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Beyond the Classroom: Analyzing the Gap Between Knowledge and Action in Sustainability Within Higher Education Sport Sciences Curricula

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Abstract

Higher Education Institutions (HEIs) are increasingly tasked with fostering pro-environmental agency to address the global climate crisis. Within physical activity and sport sciences, future nautical sports managers occupy a unique role as stewards of marine ecosystems. This study investigates the sustainability consciousness of 170 undergraduate university students from a single institution. It focuses on analyzing the knowledge–action gap within the framework of the 2030 Agenda. Utilizing the Sustainability Consciousness Questionnaire (SCQ-S), this work assessed knowledge, attitudes, and behaviors to quantify this dissonance through a robust non-parametric statistical pipeline. Results indicate a significant knowledge–action gap ($r_B = 0.903$), representing a large matched-pairs rank-biserial correlation effect size for the Wilcoxon test. Furthermore, Kruskal–Wallis analyses reveal that this discrepancy is transversal across student profiles, suggesting a state of informed paralysis within this specific cohort, where high theoretical mastery fails to translate into sustainable professional routines. Crucially, the frequency of engagement in nature-based sports, encompassing both nautical and terrestrial outdoor activities, does not significantly reduce this dissonance. These contextual findings indicate that physical exposure to nature does not automatically mitigate the knowledge–action gap, highlighting the need for explicit reflective pedagogies in higher education.

Keywords: sustainability consciousness; value–action gap; physical activity and sport sciences; nautical activities; active tourism; higher education; environmental stewardship; SDGs

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1. Introduction

The global commitment to the 2030 Agenda and the Sustainable Development Goals (SDGs) has positioned Higher Education Institutions (HEIs) as critical epicenters for societal transformation. Universities are no longer merely repositories of specialized knowledge; they are now tasked with acting as living laboratories for sustainability, fostering the competencies required for future professionals to address the climate crisis and systemic social inequality [1]. In the context of the sport sciences curricula, this mission is

particularly salient, as future graduates will assume leadership roles in sports management, active tourism, and public health policy sectors that are intrinsically linked to natural environments and community well-being [2]. The integration of sustainability within these academic programs is essential to ensure that upcoming generations possess the ethical framework and the technical rigor needed to promote a transition toward more resilient and equitable economic models [3].

However, a concerning discrepancy persists within the current educational landscape: the knowledge–action gap. This construct is formally defined as the cognitive–behavioral dissonance wherein an individual’s explicit theoretical understanding and core values regarding environmental sustainability fail to manifest in corresponding, active pro-environmental practices [4]. Extensive research highlights that while students often demonstrate high cognitive mastery of environmental problems, this intellectual achievement remains largely decoupled from sustainable choices in their daily lives or future professional routines [5]. This dissonance represents a failure in pedagogical transposition. It suggests that traditional, lecture-oriented classroom approaches are insufficient to bridge the gap between theoretical knowledge and practical action [6]. Diverging hypotheses in the field argue whether this gap stems from a lack of personal self-efficacy, cultural barriers, or simply a lack of experiential learning opportunities that could catalyze the internalization of sustainable values [7,8].

To overcome these limitations, recent pedagogical shifts emphasize that bridging the gap requires more than content delivery; it demands an emphasis on reflective and transformative learning [9]. It is not enough for a student to know the theory of ecosystem fragility; they must experience a disorienting dilemma that forces them to reconsider their relationship with nature. In this sense, outdoor education and experiential learning paradigms have emerged as powerful alternatives. By placing students in direct contact with natural environments, these approaches facilitate an embodied connection with ecosystems, a prerequisite for transforming abstract knowledge into long-term commitment [10,11]. Studies consistently show that educational interventions occurring outside institutional walls enhance environmental empathy and critical thinking more effectively than static curricula, as they engage the learner’s affective domain [12].

Furthermore, the transition from passive awareness to active agency requires what is known as “transformative learning”. This process involves a fundamental shift in the student’s frames of reference, where critical reflection acts as the catalyst for questioning previously held anthropocentric assumptions [13]. By navigating complex environmental scenarios, students move beyond the mere acquisition of facts into a stage of procedural sustainability, where values are integrated into their professional identity. This transformation is not linear; it demands pedagogical designs that challenge the learner’s comfort zone, fostering a sense of ownership over the environmental consequences of their future professional decisions [14].

Complementary to this, place-based education (PBE) emphasizes that learning is most potent when it is rooted in the specificities of a local ecosystem. In PBE, the natural environment is not a passive object of study but a co-teacher that provides immediate, multisensory feedback [15]. For students in higher education, this localized engagement helps dismantle the abstraction of crisis, transforming global ecological threats into tangible, manageable challenges within their immediate surroundings. By situating the curriculum in the here and now of a specific aquatic or terrestrial setting, educators can foster a deeper sense of stewardship and ecological belonging that is often lost in standardized classroom settings [16]. For Physical Activity and Sport Sciences (PASS) students, this localized connection is uniquely mediated through the body. Embodied learning frameworks within physical activity suggest that skill acquisition and environmental attunement develop as a deeply incorporated, pre-reflective orientation toward the world rather

than a mere cognitive construct. Through the active practice of nature-based sports, students develop a kinesthetic and somatic empathy with the ecological constraints of their environment [17]. This somatic engagement bridges the gap between theory and action by turning sustainability into muscle memory or a set of habitual practices. Consequently, the sport professional becomes an interpreter of the landscape, capable of promoting environmental literacy among the public through the very act of physical activity [18].

