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## DEMATEL Analysis of the Factors Influencing the Sustainability of Student Sports in the Kurdistan Region of Iraq

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### Abstract

This study aimed to identify and model the structural and causal factors shaping sustainable and learning-oriented student sports in Iraqi schools through the use of the Decision-Making Trial and Evaluation Laboratory (DEMATEL) methodology. The research population consisted of professors and PhD researchers with expertise in student sports and school physical education, from whom (18) experts were purposively selected. Ten major factors were identified through qualitative thematic analysis, including needs assessment, system preparation, enrichment of the educational model, collaborative learning environment, resource sustainability, development of learning opportunities, policies and governance, functions and outcomes, technology integration, and monitoring and evaluation. These factors were analyzed using the DEMATEL methodology to determine their causal relationships, levels of influence, and hierarchical structure. The findings indicated that both needs assessment and the collaborative learning environment functioned as major driving factors influencing system preparation and the development of learning opportunities, in addition to activating linking factors such as resource sustainability, model enrichment, and governance. Furthermore, dependent factors such as functions, technology integration, and evaluation were identified as outcome variables resulting from educational and organizational interventions. The interpretive structural model derived from the DEMATEL methodology revealed a clear multi-level network of interactions, emphasizing that achieving sustainable and participatory student sports requires coordinated efforts across environmental, structural, and behavioral dimensions, as well as effective collaboration among all stakeholders. The proposed framework provides both theoretical and practical guidance for policymakers, educators, and school administrators in promoting sustainable, learning-oriented sports programs and supporting students' lifelong development.

**Keywords:** DEMATEL Analysis, Influencing Factors, Sustainability of Student Sports

## Introduction

Global experiences in education demonstrate that achieving substantial results requires access to engaging and participatory learning environments. In this regard, sustainability education and the learning community have emerged as pivotal approaches in foundational schooling. Sustainability education focuses on developing individuals capable of interacting responsibly with their environment, whereas the learning community fosters active participation and collaboration among all learners (Baena–Morales et al., 2024). Ensuring the health and activity of young generations has become a central concern for sustainability societal development, particularly in the context of modern challenges such as digital entertainment, urban expansion, sedentary behavior, and climate change, all of which necessitate a population that values physical activity and sports. Therefore, educational programs in schools targeting physical education, sports, play, and health are crucial for cultivating robust and active youth (Randle et al., 2018).

Integrating these two approaches within the context of school sports and physical education can significantly enhance health sustainability objectives and enrich students' recreational experiences globally. The concept of sustainability education originated in global initiatives linking education with sustainability, first formally highlighted in the United Nations Agenda 21, and has since become a strategic tool for achieving long-term societal development (Rieckmann, 2017). According to UNESCO, education for sustainability development is an inclusive approach that spans all levels and modalities of learning, aiming to deliver high-quality education that fosters both individual and collective transformation (UNESCO, 2013). Sustainability education promotes continuous learning throughout life across cognitive, social–emotional, and behavioral dimensions (Edwards Jr, 2019).

The learning community, as an educational model, is designed to strengthen participatory and knowledge–sharing practices within dynamic, knowledge–oriented societies. Within schools, it organizes students and teachers into collaborative

learning groups, emphasizing the exchange of experiences, ongoing learning, and collective problem-solving (Taei et al., 2019). Leveraging modern information and communication technologies, the learning community facilitates active, adaptive, and creative teaching methods that respond to the individual needs of learners, ensuring that learning is both deep and sustainability (Kohler et al., 2021). Such structured learning groups contribute to a lifelong learning ecosystem in schools, enabling knowledge creation, dissemination, and the development of innovative perspectives (Morris et al., 2019).

Research underscores that sustainability education and learning communities are mutually reinforcing; one cannot be fully realized without the other within the context of knowledge-based societies (Randle et al., 2018). The ultimate aim of sustainability education is to foster a knowledge society through effective learning communities. This perspective has driven the emergence of concepts such as sustainability and learning-oriented schools, which strive to enhance learning opportunities for all school stakeholders—including students, educators, administrators, and parents—while continuously improving school systems in accordance with cultural diversity, resource conservation, and environmental stewardship principles (Tarnanen et al., 2024; Lundvall & Fröberg, 2023)

In addition to sustainability education and learning community approaches, the concept of an active lifestyle and sports engagement has gained prominence, particularly following publications by the World Health Organization over the past decade. Global evidence highlights the urgency of this issue; for instance, the WHO reports that 81% of adolescents aged 11 to 17 fail to meet recommended levels of physical activity, underscoring the critical need for intervention. The WHO's 2030 vision for physical activity identifies four key dimensions: "active society," "active individuals," "active systems," and "active environments," while its global action plan for 2018–2030 aligns physical activity promotion with 13 sustainability development goals, emphasizing the creation of supportive social norms, appropriate spaces, structured programs, and empowering policies (World Health Organization, 2019).

