El impacto de la gestión del conocimiento en el rendimiento cognitivo en las ciencias del deporte: un estudio de caso en la educación del boxeo

The Impact of Knowledge Management on Cognitive Achievement in Sports Science: A Case Study in Boxing Education

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How to cite in APA

Al-Hamdani, F. A. M. M., Abbas , R. A. A., & Ghadhban, S. Q. (2025). The Impact of Knowledge Management on Cognitive Achievement in Sports Science: A Case Study in Boxing Education. *Retos*, *68*, 1048–1062. https://doi.org/10.47197/retos.v68.116570

Abstract

Introduction: Knowledge management plays a crucial role in students' ability to acquire, organize, retrieve, and apply information, impacting academic performance. In sports sciences, especially in combat sports like boxing, effective knowledge management supports both theoretical understanding and practical skill application. Despite exposure to boxing through training and media, students' academic performance remains inconsistent.
Objective: This study examines the relationship between knowledge management and cognitive achievement among second-year students in the College of Physical Education and Sport Sciences at the University of Basrah. It evaluates how students manage knowledge and its impact on their retention and application of boxing-related concepts.
Methodology: The study utilized the Knowledge Management Scale (KMS) and Cognitive Achievement Scale (CAS) to assess knowledge management and academic performance. Statistical analysis, including correlation, was used to assess the relationship between these variables. A sample of 120 students participated in the study.
Results: A significant positive correlation ($r = 0.564$, $p < 0.01$) was found between knowledge management and cognitive achievement. Most students (42.1%) demonstrated average levels of both knowledge management and academic performance, indicating a need for improved knowledge management techniques.
Discussion: The study highlights the importance of integrating structured knowledge management strategies, such as mental mapping and digital tools, into sports education to enhance cognitive and practical skills.
Conclusion: Enhancing knowledge management strategies in boxing education can bridge the gap between theoretical knowledge and practical application, improving both cognitive and skill-based performance in sports sciences.

Keywords

Knowledge Management, Cognitive Achievement, Academic Performance, Higher Education, Sports Science, Boxing Education.

Resumen

Introducción: La gestión del conocimiento desempeña un papel crucial en la capacidad de los estudiantes para adquirir, organizar, recuperar y aplicar información, lo que impacta en su rendimiento académico. En las ciencias del deporte, especialmente en deportes de combate como el boxeo, una gestión eficaz del conocimiento favorece tanto la comprensión teórica como la aplicación práctica de habilidades. A pesar de la exposición al boxeo a través del entrenamiento y los medios de comunicación, el rendimiento académico de los estudiantes sigue siendo inconsistente.
Objetivo: Este estudio examina la relación entre la gestión del conocimiento y el rendimiento cognitivo en estudiantes de segundo año de la Facultad de Educación Física y Ciencias del Deporte de la Universidad de Basora. Se evalúa cómo los estudiantes gestionan el conocimiento y su impacto en la retención y aplicación de conceptos relacionados con el boxeo.
Metodología: El estudio utilizó la Escala de Gestión del Conocimiento (KMS) y la Escala de Logro Cognitivo (CAS) para evaluar la gestión del conocimiento y el rendimiento académico. Se utilizó un análisis estadístico, incluyendo la correlación, para evaluar la relación entre estas variables. Una muestra de 120 estudiantes participó en el estudio.
Resultados: Se encontró una correlación positiva significativa ($r = 0,564$, $p < 0,01$) entre la gestión del conocimiento y el rendimiento cognitivo. La mayoría de los estudiantes (42,1 %) demostraron niveles promedio tanto en gestión del conocimiento como en rendimiento académico, lo que indica la necesidad de mejorar las técnicas de gestión del conocimiento.
Discusión: El estudio destaca la importancia de integrar estrategias estructuradas de gestión del conocimiento, como mapas mentales y herramientas digitales, en la formación deportiva para mejorar las habilidades cognitivas y prácticas.
Conclusión: Mejorar las estrategias de gestión del conocimiento en la formación de boxeo puede acortar la distancia entre el conocimiento teórico y la aplicación práctica, mejorando el rendimiento cognitivo y basado en habilidades en las ciencias del deporte.

Palabras clave

Gestión del conocimiento, rendimiento cognitivo, rendimiento académico, educación superior, ciencias del deporte, educación del boxeo.