As higher education institutions adapt to global trends, the natural environment emerges as a vital, non-traditional pedagogical laboratory [19]. For PASS students, this environment is their primary workspace. Within nature-based sports, nautical activities offer a highly dynamic, place-responsive platform. Unlike a controlled sports hall, the unpredictable aquatic environment makes the impact of human activity and marine fragility immediately tangible. As Morgan and Braungardt [20] demonstrate through marine experiential learning frameworks such as sail training, these interactions are powerful vehicles for developing ocean literacy, a defined marine identity, and ocean stewardship among participants. Future managers of active tourism act as gatekeepers of these natural spaces [21]. However, empirical evidence remains scarce regarding how the frequency of these interactions influences the knowledge–action gap [22]. To address these gaps in the literature, the unique novelty of this study lies in mathematically quantifying the exact magnitude of the knowledge–action dissonance using robust statistical effect sizes, while demonstrating its absolute transversality within a highly specialized professional cohort (Physical Activity and Sport Sciences) intimately connected to aquatic and nautical environments.

This study aims to address this research void by analyzing whether specialized nautical training acts as a catalyst for reducing the dissonance between knowledge and action, providing a realistic approach to the implementation of the 2030 Agenda in higher education [22,23]. Specifically, the research evaluates the framework of this experiential model through three sequentially aligned research objectives, recognizing from the outset that behavioral metrics rely on subjective, self-reported data:

1. To assess the baseline levels of self-reported sustainability consciousness (distinguishing between cognitive, affective, and behavioral dimensions) in university students specializing in nautical activities.
2. To quantify the mathematical magnitude of the knowledge–action gap (GAP_{KT-BT}) and the attitude–action gap (GAP_{AT-BT}) by statistically comparing students' theoretical scores against their self-reported sustainable practices.
3. To determine if demographic and categorical background profiles (specifically gender, the frequency of participation in nature-based sports, nautical activities, and professional interest in active tourism) significantly influence the magnitude of these self-reported gaps.
4. To provide evidence-based recommendations for the integration of the Sustainable Development Goals (SDGs) into the curricula of higher education institutions focused on sports and active tourism.

2. Materials and Methods

2.1. Participants and Design

A priori power analysis was conducted to determine the minimum sample size required for the study. To achieve 80% power for detecting a medium effect size ($f = 0.25$) with a significance level of $\alpha = 0.05$, a minimum sample of $n = 159$ was required for ANOVA-based comparisons. For bivariate correlations (power = 0.95, $\alpha = 0.05$, $qH1 = 0.3$), a minimum of $n = 138$ was established.

The final sample consisted of 170 undergraduate students (58.8% male, 41.2% female; $M_{age} = 20.5$, $SD = 4.039$) from the University of Murcia (Spain). Participants were enrolled

in the Bachelor's Degree in Physical Activity and Sport Sciences (PASS) and the joint Degree in Nutrition and PASS. Specifically, students were recruited from the courses Fundamentals of canoeing (1st year, 2nd semester) and sports specializations 3 and 4 (canoeing and sailing options, 4th year). These subjects were integrated into the pedagogical framework of the Erasmus+ Voga & Share project. Data collection occurred during the second and third weeks of the academic semester. The questionnaire was administered during the first 20 min of compulsory practical sessions, resulting in a high participation rate (96.5%).

2.2. Measure and Instrumentation

For data collection, a digital survey was administered via Google Forms to ensure an efficient and sustainable data collection process without the use of paper. The instrument was structured into two distinct parts:

1. Socio-demographic and contextual variables. The first part gathered data on age, gender, and habitual residence (urban area; interurban area; orchard, field, or forest; protected natural space). Furthermore, it included qualitative variables relevant to the students' academic and sports backgrounds that could influence their level of environmental awareness, as utilized in previous studies [24,25]. These variables were assessed:
 - a. Previous training in environmental sustainability.
 - b. Frequency of physical sports activities (PSA) in the natural environment.
 - c. Frequency of nautical activities.
 - d. Interest in the integrity of marine and inland habitats.
 - e. Preferences regarding the type of active tourism (coastal PSA, inland PSA, social, cultural, or gastronomic).
2. Sustainability Consciousness Questionnaire (SCQ-S). The second part consisted of the 27-item version of the SCQ-S [4], adapted and validated in Spanish [26]. This questionnaire covers the environmental, social, and economic dimensions, aiming to measure three constructs through a 5-point Likert scale (1: strongly disagree to 5: strongly agree): knowingness (items K1–K9), attitudes (items A1–A9), and behavior (items B1–B9).

To address the core objective of this study, a composite variable named the knowledge–action gap was calculated by determining the difference between the total knowingness and total behavior scores ($GAP_{KT-BT} = KT - BT$). This variable represents the empirical distance between students' theoretical knowledge and their self-reported sustainable behavior. It serves as our primary indicator for evaluating how effectively current pedagogical strategies transform knowledge into action. Additionally, the attitude–action gap ($GAP_{AT-BT} = AT - BT$) was calculated as the difference between the affective and behavioral domains. Together, these two composite variables provide a robust metric to evaluate the internal consistency of the students' sustainability profiles.

2.3. Procedure and Ethical Considerations

Data collection took place during the academic sessions of the nautical courses. Participation was strictly voluntary and anonymous. Before completing the questionnaire, students were informed about the research objectives and provided written informed consent. The study followed the ethical guidelines of the Declaration of Helsinki and received approval from the Research Ethics Committee of the University of Murcia (ID: 3270/2021).

2.4. Data Analysis

Statistical analysis was performed entirely using jamovi (version 2.4) [27]. Internal consistency was verified using Cronbach's alpha coefficient for each sub-construct.