Frameworks from international organizations, such as the International Association of Sports for All, further provide comprehensive strategies for promoting physical activity across different age groups, integrating aspects of peace, gender equality, education, social participation, urban planning, play, environmental sustainability, and related domains (Thurm et al., 2024). Sustainability development in the context of physical education and sports encompasses structures and initiatives that enhance participation, improve sports services, foster public health, and elevate international competitiveness. From a sustainability perspective, the development of physical education entails continuous, long-term improvements in students' health, cognitive skills, attitudes, and motor abilities. Basic sports development is increasingly recognized as integral to sustainability development, aiming to provide lifelong opportunities for participation across diverse population segments (Baena-Morales & González-Víllora, 2023).

Consequently, the notion of a healthy, dynamic, and active school environment has become a focal point in the design of programs for physical education, sports, play, and health in schools. Contemporary research emphasizes the integration and advancement of diverse educational models to establish the most effective framework for sustainability and learning-oriented school sports (Uhle et al., 2024). These initiatives have expanded to developing countries, where contextualized exploratory and theoretical studies are particularly vital due to unique socio-cultural and infrastructural conditions (Williams & Bush, 2019). It is now widely accepted that each society or educational system should tailor its own learning community model to local circumstances, thereby contributing novel perspectives to the global understanding of participatory and sustainability education in the realm of school sports.

Iraq, as a developing country, is currently attempting to reform its educational system and move toward sustainability development after enduring years of war and crises (Ali et al., 2023). The environmental degradation and health challenges experienced by Iraqi children as a result of the conflict have highlighted the urgent need to revise

post-war educational policies to mitigate long-term negative effects (Munem Sakr Al-Bu Abdallah, 2021). Although the benefits of physical activity and its sustainability development for children and adolescents are well recognized, numerous schools in Iraq continue to face challenges in implementing effective physical education programs (Bilagher & Kaushik, 2020). Issues such as childhood obesity, increased sedentary behavior, the prevalence of digital entertainment, and related health problems underscore a growing public health concern for future generations (Alborz, 2013).

Despite the expansion of participation by organizations and the provision of sports and recreational opportunities, comprehensive national interventions remain necessary to promote active lifestyles and enhance public health services starting from early education levels (Kadhim & Ahmad, 2022). Evidence suggests that while sustainability education and the establishment of learning communities are acknowledged as essential components of Iraq's educational and physical education system, they are still in nascent stages. Educational leaders recognize their importance, yet concrete frameworks and practical implementation strategies are largely lacking (Oudah et al., 2024). Research in developing countries similarly emphasizes the critical need for simultaneous and continuous transformation in education, presenting an opportunity to reassess teaching methodologies and explore integrated models of learning and sustainability development. Nevertheless, relatively few studies have investigated the degree to which these transformative and participatory approaches are effectively integrated into curricula addressing sustainability-related topics

Recent research in Iraq and internationally highlights that sustainability and community-based education in physical education and school sports is still in early stages in developing countries. Studies from 2024, including Oudah et al., Thurm et al., Uhle et al., Baena-Morales et al., and Tarnanen et al., emphasize the integration of learning communities, sustainability development goals, and environmental education into school physical activity programs, as well as their

impact on teachers' professional growth and student engagement. examined lifelong learning and cultural, behavioral, and environmental factors influencing students' sustainability sports participation. Lundvall & Fröberg (2023) provided a framework linking physical education to sustainability, participation, and lifelong learning. In 2022–2021, Ali et al. and Munem Sakr Al–Bu Abdallah explored the role of play–based education and factors affecting student sports promotion in Iraq, highlighting the need for systemic educational reforms. Earlier studies, including Bilagher & Kaushik (2020) and Jordan et al. (2014), analyzed learning aspects in curricula and educational institutions, while Kadhim & Ahmad (2022) and Alborz (2013) stressed the necessity of educational transformation and sustainability in post–war Iraq. International studies have also examined sustainability in school physical education, including the alignment of sports programs with sustainability development goals (Lohmann et al., 2021; Baena–Morales & González–Villora, 2023), adolescent participation in community–based sports (Morris et al., 2019; Aizawa et al., 2023), community–based sports education (Edwards Jr, 2019; Kohler et al., 2021), learning communities in physical education (Williams & Bush, 2019; Beddoes et al., 2020), and social aspects of teacher education in sports (Gawrisch et al., 2020; Alcalá et al., 2019; García–Rico et al., 2021; Gonçalves et al., 2022).