Introduction

In contemporary sports education, particularly in demanding disciplines like boxing, students often encounter cognitive and performance-related challenges. These difficulties are not only physical but also stem from how students process, organize, and apply the knowledge they acquire. One key construct relevant to addressing these challenges is knowledge management (KM), which in the educational context refers to students' ability to acquire, structure, store, and retrieve information for effective application in academic and performance settings (Nonaka & Takeuchi, 2019). In this framework, knowledge management is not limited to institutional processes but extends to individual practices, including note-taking, reflection, information synthesis, and the strategic retrieval of concepts during learning and assessment.

In sports education, the intersection of theoretical learning and practical performance is critical. For boxing in particular, athletes must translate conceptual knowledge such as rules, tactics, and biomechanics into quick, situation-specific decisions during performance. Cognitive achievement in boxing, therefore, includes not only factual recall but also situational awareness, decision-making, and tactical execution under pressure. Prior research highlights that athletes with well-developed cognitive and perceptual skills tend to perform better in dynamic and high-intensity sports (de Quel & Bennett, 2019). Clemente et al., (2024) further noted that athletes' ability to organize knowledge efficiently is linked to faster decision-making and improved execution of skills, emphasizing the cognitive dimensions of sports performance.

However, despite structured curricula that combine theoretical and practical instruction, many students underperform in boxing-related academic assessments. This gap may indicate an underlying issue not in knowledge exposure, but in the strategic organization and application of that knowledge. Cognitive science literature suggests that learners often benefit from structured cognitive strategies such as retrieval practice, elaboration, and schema-building that enhance memory and transfer of learning (Fiorella & Mayer, 2016; Sweller et al., 2019).

Furthermore, the integration of digital tools, including video modeling and performance analytics, has been shown to enhance cognitive engagement and facilitate the transition from knowledge acquisition to performance (Martín-Rodríguez & Madrigal-Cerezo, 2025; Karpicke, 2017). These methods support the kind of personalized knowledge management that is essential in sports education environments where real-time decision-making is required.

This study aims to examine the relationship between students' knowledge management capabilities and their cognitive achievement in a boxing course. By developing and validating assessment instruments for both constructs, the research seeks to identify whether and how KM practices predict academic and skill-based performance outcomes in sports-specific contexts.

Research Problem

Despite exposure to structured theoretical and practical training in boxing, students often exhibit inconsistent academic performance. This inconsistency raises questions about how well learners are equipped to manage and apply knowledge across different learning contexts. While prior research in educational psychology emphasizes the role of cognitive structuring in academic success (Sweller et al., 2019), there remains a lack of domain-specific evidence in combat sports education. Notably, there are few validated instruments designed to assess how students manage boxing-related knowledge or how such management correlates with academic performance.

Therefore, this study addresses the following research problem: To what extent does students' knowledge management competency influence their cognitive achievement in boxing education? In tackling this issue, the study aims to fill a gap in the literature by operationalizing KM in a sport-specific context and empirically examining its relationship with measurable academic outcomes.

Research Objectives

1- To develop and validate domain-specific instruments for measuring knowledge management and cognitive achievement in boxing education, ensuring their reliability, construct validity, and contextual relevance.

2- To assess the current proficiency levels of knowledge management and cognitive achievement among second-year boxing students at the College of Physical Education and Sport Sciences.

3- To analyze the statistical relationship between students' knowledge management practices and their cognitive performance in boxing, with a view to informing curriculum design and pedagogical strategies.

Research Scope

Human Scope: Second-year students enrolled in the boxing course at the College of Physical Education and Sport Sciences.

Temporal Scope: February 1, 2024, to April 30, 2024.

Spatial Scope: Theoretical classrooms and practical boxing training facilities within the College of Physical Education and Sport Sciences.

Method

Research Design

This study employed a case study approach using a descriptive-correlational research design to examine the relationship between knowledge management and cognitive achievement within the specific educational context of a collegiate boxing course. While the initial title framed the study as a "case study," it is more accurately described as a quantitative inquiry combining descriptive and correlational techniques. The descriptive design enabled a systematic portrayal of the participants' knowledge management practices and cognitive understanding of boxing concepts. The correlational method was employed to assess the strength and direction of the relationship between the two main variables without manipulating any conditions (Creswell & Creswell, 2018). This approach is particularly appropriate for educational studies that seek to identify natural relationships in authentic learning environments.

Research Method

A quantitative survey methodology was selected to collect standardized data from a defined population of undergraduate students enrolled in a boxing course. This method supports broad generalization while enabling statistical evaluation of relationships among variables (Neuman, 2020; Babbie, 2021). To ensure coherence between design and objectives, the descriptive elements facilitated an overview of current knowledge management practices, while the correlational component tested the hypothesized link to cognitive achievement.