Normality was assessed using the Shapiro–Wilk test; since the data significantly violated the assumptions of normality, non-parametric statistical procedures were applied throughout the inferential stage. To ensure a rigorous statistical roadmap and an explicit alignment with the research objectives, the statistical pipeline was executed in the following chronological order:

1. To address objective 1 (baseline profile). Descriptive statistics (mean, standard deviation, median, minimum, maximum, skewness, and kurtosis) were calculated to establish the baseline levels of the sustainability consciousness domains.
2. To address objective 2 (quantification of gaps). A Wilcoxon signed-rank test was executed to evaluate the statistical significance of the two identified sustainability gaps based on self-reported practices: the knowledge–action gap ($GAP_{KT-BT} = KT - BT$) and the attitude–action gap ($GAP_{AT-BT} = AT - BT$). The magnitude of these paired differences was quantified using the matched-pairs rank-biserial correlation (r_B) as the standard effect size indicator.
3. To address objective 3 (profile transversality). A Kruskal–Wallis test, accompanied by Dwass–Steel–Critchlow–Fligner (DSCF) post hoc pairwise comparisons, was deployed to evaluate whether demographic and categorical factors (gender, frequency of nautical activities, frequency of physical activity in natural environments, and interest in active tourism) significantly altered the magnitude of either gap. Additionally, bivariate correlations between the continuous sub-dimensions were exploratively analyzed using Spearman’s Rho (ρ). The statistical significance level for all inferential tests was established a priori at $p < 0.05$.
4. Regarding objective 4 (curricular recommendations). This objective does not entail an independent statistical test; instead, it is qualitatively addressed within the Discussion section as an operational synthesis derived from the empirical findings of objectives 1, 2, and 3.

3. Results

This section provides a detailed description of the levels of sustainability consciousness among the participants ($n = 170$). The results are structured to first present a descriptive profile of the dimensions, followed by the inferential analysis of the gaps between knowledge, attitudes, and behaviors.

3.1. Descriptive Analysis of Sustainability Consciousness Dimensions

The initial analysis revealed a heterogeneous distribution across the three main domains of sustainability consciousness. As shown in Table 1, participants exhibited the highest scores in the knowledge (K) domain ($M = 4.56$; $SD = 0.52$), indicating a high theoretical understanding of sustainable development. This was followed by the attitude (A) domain ($M = 4.12$; $SD = 0.59$), while the behavior (B) domain showed the lowest average scores ($M = 3.79$; $SD = 0.66$).

Table 1. Descriptive statistics for sustainability consciousness domains and factors ($n = 170$).

Domain/Factor	Mean	SD	Median	Min	Max	Shapiro–Wilk (p)
Total Knowledge (KT)	4.56	0.52	4.78	2.67	5.00	<0.001
Environmental (K-EN)	4.55	0.65	5.00	2.67	5.00	<0.001
Social (K-SO)	4.65	0.52	5.00	2.33	5.00	<0.001
Economic (K-EC)	4.48	0.67	4.67	2.00	5.00	<0.001
Total Attitude (AT)	4.12	0.59	4.11	1.89	5.00	<0.001
Environmental (A-EN)	3.89	0.69	3.67	2.33	5.00	<0.001
Social (A-SO)	4.35	0.75	4.33	1.00	5.00	<0.001
Economic (A-EC)	4.12	0.76	4.00	1.00	5.00	<0.001
Total Behavior (BT)	3.79	0.66	3.78	1.67	5.00	0.013
Environmental (B-EN)	3.77	0.89	4.00	1.67	5.00	<0.001

Social (B-SO)	4.07	0.72	4.00	1.00	5.00	<0.001
Economic (B-EC)	3.53	0.92	3.67	1.00	5.00	<0.001

Regarding the specific factors, social knowledge (K-SO) and environmental knowledge (K-EN) were the highest-rated sub-dimensions. Conversely, economic behavior (B-EC) and environmental behavior (B-EN) represented the lowest scores, highlighting a potential dissonance between theoretical awareness and daily practical application. The Shapiro–Wilk test results ($p < 0.001$) confirmed that the data do not follow a normal distribution, thereby justifying the use of non-parametric procedures for subsequent comparative analyses.

As illustrated in Figure 1, there is a visible downward trend from theoretical dimensions to practical implementation.

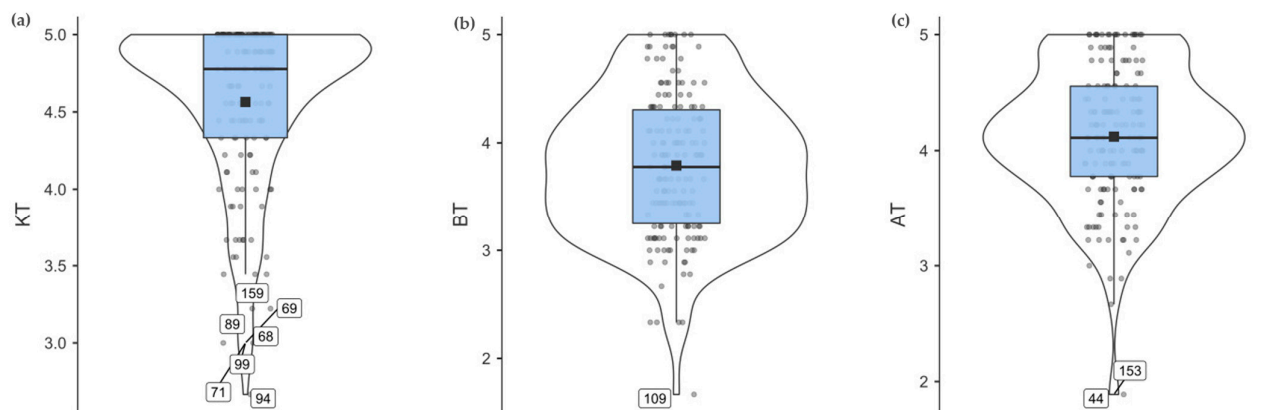


Figure 1. Distribution of sustainability consciousness domains: (a) Total Knowledge (KT); (b) Total Behavior (BT); (c) Total Attitude (AT). The plots combine violin distributions, boxplots, and individual raw data points, revealing a wider dispersion of behavioral scores compared with theoretical knowledge.

3.2. Statistical Evaluation of the Value–Action Gap

To determine the existence and magnitude of the sustainability gap, a Wilcoxon signed-rank test was conducted, as the normality assumptions were violated in the distribution of the domains. The inferential analysis revealed significant differences across all paired comparisons, confirming a profound dissonance between theoretical dimensions and practical implementation.