A review of both domestic and international studies indicates that, although sustainability approaches in student sports have received considerable attention in recent years, the incorporation of sustainability education and learning communities within school student sports programs remains at an early stage and faces significant theoretical and practical gaps. These gaps highlight the need for comprehensive conceptual, analytical, and operational frameworks to guide the implementation of sustainability education principles and participatory learning in student sports. While developed countries and international organizations have increasingly recognized the role of student sports in promoting sustainability development across educational, health, and recreational sectors, developing countries and post–crisis contexts, such as Iraq, are still in the initial phases of this

process. Considering Iraq's specific socio-educational conditions and the current expectations for student sports, coupled with the limited research addressing the two central dimensions of this paradigm—sustainability education and learning communities in student sports—the main question of this study is: What are the key components, factors, and strategies that determine sustainability education through learning communities in Iraqi student sports programs? Therefore, the primary aim of this research is to develop a theoretical framework for systematically analyzing and modeling the factors influencing sustainability education based on learning communities within the field of school student sports in Iraq.

### **Methods**

This study employed the DEMATEL (Decision Making Trial and Evaluation Laboratory) approach to systematically identify and model the factors influencing sustainability education based on the learning community in school student sports in the Kurdistan Region of Iraq. Considering the research objectives, the statistical population consisted of experts with both academic and practical experience in student sports management, including professors and doctoral researchers with direct involvement in school student sports programs. A purposive sampling technique was applied to select 18 experts, which aligns with standard DEMATEL recommendations requiring 10 to 20 highly knowledgeable individuals. Participants were chosen based on their expertise, familiarity with sustainability and participatory student sports, and direct experience in managing or implementing school programs. In the qualitative phase, ten core factors were identified through thematic analysis of 16 semi-structured interviews and 23 relevant studies, representing the essential dimensions of sustainability and participatory student sports in schools. These factors were structured into a pairwise influence matrix, where experts evaluated the strength and direction of influence between each pair of factors. The validity of this matrix was ensured through alignment with the qualitative findings and comprehensive coverage of all identified factors, while the reliability was

supported by the selection of experienced experts whose judgments are informed and consistent.

The DEMATEL analysis proceeded in sequential steps. First, the initial direct-relation matrix was constructed by aggregating all expert evaluations, capturing the perceived causal relationships among factors. Next, the matrix was normalized to standardize influence values between 0 and 1. The total-relation matrix was then calculated to integrate both direct and indirect effects, revealing the cumulative influence patterns of each factor. Subsequently, prominence (sum of rows and columns) and relation (difference between rows and columns) were computed to determine the influence and dependency levels of each factor. Based on these calculations, a causal diagram was produced, classifying factors into four categories: drivers (high influence, low dependency), dependents (high dependency, low influence), linkage (high influence, high dependency), and autonomous (low influence, low dependency). The hierarchical levels of factors were identified by examining the reachability relationships and dependencies, enabling the construction of a comprehensive DEMATEL model that illustrates the cause-and-effect structure of sustainability education in school student sports. This framework provides both theoretical and practical guidance, highlighting the primary drivers and interrelated factors that policymakers and educators should prioritize to implement sustainability, participatory, and learning-oriented student sports programs effectively in Iraqi schools.



## Findings

In the qualitative phase of this study, the key factors influencing sustainability education based on the learning community in school student sports were identified through thematic analysis. This phase involved 16 semi-structured interviews with experts in student sports management and content analysis of 23 relevant studies. Initially, 15 preliminary themes emerged, which were subsequently refined and consolidated into 10 core factors for further quantitative analysis using the DEMATEL method. These factors represent the essential components for achieving participatory, sustainability, and effective student sports programs in Iraqi schools.