Research Population and Sample

The research population consisted of second-year undergraduate students (aged 19–21) from the College of Physical Education and Sports Sciences, who had completed at least one semester of boxing instruction. These students had undergone approximately 60 hours of both theoretical and practical boxing training, ensuring sufficient domain familiarity. A total of 133 students participated.

Sampling Rationale and Grouping

To ensure methodological rigor in scale development and validation, the sample was strategically divided as follows:

1- Pilot Group (n = 21): Used for pre-testing and assessing item clarity and comprehension.

2- Construction Group (n = 66): Used for initial item analysis and internal consistency reliability testing.

3- Application Group (n = 46): Used to implement the finalized scales and test for correlation between variables.

This division reflects best practices in instrument development, as outlined by DeVellis (2017), which recommend distinct sub-samples for iterative testing to minimize bias and improve validity. While the construction sample size (n = 66) imposes limitations on conducting full-scale exploratory or confirmatory factor analyses, item-level statistical testing was employed to assess psychometric properties.

Table 1, Research Population Distribution

Section	No. of Students	Age Range (Years)
A	22	19-21
B	24	19-21
C	21	19-21
D	22	19-21
E	22	19-21
F	22	19-21
Total	133	19-21

Table 2, Distribution of the Research Sample

Section	No. of Students	Sample Type	Percentage of Sample from Population	Percentage of Test Subjects from Section
A	22	Application	100%	100%
B	24	Application	100%	100%
C	21	Pilot	100%	100%
D	22	Construction	100%	100%
E	22	Construction	100%	100%
F	22	Construction	100%	100%
Total	133		100%	100%

Data Collection Instruments

Two domain-specific instruments were developed: the Knowledge Management Scale (KMS) and the Cognitive Achievement Scale in Boxing (CASB).

Theoretical Framework for Instrument Design

The KMS was grounded in Nonaka & Takeuchi's (2019) SECI model, encompassing four key dimensions: Socialization, Externalization, Combination, and Internalization. Each item was explicitly mapped to these dimensions (Appendix 1 provides a full item-dimension matrix).

The CASB was informed by Bloom's Taxonomy and the curricular competencies defined in the boxing course. It included items measuring factual recall, conceptual understanding, procedural knowledge, and conditional decision-making.

Field Research Procedures

Scale Development and Validation Procedures

Expert Panel Review: Twelve specialists in sports science, psychology, and education reviewed the initial item pool for both instruments (KMS and CASB). Each item was evaluated for content relevance, alignment with theoretical constructs, and linguistic clarity. Items receiving less than 75% agreement were either revised or removed. This ensured content validity based on expert consensus.

Item Pool and Refinement: The initial pool included 28 items for the Knowledge Management Scale (KMS) and 50 items for the Cognitive Achievement Scale in Boxing (CASB). Following expert review, 6 items from KMS and 7 from CASB were excluded due to redundancy or weak conceptual alignment. This resulted in 22 KMS and 43 CASB items.

Item Analysis: Using the Construction Group (n = 66), independent t-tests evaluated item discrimination. Thresholds for item-total correlation and t-values were set based on Field (2018), requiring statistical significance at $p < 0.05$ and item-total correlation > 0.30.

Pilot Testing and Item Clarity: A pilot study with 21 students assessed item clarity, comprehension, and time to completion. Based on student feedback and item response patterns, 2 KMS and 3 CASB items were further removed or reworded to improve clarity and eliminate ambiguity.

Item Discrimination and Statistical Filtering: The remaining items were subjected to independent-sample t-tests using the Construction Group (n = 66) to determine item discrimination power. Items with non-significant t-values ($p > 0.05$) or item-total correlations below 0.30 were flagged for exclusion (Field, 2018). Based on this criterion, an additional 2 items from each scale were discarded.

Final Item Selection: After expert review, pilot feedback, and statistical filtering, the finalized scales comprised 20 items for the Knowledge Management Scale and 40 items for the Cognitive Achievement Scale. These final items demonstrated acceptable psychometric properties and were used in the Application Group for final data collection.

Reliability Assessment: Cronbach's alpha yielded 0.849 for the KMS and 0.84 for the CASB, indicating high internal consistency (DeVellis, 2017).

Objectivity Measures: Standardized administration protocols and scoring rubrics were used. Inter-rater reliability was evaluated for the CASB via paired scoring of open-ended responses.

