



SELF-REGULATED LEARNING IN UNIVERSITY VOLLEYBALL PLAYERS: EFFECTS OF METACOGNITIVE STRATEGIES ON ACADEMIC PERFORMANCE

APRENDIZAJE AUTORREGULADO EN VOLEIBOLISTAS UNIVERSITARIOS: EFECTOS DE ESTRATEGIAS METACOGNITIVAS EN EL RENDIMIENTO ACADÉMICO

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Suggested citation (APA, seventh ed.)

Calero Morales, S., Realpe-Zambrano, Z. E., Jacqueline Mendoza, A. & Guarnizo Eras, W. S. (2026). Self-Regulated Learning in University Volleyball Players: Effects of Metacognitive Strategies on Academic Performance. *Universidad y Sociedad* 18(2). e5832.

ABSTRACT:

Self-regulated learning can function as a key factor in university academic performance, particularly among students exposed to high academic-athletic demands. University volleyball, due to its academic and self-regulatory requirements, represents an appropriate context for the application of metacognitive strategies. Accordingly, this study aimed to analyse the effects of self-regulated learning supported by metacognitive strategies on the academic performance of university volleyball players. A quantitative applied study with a quasi-experimental (pretest-posttest) design was conducted. Seventeen university volleyball players participated; completing validated instruments (MSLQ, MAI, and AMS-C28) before and after the implementation of a pedagogical programmer focused on the explicit development of metacognitive strategies and self-regulated learning. All dimensions of self-regulated learning showed statistically significant improvements ($p \leq .002$), with moderate-to-large effect sizes (Z ranging from -3.06 to -3.44). Metacognitive awareness improved significantly in both knowledge and regulation of cognition ($p \leq .002$), with a predominance of positive ranks. Significant increases were observed in intrinsic motivation and identified regulation, alongside a significant decrease in amotivation ($p \leq .002$). Regarding academic

performance, only the overall grade point average and one theoretical-methodological course showed significant differences ($p < .05$), while no significant changes were found in procedurally oriented courses ($p > .05$). Posttest correlations revealed positive and significant associations between self-regulated learning, metacognitive awareness, intrinsic motivation, and overall academic performance ($p \approx .44-.55$, $p < .05$). The implementation of metacognitive strategies oriented towards self-regulated learning may contribute to strengthening cognitive, metacognitive, and motivational processes in university volleyball players, with implications for academic performance.

Keywords: Self-regulated learning, University volleyball players, Metacognitive strategies, Academic performance.

RESUMEN:

El aprendizaje autorregulado puede funcionar como un factor clave en el rendimiento académico universitario, particularmente en el estudiantado sometido a altas demandas académico/deportivas. El voleibol universitario, por sus exigencias académicas y autorregulatorias, podría ser un contexto ideal para la aplicación de estrategias metacognitivas. Por ello, se planteó como objetivo



analizar los efectos del aprendizaje autorregulado con estrategias metacognitivas en el rendimiento académico de voleibolistas universitarios. Investigación con enfoque cuantitativo aplicado, y diseño cuasi-experimental (pre-test–posttest). Participaron 17 voleibolistas universitarios, a quienes se aplicaron instrumentos validados (MSLQ, MAI y AMS-C28) antes y después de implementar un programa pedagógico centrado en el desarrollo explícito de estrategias metacognitivas y aprendizaje autorregulado. Todas las dimensiones del aprendizaje autorregulado fueron significativas ($p \leq .002$), con tamaños de efecto moderados–altos (Z entre -3.06 y -3.44). La conciencia metacognitiva mejoró significativamente en el conocimiento y la regulación de la cognición ($p \leq .002$), con predominio de rangos positivos. Se observaron aumentos significativos en motivación intrínseca y regulación identificada, con disminución significativa de la amotivación ($p \leq .002$). En el rendimiento académico, solo el promedio global y una asignatura teórico-metodológica presentaron diferencias significativas ($p < .05$). No se evidenciaron cambios significativos en asignaturas de carácter procedimental ($p > .05$). Las correlaciones posttest mostraron asociaciones positivas y significativas entre aprendizaje autorregulado, conciencia metacognitiva, motivación intrínseca y promedio académico global ($r \approx .44-.55$, $p < .05$). Implementar estrategias metacognitivas orientadas al aprendizaje autorregulado puede contribuir al fortalecimiento de los procesos cognitivos, metacognitivos y motivacionales en voleibolistas universitarios, con implicaciones en el desempeño académico.

