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The Role of Knowledge of Physical Education Trainers and Teachers in Applying the Concepts of Biomechanics and Kinesiology in Jordan

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الملخص:

تهدف هذه الدراسة إلى التعرف على أثر معرفة المدربين ومعلمي التربية الرياضية في تطبيق مفاهيم الميكانيكا الحيوية (Biomechanics) والحركيات (Kinesiology) في المجال الرياضي في الأردن. استخدمت الدراسة المنهج الوصفي التحليلي، وتم تحليل النتائج واختبار الفرضيات باستخدام برنامج التحليل الإحصائي (SPSS). وقد تكون مجتمع الدراسة من جميع مدربي ومعلمي التربية الرياضية في الجامعات والمدارس، وتم اختيار عينة الدراسة بطريقة العينة العشوائية البسيطة، حيث بلغ عدد أفراد العينة (150) معلمًا ومدربًا من الذكور والإناث .أظهرت نتائج الدراسة وجود أثر دال إحصائيًا للحصيلة المعرفية على تطبيق مفاهيم الميكانيكا الحيوية والحركيات في الرياضة بالأردن. وأوصت الدراسة بضرورة أن يعمل صناع القرار في الجامعات والمدارس والأندية على استخدام مفاهيم الميكانيكا الحيوية والحركيات في تطوير البرامج التدريبية التي تعزز من الأداء وتقلل من احتمالية الإصابات، بالإضافة إلى ترسيخ المعرفة النظرية وتوظيفها في التطبيقات العملية.

الكلمات المفتاحية: الميكانيكا الحيوية، الحركيات، الرياضة في الأردن.

Abstract:

The current study aimed to identify the impact of the knowledge of trainers and teachers of physical education on the application of the concepts of biomechanics and kinesiology in sports in Jordan. The study used the descriptive analytical approach, and used the SPSS program to analyze the results and test the hypotheses. The study community consisted of all trainers of physical education teachers in universities and schools, and the sampling unit consisted of all trainers and teachers of physical education in universities and schools, using the simple random sample method, and their number was (150) male and female teachers and trainers. The results of the study showed a statistically significant impact of the knowledge outcome on the application of the concepts of biomechanics and kinesiology in sports in Jordan. The study recommended that decision-makers in universities, schools, and clubs use biomechanics and

kinesiology in developing training programs that enhance performance and reduce the risk of injury, and in consolidating theoretical knowledge and employing it in practical applications.
Keywords: Biomechanics and Kinesiology, Sports in Jordan.

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1. Introduction

Physical education is considered one of the fundamental components of educational systems worldwide, due to its role in promoting public health, enhancing physical performance, and developing social and psychological values among individuals. In this context, teachers in schools and universities in Jordan play a significant role in improving the athletic performance of students and athletes.

Biomechanics is considered one of the leading sciences focused on studying and analyzing human motor performance to develop appropriate mechanical solutions for enhancing and modifying performance methods in various sports skills (Khoulie et al., 2024). Kinesiology, on the other hand, is regarded as the foundation of various sports sciences, as analyzing and evaluating motor performance helps sports professionals choose new theories and methods for teaching sports movements (Khater et al., 2023).

Based on the above, this study aims to explore the impact of the knowledge base of physical education trainers and teachers on the application of biomechanics and kinesiology concepts in sports in Jordan.

2. Problem of the Study

The problem of this research lies in determining the impact of the knowledge base of trainers and teachers in the fields of biomechanics and kinesiology on the implementation of effective training programs in Jordanian schools, universities, and sports clubs. It is well known that the effectiveness of sports training largely depends on how well trainers and teachers are familiar with the scientific concepts of movement and biomechanics. However, many studies indicate that there is a significant gap in the scientific knowledge of trainers in this field (Jordan Ministry of Education Report, 2019). Furthermore, many trainers and teachers in

Jordan rely on personal experience and traditional training methods, which may not be based on solid scientific foundations in biomechanics and kinesiology. This exposes athletes to the risk of injuries and reduces the effectiveness of training. Additionally, some studies suggest that trainers without sufficient scientific background in these fields may be less capable of accurately analyzing sports movements and correcting technical errors among athletes (Al-Issa, 2020).

On the other hand, despite the comprehensive integration of biomechanics into the study of kinesiology, there are gaps in understanding the effectiveness of applying these principles in real-world scenarios, particularly in educational environments (Potop et al., 2024).