Scale Limitations and Justifications: The study acknowledges that the construction sample size may be insufficient for full exploratory or confirmatory factor analysis, as these procedures generally require 5–10 participants per item (de Winter et al., 2009). However, rigorous item-level psychometrics were applied to mitigate this limitation.

Validity and Reliability

Content Validity: Established through expert consensus and alignment with theoretical constructs.

Construct Validity: Supported by item discrimination analysis and conceptual coherence with the SECI and Bloom's models.

Face Validity: Confirmed during pilot testing.

Reliability: Cronbach's alpha coefficients exceeded 0.80 for both instruments.

Objectivity: Ensured through standardized administration and inter-rater agreement.

Statistical Analysis

Data were processed using SPSS (Version 29). Analyses included:

Descriptive Statistics: Mean and standard deviation.

Normality Testing: Kolmogorov–Smirnov and Shapiro–Wilk tests ($p > 0.05$), confirming normal distribution.

Correlation Analysis: Pearson's r tested the relationship between knowledge management and cognitive achievement.

T-Test: Paired sample t-tests examined within-group changes across testing phases.

Table 3, Summary of Scale Psychometrics

Scale	No. of Items	Cronbach's α	Validity Approach	Expert Agreement	Pilot Sample Clarity
Knowledge Management	20	0.849	SECI model-based	≥75%	Confirmed
Cognitive Achievement	40	0.84	Bloom's Taxonomy	≥75%	Confirmed

Table 3 provides an overview of the reliability and validity of the measurement tools (the Knowledge Management and Cognitive Achievement scales). It summarizes: Number of items per scale, internal consistency (via Cronbach's α), Theoretical foundation used to establish construct validity (SECI model for knowledge management, Bloom's Taxonomy for cognitive achievement)

Expert agreement percentage for content validation, Pilot testing outcomes regarding item clarity

Normality Test

To verify whether the data followed a normal distribution, the Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted. The results are presented in the table below:

Table 4, Normality Test Results

Scale	Kolmogorov-Smirnov (p-value)	Shapiro-Wilk (p-value)
Knowledge Management Scale	0.087	0.094
Cognitive Achievement Scale	0.092	0.101

The p-values for both tests were above 0.05, indicating that the data were normally distributed, justifying the use of parametric statistical analyses.

Results

To address the research objectives, the results are presented following comprehensive statistical analysis. The analysis involved evaluating the distribution of student responses across performance levels for both the Knowledge Management Scale and the Cognitive Achievement Scale, followed by correlation testing to examine their relationship.

Knowledge Management Scale Results

The researchers developed standardized performance levels for the Knowledge Management Scale based on z-scores derived from raw scores. These levels were categorized into five qualitative descriptors: Very Good, Good, Average, Acceptable, and Weak. However, it is important to note that the basis for these qualitative thresholds aligns with standard deviation bands around the mean.

Table 5, Standardized Levels of the Knowledge Management Scale

Standard Level	z-Score Range	Raw Score Range	Count (n)	Percentage (%)
Very Good	1.8 to 3	84 - 100	8	6.01%
Good	0.6 to 1.79	68 - 83	12	9.02%
Average	-0.59 to 0.59	52 - 67	56	42.1%
Acceptable	-1.79 to -0.60	36 - 51	50	37.59%
Weak	-3 to -1.8	20 - 35	7	5.26%

Note: "Standard Scores" refer to z-scores, which standardize raw scores around the mean with a standard deviation of 1. The cut-off thresholds reflect ±0.6 and ±1.8 SD from the mean.

The majority of students scored in the Average (42.1%) and Acceptable (37.59%) categories, while fewer reached Very Good (6.01%) or Good (9.02%) levels. This suggests a clustering around the mid-range of the knowledge management spectrum.

Cognitive Achievement Scale Results

The same standardization approach was applied to the Cognitive Achievement Scale. Table 6 provides a breakdown by level.

Table 6, Standardized Levels of the Cognitive Achievement Scale

Standard Level	z-Score Range	Raw Score Range	Count (n)	Percentage (%)
Very Good	1.8 to 3	104 - 120	5	3.75%
Good	0.6 to 1.79	88 - 103	22	16.54%
Average	-0.59 to 0.59	72 - 87	54	40.60%
Acceptable	-1.79 to -0.60	56 - 71	48	36.09%
Weak	-3 to -1.8	40 - 55	4	3.00%

As with the Knowledge Management Scale, most students fell within the Average and Acceptable ranges, highlighting moderate cognitive acquisition levels among the cohort.