Palabras clave: Aprendizaje autorregulado, Voleibolistas universitarios, Estrategias metacognitivas, Rendimiento académico.

INTRODUCTION

Over recent decades, university teaching–learning processes have undergone significant transformations driven by socio-technological changes, as well as by epistemological shifts that have shaped diverse paradigms applied to higher education learning. Students are no longer positioned as passive recipients of information but rather assume an active and reflective role in the construction of their own knowledge. These paradigm shifts in education have positioned self-regulated learning (SRL) as one of the central constructs for understanding students' academic performance, persistence in higher education, and the development of professional competencies required in highly demanding university contexts (Caixia et al., 2025; Han, 2025).

Self-regulated learning is an active and cyclical process in which students organize, monitor, and evaluate their own learning, incorporating key metacognitive, cognitive, behavioral, and motivational factors (Shen et al., 2025).

Learning is not limited solely to the acquisition of instructional content; rather, it requires the ability to manage individual resources, set realistic goals, and, accordingly, select the most effective strategies to regulate individual and collective efforts in response to academic demands within a given context (Simón-Grábalos et al., 2025). From an empirical perspective, evidence has shown that students with high levels of self-regulation achieve superior academic performance across educational levels (Caixia et al., 2025; Tao et al., 2025; Villalobos et al., 2025), as well as greater intellectual autonomy, which enables more effective adaptation to increasingly complex educational environments.

In university-level learning environments, self-regulated learning (SRL) is of particular relevance due to the high instructional and overall academic workload, the need for autonomous learning, and the requirement to integrate multiple extracurricular responsibilities. In this context, university students who combine their academic commitments with scientific sports training must balance academic demands with systematic training sessions, competitive events, and other psychosocial demands associated with athletic performance (Hart et al., 2025; Kang & Alaeddini, 2025; Liu & Tareh, 2024).

University athletes constitute a highly distinctive population within higher education, characterized by dual professional demands that encompass both academic performance and athletic performance. In specific sports such as volleyball—a discipline that is physically, cognitively, and tactically demanding—students are exposed to intense and prolonged training sessions, demanding competitive periods, and elevated levels of psychosocial pressure, all of which may directly and indirectly affect their academic performance (del Campo-Barraza et al., 2024).

Numerous studies indicate that university athletes face various risks associated with physical and mental exhaustion (Xu et al., 2025), largely due to reduced time available for autonomous study as a consequence of difficulties in managing professional commitments and leisure time. Nevertheless, the literature also highlights that athletes, from a professional standpoint, develop significant self-regulation skills that can be transferred to academic competencies, such as discipline, planning, and emotional control (Corlaci et al., 2023; Young et al., 2023).

In the case of university-level volleyball players, athletic performance depends not only on physical and technical abilities but also on processes related to sport-specific tactics, including effective decision-making, anticipation, and emotional self-regulation during gameplay (Zhu et al., 2024). These demands position volleyball as a privileged context for examining metacognitive strategies and

their potential relationship with, and transfer to, academic performance.

Metacognition is understood as the awareness and control of one's own cognitive processes (Fleur et al., 2021) and constitutes a core pillar of self-regulated learning, enabling students to reflect on their self-learning processes, identify personal strengths and limitations, and self-adjust the methods applied to autonomous study and the effective evaluation of strategies used, such as planning, monitoring, and evaluation (Rivas et al., 2022). Accordingly, scientific evidence demonstrates that explicit instruction incorporating metacognitive strategies significantly enhances academic performance, intrinsic motivation, and perceived self-efficacy (Celik, 2022; Grados-Villagaray et al., 2025).

Among university student-athletes, these strategies acquire added proportional value, including opportunities for performance self-assessment, error analysis, and strategic planning of short- and long-term goals. These elements may function as integrative bridges that foster holistic development in student-athletes. Although academic performance in higher education is commonly measured through quantifiable indicators such as grades and pass rates aligned with curricular progression, a comprehensive understanding of academic performance should also encompass qualitative dimensions related to deep comprehension, knowledge transfer, and autonomous learning capacities (Lim, 2024; Rice et al., 2025), with self-regulated learning emerging as a key predictor of sustainable academic performance.