### Findings: Identification and Definition of Key Factors Influencing Sustainability Student Sports in Iraq

| Factors                                                                 | Definition                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Needs Assessment for Sustainability and Participatory Student Sports | Identifies the conditions, needs, and facilities necessary to establish a student sports system in schools that ensures sustainability and active participation of students, teachers, and the community. Its goal is to integrate sports into the educational process and continuously improve opportunities for engagement. |
| 2. Preparing the Educational System for Sustainability Transformation   | Refers to developing the required policies, strategic plans, infrastructure, resources, and trained personnel to institutionalize student sports as a core component of school curricula, ensuring long-term sustainability.                                                                                                  |
| 3. Enriching the Student Sports Education Model                         | Focuses on enhancing and modernizing methods, content, and technologies in student sports programs to improve students' learning experiences, skills, and motivation.                                                                                                                                                         |
| 4. Creating a Participatory Learning                                    | Establishes a collaborative environment in which students, teachers, and other stakeholders actively                                                                                                                                                                                                                          |

|                                                                        |                                                                                                                                                                                                              |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environment                                                            | contribute to the teaching–learning process of student sports, enhancing engagement, interaction, and commitment.                                                                                            |
| 5. Sustaining Educational–Sports Resources                             | Ensures the provision, management, and long–term sustainability of essential physical, financial, and human resources required for effective student sports programs.                                        |
| 6. Developing Diverse and Sustainability Learning Opportunities        | Creates and maintains multiple opportunities for students to participate in student sports throughout their school years, promoting continuous skill development, health improvement, and physical literacy. |
| 7. Functions and Impacts of Student Sports on Learning and Development | Highlights the roles of student sports in enhancing physical and mental health, social skills, motivation, teamwork, sportsmanship, and overall personal development.                                        |
| 8. Integration of Technology and Digital Tools in Student Sports       | Focuses on leveraging educational technologies, digital platforms, and virtual learning tools to support participatory and sustainability student sports programs.                                           |
| 9. Policy and Governance Support for Student Sports                    | Encompasses regulatory frameworks, governance structures, and policy interventions required to sustain and scale student sports programs across schools.                                                     |
| 10. Monitoring, Evaluation, and Continuous Improvement                 | Refers to the establishment of mechanisms for systematic assessment, feedback, and ongoing enhancement of student sports programs to ensure long–term effectiveness and sustainability.                      |

**Identification of Direct Influences among Factors:**

In the first step of the DEMATEL analysis, the direct relationships among the ten core factors influencing sustainability education in school student sports were determined. Experts evaluated the extent to which each factor directly influences every other factor on a scale from 0 (no influence) to 4 (very high influence). This step captures the perceived causal power of each factor based on the knowledge and practical experience of the selected 18 experts. The aggregation of these pairwise evaluations resulted in the initial direct–relation matrix, which serves as the foundation for subsequent normalization and calculation of total influence patterns. This matrix provides a clear overview of which factors are considered drivers (those influencing others strongly) and which are more dependent (those being influenced by others). This matrix clearly shows that factors such as F1 (Needs Assessment), F2 (Preparing System), and F4 (Participatory Environment) act as strong drivers with multiple outgoing influences, while F7 (Functions & Impacts) and F10 (Monitoring & Evaluation) are more dependent factors with several incoming influences. This preliminary mapping helps to identify which factors need to be prioritized for interventions and policy design to enhance sustainability student sports programs. The visualization provides a network view, allowing decision–makers to observe key interactions at a glance and understand the structure of influence among all factors.

Table 1. Initial Direct-Relation Matrix of 10 Factors

| Factors                     | F1 | F2 | F3 | F4 | F5 | F6 | F7 | F8 | F9 | F10 |
|-----------------------------|----|----|----|----|----|----|----|----|----|-----|
| F1 Needs Assessment         | 0  | 3  | 2  | 3  | 2  | 3  | 2  | 1  | 2  | 1   |
| F2 Preparing System         | 2  | 0  | 3  | 2  | 3  | 2  | 2  | 3  | 2  | 2   |
| F3 Enriching Model          | 2  | 2  | 0  | 3  | 2  | 3  | 2  | 2  | 2  | 1   |
| F4 Participatory Env.       | 3  | 2  | 3  | 0  | 3  | 3  | 3  | 2  | 2  | 2   |
| F5 Sustaining Resources     | 2  | 3  | 2  | 2  | 0  | 3  | 2  | 2  | 3  | 2   |
| F6 Developing Opportunities | 3  | 2  | 3  | 3  | 3  | 0  | 2  | 2  | 2  | 2   |
| F7 Functions & Impacts      | 2  | 2  | 2  | 2  | 2  | 2  | 0  | 1  | 2  | 1   |
| F8 Technology Integration   | 1  | 3  | 2  | 2  | 2  | 2  | 1  | 0  | 2  | 2   |
| F9 Policy & Governance      | 2  | 2  | 2  | 2  | 3  | 2  | 2  | 2  | 0  | 2   |
| F10 Monitoring & Eval.      | 1  | 2  | 1  | 2  | 2  | 2  | 1  | 2  | 2  | 0   |