Comparative Analysis across Groups

To investigate potential differences in Knowledge Management and Cognitive Achievement among the study's three groups Pilot**,** Construction, and Application a one-way Analysis of Variance (ANOVA) was conducted. This analysis aimed to determine whether group assignment significantly affected students' knowledge management practices and cognitive learning outcomes.

Table 7, Group Means and Standard Deviations for Knowledge Management and Cognitive Achievement

Group	Knowledge Management (Mean ± SD)	Cognitive Achievement (Mean ± SD)
Pilot Group (n=30)	61.20 ± 6.45	77.85 ± 7.12
Construction Group (n=66)	63.55 ± 7.03	79.30 ± 6.85
Application Group (n=37)	67.55 ± 5.98	83.22 ± 5.92

To test for statistical significance, a one-way ANOVA was applied separately for each scale:

- **Knowledge Management**: $F(2, 130) = 6.82$, $p = 0.002$
- **Cognitive Achievement**: $F(2, 130) = 5.64$, $p = 0.004$

These results indicate that there were statistically significant differences between the groups in both Knowledge Management and Cognitive Achievement scores. Post hoc analysis (Tukey HSD) revealed that the Application group performed significantly better than both the Pilot and Construction groups, while the difference between Pilot and Construction groups was not statistically significant.

Effect Size: The partial eta-squared (η^2) was calculated for both ANOVAs to determine effect magnitude:

- Knowledge Management: $\eta^2 = 0.095$ (medium effect)
- Cognitive Achievement: $\eta^2 = 0.080$ (medium effect)

These effect sizes indicate that group membership explained approximately 8–10% of the variance in the outcomes, reflecting practical significance in an educational context.

These findings suggest that the structured application of knowledge management strategies (as implemented in the Application group) may contribute to better knowledge organization and higher cognitive achievement. The Application group's superior performance supports the effectiveness of the developed scale and the instructional intervention tied to its use.

Relationship between Knowledge Management and Cognitive Achievement

To explore the relationship between knowledge management practices and students' cognitive achievement, a Pearson correlation test was conducted. Descriptive statistics are shown in Table 8, followed by correlation results in Table 9.

Table 8, Mean and Standard Deviation of Knowledge Management and Cognitive Achievement

Scale	Mean Score	SD	Interpretation
Knowledge Management	64.65	1.78	Average
Cognitive Achievement	80.32	3.66	Average

A correlation analysis was conducted to examine the relationship between these two variables.

Table 9, Correlation between Knowledge Management and Cognitive Achievement

Variables	r	p-value	Significance
Knowledge Mgmt vs. Cognitive Achievement	0.564	0.000	$p < 0.01$

The Pearson correlation coefficient ($r = 0.564$) indicates a moderate-to-strong positive relationship between knowledge management and cognitive achievement, and the p-value ($p = 0.000$) confirms this association is statistically significant at the 0.01 level.

Effect Size Interpretation: A Pearson's r of 0.564 corresponds to a large effect size in behavioral sciences, suggesting that knowledge management practices meaningfully contribute to students' academic performance.

This relationship suggests that students who effectively engage in knowledge management strategies such as organizing, retaining, and applying information are more likely to perform well in cognitive assessments. This finding supports the theoretical linkage between knowledge construction and academic performance.

Effect Size Consideration: A correlation of 0.564 represents a moderate effect size, implying meaningful practical relevance.

Discussion

Summary of Key Findings

The study found a statistically significant positive correlation between knowledge management and cognitive achievement in sports education, specifically within the context of boxing. The correlation coefficient of 0.564 ($p < 0.01$) suggests that higher levels of structured knowledge management are associated with better cognitive achievement. While the majority of students fell within the "average" category for both scales, this indicates that while most students possess basic knowledge management skills, the ability to effectively apply these skills in academic contexts is not widespread. This aligns with findings from previous studies, such as Ogundiwin (2013), who reported a similar distribution of knowledge management abilities among students in educational settings.

Importantly, the results underscore the role of structured knowledge management in sports education, where cognitive structuring is essential for making tactical decisions and executing skills effectively. These findings have practical implications for improving educational strategies in combat sports, particularly boxing, where both theoretical knowledge and practical application must be closely linked.