For university athletes, the relationship between self-regulated learning and academic performance has been documented from a mediating perspective involving variables such as academic motivation, time management, and stress regulation (Kang & Alaeddini, 2025). However, a gap remains in both national and international literature regarding specialized analyses of metacognitive interventions applied to athletes in cooperation-opposition sports, such as university volleyball, and their direct impact on academic performance.

Likewise, a substantial proportion of existing empirical studies has focused on general populations of non-athlete university students, thereby overlooking the specific characteristics of university student-athletes. This limitation not only underscores the originality of the present research topic but also highlights the need to examine specific populations that integrate psychopedagogical and sport-related approaches, allowing for a more comprehensive understanding of how self-regulation processes may enhance academic and educational performance in ways that support the individual development of university athletes. Accordingly, the aim of the present study is to analyze the effects of self-regulated learning with

metacognitive strategies on the academic performance of university volleyball players.

MATERIALS AND METHODS

This study corresponds to an applied quantitative investigation with a quasi-experimental design and an explanatory scope, using a pretest-posttest measurement approach. The research hypothesis posits that the implementation of metacognitive strategies associated with self-regulated learning produces statistically significant effects on the academic performance of university volleyball players.

Participants

A sample of 17 male university volleyball athletes (age: 18–24 years) was randomly selected from an existing population at the University of Physical Culture and Sports “Manuel Fajardo” in Havana, Republic of Cuba (N = 22; Confidence level: 90%; Margin of error: 10%). The sample size was estimated using G*Power under the following parameters: Test family: Exact tests; Statistical test: Wilcoxon signed-rank test (matched pairs); Type of power analysis: A priori; Expected effect size: 0.65; α error probability: 0.05; Statistical power (1- β): 0.80; estimated pre-post correlation: 0.50. The inclusion criteria were:

- University student enrolled at the aforementioned institution and member of the provincial university volleyball team, with a minimum of five years of participation;
- Regular attendance at training sessions and academic activities ($\geq 90\%$), with availability to participate in all phases of the intervention process;
- No prior participation in similar intervention programs;
- Provision of written informed consent.

Procedures

The procedures were structured into sequential phases to ensure methodological coherence, internal validity of the process, and compliance with ethical standards applicable to studies in the educational field. These phases included:

- Phase 1. Prior to the start of the intervention, participants were informed about the objectives of the study, the confidential nature of the information, and the exclusive use of the data for academic and scientific purposes. Written informed consent was obtained accordingly.
- Phase 2. The relevant measurements were administered collectively and in a face-to-face format using standardized psychometric instruments, including self-regulated learning (MSLQ), metacognitive awareness (MAI), and academic motivation (AMS-C28). Data collection was conducted in a controlled environment during academic hours, previously coordinated with the higher education institution (Average administration time: 60–75 minutes).

3. Phase 3. The intervention process involved the implementation of a pedagogical program focused on the explicit development of metacognitive strategies and self-regulated learning. The program was conducted over several structured sessions (Period: September 2024–February 2025; 12 in-person sessions with a weekly frequency, 90 minutes per session), integrated into the participants' academic context, and included activities aimed at learning planning, goal setting, cognitive monitoring, self-reflection, time and effort management, and evaluation of academic performance. The strategies encompassed reflective dynamics, analysis of authentic academic tasks, guided self-assessments, and skill-transfer exercises between the sporting and academic domains, organized into four progressive pedagogical modules (Module 1: Introduction to self-regulated learning, sessions 1–3; Module 2: Strategic learning planning and management, sessions 4–6; Module 3: Metacognitive monitoring and learning control, sessions 7–9; Module 4: Self-reflection and performance evaluation, sessions 10–12). Structured work guides, metacognitive self-record notebooks, academic planning matrices, self-assessment sheets, and multimedia presentations developed by the research team were among the educational resources employed.
4. Phase 4. The aforementioned tests were re-administered under conditions equivalent to those of the pretest to ensure measurement comparability. Official academic records corresponding to the intervention period were collected, including both overall grade point average and course-specific grades, with institutional authorization and strict protection of participants' confidentiality.

The collected data were systematized and analyzed using descriptive and inferential statistical procedures aimed at comparing outcomes across two time points of the intervention process (pretest/posttest). Relationships between psychological variables and academic performance were also examined. All procedures were conducted in accordance with the ethical principles of educational research and current institutional regulations, ensuring anonymity, voluntary participation, and participants' right to withdraw from the study at any time.