In light of this, the researcher identified the problem of the study as examining the impact of the knowledge base of physical education trainers and teachers on applying biomechanics and kinesiology concepts in sports in Jordan.

3. Research Questions

The study aims to answer the following questions:

Main Question: What is the impact of the knowledge base of physical education trainers and teachers on applying biomechanics and kinesiology concepts in sports in Jordan?

4. Objectives of the Study

The study aims to achieve the following objectives:

- To identify the relative importance of the knowledge base of physical education trainers and teachers.

- To identify the relative importance of applying biomechanics and kinesiology concepts in sports in Jordan.

- To determine the impact of the knowledge base of physical education trainers and teachers on applying biomechanics and kinesiology concepts in sports in Jordan.

5. Significance of the Study

The importance of the study is divided into two main sections:

First: Scientific (Theoretical) Importance The significance of the study arises from the importance of the variables and dimensions it addresses, particularly the knowledge base of physical education trainers and teachers in applying biomechanics and kinesiology concepts in sports in Jordan. To the best of the researcher's knowledge, and based on a review of previous studies, there are no studies that address the variables of this research (the knowledge base of physical education trainers and teachers in applying biomechanics and kinesiology concepts in sports in Jordan) in a unified model for trainers and teachers in Jordan.

Second: Practical (Applied) Importance The practical significance of this study lies in the outcomes it produces, namely the results and recommendations. These will provide valuable insights to decision-makers in universities, the Jordanian Ministry of Education, and sports clubs, helping them focus on the knowledge base required for applying biomechanics and kinesiology concepts. This, in turn, contributes to improving the physical education curriculum and training programs.

6. Hypotheses of the Study

To achieve the study's objectives, the following hypotheses have been formulated:

Main Hypothesis HO1: There is no statistically significant effect at the significance level ($\alpha \geq 0.05$) of the knowledge base on applying biomechanics and kinesiology concepts in sports among physical education trainers and teachers in Jordan.

7. Study Model

The study model was designed, including the study's dimensions and variables. Figure (1) shows the study model and its variables:

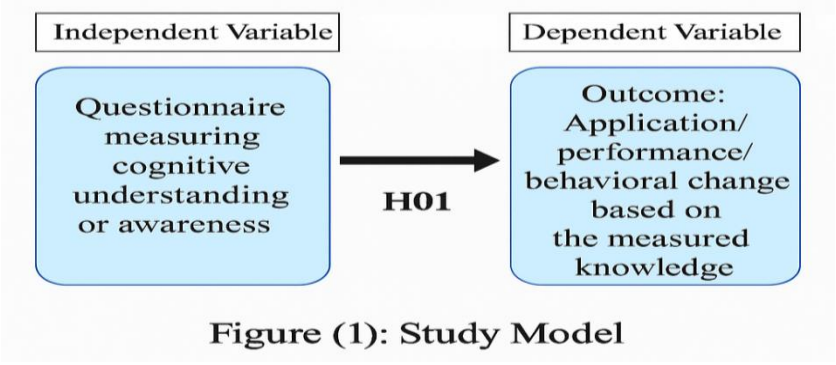

Figure (1): Study Model

8. Study Limitations

Spatial Limitations: Schools and universities in Jordan. -

- **Temporal Limitations:** This study was conducted during the academic year 2025.

- **Human Limitations:** All physical education teachers in universities and public schools.

- **Scientific Limitations:** This study focused on literature and studies related to the knowledge base of physical education trainers and teachers in applying biomechanics and kinesiology concepts in sports in Jordan.

9. Theoretical Framework and Previous Studies

Section One: Knowledge Base in Applying Biomechanics and Kinesiology Concepts

Concept of Biomechanics and Kinesiology:

Biomechanics is one of the first sciences concerned with studying the rest and movement of bodies, regardless of their characteristics and sizes. Pioneers of this science include Aristotle, who discussed basic movements such as running and walking, as well as Archimedes, who applied the laws of motion in fluids. Biomechanics is considered one of the modern sciences, with various definitions. It is the applied science of mechanical laws in performing sports movements according to biological conditions (Tawazet, 2024). Sports biomechanics is the study and quantitative analysis of professional athletes and sports activities in general. It can be simply described as the physics of sports, where mechanical laws are applied to gain a better understanding of sports performance through mathematical modeling, computer simulations, and measurements.