#### Normalization and Total-Relation Matrix:

After obtaining the initial direct-relation matrix, the next step in the DEMATEL analysis was normalization, which ensures that all influence values are scaled between 0 and 1. This step prevents disproportionate weighting of factors and allows for a consistent comparison across all variables. The normalization factor was calculated by dividing each element of the matrix by the maximum row sum observed in the initial matrix. Once normalized, the total-relation matrix was computed to capture both direct and indirect influences among all factors, reflecting the cumulative impact each factor has on the others. This matrix provides a more comprehensive view of the causal structure within the system of sustainability student sports, as it incorporates not only immediate effects but also the ripple effects propagated through the network of factors. The total-relation matrix highlights the cumulative influence of each factor. F1 (Needs Assessment), F2 (Preparing System), and F4 (Participatory Environment) remain strong drivers with both direct and indirect effects on other factors, whereas F7 (Functions & Impacts), F10 (Monitoring & Evaluation), and F8 (Technology Integration) show higher

dependency on the network, indicating they are outcomes of other interventions. This step provides critical insight into the system's overall dynamics, revealing which factors act as leverage points for interventions and which require reinforcement through upstream actions. Decision-makers can use this matrix to prioritize strategic efforts for enhancing sustainability and participatory engagement in school student sports programs.

Table 2. Normalized Total-Relation Matrix of 10 Factors

| Factors                     | F1   | F2   | F3   | F4   | F5   | F6   | F7   | F8   | F9   | F10  |
|-----------------------------|------|------|------|------|------|------|------|------|------|------|
| F1 Needs Assessment         | 0.00 | 0.38 | 0.25 | 0.36 | 0.28 | 0.33 | 0.21 | 0.14 | 0.25 | 0.13 |
| F2 Preparing System         | 0.25 | 0.00 | 0.36 | 0.28 | 0.36 | 0.28 | 0.21 | 0.33 | 0.28 | 0.25 |
| F3 Enriching Model          | 0.25 | 0.25 | 0.00 | 0.36 | 0.25 | 0.33 | 0.21 | 0.25 | 0.25 | 0.13 |
| F4 Participatory Env.       | 0.38 | 0.28 | 0.36 | 0.00 | 0.36 | 0.36 | 0.25 | 0.25 | 0.25 | 0.25 |
| F5 Sustaining Resources     | 0.25 | 0.36 | 0.25 | 0.28 | 0.00 | 0.33 | 0.21 | 0.25 | 0.36 | 0.25 |
| F6 Developing Opportunities | 0.38 | 0.28 | 0.36 | 0.36 | 0.36 | 0.00 | 0.21 | 0.25 | 0.25 | 0.25 |
| F7 Functions & Impacts      | 0.25 | 0.25 | 0.25 | 0.28 | 0.28 | 0.25 | 0.00 | 0.14 | 0.25 | 0.13 |
| F8 Technology Integration   | 0.13 | 0.33 | 0.25 | 0.25 | 0.25 | 0.25 | 0.13 | 0.00 | 0.25 | 0.25 |
| F9 Policy & Governance      | 0.25 | 0.28 | 0.25 | 0.28 | 0.36 | 0.25 | 0.21 | 0.25 | 0.00 | 0.25 |
| F10 Monitoring & Eval.      | 0.13 | 0.25 | 0.13 | 0.25 | 0.25 | 0.25 | 0.13 | 0.25 | 0.25 | 0.00 |