Instruments

The present study employed the following assessment instruments:

1. MSLQ – Motivated Strategies for Learning Questionnaire. This instrument assesses academic motivation and self-regulated learning strategies in university students (Pintrich & De Groot, 1990). Dimensions: Motivation, including the subscales of Intrinsic Goal Orientation, Extrinsic Goal Orientation, Task Value, Control of Learning Beliefs, Academic Self-Efficacy, and Test Anxiety; Learning Strategies, including the subscales of Rehearsal, Elaboration, Organization, Critical Thinking, Metacognitive

Self-Regulation, Time and Study Environment Management, Effort Regulation, Peer Learning, and Help Seeking. Scoring: A 7-point Likert-type scale (1 = does not describe my way of studying at all; 7 = describes my way of studying very well). Higher scores indicate greater use of self-regulated learning strategies and a more favorable motivational orientation.

2. MAI – Metacognitive Awareness Inventory. This instrument assesses metacognitive awareness, defined as knowledge of one's own thinking and the regulation of cognitive processes in learning situations. Dimensions: Two major categories: Knowledge of Cognition, comprising three subcomponents (Declarative Knowledge— “knowing what”; Procedural Knowledge— “knowing how”; Conditional Knowledge— “knowing when and why”); Regulation of Cognition, comprising five subcomponents (Planning, Organization, Monitoring, Evaluation, and Strategy Adjustment or Debugging). Scoring: The MAI consists of 52 items rated on a 5-point Likert scale (1 = always false; 5 = always true). The total MAI score is obtained by summing the items across dimensions, with higher scores indicating greater metacognitive awareness.
3. AMS-C28 – Academic Motivation Scale. This scale assesses academic motivation in students (version adapted for higher education) (Vallerand et al., 1992). Dimensions: Intrinsic Motivation to Know; Intrinsic Motivation toward Accomplishment; Intrinsic Motivation to Experience Stimulation; Extrinsic Motivation— Identified Regulation; Extrinsic Motivation—Introjected Regulation; Extrinsic Motivation—External Regulation; and Amotivation. Scoring: A 7-point Likert scale (1 = does not correspond at all; 7 = corresponds exactly). Each subscale is scored independently. Higher scores on intrinsic motivation dimensions reflect an orientation toward autonomous and meaningful learning, whereas higher scores on amotivation indicate a lack of academic motivation. For comparative purposes, means and standard deviations are reported by instructional group.
4. Academic Grades. This measure combines objective indicators of academic performance based on weighted grade point averages. Dimensions: Average grades across five courses during the academic semester. Scoring: University weighted grade point average (maximum = 5 points; 1–2 = Fail; 3 = Pass; 4 = Good; 5 = Excellent).

The internal consistency of the instruments used was calculated using Cronbach's α , with the studied sample achieving adequate reliability values ($\alpha > 0.70$).

Data Analysis

The data obtained from the different instruments described in the subsection Instruments did not meet the assumption of normality, as assessed by the Shapiro–Wilk test. Accordingly, the use of non-parametric statistical procedures was justified. The Wilcoxon signed-rank test

for two related samples was applied ($p \leq 0.05$), and Spearman's rank-order correlation was used to examine the strength and direction of monotonic relationships between variables.

RESULTS AND DISCUSSION

The analysis conducted using the MSLQ (Table 1) revealed significant posttest increases across all analyzed dimensions following the completion of the intervention process based on metacognitive strategies ($p \leq .002$). Measures of central tendency in the posttest (mean/median) consistently exceeded pretest values, indicating notable improvements in intrinsic goal orientation, task value, and academic self-efficacy. Additionally, significant increases were observed in metacognitive self-regulation and time and effort management, with positive ranks predominating in the Wilcoxon signed-rank test, including Z values ranging from -3.06 to -3.44 . These results indicate effect magnitudes from moderate to high, statistically confirming the comprehensive enhancement of motivational and self-regulatory processes among university volleyball players.

Table 1. Wilcoxon signed-rank test results for the MSLQ.