Additionally, sports biomechanics includes the analysis of movements, improving techniques, and understanding the mechanisms behind injuries to develop better training and rehabilitation protocols (Kilani et al., 2009). It is, therefore, a dynamic field applying mechanical principles to understand and improve sports performance while reducing injury risks in athletic activities (Plakias et al., 2024). Kinesiology is defined as the science concerned with analyzing random and purposeful human

movements, selecting the beneficial ones to maintain physical health, social interaction, self-defense, and for recreational purposes. It is the foundational science from which various sports sciences branch out. Biomechanics has been a key tool since the second half of the 20th century, and since then, it has been regarded as an independent specialization with a broad research perspective. Mental and physical effects have been observed in the Olympic Games, especially with the continuous breaking of world records in athletics, long jump, javelin, boxing, karate, and taekwondo (Blanco Ortega et al., 2022). It also aids in updating training and developing athletes to facilitate better injury rehabilitation (Li & Xiao, 2024).

Sections of Biomechanics:

Kinematics

Kinematics is a branch of classical mechanics that describes the motion of points (or "particles"), bodies, and systems of bodies without considering the masses of those bodies or the forces that may have caused the motion (Kumar, 2021). It is a series of physical parameters dealing with the positions and motions of objects, where direction, magnitude, and frequency of movements can be distinguished. Effective monitoring helps detect posture defects and acquire personal characteristics to improve training strategies and reduce injuries (Liu & Zhang, 2022).

Kinematics is the most commonly used approach in biomechanical analyses with less focus on kinetics, especially when integrating muscle activation data and musculoskeletal modeling approaches (Ramasamy et al., 2023). As a branch of science, kinematics helps researchers and athletes understand the mechanics and momentum of bodies, including displacement, speed, and acceleration in sports motion, as understanding the concept of kinematics helps explain the forces that cause gravity to affect the athlete's movement trajectory (Li & Xiao, 2024).

Kinetics

Kinetics is a term used for a branch of mechanics that concerns the relationship between motion and its causes, i.e., forces and torque (Kumar, 2021). It is the section that examines the impact of forces that change or cause motion, and studies the forces associated with movement, including the forces that cause motion and those resulting from it (Al-Mukhatar, 2021). It deals with the forces and torques that

cause motion, such as the performance kinetics of athletes, which is used in sports to analyze the movements of athletes to improve their techniques and performance (Li & Xiao, 2024). It involves studying the forces that produce or change motion, such as ground reaction forces, muscle forces, and joint torques (Naseri, 2024).

Section Two: Application of Biomechanics and Kinesiology Concepts in Sports

1. Application of Biomechanics Concepts in Training Performance

In the world of sports, kinesiology plays a critical role in enhancing performance. By analyzing movement patterns and understanding the biomechanical and physiological requirements of different sports, movement scientists can develop training programs that enhance performance and reduce injury risks. This includes studying the mechanisms of specific movements, such as running or throwing, and designing interventions to improve technique and efficiency (Naseri, 2024). Biomechanics scientists can develop methods to enhance athletic performance, reduce fatigue, and design more comfortable equipment and workspaces (Malik, 2020). Biomechanics studies the human body's motion and physical mechanics to understand the fundamental aspects of how the human body moves and ways to improve movement to ensure minimal injury risks and other physical hazards (Al-Jaafreh & Qawaqzeh, 2024).

Biomechanics in physical education is a field of science that deals with analyzing mechanical laws and ideologies governing the coordination of human movement and the functions of biological systems. In physical education, exercise, and fitness, biomechanics is a crucial tool for understanding the most effective and efficient ways to improve health and well-being (Jiang, 2024).

Biomechanics helps trainers develop injury prevention strategies. Biomechanical research on human movement has focused on two main goals: improving human performance and alleviating injury risks associated with physical activities. This is achieved by revealing movement control patterns that enhance performance, allowing for better training methods and developing injury prevention strategies for safer and more efficient physical training (Shan, 2024).

Sports injuries are continuously increasing due to the growing number of athletes at various levels, the intensity of competition, and the associated

stress. An athlete not only requires treatment and rehabilitation but also injury prevention to reduce the likelihood of injuries (Ahmed et al., 2024). Biomechanics scientists can track joint and limb movements, understand walking mechanisms, and identify abnormalities in movement that may indicate underlying issues or potential injuries (Malik, 2020). Moreover, previous studies emphasize the critical importance of biomechanics in evaluating and enhancing athletic performance, preventing injuries, and improving the quality of life through physical activity (Potop et al., 2024).