As shown in Table 2, the most critical discrepancy was found between Total Knowledge (KT) and Total Behavior (BT). Despite the high levels of environmental and social knowledge, participants reported significantly lower levels of sustainable practices ($W = 12259$; $p < 0.001$). The magnitude of this difference is characterized by a very large matched-pairs rank-biserial correlation effect size ($r_B = 0.903$; Mean Diff. = 0.833; 95% CI [0.722, 0.944]), suggesting that theoretical mastery of the 2030 Agenda does not translate into proportional pro-environmental actions in the students' daily or professional lives.

Table 2. Wilcoxon signed-rank test results for the sustainability gap ($n = 170$).

Paired Comparison	Wilcoxon W	p-Value	Mean Diff.	Effect Size (r_B)	95% CI (Effect Size)
KT – BT (Knowledge Gap)	12259	<0.001	0.833	0.903	[0.722, 0.944]
AT – BT (Attitude Gap)	9899	<0.001	0.333	0.537	[0.278, 0.500]

Note: Mean Diff. indicates the Hodges–Lehmann estimate of the median difference between pairs; [95% CI] denotes the 95% confidence interval for the mean/median difference. r_B = Rank-biserial correlation. A value closer to 1 indicates a stronger discrepancy between the paired variables.

Furthermore, a significant gap was also identified between Total Attitude (AT) and Total Behavior (BT) ($W = 9899$; $p < 0.001$). Although the students demonstrate a positive predisposition and ethical commitment toward sustainability, this affective domain still remains significantly higher than their self-reported behavior. The effect size for this second gap remains substantial and moderate-to-large ($r_B = 0.537$; Mean Diff. = 0.333; 95% CI [0.278, 0.500]). These findings statistically quantify the value–action gap within the PASS student body, highlighting that while the cognitive and affective pillars are well-established, the behavioral dimension remains the most significant pedagogical challenge for higher education institutions.

3.3. Transversality of the Sustainability Gap Across Demographic and Experiential Profiles

To determine whether the magnitude of the identified sustainability gaps was influenced by the students' demographic characteristics, practical experience, or professional interests, a series of non-parametric One-Way ANOVAs (Kruskal–Wallis tests) were executed. The analysis systematically evaluated the behavior of both the knowledge–action gap (GAP_{KT-BT}) and the attitude–action gap (GAP_{AT-BT}) across four categorical grouping variables: gender, engagement in physical activity in natural environments, frequency of nautical activities, and professional interest in active tourism.

The inferential results reveal a remarkable statistical stability, demonstrating that the magnitude of both sustainability gaps remains entirely unchanged regardless of the participants' backgrounds. Regarding gender profiles, no significant differences were observed for either the GAP_{KT-BT} ($\chi^2(1) = 3.161$, $p = 0.075$, $\epsilon^2 = 0.0187$) or the GAP_{AT-BT} ($\chi^2(1) = 0.0278$, $p = 0.867$, $\epsilon^2 < 0.001$). The Dwass–Steel–Critchlow–Fligner (DSCF) pairwise comparisons confirmed the absence of any significant distance between female and male students ($W = -2.510$, $p = 0.075$ for GAP_{KT-BT} ; $W = 0.236$, $p = 0.868$ for GAP_{AT-BT}).

This pattern of homogeneity was strictly replicated when analyzing the specific frequency of nautical activities, where no significant variations were found for GAP_{KT-BT} ($\chi^2(4) = 1.054$, $p = 0.902$, $\epsilon^2 = 0.0062$) or GAP_{AT-BT} ($\chi^2(4) = 3.444$, $p = 0.487$, $\epsilon^2 = 0.0204$; Figure 2). The combination of violin plots, boxplots, and jittered raw data illustrates a consistent and uniform distribution of the dissonance across all nautical engagement levels.