Dimension (MSLQ)	Pretest Mean / Median	Posttest Mean / Median	Ranks (- / + / =)	Z	p
Intrinsic Goal Orientation	4.62 / 4.60	5.38 / 5.40	2 / 13 / 2	-3.12	.002
Task Value	4.75 / 4.70	5.44 / 5.45	1 / 14 / 2	-3.28	.001
Academic Self-Efficacy	4.58 / 4.55	5.31 / 5.30	2 / 13 / 2	-3.06	.002
Metacognitive Self-Regulation	4.41 / 4.40	5.29 / 5.30	1 / 15 / 1	-3.44	<.001
Time and Effort Management	4.36 / 4.35	5.18 / 5.20	2 / 14 / 1	-3.21	.001

Note. Z = Wilcoxon test statistic; p = statistical significance level. The effect size was estimated using Rosenthal's r ($r = Z/\sqrt{N}$; N = 17). Obtained values ranged from 0.74 to 0.83 (large effects).

For metacognitive awareness assessed using the MAI (Table 2), all dimensions showed clear and statistically significant increases ($p \leq .002$), including declarative, procedural, and conditional knowledge, as well as learning-related processes of planning, monitoring, and evaluation. The Wilcoxon signed-rank test indicated a predominance of positive ranks, with Z values exceeding -3.0 across all comparisons, suggesting a consistent effect of the intervention process on university students' capacity to consciously regulate cognitive processes during academic learning.

Table 2. Results of the test Wilcoxon for the MAI.

Dimension (MAI)	Pretest Mean / Median	Posttest Mean / Median	Ranks (- / + / =)	Z	p
Declarative Knowledge	3.62 / 3.60	4.28 / 4.30	1 / 14 / 2	-3.17	.002
Procedural Knowledge	3.58 / 3.55	4.31 / 4.30	2 / 13 / 2	-3.05	.002
Conditional Knowledge	3.55 / 3.50	4.36 / 4.35	1 / 15 / 1	-3.42	<.001
Planning	3.48 / 3.45	4.33 / 4.30	1 / 15 / 1	-3.39	<.001
Monitoring and Evaluation	3.46 / 3.45	4.29 / 4.30	2 / 14 / 1	-3.26	.001

Note. Z = Wilcoxon test statistic; p = statistical significance level. The effect size was calculated using Rosenthal's r ($r = Z/\sqrt{N}$; N = 17). The obtained coefficients ranged from 0.74 to 0.83 (large effects).

The results obtained with the AMS-C28 (Table 3) indicate statistically significant changes across all motivational dimensions following the completion of the intervention process ($p \leq .002$). These changes include notable increases in the three forms of intrinsic motivation and in identified regulation, along with a significant decrease in amotivation, as reflected by measures of central tendency that indicate a more autonomous and learning-oriented motivational profile, with Z values ranging from -3.09 to -3.41 . In this regard, the metacognitive intervention not only demonstrated improvements in self-regulated learning but also promoted a more adaptive pattern of academic motivation in the intervened sample.

Table 3. Wilcoxon signed-rank test results for the AMS-C28

Dimension (AMS-C28)	Pretest Mean / Median	Posttest Mean / Median	Ranks (- / + / =)	Z	p
Intrinsic Motivation toward Knowledge	4.71 / 4.70	5.46 / 5.45	1 / 15 / 1	-3.41	<.001
Intrinsic Motivation toward Accomplishment	4.68 / 4.65	5.39 / 5.40	2 / 14 / 1	-3.18	.001

Intrinsic Motivation toward Stimulation	4.59 / 4.55	5.34 / 5.35	1 / 15 / 1	-3.36	<.001
Identified Regulation	4.82 / 4.80	5.52 / 5.50	2 / 14 / 1	-3.22	.001
Amotivation	2.41 / 2.40	1.89 / 1.90	14 / 2 / 1	-3.09	.002

Note. Z = Wilcoxon test statistic; p = statistical significance level. The effect size was estimated using Rosenthal's r ($r = Z/\sqrt{N}$; $N = 17$). The r values ranged from 0.75 to 0.83 (large effects).

Regarding the results presented in Table 4 for final semester grades, the Wilcoxon signed-rank test revealed statistically significant differences only for Course 1 and for the overall academic grade point average ($p < .05$), with no significant changes observed in the remaining courses ($p > .05$). These findings indicate that the metacognitive intervention had a specific academic impact in terms of grades, rather than a broadly generalizable effect across all courses.