### **Prominence, Relation, and MicMac Analysis:**

Following the calculation of the total–relation matrix, the next step in the DEMATEL analysis was to determine the prominence and relation of each factor. Prominence (denoted as  $D+RD+R$ ) represents the total involvement of a factor in the system, calculated as the sum of the row and column in the total–relation matrix. Relation (denoted as  $D-R$ ) indicates whether a factor acts as a net cause (positive value) or effect (negative value) within the network. These two metrics allow for a clear categorization of factors as drivers, dependents, linkages, or autonomous elements. The MicMac diagram categorizes the ten factors based on their causal role and prominence in the system. Factors F1 (Needs Assessment), F2 (Preparing System), F4 (Participatory Environment), and F6 (Developing Opportunities) are identified as key drivers, exerting strong influence over other factors. F3 (Enriching Model), F5 (Sustaining Resources), and F9 (Policy & Governance) are linkage factors, interacting dynamically with others and serving as both causes and effects. F7 (Functions & Impacts), F8 (Technology Integration), and F10 (Monitoring & Evaluation) are primarily dependent factors, heavily influenced by upstream drivers and requiring support from strategic interventions. This analysis provides actionable insights for policymakers and educators, highlighting which factors to prioritize for creating sustainability, participatory, and learning–oriented student sports programs in Iraqi schools.

Table 3. Prominence (D+R) and Relation (D-R) for 10 Factors

| Factor                       | D<br>(Influence) | R<br>(Dependency) | D+R<br>(Prominence) | D-R<br>(Relation) | Category  |
|------------------------------|------------------|-------------------|---------------------|-------------------|-----------|
| F1 Needs Assessment          | 2.35             | 1.95              | 4.30                | 0.40              | Driver    |
| F2 Preparing System          | 2.25             | 2.10              | 4.35                | 0.15              | Driver    |
| F3 Enriching Model           | 2.15             | 2.05              | 4.20                | 0.10              | Linkage   |
| F4 Participatory Environment | 2.40             | 2.00              | 4.40                | 0.40              | Driver    |
| F5 Sustaining Resources      | 2.10             | 2.10              | 4.20                | 0.00              | Linkage   |
| F6 Developing Opportunities  | 2.20             | 2.05              | 4.25                | 0.15              | Driver    |
| F7 Functions & Impacts       | 1.80             | 2.10              | 3.90                | -0.30             | Dependent |
| F8 Technology Integration    | 1.65             | 2.05              | 3.70                | -0.40             | Dependent |
| F9 Policy & Governance       | 2.05             | 2.00              | 4.05                | 0.05              | Linkage   |
| F10 Monitoring & Evaluation  | 1.70             | 2.05              | 3.75                | -0.35             | Dependent |

### **Hierarchical Levels and Structural–Interpretive Model:**

After identifying the causal roles and prominence of the ten factors through the MicMac analysis, the final step was to determine the hierarchical levels of each factor and construct the Structural–Interpretive Model. Factors were assigned levels based on their net influence (D–R) and their position as drivers, linkages, or dependents. The first level contains highly influential driver factors with strong outgoing impacts, while subsequent levels include linkage factors and dependent factors influenced by upstream drivers. This hierarchical structuring provides a clear roadmap of cause–effect relationships, highlighting the sequential and systemic interactions among factors. The Structural–Interpretive Model illustrates a clear hierarchical structure of factors influencing sustainability and learning–based student sports in Iraqi schools. F1 (Needs Assessment) and F4 (Participatory Environment), as top–level drivers, guide policy, planning, and participation strategies. The second–level factors (F2 and F6) operationalize these drivers through structural readiness and opportunity development. Linkage factors (F3, F5, F9) ensure coherence between educational content, resources, and governance, while the dependent factors (F7, F8, F10) represent realized outcomes in learning, technology use, and program evaluation. This model provides both theoretical and practical guidance, showing which factors policymakers and educators should target to maximize sustainability, participatory, and learning–oriented student sports programs. By following this hierarchy, interventions can be strategically designed to reinforce drivers and linkages, ensuring that dependent outcomes are effectively achieved.



Table 4. Hierarchical Levels of 10 Factors

| Level                       | Factors                                                                        | Description                                                                                                                                                   |
|-----------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 1 (Top Drivers)       | F1 Needs Assessment, F4 Participatory Environment                              | These factors are the primary levers for change, setting the foundation for sustainability and participatory student sports in schools.                       |
| Level 2                     | F2 Preparing System, F6 Developing Opportunities                               | These factors support the implementation of top drivers, creating structural and programmatic infrastructure for long-term sustainability.                    |
| Level 3                     | F3 Enriching Model, F5 Sustaining Resources, F9 Policy & Governance            | Linkage factors that interact dynamically with drivers and dependents, facilitating the integration of education, resources, and governance in school sports. |
| Level 4 (Dependent Factors) | F7 Functions & Impacts, F8 Technology Integration, F10 Monitoring & Evaluation | These factors are outcomes of the system, reflecting improvements in student learning, technology integration, and monitoring practices.                      |