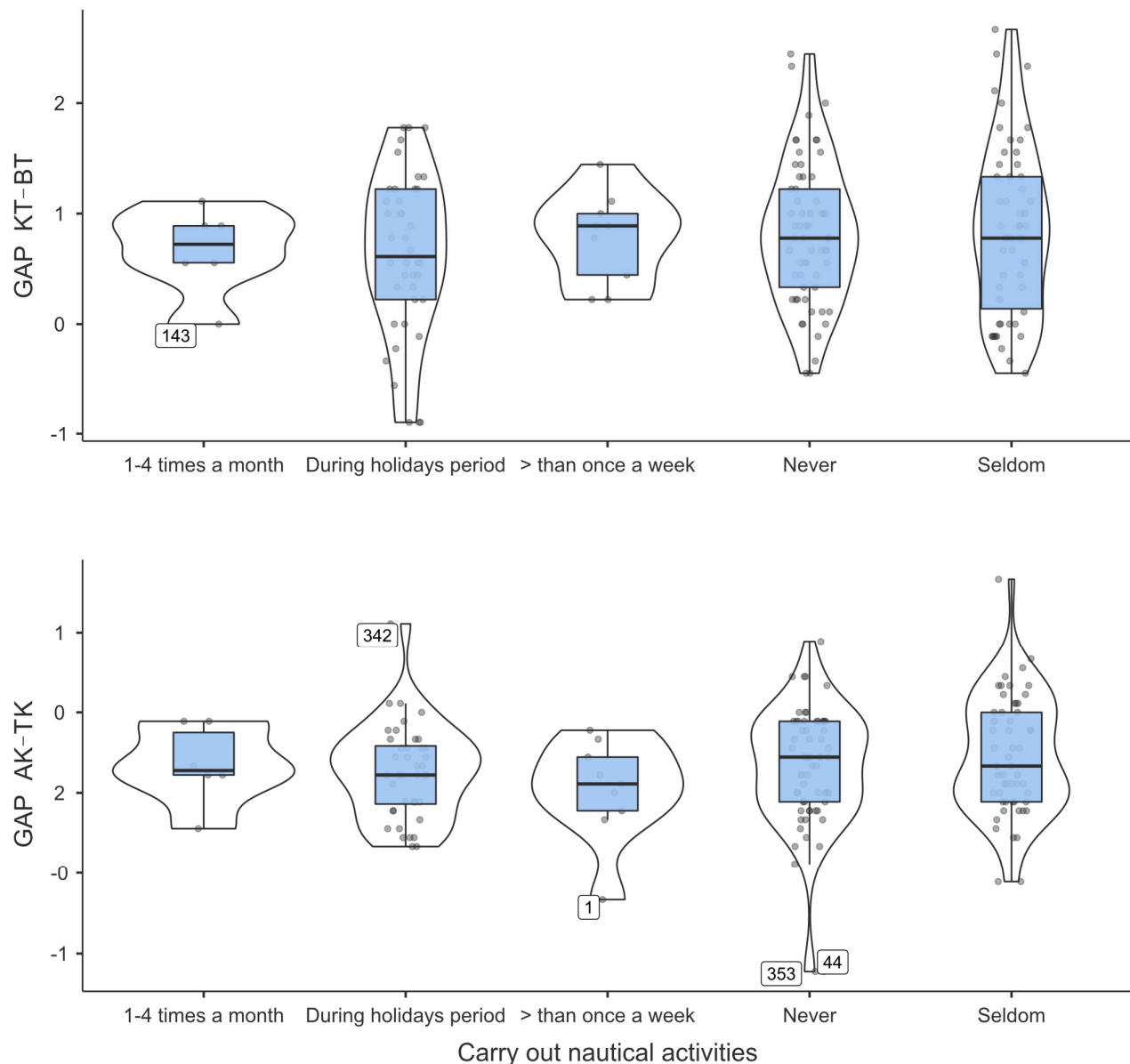


Figure 2. Distribution of sustainability gaps (GAP_{KT-BT} and GAP_{AT-BT}) according to the frequency of nautical activities.

Similarly, the frequency of engagement in physical activities within natural environments did not exert a significant effect on the variables (Figure 3), yielding non-significant results for both the cognitive-behavioral dissonance ($\chi^2(4) = 7.544$, $p = 0.110$, $\varepsilon^2 = 0.0446$) and the affective-behavioral dissonance ($\chi^2(4) = 2.914$, $p = 0.573$, $\varepsilon^2 = 0.0172$). For this environmental exposure variable, the DSCF post hoc matrices indicated that all pairwise combinations between experience levels (ranging from "Never" to "More than once a week") were thoroughly non-significant (all $p > 0.05$, with W values failing to reach critical thresholds), confirming visual density and median stability across all subgroups.

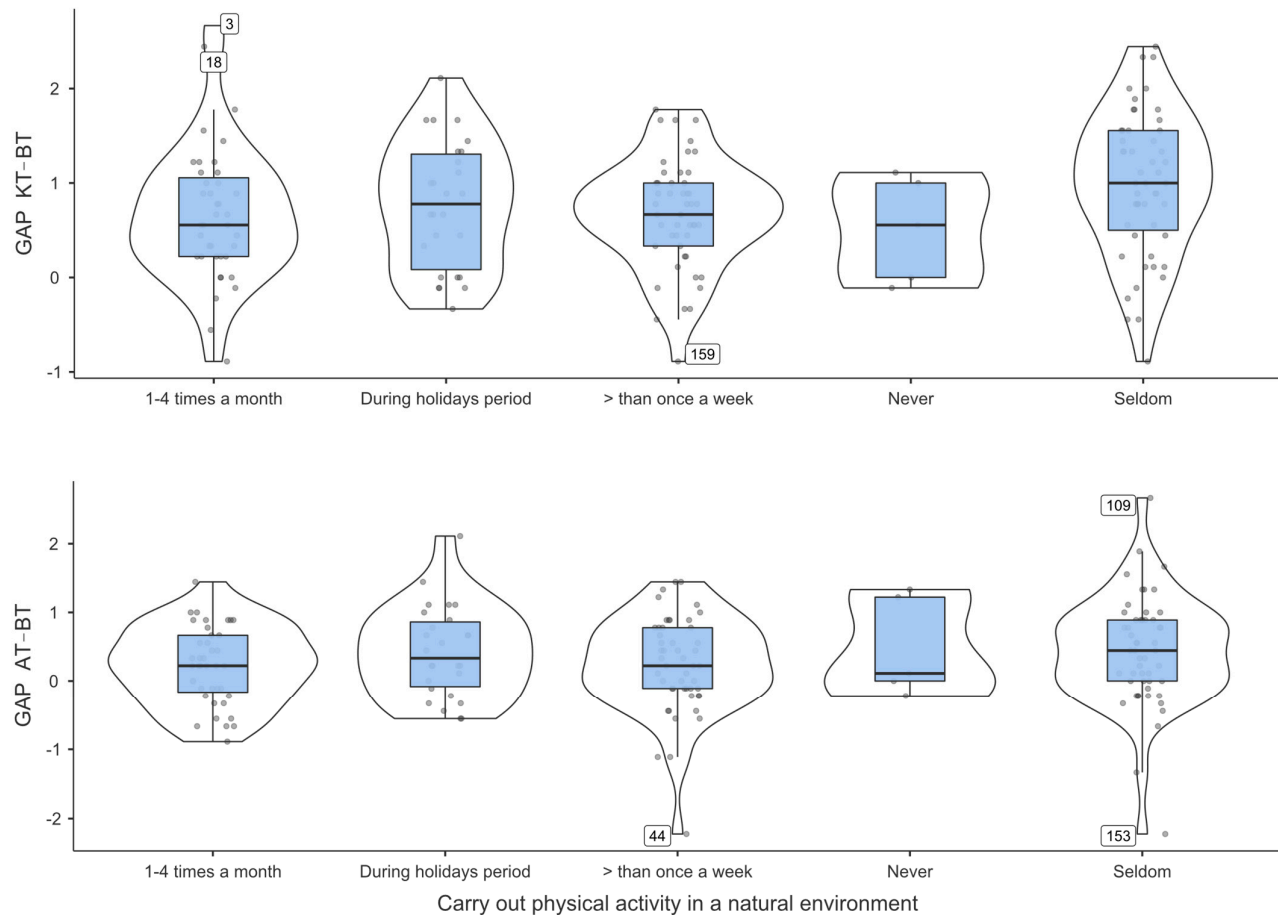


Figure 3. Distribution of sustainability gaps according to the frequency of physical activity in natural environments.