Table 4. Wilcoxon signed-rank test results for Academic Grades

Indicator	Pretest Mean / Median	Posttest Mean / Median	Ranks (- / + / =)	Z	p
Overall Academic GPA	3.82 / 3.80	3.90 / 3.89	3 / 11 / 3	-2.01	.044*
Course 1	3.78 / 3.75	3.86 / 3.85	3 / 12 / 2	-2.21	.027*
Course 2	3.85 / 3.84	3.88 / 3.87	5 / 8 / 4	-0.91	.363
Course 3	3.76 / 3.74	3.79 / 3.78	6 / 7 / 4	-0.52	.604
Course 4	3.90 / 3.88	3.93 / 3.92	4 / 9 / 4	-1.07	.286
Course 5	3.81 / 3.80	3.83 / 3.82	5 / 7 / 5	-0.43	.667

Note. Z = Wilcoxon test statistic; p = statistical significance level. The effect size was estimated using Rosenthal's r ($r = Z/\sqrt{N}$; $N = 17$). Obtained values ranged from 0.10 to 0.54 (small to large effects).

Regarding the correlations applied to each variable of analysis (Table 5), positive and statistically significant associations were observed between self-regulated learning and overall academic grade point average, as well as with Course 1 ($p < .05$). In contrast, no significant correlations were identified for courses with a more procedural focus, including Course 5, which reinforces the hypothesis of a specific and mediated academic effect of self-regulated learning.

Table 5. Correlations between self-regulated learning and posttest academic performance in university volleyball players

Self-Regulated Learning Variables (Posttest)	Overall Academic GPA	Course 1	Course 2	Course 3	Course 4	Course 5
Metacognitive autoregulation (MSLQ)	.48*	.52*	.29	.26	.31	.27
Management of time and effort (MSLQ)	.44*	.46*	.24	.22	.28	.25
Overall metacognitive awareness (MAI)	.51*	.55*	.33	.30	.34	.29
Overall intrinsic motivation (AMS-C28)	.47*	.49*	.35	.27	.32	.30

DISCUSSION

Based on the results obtained in the research presented as part of this research report, the fulfillment of the objective and its corresponding hypothesis is evidenced. These were related to the analysis of the effects of self-regulated learning supported by metacognitive strategies on the academic performance of university volleyball players. The findings confirm positive effects on key psychological variables of learning, such as self-regulation, metacognition, and academic motivation, as well as a partial and specific academic impact, in coherence with the scientific evidence reviewed.

Considering the results of each standardized test applied, and specifically the MSLQ, which assesses self-regulated learning, significant increases were observed in intrinsic goal orientation, task value, and academic self-efficacy. These findings are relatively consistent with the results reported by Pintrich & De Groot (1990), who proposed that positive motivational beliefs act as catalysts for the strategic use of cognitive and metacognitive processes.

In the context of higher education, it is commonly confirmed that interventions focused on self-regulation can strengthen self-efficacy and the value attributed to academic tasks, variables closely associated with academic persistence and sustained effort (Caixia et al., 2025; Tao et al., 2025). Furthermore, within the specific context of university student-athletes, these results align with the conclusions of Corlaci et al. (2023) and Kang & Alaeddini (2025), who indicate that both discipline and goal orientation derived from the sport domain facilitate the adoption of more adaptive motivational patterns in academic learning.

The significant increases observed in metacognitive self-regulation and in time and effort management confirm one of the core assumptions of the research hypothesis. These findings are consistent with the systematic reviews conducted by Simón-Grábalos et al. (2025) and Villalobos et al. (2025), which identify these dimensions as particularly sensitive components within explicit pedagogical interventions applied in higher education. In the case of university volleyball players, improvements in time management are especially relevant, given empirical evidence showing that the primary difficulties faced by student-athletes are related to balancing academic and athletic demands (Hart et al., 2025; Liu & Taresh, 2024).

Moreover, the results obtained through the MAI reveal significant increases in cognitive knowledge and its regulation, confirming an overall strengthening of metacognitive awareness. These outcomes are consistent with the findings of Fleur et al. (2021) and Rivas et al. (2022), who emphasized that explicit instruction using metacognitive strategies enhances students' ability to plan, monitor, and evaluate their learning processes. Accordingly, and in line with the reports of Grados-Villagaray et al. (2025) and Celik (2022), the results of the present research report confirm that metacognition does not operate in isolation, but rather in interaction with motivation and self-efficacy, shaping a more autonomous and strategic learning profile.

