including financial support, technical training, and software development

Discussion of the Results of the First Hypothesis

Hypothesis

of the sports training process and the monitoring of training loads.

The results related to the first hypothesis revealed a broad agreement among coaches regarding the effectiveness of GPS devices in improving training quality and monitoring training loads. The second question showed that 80% of coaches believe that GPS devices greatly assist in tracking and analyzing training loads. This finding aligns with the study by **Murad Qallhouz and Zoubir Latrash (2022)**, which confirmed that 80% of football coaches in Algeria use technology for performance analysis, reflecting a similar level of awareness among the current sample.

Furthermore, the results of the third question indicated that 75% of coaches trust the accuracy of GPS data related to sports performance. This finding is consistent with the study conducted by **Alessio Rossi et al. (2018)**, which developed a predictive model for injury risk using GPS data and demonstrated high accuracy in tracking physical loads and associated risks. These findings also intersect with the results of the fourth question, which showed that 80% of

coaches believe GPS usage reduces injury risk caused by excessive training loads.

Regarding training load individualization, the results of the fifth question revealed that 75% of coaches believe GPS helps adapt training loads according to each athlete's capabilities. This result is in line with **Xinyu Tang et al. (2025)**, who developed a smart monitoring system using precise sensors and confirmed that modern technology enables individualized athlete monitoring, enhancing the effectiveness of personalized physical adaptation.

Concerning the evaluation of training effectiveness using GPS compared to traditional methods (sixth question), more than 82% of coaches believed that GPS improves training quality. This result supports the findings of **Baffa Abdullah and Abdelrahman Zemmam (2022)**, who emphasized the positive role of technological tools in developing the training process, while also noting that limited technological competence among some coaches remains an obstacle.

Additionally, the ninth question indicated that 75% of coaches acknowledge the need for specialized training to understand GPS data, which is supported by **Awad Younes Ouda et al. (2024)**, who emphasized the importance of qualifying coaches to understand artificial intelligence technologies and integrate them into physical education curricula. Similar conclusions were drawn by **Khalafi Tarek and Dashri Hamid (2024)**, highlighting the importance of technical training for optimal use of performance-tracking applications.

Regarding challenges, the tenth question revealed that high cost and lack of training are the primary obstacles to GPS usage. This finding is consistent with **Mohammed Qasim Jameel (2024)**, who recommended integrating technology into educational and training programs to reduce the technological gap, particularly among younger athletes. Similar conclusions were reported by **Khawla Milyani et al. (2021)**, who noted that the limited use of technological tools in training is often due to insufficient dissemination and technical support.

Based on the questionnaire results and their comparison with previous studies, it can be concluded that GPS devices represent an effective and reliable tool for supporting coaches in monitoring training loads, evaluating performance, preventing injuries, and improving physical planning. Accordingly, the first hypothesis is confirmed.

Discussion of the Results of the Second Hypothesis

Hypothesis

Video analysis technologies contribute to the success of the sports training process and training load monitoring.

The questionnaire results related to this hypothesis revealed increasing awareness among coaches of the importance of video analysis technologies in improving athletic performance and monitoring training loads, despite their limited actual use in practice. The first question indicated that 62.5% of coaches do not use video analysis technologies, compared to only 37.5% who do, reflecting limited implementation despite acknowledged benefits.

This discrepancy between awareness and actual use aligns with **Baffa Abdullah and Abdelrahman Zemmam (2022)**, who emphasized that technology use in team sports remains limited due to insufficient technological competence among coaches.

However, the second and third questions showed that more than 75% of coaches strongly believe that video analysis helps improve performance and identify and correct movement errors. These

findings are consistent with **Ryan Njami and Rami Ghannam (2025)**, who demonstrated that virtual reality and real-time feedback improved players' strategic awareness and technical performance.

Regarding data accuracy, the fourth question revealed that only 32.5% of coaches fully trust video analysis accuracy, while 50% believe it is sometimes accurate. This finding supports **Mohammed Qasim Jameel (2024)**, who argued that the benefits of technological applications vary according to usage quality and tool efficiency.

Concerning training load individualization, 77.5% of coaches believed that video analysis contributes to customizing training programs based on athletes' capabilities. This result aligns with **Xinyu Tang et al. (2025)**, who emphasized individualized training through advanced performance-monitoring technologies.

Moreover, 62.5% of coaches believed that video analysis helps reduce injury risk by improving movement technique, consistent with **Rossi et al. (2018)**. Additionally, over 82% of coaches indicated that video analysis requires specialized professionals, reinforcing the need for specialized training, as highlighted by **Awad Younes Ouda et al. (2024)**.

Finally, 62.5% of coaches suggested that video analysis should be a fundamental component of every training program, reflecting a general conviction of its importance. Based on these findings, the second hypothesis is confirmed.

12. Discussion of the Results of the Third Hypothesis

Hypothesis

The use of modern technological applications in sports training and training load monitoring faces technical and human-related obstacles.

The results showed that 75% of coaches face real difficulties in using technological applications. Financial constraints ranked first (75%), followed by human and technical barriers. These results align with **Baffa Abdullah and Abdelrahman Zemmam (2022)** and **Mohammed Qasim Jameel (2024)**.

Technological skill limitations were also evident, as 62.5% of coaches reported partial technological competence. Technical issues such as equipment compatibility and weak internet connectivity further hindered effective usage. These findings are consistent with **Khalafi Tarek and Dashri Hamid (2024)**.

Data accuracy was also a major concern, as all coaches acknowledged its impact on training decisions. Coaches emphasized the need for simpler and more user-friendly applications, echoing **Xinyu Tang et al. (2025)**. Consequently, the third hypothesis is confirmed.

13. General Conclusion

Based on the study findings derived from questionnaire data collected from Wilaya League coaches in Sétif, the following conclusions were reached:

- GPS devices contribute to the success of the sports training process and training load monitoring.
- Video analysis technologies support the success of the training process and training load monitoring.
- The use of modern technological applications faces financial, technical, and human-related obstacles.

Accordingly, the research problem is answered as follows:
Modern technological applications contribute to the success of the training process and training load monitoring.

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