On the other hand, kinesiology also significantly contributes to injury prevention and rehabilitation. By understanding injury mechanisms and the body's response to physical stress, kinesiology professionals can develop strategies to prevent injuries and facilitate recovery. This includes analyzing movement patterns to identify potential risk factors and designing rehabilitation programs that address specific needs and optimize recovery (Naseri, 2024). In biomechanics, forces are responsible for motion and stability, acting externally (such as gravity and friction) and internally (such as muscle contractions). Understanding how these forces are applied, distributed, and absorbed by the body is crucial for analyzing movement patterns, enhancing athletic performance, and preventing injuries (Malik, 2020). Finally, since exercise is now prescribed as medicine, it is important to understand kinesiology in strength and fitness as we apply biomechanical principles to achieve the desired outcome (Hazari et al., 2022).

Biomechanics in physical education involves the detailed analysis of sports movements aimed at improving performance levels while reducing injury risks. The biomechanics of sport and exercise covers the scientific field dealing with analyzing the mechanics and actions of the moving body. This includes explaining and analyzing in detail the body’s movement during physical exercise (Jiang, 2024).

2. The Role of Kinesiology in Enhancing Education

Understanding kinesiology is essential not only for practical application in the professional training of specialists in health and physical performance but also for academic purposes. Kinesiology serves as a key bridge between theoretical knowledge and practical application in physical activities, sports, and health. It is crucial for the professional development of physical education specialists, with biomechanics, as a fundamental aspect of kinesiology, playing a central role in solidifying theoretical knowledge into practical applications. Integrating biomechanics into

kinesiology programs in higher education is becoming increasingly important, as it plays a critical role in enhancing the understanding and application of physical activity principles. Biomechanics courses are typically offered at the undergraduate level, particularly in engineering and health sciences, as an introductory course. They apply mechanical principles to the analysis of human movement, providing a fundamental understanding of the interactions between human movement and the physical environment (Potop et al., 2024). Recently, physical education teachers have employed innovative techniques, including biomechanics and psychological feedback, to improve physical education outcomes.

Kinesiology has evolved to become one of the most dynamic fields for studying and examining various aspects of human body movement from a scientific perspective. Biomechanics is essential for guiding the principles and laws of body movement applicable in professional environments. Kinesiology professionals frequently use biomechanical knowledge to improve movement and prevent or treat injuries through qualitative analyses of human movement (Al-Jaafreh & Qawaqzeh, 2024).

Teaching through kinesiology can help students distinguish between related concepts, establish clear connections between those concepts, their graphical representations, and the real world (Cashman & O'Mahony, 2022).

It is crucial that the teaching of biomechanics enhances not only theoretical knowledge but also practical application, ensuring that future professionals can effectively translate academic insights into real-world benefits (Potop et al., 2024).

Methodology and Procedures:

This section discusses the methodology used in the study, which includes the research methodology, the study population and sample, data collection sources, study tools, and the statistical methods used in the study.

1.12 Research Methodology

The current study relied on the (descriptive analytical) methodology.

2.12 Study Population and Sample

The study population consists of all physical education teachers and instructors in public schools and universities in Jordan. A simple random

sample of 150 physical education teachers and instructors (both male and female) was selected.

3.12 Data Collection Sources

For data collection purposes, two main sources were used:

1. Secondary Data Source: This includes Arabic and foreign references, articles, previous studies, and research.

2. Primary Data Source: This involved using a questionnaire as the main tool for collecting primary data, which was developed based on previous studies related to the study variables.

4.12 Study Tool

A questionnaire was developed to collect data, drawing on previous studies related to the dependent variable (application of biomechanics and kinesiology concepts) and the independent variable (knowledge level in applying biomechanics and kinesiology concepts). The questionnaire consisted of four sections:

- The first section covers the demographic variables of the study sample.
- The second section includes items on the independent variable.
- The third section includes items for measuring the dependent variable.

  Tables 1 and 2 show the source of these items and the number of items for each variable.

Variable	Number of Items	Cronbach's Alpha
Knowledge in Applying Biomechanics and Kinesiology Concepts	8	0.789
Application of Biomechanics and Kinesiology Concepts	8	0.877

5.12 Validity of the Study Tool

The questionnaire was presented to a number of reviewers to achieve content validity and to specialists in physical education at Jordanian universities to ensure the appropriateness and clarity of the items.