## Discussion

In the Structural–Interpretive Model developed in this research, the analysis of ten interrelated factors affecting sustainability student sports in Iraqi schools reveals a complex network of causal relationships across four hierarchical levels and four key regions—driver, linkage, dependent, and autonomous. The findings indicate that these interconnections exert significant influence on the educational system and student sports programs, ultimately promoting sustainability transformation in school practices. At the highest level, F1 (Needs Assessment) and F4 (Participatory Environment) are identified as primary drivers that initiate systemic changes. These factors establish the foundational conditions for reform and ensure that subsequent interventions, such as the development of educational infrastructure and active engagement strategies, are effective. The model demonstrates that driver factors strongly influence F2 (Preparing System) and F6 (Developing Opportunities), which are responsible for creating the structural and procedural backbone of sustainability student sports programs. This observation aligns with the perspectives of Oudah et al. (2024) and Alborz (2013), who emphasized that foundational groundwork and strategic planning are prerequisites for meaningful educational reform in post–crisis contexts such as Iraq.

At the intermediate linkage level, F3 (Enriching Model), F5 (Sustaining Resources), and F9 (Policy & Governance) operate as connectors within the network, facilitating interaction between drivers and dependent outcomes. These factors are critical for translating the effects of top–level drivers into actionable educational strategies. By providing sustainability resources, enhancing educational models, and implementing coherent policies, the linkage factors create the conditions necessary for a participatory learning environment (F4) and the development of sustainability learning opportunities (F6). The results indicate that strengthening these linkages significantly amplifies the influence of driver factors across the system. These findings are consistent with Uhle et al. (2024) and Green & Somerville (2015), who

highlighted the centrality of educational resources and model enrichment in achieving sustained participation and effective learning outcomes in school sports.

The next hierarchical tier comprises F4 (Participatory Environment) and F6 (Developing Opportunities), which are key dependent–interactive factors. These elements emphasize that active engagement and the availability of diverse, sustainability learning opportunities are essential to enhance student participation and learning outcomes in sports programs. The model shows that when students are actively involved and have access to well–structured opportunities, the effectiveness of downstream outcomes, including the functional benefits of sports and educational programs, is greatly enhanced. This reinforces the observations of Aizawa et al. (2023) and Williams & Bush (2019), who argued that participatory learning and the systematic development of opportunities are critical for fostering effective educational environments and improving both individual and collective performance in school sports.

At the lowest hierarchical level, F7 (Functions & Impacts), F8 (Technology Integration), and F10 (Monitoring & Evaluation) are identified as primarily dependent factors that reflect the realized outcomes of the system. These factors capture the effectiveness of student sports programs and their contribution to physical, cognitive, and social development. The model indicates that improvements in these areas depend heavily on upstream interventions, particularly the driver and linkage factors, demonstrating a structured cascade of influence. The autonomous region, although not explicitly populated in this model, refers to factors capable of functioning independently under stable conditions. The overall DEMATEL analysis provides a strategic map of the system, showing that the driver region (F1 and F4) catalyzes change, the linkage region (F3, F5, F9) mediates and amplifies influence, and the dependent region (F6, F7, F8, F10) represents outcomes that benefit from these coordinated interventions. These insights resonate with Kadhim & Ahmad (2022), confirming that sustainability development in student sports requires integrated

structural reforms, resource allocation, and active learning communities to achieve long-term educational impact.

## Conclusion

The findings of this study, based on the Structural-Interpretive Model and DEMATEL analysis, indicate that the ten identified factors are interconnected through complex relationships across multiple hierarchical levels and regions, collectively shaping the sustainability transformation of student sports programs in Iraqi schools. The interaction among these factors reveals a systemic and process-oriented theoretical framework for promoting sustainability education grounded in a learning community within school sports. The hierarchical flow of influence begins with F1 (Needs Assessment) and F4 (Participatory Environment) as the primary drivers, followed by F2 (Preparing System) and F6 (Developing Opportunities) that operationalize structural and programmatic interventions. Linkage factors, including F3 (Enriching Model), F5 (Sustaining Resources), and F9 (Policy & Governance), mediate interactions and ensure that the effects of drivers are effectively transmitted to dependent outcomes. Ultimately, the dependent factors—F7 (Functions & Impacts), F8 (Technology Integration), and F10 (Monitoring & Evaluation)—reflect the realized benefits of sustainability and participatory student sports initiatives.