Finally, the students' professional orientation towards active tourism models did not partition the sample significantly (Figure 4). The Kruskal–Wallis test showed no robust statistical effect for GAP_{KT-BT} ($\chi^2(4) = 6.774$, $p = 0.148$, $\varepsilon^2 = 0.0401$) or GAP_{AT-BT} ($\chi^2(4) = 3.794$, $p = 0.435$, $\varepsilon^2 = 0.0224$). The DSCF pairwise tests established that students with no interest in active tourism did not differ significantly from those interested in coastal, inland, or socio-cultural tourism typologies (all pairwise $p > 0.05$). Even though minor descriptive variations were visually apparent in the distributions, the post hoc tests confirm no robust differences between professional interest profiles.

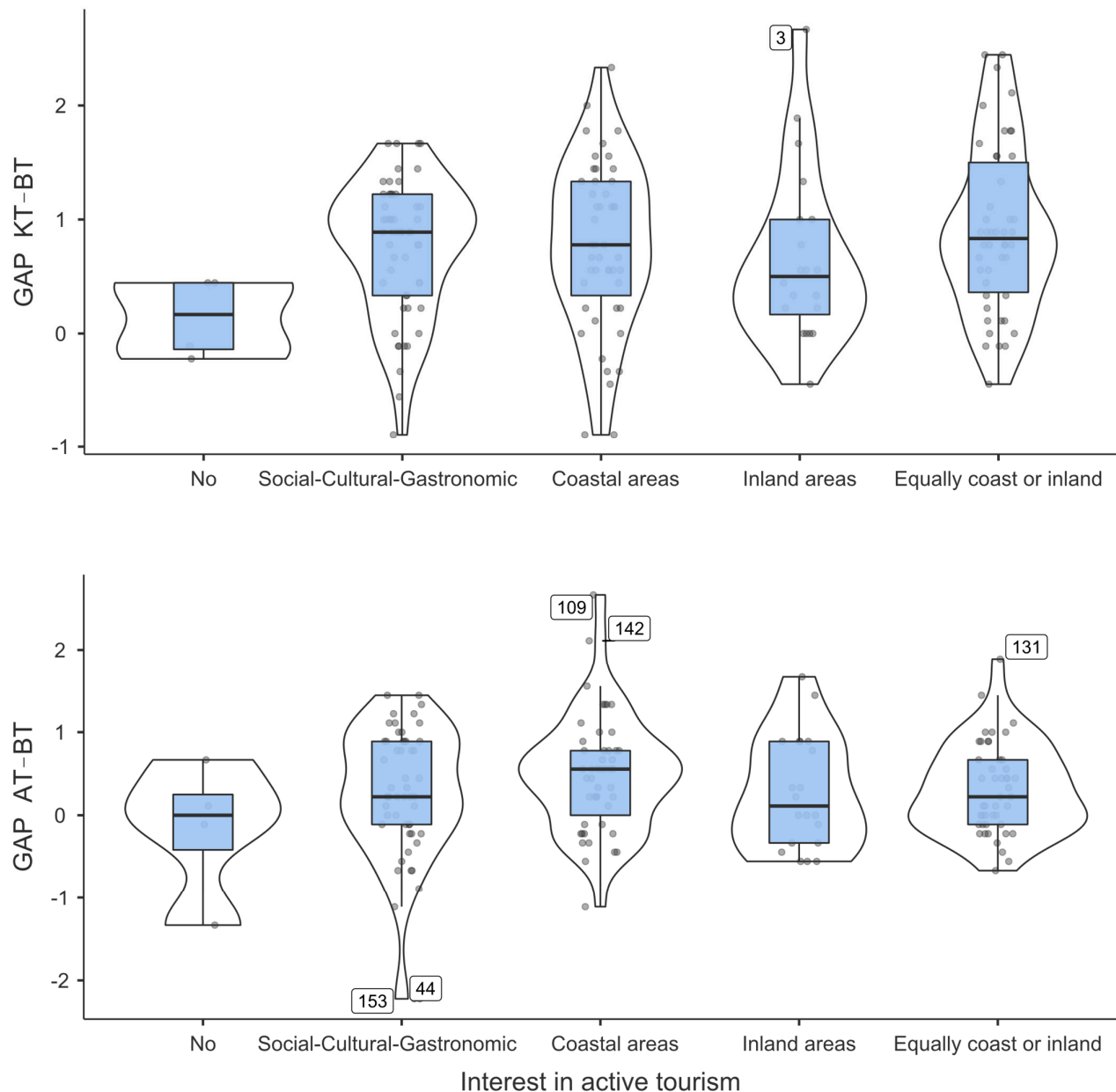


Figure 4. Distribution of sustainability gaps based on the interest in active tourism.

Collectively, these findings statistically validate the absolute transversality of the value–action gap within the investigated cohort. The dissonance between high theoretical mastery of the 2030 Agenda and self-reported daily sustainable practices represents a generalized, systemic phenomenon rather than an individual or profile-specific deficit. This highlights that traditional, unstructured contact with natural/nautical settings or a specialized professional interest are insufficient drivers to spontaneously bridge the gap, pointing directly to a structural limitation in current higher education sport sciences curricula.

4. Discussion

The findings of this study offer a sobering reality regarding the effectiveness of current pedagogical models in higher education. While the results confirm that students

possess an advanced theoretical command of the Sustainable Development Goals (SDGs), this cognitive excellence stands in stark contrast to their self-behavioral commitment. The data paints a picture of what could be termed as informed paralysis: a state where future professionals can expertly articulate the complexity of the climate crisis yet fail to integrate sustainable practices into their immediate professional and personal routines. This transition from results to discussion necessitates a critical interrogation of why the university, as a living laboratory [1], is succeeding in the transmission of data but seemingly failing in the cultivation of agency.