Comparison with Previous Studies

While the "average" knowledge management scores of most students suggest a baseline understanding, the study highlights significant challenges in translating this knowledge into practical academic outcomes. Existing literature suggests that many students, especially in sports education, struggle with organizing and applying acquired knowledge effectively (Brown & Green, 2019; Xu et al., 2021). This may be due to the traditional emphasis on content delivery over teaching structured cognitive strategies.

Although the study supports the notion that combat sports education requires structured cognitive frameworks, it also emphasizes the complexity of achieving this in practice. For instance, research by Papastergiou (2010) suggests that while sports media exposure can provide intuitive understanding, it does not equate to academic knowledge unless it is structured and formalized within the educational context.

While higher-achieving students may intuitively employ mental mapping or spaced repetition (Xu et al., 2021), this study does not directly examine these techniques within the sample, and such statements remain speculative without empirical support. The data from the study, however, strongly indicates that students' cognitive achievements are influenced by the way they organize and retrieve knowledge, which could be further enhanced through targeted interventions. Recent studies have further explored these dynamics. For example, a study by Aulia et al., (2024) demonstrated that mental training effectively increases self-efficacy and reduces competition anxiety among taekwondo athletes. This aligns with the current study's findings, suggesting that structured cognitive strategies can enhance academic and practical performance in combat sports education.

Additionally, research by Kamil et al., (2025) highlighted the positive impact of gamification on student motivation and learning outcomes in physical education. Their findings support the idea that integrating engaging and structured learning approaches can improve knowledge application in sports education contexts.

Lastly, a study by Widyastuti et al., (2024) developed the PETTLEP imagery model to improve self-efficacy among karate athletes. This model emphasizes the importance of structured mental training techniques, which could be beneficial in enhancing cognitive achievement in sports education.

Implications of the Findings

The study's findings suggest several potential approaches for improving knowledge management in combat sports education. Based on the correlation between knowledge management and cognitive achievement, it is evident that structured learning methods, such as mental mapping, could help students better organize and retain key boxing concepts. Novak & Cañas (2020) have demonstrated the effectiveness of mind maps in complex domains, and this approach could be beneficial in sports education, particularly for organizing tactical knowledge in boxing.

Moreover, the use of technology, including digital tools like flashcards and learning management systems, could aid students in organizing and retrieving knowledge more effectively. Dabbagh & Kitsantas (2019) have highlighted the positive impact of such tools on learning retention, a concept that could be applied to enhance cognitive achievement in boxing.

In addition to structured learning methods, active learning techniques such as case studies and problem-solving tasks are likely to bridge the gap between knowledge acquisition and its practical application. Freeman et al., (2019) emphasized that active learning increases student engagement and critical thinking, which is essential for improving decision-making in combat sports.

Limitations of the Study

Despite the valuable insights provided by this study, several limitations must be considered. One of the most critical limitations is the sample size and its representativeness. The study focused on a specific group of second-year students from the University of Basrah, which restricts the generalizability of the findings. Future research should aim to include a broader sample from various educational levels and combat sports backgrounds to ensure the findings are more widely applicable.

Another significant limitation is the reliance on self-reported scales for both knowledge management and cognitive achievement. Self-reports are subject to biases, such as social desirability or inaccurate self-assessment, which could affect the reliability of the results. Alternative objective measures, such as knowledge recall tests or structured cognitive assessments, should be employed in future studies to enhance the accuracy of the findings.

Furthermore, the newly created Knowledge Management Scale and Cognitive Achievement Scale lack sufficient psychometric validation. The study acknowledged the sample size limitations for factor analysis and other advanced psychometric techniques, and the absence of such analyses calls into question the robustness of these scales. Future studies should incorporate more rigorous validation methods, including exploratory and confirmatory factor analyses, to ensure the reliability and validity of these measurement tools.

Future Research Directions

Future research should address the limitations of the current study and explore additional dimensions of knowledge management in sports education. Longitudinal studies could examine the long-term impact of knowledge management interventions on students' academic and practical performance in combat sports. This would provide deeper insights into how knowledge management strategies influence learning over time.

Further research could also include comparative studies across different combat sports, such as boxing and judo, to identify sport-specific differences in knowledge management needs and strategies. This would allow for more tailored approaches to sports education, depending on the specific cognitive demands of each sport.

Additionally, incorporating neuroscientific methods, such as EEG or fMRI, could help researchers understand how knowledge management strategies affect brain activity and decision-making in sports. This approach would provide a deeper understanding of the cognitive processes underlying sports performance and help refine teaching strategies to optimize both theoretical learning and practical skills.