From a comparative perspective, and within the specific context of volleyball as a cooperative–oppositional sport at the university level, the relevance of the findings is further reinforced. Applied research in sports contexts has demonstrated that such sports require high levels of accurate decision-making, anticipation, and emotional self-regulation (Millán-Sánchez et al., 2023; Zhu et al., 2024). In this sense, the improvement observed in metacognitive dimensions suggests a possible bidirectional transfer between athletic and academic learning, an aspect highlighted by Young et al. (2023), who argue that self-regulation constitutes a transversal competence across both domains.

Regarding academic motivation, the AMS-C28 results indicate notable improvements in the different forms of intrinsic motivation examined, as well as in identified regulation, together with a marked reduction in amotivation. This motivational pattern is consistent with the self-determination model proposed by Vallerand et al. (1992), as well as with more recent studies showing that metacognitive strategies facilitate the internalization of academic motives (Han, 2025; Shen et al., 2025). For university student-athletes, these findings are particularly relevant, given that several international studies have demonstrated that high levels of academic stress and burnout risk are significantly exacerbated when external regulation or amotivation predominates (del Campo-Barraza et al., 2024; Xu et al., 2025).

However, with respect to academic performance measured through grades across different courses, the results show a significant impact only on overall academic GPA and on one course of a theoretical–methodological nature. This finding is consistent with the arguments of Lim (2024) and Rice et al. (2025), who suggest that grades do not always immediately capture the benefits of interventions targeting deep learning processes. Similarly, authors such as Villalobos et al. (2025) indicate that the effects of self-regulated learning on academic performance tend to manifest first in courses that require analysis, planning, and cognitive self-regulation, rather than in those that are predominantly procedural.

In terms of the positive and significant correlations identified among the learning dimensions included in the present study, the association between self-regulated learning and overall academic GPA reinforces the evidence of a functional relationship between these variables. This finding is consistent with the results of international systematic reviews (Caixia et al., 2025; Tao et al., 2025). Conversely, the absence of significant correlations with practical courses aligns with the conclusions of Kang & Alaeddini (2025), who argue that the academic impact of self-regulated learning in student-athletes is mediated by the type of assessment, curricular structure, and the specific cognitive demands of each course.

Among the strengths of the study is its applied focus on a scarcely explored population, the use of internationally validated instruments, and the integration of motivational, metacognitive, and academic variables. However, the various results obtained in the present research should be interpreted in light of several limitations, such as the small sample size due to the highly specialized nature of the volleyball players within such a specific context as the university setting, and the study being limited to a single intervention group without the possibility of establishing a control group. Furthermore, conducting multiple statistical tests within the analysis potentially increases the probability of accumulated Type I error, although this was partly considered given the exploratory nature of trends among non-parametric correlations, which should be interpreted with caution.

The exclusive use of grades as the primary indicator of academic performance (despite the availability of alternative measures such as cognitive, motivational, or competency-based processes involved in learning) represents another limitation of the research, conditions that align with methodological constraints reported in similar studies in higher education and university sports (Hart et al., 2025; Simón-Grábalos et al., 2025). Additionally, potentially influential variables on academic performance, such as individual academic workload, prior performance, socioeconomic status, dedication to sports training, academic

stress, and independent study time, were not taken into account in the study.

From a prospective standpoint, future research is encouraged to address the limitations identified and to incorporate longitudinal designs focused on metacognitive strategies. Additionally, it would be pertinent to emphasize the integration of qualitative indicators and alternative measures of academic performance in order to more comprehensively capture the effects of self-regulated learning on the holistic development of university student-athletes.

CONCLUSIONS

Implementing metacognitive strategies oriented toward self-regulated learning may contribute to strengthening cognitive, metacognitive, and motivational processes in university volleyball players, with direct or indirect implications for academic performance depending on students' final grades and the nature of the courses, particularly those of a theoretical-methodological character. Nevertheless, further research is required in this regard. The aforementioned qualitative findings reinforce the relevance of self-regulated learning as a relatively effective pedagogical resource for promoting meaningful, autonomous, and sustainable learning in highly demanding academic-sport contexts at the university level.

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ACKNOWLEDGMENTS

To the Teaching Innovation Project entitled: "Metodologías activas para el proceso de enseñanza-aprendizaje en educación física y deportes" ASESDECO-PI14/22. And to the AFIDESA Research Group (Actividad Física, Deporte y Salud), de la Universidad de las Fuerzas Armadas-ESPE.

CONFLICTS OF INTEREST:

The authors declare that there are no conflicts of interest.

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