4.1. *The Persistence of the Value–Action Gap in Sport Sciences*

The hierarchical distribution of the sustainability consciousness domains, where knowledge (KT = 4.56) significantly outweighs attitude (AT = 4.12) and behavior (BT = 3.79), confirms that the sustainability gap is not merely a statistical nuance but a structural feature of the PASS student body. This downward trend from the cognitive to the active domain aligns with the psychometric testing of the SCQ-S instrument by Gericke et al. [4], who noted that behavioral changes often lag behind cognitive acquisitions due to the higher personal cost and effort required for practical implementation.

These results statistically quantify this dissonance through a very large rank-biserial correlation effect size in the GAP_{KT-BT} ($r_B = 0.903$), suggesting that the mastery of the 2030 Agenda [23] within the University of Murcia's curricula remains largely abstract. This phenomenon, described by Rickinson [6] as a failure in pedagogical transposition, indicates that students are treating sustainability as content to be learned rather than a value to be lived. As Leal Filho et al. [2] argue, many Higher Education Institutions (HEIs) have successfully mapped the SDGs onto their syllabi but have yet to transform their institutional culture to foster the pro-environmental agency required for genuine societal transformation [3].

Furthermore, the significant gap between attitude and behavior (GAP_{AT-BT}) reveals a deeper psychological tension. Students demonstrate an ethical predisposition and empathy toward the environment, yet this affective commitment does not survive the transition into action. According to Khan et al. [7], this intention–behavior gap is often mediated by perceived behavioral control and the lack of immediate reinforcement in the social or educational environment. In this sense, recent trends in higher education research emphasize that the field operates in a landscape where GenAI and digital information flow, as discussed by Al-Shabandar et al. [19], provide instant access to knowledge but do not necessarily provide the disorienting dilemmas or the critical reflection needed to alter long-term habits.

To bridge this gap, as Georgiadi and Papazafiri [12] highlight, there is a clear need for a renewed emphasis on reflection as a core inclusive practice. Without a pedagogical design that encourages students to confront their own contradictions (such as the dissonance between knowing the fragility of marine ecosystems and failing to act during a nautical session), the university risks producing sustainable experts who lack the procedural competencies to lead the ecological transition in the sports and tourism sectors [8].

4.2. *The Paradox of Practical Engagement: Why Nautical Frequency Fails to Close the Gap*

A central hypothesis of this study was that the physical, embodied nature of nautical activities would act as a natural catalyst for closing the sustainability gap. Drawing on the paradigms of place-based education (PBE) [15,16] and embodied learning [17], it is expected that students with higher frequencies of contact with marine environments would demonstrate lower dissonance (GAP_{KT-BT} and GAP_{AT-BT}) than their less active counterparts. However, the results of the present study do not support this expectation: the

frequency of engagement in nautical activities and physical activity in natural environments shows no significant correlation with a reduction in the sustainability gap.

This paradox of engagement suggests that the mere presence of students in the marine environment is insufficient for fostering stewardship if the pedagogical framing remains static. As Brown [17] posits, embodied learning requires more than physical proximity to ecosystems; it demands a kinesthetic empathy that transforms the environment from a sports arena into a living entity. If nautical training is delivered primarily through a performance-oriented lens (focusing on technical proficiency, speed, or navigational safety), the student's somatic engagement remains instrumental rather than ecological.

In this regard, systematic reviews by Findler et al. [28] on institutional maturity in sustainability highlight that a gap persists between institutional policy and the actual pedagogical depth experienced by students. Furthermore, research by Montoro-Pérez et al. [29] in the context of physical activity and sports sciences (PASS) underscores that even when using advanced simulated environments, competency-based education models require the explicit integration of reflective practices to be effective. Without this explicit sustainability-linked reflection embedded into physical practice, the cognitive benefits are not translated into habitual stewardship [15]. Consequently, the natural environment is reduced to a passive backdrop for sport, rather than a co-teacher providing multisensory feedback on ecosystem fragility.

These findings resonate with the observations of Mullins [20], who warned that nautical sports professionals risk becoming mere technicians if they are not trained to interpret the landscape through a sustainability-oriented framework. When students navigate without critical reflection, they often develop a leisure-based relationship with the sea, where the environmental cost of their activity is ignored or externalized [21]. This reinforces the idea that the disorienting dilemma, a fundamental component of Mezirow's transformative learning theory [13], is missing from the curriculum. Without an educational intervention that prompts students to confront the ecological consequences of their practice, nautical activities fail to challenge anthropocentric assumptions, leaving the value-action gap intact despite high levels of exposure to the natural environment.

4.3. Transversality of the Sustainability Gap and Professional Identity

A significant finding of this research is the transversal nature of the knowledge-action gap across all analyzed student profiles. Whether categorized by their gender, their interest in active tourism, their frequency of participation in nature-based sports, or their nautical activities background, the dissonance between knowledge and behavior remains a constant, systemic feature. This stability suggests that the knowledge-action gap is not an individual failing of certain less aware students, but rather a collective characteristic of this specific cohort of future sports managers and educators. This systemic profile aligns with the baseline data presented by Pelcher et al. [30], who examined how environmental values, beliefs, and norms among sports management students in higher education establish a foundational framework that does not automatically yield pro-environmental behaviors.

When comparing these results with the previous study by Morales-Baños et al. [21], it is observed that while the general levels of sustainability consciousness have remained relatively stable, the implementation of more robust metrics to quantify this dissonance suggests a deeper challenge in professional identity formation. In the current analysis, even those students with a high interest in active tourism (Figure 4) exhibit a profound knowledge-action gap (GAP_{KT-BT}). This indicates that a professional interest in natural spaces does not automatically translate into a sense of professional stewardship. As Richards et al. [31] argue, preservice physical education teachers often exhibit a significant resistance to change rooted in their previous occupational socialization; they tend to

replicate traditional, performance-oriented models of sports participation that overlook the socio-ecological dimensions of the 2030 Agenda.