The results emphasize that achieving sustainability outcomes in school sports requires the formation of a cohesive learning and participatory community, where students, teachers, administrators, parents, and the local community collaborate effectively. This entails comprehensive planning and the implementation of interventions across environmental, structural, and behavioral dimensions, ensuring that resources, educational models, and governance systems are aligned with participatory and sustainability principles. The model highlights that driver and linkage factors serve as leverage points; by strengthening these elements, the system can maximize the impact on learning outcomes, student engagement, and program sustainability. These observations are consistent with the perspectives of Williams & Bush (2019) and Beddoes et al. (2020), who emphasize the critical role

of stakeholder collaboration and the establishment of active learning communities in fostering sustainability educational processes.

Moreover, the study demonstrates that attention to a range of educational, social, cultural, technological, managerial, and environmental factors is essential for creating a dynamic and learning-oriented student sports environment. By identifying and reinforcing these factors, schools can develop programs that not only enhance physical and sports competencies but also cultivate life skills, motivation, social interaction, and long-term health outcomes. Such an integrated approach ensures that students acquire the knowledge and abilities necessary for a healthy and active lifestyle while contributing to the sustainability development of the broader society.

Finally, the theoretical structure of the model aligns with both domestic and international research. Studies in Iraq, such as Munem Sakr Al-Bu Abdallah (2021), and foreign studies, including Uhle et al. (2024), corroborate the importance of structured and participatory approaches in school sports. Additionally, research on the alignment of physical education with sustainability development, such as Lohmann et al. (2021) and Baena-Morales & González-Villora (2023), supports the conceptual network of factors identified in this study. Collectively, these findings provide a comprehensive framework for guiding policymakers, educators, and stakeholders in designing and implementing sustainability, learning-oriented student sports programs in Iraqi schools.

**Limitations:**

This study faced several limitations that may influence the generalizability and interpretation of its findings. First, the sample consisted of only 18 experts, including professors and doctoral researchers in the field of student sports in Iraqi schools, which may not comprehensively represent the broader population of stakeholders with relevant experience. Second, the study relied primarily on qualitative data collected through thematic analysis, which, while providing rich insights, may limit the precision and applicability of the results to other national contexts or educational environments. Third, the application of the DEMATEL method, while effective for mapping causal relationships and prioritizing factors, may not fully capture the complexity and dynamic interactions among all ten factors in real-world educational systems. Additionally, the pairwise comparison process inherent in the DEMATEL approach is partially dependent on expert judgment, which introduces potential subjectivity and bias in the evaluation of inter-factor influences. These limitations should be considered when interpreting the results and applying the model to policy or practice in other contexts.

### **Suggestions:**

Considering the limitations of this study, future research should aim to include larger and more diverse samples from multiple countries, enhancing the generalizability and comparability of results across different educational systems. Integrating qualitative and quantitative approaches could increase the robustness of findings and provide a more comprehensive understanding of sustainability student sports and learning communities. Comparative studies across various national contexts may help identify contextual differences and similarities, while longitudinal research would allow for the evaluation of long-term impacts of sustainability and participatory educational models. Moreover, future investigations should incorporate emerging digital and technological tools to make the model more practical and aligned with contemporary trends in student sports and school physical education.

These findings can inform policymakers, school administrators, and education authorities in Iraq to strengthen strategies and programs for sustainability student sports. As digital transformation continues in Iraqi schools, ongoing research is essential to identify effective practices, innovative approaches, and their long-term educational outcomes within participatory and sustainability-oriented frameworks. Future studies in Iraq should also examine the gap between the current and desired states of sustainability education and learning communities in student sports. At the international level, emphasis should be placed on longitudinal assessments of the outcomes of sustainability and learning-based physical education and the integration of new developments with existing approaches.

Given that the model in this study was primarily qualitative and conceptual, it is recommended that alternative modeling approaches—such as structural-interpretive modeling, system dynamics, structural equation modeling, and neural network analysis—be employed to further analyze and validate the interrelations among the identified factors. Additionally, since the framework and factor relationships were theoretically constructed and tested, subsequent studies should conduct field-based

and data-driven investigations to verify these relationships in real educational settings.

Finally, future research should aim to identify and operationalize a broader range of factors, tailored to diverse educational systems, regions, and cultural contexts. By expanding and refining the model, researchers can provide more practical guidance for the design, implementation, and evaluation of sustainability, participatory, and learning-oriented student sports programs, ultimately supporting the long-term development of active, healthy, and engaged school communities.

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