Finally, cross-cultural research could explore how knowledge management strategies vary across different educational and sporting contexts. This would contribute to a more comprehensive understanding of effective knowledge management practices in diverse environments, supporting the development of globally applicable educational strategies.

Conclusions

The results of this study reveal a moderate correlation (r = 0.564) between knowledge management practices and cognitive achievement. This suggests that students who engage in more structured knowledge management activities tend to exhibit higher academic performance. However, it is essential to interpret this finding with caution due to the study's cross-sectional design and the relatively small sample size. These limitations prevent us from establishing a causal link between knowledge management and cognitive achievement, and future research with longitudinal designs and larger, more diverse populations is needed to better understand the nature and strength of this relationship.

The Knowledge Management Scale proved useful for assessing students' self-reported cognitive abilities, but further validation of this tool through more rigorous statistical methods is required. Similarly, while the Cognitive Achievement Scale provided valuable insights into the distribution of academic performance within the sample, its conclusions should be viewed as preliminary and are not supported by experimental evidence, which limits our ability to draw definitive conclusions regarding causality.

While the findings indicate a moderate relationship between knowledge management and cognitive achievement, it would be premature to claim that knowledge management alone is a key determinant of academic success, particularly in sports education. The relationship observed in this study is not strong enough to conclude that knowledge management strategies are universally effective across all educational contexts, especially those involving both cognitive and motor skills, such as in sports sciences.

Recommendations

Despite the cautious conclusions based on the empirical findings, several practical recommendations can be drawn for enhancing knowledge management and cognitive achievement in sports education:

1. **Structured Knowledge Management**: The study suggests that systematic structuring of both theoretical and practical knowledge can enhance comprehension and retention. Educational tools like mind maps, symbols, and indicators should be incorporated into curricula to help students organize and retain key concepts effectively.

2. **Diverse Instructional Methods**: To cater to diverse learning styles, it is recommended that educators adopt a mixed approach to teaching, incorporating cooperative learning, blended learning, and structured learning techniques. This diversified approach can increase engagement and foster deeper understanding.

3. **Ongoing Assessments**: Continuous formative assessments, such as quizzes, analytical reports, and applied exercises, should be implemented to monitor students' progress in both cognitive and practical domains. These assessments will help ensure that students not only understand theoretical content but also apply it effectively in real-world sports contexts.

4. **Use of Technology**: The integration of instructional videos and scenario-based learning can deepen students' understanding by providing contextual examples, particularly in complex fields such as sports education. This will enhance students' ability to apply theoretical knowledge in practical settings.

5. **Support for Struggling Students**: Targeted support should be offered to students who are struggling with comprehension or practical application. Methods such as simplified explanations, repeated reinforcement, and focused questioning can help bridge gaps in understanding and facilitate mastery of complex content.

These recommendations are based on the current study's findings and should be regarded as preliminary. They require further testing and refinement through future studies. By incorporating these strategies, educators can create a more effective learning environment that fosters both knowledge management and cognitive achievement, ultimately enhancing students' ability to bridge the gap between theory and practice, particularly in disciplines requiring both cognitive and motor skill development, such as sports sciences.

Acknowledgements

Authors would like to thank everyone who helped in completing this research

Financing

This research was self-financed by the authors

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Apendixes

Appendix (1)

Final Version of the Knowledge Management Scale

No.	Items	Always	Often	Sometimes	Rarely	Never
1	I strive for continuous improvement in my academic level.					
2	I aim to reduce mistakes in exams by leveraging my past experience.					
3	I work with my peers as a team to enhance our academic achievement.					
4	I intentionally ask the instructor questions to increase my knowledge.					
5	I keep course notebooks and exam papers as an archive for future reference.					
6	I allocate most of my time to reading and studying to fully grasp the material.					
7	I determine the necessary steps to complete my academic assignments.					
8	I manage my time effectively to complete all my assignments properly.					
9	Students support each other, especially the talented ones, in practical learning.					
10	Students find easy ways to implement practical lessons through active collaboration.					
11	There is a sense of competition among students driven by excellence and high achievement.					
12	Some students guide their peers in understanding and executing practical lessons.					
13	Certain students demonstrate innovation in carrying out practical tasks.					
14	Self-management is crucial for a student to master and control the subject matter.					
15	As students, we strive to create an environment that facilitates understanding practical subjects.					
16	A student's knowledge base and academic reservoir are their assets for success.					
17	Decisions regarding exams (quantity and timing) are made collectively.					
18	Exams provide opportunities for students of all levels to answer questions.					
19	Reviewing past exam questions offers valuable experience in preparation.					
20	Watching practical skills, whether directly or through media, helps in executing skills correctly and precisely.					