6.12 Statistical Methods Used

The researcher used several statistical methods, using the Statistical Package for the Social Sciences (SPSS). The following statistical methods were used:

1. **Percentages and Frequencies:** To show frequency distributions related to the characteristics of the respondents and their answers, as well as their percentage for a given variable, and Kolmogorov-Smirnov test to confirm the normal distribution of data.
2. **Mean:** To calculate the average responses of the participants on the items.
3. **Standard Deviation:** To show the degree of dispersion of the responses around the mean.
4. **Relative Importance:** To determine the relative importance of the items in three levels.
5. **Cronbach's Alpha:** To assess the reliability of the study measures.

Table 2
Reliability Coefficients for the Study Variables

13. Study Hypotheses Results:

1.13 Description of the Sample Characteristics

Table 3 shows that the sample consisted of 150 teachers. The study analyzed the demographic characteristics of the sample, including gender, age group, educational qualification, and experience. Regarding the gender variable, the study showed that there were 89 male teachers and 61 female teachers, representing 59.3% and 40.7%, respectively. This disparity is attributed to prevailing social norms in Jordanian society.

As for the age group, the largest age group was between 25 and under 35 years, comprising 40.6%, while the smallest age group was under 25 years, comprising 12%. The researcher inferred from this result that there are teachers with relatively young age groups.

Regarding the educational qualification variable, those with a Bachelor's degree represented the largest group, totaling 112 teachers, representing 74.6%. Those with a doctoral degree ranked the lowest with only 3 teachers, representing 2.2%. The researcher attributes this result to the fact

that a Bachelor's degree is the primary qualification required for employment in the Ministry of Education.

In terms of years of experience, the majority of the sample had 5 to less than 10 years of experience, representing 44%, while the lowest percentage was among teachers with 20 or more years of experience, representing 8%.

Table 3
Demographic Characteristics of the Study Sample

Variable	Category	Frequency	Percentage (%)
Gender	**Male**	**89**	**59.3**
	Female	**61**	**40.7**
Age Group	**Less than 25 years**	**18**	**12**
	25 to less than 35 years	**61**	**40.6**
	35 to less than 45 years	**42**	**28**
	45 years and above	**29**	**19.4**
Educational Qualification	**Diploma or lower**	**19**	**12.6**
	Bachelor's Degree	**112**	**74.6**
	Master's Degree	**16**	**10.6**
	Doctorate	**3**	**2.2**
Experience	**Less than 5 years**	**14**	**9.4**
	5 to less than 10 years	**66**	**44**
	10 to less than 15 years	**37**	**24.6**

3. Analysis of the Study's Responses

The five-point Likert scale was used to assess the respondents' agreement with the questionnaire items, with the following weights: Strongly Agree (5 points), Agree (4 points), Neutral (3 points), Disagree (2 points), and Strongly Disagree (1 point). The relative importance was determined within three levels, according to the following formula:
Relative Importance = (Upper Limit of the Scale - Lower Limit of the Scale) / Number of Levels, which is 3 / (1-5) = 1.33. Therefore, the relative importance levels are as follows:

- Low Importance: Mean score between 1 and 2.33
- Moderate Importance: Mean score between 2.34 and 3.67
- High Importance: Mean score between 3.68 and 5

To calculate the sample estimates, the means and standard deviations were computed as shown in **Table 4**.

Table 4
Descriptive Analysis of All Study Variables

Variable	Mean	Standard Deviation	Importance Level
Knowledge in Applying Biomechanics and Kinesiology Concepts	**3.44**	**0.84**	**Moderate**
Application of Biomechanics and Kinesiology Concepts	**3.49**	**0.92**	**Moderate**

Table 4 shows that the variable "Application of Biomechanics and Kinesiology Concepts" had a mean score of 3.49, with a standard deviation of 0.92, and was classified as having a moderate relative importance. The variable "Knowledge in Applying Biomechanics and Kinesiology Concepts" also had a mean score of 3.44, with a standard deviation of 0.84, and was similarly classified as moderate in terms of relative importance.

3.13 Testing of the Study Hypotheses

Results of Hypothesis 1: H01

There is no statistically significant effect at the 0.05 significance level ($\alpha \geq 0.05$) of the knowledge level of physical education teachers and trainers in applying biomechanics and kinesiology concepts in sports in universities, schools, and sports clubs in Jordan.