This lack of behavioral translation may also be linked to a deficit in professional self-efficacy. According to Agiasotelis et al. [32], the ability of future teachers and sports professionals to adopt contemporary instructional models is heavily dependent on their participation in professional communities that support context-specific sustainability practices. If students do not perceive themselves as part of a sustainable professional collective, their individual theoretical knowledge remains dormant. Furthermore, as explored by Ahn and Davis [33], the sense of belonging in higher education is a critical driver of engagement; for PASS students, if sustainability is not perceived as a core element of their professional belonging (as essential as physiology or biomechanics), it will continue to be treated as a peripheral, theoretical requirement rather than a core behavioral driver.

Consequently, the transversality of this discrepancy underscores the need to shift from a content-based curriculum to one centered on the professionalization of sustainability. It is no longer enough for a future nature-based sports manager to know the SDGs; they could benefit from developing the metacognitive justifications [12] and the emotional intelligence [29] necessary to navigate the ethical complexities of their future workspace. Without this shift, the knowledge–action gap will remain a persistent barrier to the implementation of the 2030 Agenda in the sports and active tourism sectors.

4.4. Practical Implications and Limitations

The evidence of a systemic knowledge–action gap across all student profiles necessitates a paradigm shift in how sport sciences curricula are designed. It is clear that the infusion of environmental content is insufficient; HEIs could benefit from transitioning toward sustainability-linked pedagogy. This involves moving beyond technical performance training in nature-based sports to incorporate ethical friction in the natural environment. Practically, this could mean replacing standard practical sessions with scenario-based learning where students are required to make professional decisions under ecological constraints, thereby encouraging them to bridge the gap between their theoretical knowledge and their self-reported behavior [9,34].

Furthermore, the results suggest that sports federations and active tourism companies should prioritize environmental interpretation as a core professional competency. If future managers do not perceive sustainability as a functional tool for long-term viability, this knowledge–action gap will persist. As Sterling [14] emphasizes, a truly sustainable education is not just about learning about change but learning for change. This prospective curricular adaptation is further supported by the updated environmental behavior frameworks put forward by Pelcher et al. [35], which emphasize that higher education curricula for future sports professionals could benefit from transitioning from abstract awareness to concrete, context-specific professional competencies for sustainability.

Despite the robustness of the statistical analysis, several structural limitations must be explicitly acknowledged. First, the empirical data were gathered from a single higher education institution, which limits immediate geographical generalization. Second, the cross-sectional design captures a specific temporal snapshot, preventing long-term causal inferences regarding behavioral evolution [36]. Third, the reliance on the SCQ-S instrument introduces potential self-report and social desirability biases, meaning responses reflect students' subjective perceptions rather than verified habits. Fourth, this study lacks direct behavioral observation of actual sustainable practices within real-world sport environments. Additionally, while the non-parametric procedures applied successfully managed the sample size inequalities across specific subgroups (such as the “No interest in active tourism” cohort, $n = 4$), future replication studies should aim for more balanced, multi-centric samples to maximize statistical power.

5. Conclusions

This exploratory study provides a contextual analysis of the sustainability consciousness of future professionals in Physical Activity and Sport Sciences (PASS) engaged in nautical activities. The main conclusion is the empirical confirmation of a structural knowledge–action gap within the investigated university cohort. While students demonstrate a high level of cognitive mastery regarding the 2030 Agenda, reflecting the success of Higher Education Institutions (HEIs) in integrating the Sustainable Development Goals (SDGs) into the theoretical curriculum, this knowledge remains largely inert. The statistical quantification of the discrepancies, particularly the large rank-biserial correlation effect size found in the GAP_{KT-BT} ($r_B = 0.903$), suggests a state of informed paralysis within this sample: students possess the data to understand the ecological crisis but lack the procedural and behavioral competencies to mitigate it in their self-reported practices.

Crucially, this study contextualizes the assumption that frequent contact with natural environments automatically fosters pro-environmental behavior. The results indicate that, within this sample, neither gender nor the frequency of engagement in nature-based sports and physical exercise in nature significantly reduces the knowledge–action gap. This finding poses a critical challenge to traditional, unstructured models of outdoor education. It suggests that mere exposure to the sea or terrestrial ecosystems is insufficient if it is not accompanied by an explicit pedagogical framework rooted in place-based education and embodied learning. For these future sports managers, the natural environment is often perceived primarily as a high-performance sports arena rather than a fragile ecosystem requiring stewardship. Without targeted pedagogical interventions that trigger critical reflection on the human–nature relationship, physical activity remains an anthropocentric exercise that fails to close the dissonance between knowing and doing.

Furthermore, the transversality of these findings across all analyzed profiles suggests that the knowledge–action gap represents a systemic challenge within this educational context rather than an individual deficit. This highlights a critical area for professional identity formation. The findings suggest that educational models in sport sciences may continue to prioritize technical proficiency and performance over socio-ecological agency. As long as sustainability is treated as a peripheral topic rather than a core pillar of professional excellence, future managers might continue to replicate unsustainable leisure and tourism models. The comparison with previous data highlights that while awareness levels remain stable, the behavioral translation has stalled, necessitating a shift toward more transformative learning approaches.

Finally, the practical implications of this case study are clear: HEIs should transition from teaching about sustainability to educating for sustainability. This requires a curriculum that incorporates ethical friction and disorienting dilemmas directly into practical nature-based sports training. It is recommended that sports federations and university departments move beyond a purely technical-navigational focus to include environmental interpretation and ecological impact management as mandatory professional competencies. Confronting behavioral contradictions in the living laboratory of the natural environment appears to be a promising step to bridge the gap. While this study is bounded by its cross-sectional nature and self-reported metrics, it sets a baseline for future longitudinal research to monitor how reflective pedagogical models might transform sustainable knowledge into active stewardship for the benefit of the 2030 Agenda.

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