Appendix (2)

Final Version of the Cognitive Achievement Scale for Boxing

No.	Items	Yes	Somewhat	No
1	Do you know the names of the weight categories in boxing?			
2	Is it possible for a boxer to officially compete against another boxer of a different weight category?			
3	There is no fixed rest time between rounds.			
4	There is freedom in wearing the three protective gears (headgear, groin protector, mouthguard).			
5	Do you think that exceeding the official weight allows a boxer to compete in a higher category?			
6	The higher the weight of the boxers, the easier and smoother the fight.			
7	A boxer has the freedom to choose their own gloves for matches.			
8	A boxer can participate in more than one match in a single day.			

9	A boxer is allowed to wear gloves without hand wraps.			
10	If a boxer loses by knockout, they are allowed to fight again after only 24 hours.			
11	During the rest period between rounds, all assistants are allowed to enter the ring.			
12	A boxer can wear any color they prefer during matches.			
13	There are special shoes for boxers with specific requirements.			
14	Headgear is made of reinforced plastic covered with leather.			
15	It is acceptable for a boxer to have minor vision or hearing impairments.			
16	Female boxers do not wear any protective gear.			
17	Female boxing weight categories are the same as those for men.			
18	The official boxing ring must have only four ropes, and no other configuration is allowed.			
19	A match cannot begin without the presence of a doctor.			
20	In case of an emergency, the referee has the right to stop the match at any time.			
21	The referee can enter the ring from any side they prefer.			
22	A boxing match is officiated by only one referee and one judge.			
23	A male boxer is allowed to fight a female boxer if they are in the same weight category.			
24	A supervisor cannot expel a boxer from the ring for any reason.			
25	If a referee has poor eyesight, they are allowed to wear glasses during the match.			
26	No one has the authority to remove a coach from the ring area.			
27	In cases of serious misconduct, a boxer may be disqualified after the first offense without warning.			
28	A coach can withdraw their boxer from a match without consulting the assistant coach.			
29	If a boxer suffers a severe injury, they can postpone the match until the next day only.			
30	A boxer can register for a higher weight category if their weight exceeds the official limit during the weigh-in.			
31	All referees and judges in friendly and Olympic tournaments must be from different countries than the competing boxers.			
32	The referee supervision committee consists of a chairman and two assistants.			
33	The referee supervision committee has the authority to overturn a referee's or judge's decision if found incorrect.			
34	One of the referee supervision committee's duties is to inspect gloves, protective gear, and attire before the match.			
35	The referee is the first to leave the ring after the result is announced.			
36	The referee is the one who declares the winner based on points.			
37	If extreme weather conditions occur during the third round, the match is postponed to the next day.			
38	In Olympic and world championships only, the number of rounds can be increased based on the decision of the international federation.			
39	If a boxer is unable to attend due to unforeseen circumstances, the match is postponed to the next day.			
40	A referee has the right to end a match by disqualifying a boxer deemed unfit without consulting the referee supervision committee.			

Appendix (3)

t-values for Discrimination of Knowledge Management Scale Items

Item	t-value	Item	t-value	Item	t-value	Item	t-value
1	7.99	6	7.89	11	8,89	16	7,49
2	8.65	7	8,58	12	9,01	17	9,34
3	7,92	8	7,15	13	8,81	18	9,27
4	9.11	9	9.04	14	7,46	19	8,97
5	9,30	10	8,67	15	7,86	20	7,47

Appendix (4)

Illustrates the (t) value indicating the discrimination of cognitive achievement scale items.

Discrimination Coefficient	Item	Discrimination Coefficient	Item	Discrimination Coefficient	Item	Discrimination Coefficient	Item
7.87	34	7.27	23	6.79	12	6.88	1
7.03	35	8.50	24	7.86	13	7.92	2
8.52	36	8.35	25	8.11	14	7.89	3

8.49	37	7.34	26	7.69	15	6.95	4
8.05	38	6.77	27	8.45	16	6.76	5
7.75	39	7.97	28	8.48	17	8.51	6
7.79	40	6.85	29	7.09	18	6.70	7
8.44	41	8.22	30	8.54	19	6.80	8
7.81	42	7.83	31	7.90	20	7.99	9
7.82	43	7.98	32	7.86	21	7.35	10
6.89	44	7.86	33	7.99	22	6.99	11