Table 5
Summary of the Model, Coefficient Table, and Variance Analysis for Hypothesis 1

	Model Summary			ANOVA			Coefficient		
Dependent Variable	(R) Correlation Coefficient	(R^2) Determination Coefficient	Adjusted (R^2) Adjusted Determination Coefficient	F (Calculated)	DF (Degrees of Freedom)	Sig (Significance Level)	Beta (β) Coefficient	T (Calculated)	Sig (Significance Level)

Application of biomechanical concepts and movement science	0.662	0.721	0.669	101.515	Regression: Residual:	3 / 147	0.000	Cognitive achievement in applying biomechanical concepts and movement science	0.43	19.700	0.000

Table 5 shows that there is a statistically significant effect at the 0.05 significance level ($\alpha \geq 0.05$) of the knowledge level of physical education teachers and trainers in applying biomechanics and kinesiology concepts in sports in Jordan. The correlation coefficient was found to be ($R = 0.662$), indicating a positive relationship between the knowledge level of physical education teachers and trainers in applying biomechanics and kinesiology concepts in sports. The coefficient of determination (R^2) was 0.721, which means that the knowledge level in applying biomechanics and kinesiology concepts explained 72.1% of the variation in the application of these concepts in sports in Jordan. The remaining 32.1% is attributed to other factors not included in the regression model.

The impact degree (β) was 0.43, meaning that a one-unit increase in the knowledge level of applying biomechanics and kinesiology concepts leads to a 43% increase in the application of these concepts in sports in Jordan. The significance of this impact is confirmed by the calculated F value, which was 101.515, and the significance level of 0.000, which is significant at $\alpha \geq 0.05$. Therefore, we reject the null hypothesis and accept the alternative hypothesis.

14. Discussion of Study Results

14.1 Knowledge Level of Physical Education Teachers and Trainers

The analysis revealed that the independent variable—the knowledge level of physical education teachers and trainers regarding biomechanics and kinesiology—scored a moderate level of relative importance, with a mean of 3.44. This suggests that, from the respondents' perspective, there is a

moderate degree of understanding and familiarity with these scientific concepts among professionals in the field.

This finding aligns with previous research indicating that biomechanics and kinesiology remain underemphasized in teacher preparation programs and continuing professional development within certain educational systems, including Jordan's (Mohamed & Kilani, 2019). The moderate knowledge level may stem from limited exposure to specialized training or the perception that these sciences are secondary to traditional pedagogical or coaching approaches (Knudson, 2007). As such, many educators and trainers may not prioritize developing deep expertise in these domains, despite their relevance to effective movement instruction and injury prevention.

14.2 Application of Biomechanics and Kinesiology Concepts in Sports in Jordan

The dependent variable—the application of biomechanics and kinesiology concepts in sports—also registered a moderate level of relative importance, with a mean score of 3.49. This indicates that while some implementation exists, the integration of these concepts into training and teaching practices is not yet widespread or consistent.

This moderate application level may be due to systemic barriers such as lack of resources, insufficient institutional support, or minimal emphasis on these sciences in curricula (Zahran, 2020). Moreover, when educators and coaches do not possess strong foundational knowledge in biomechanics and kinesiology, their practical application in real-world teaching or training scenarios remains limited (Enoka, 2008). The findings highlight a gap between theoretical knowledge and practical implementation, suggesting a need for targeted interventions to bridge this divide.

15. Study Recommendations

In light of the study's findings, the following recommendations are proposed to enhance both the knowledge and practical application of biomechanics and kinesiology concepts among physical education professionals in Jordan:

1. **Foster an Enriched Educational Environment:**

   Establish learning environments that support professional growth by providing access to updated scientific resources, professional workshops, and continuous education. Classrooms and training facilities should be equipped with modern teaching aids and biomechanical analysis tools to support experiential learning.

2. **Cultivate an Innovation-Oriented Institutional Culture:**

   Promote a culture that values innovation, creativity, and evidence-based practice among educators. Institutions should encourage collaborative learning and support initiatives that integrate biomechanics and kinesiology into daily teaching and coaching practices.

3. **Leverage Technology for Teaching and Assessment:**

   Integrate technology—such as motion analysis software, virtual simulations, and wearable devices—into lesson planning, student assessment, and performance evaluation. These tools can enhance understanding and facilitate real-time application of biomechanical and kinesiological principles.

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