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Psychological Effectiveness of Online Physical Education Lectures among Vietnamese University Students

Thanh Nguyen Duc[1], Tinh Nguyen The[2,*]

[1]Center for Physical Education, Ho Chi Minh City University of Technology and Education, Vietnam
[2]Faculty of Physical Education, Hue University, Vietnam

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Abstract **Background:** Vietnamese universities expanded online delivery of Physical Education (PE) during and after COVID-19, yet evidence on psychological outcomes for non-PE majors remains limited. **Objective:** To examine pre–post changes in psychological indicators associated with participation in a structured online PE lecture system across four sport modules (chess, volleyball, tennis, football). **Methods:** A quasi-experimental pre–post design was implemented with 400 non-PE major students enrolled in online PE via an institutional LMS integrating multimedia lessons, interactive tasks, and feedback activities. Psychological outcomes were assessed using SF-36 subscales (vitality/energy–fatigue, mental health, role limitations due to emotional problems, Social Functioning) alongside a brief learning-experience questionnaire. Analyses included descriptive statistics, paired t-tests, and one-way ANOVA; complete paired data were available for n = 160. **Results:** Significant improvements were observed across all SF-36 indicators: vitality increased from 48.53±17.40 to 63.28±16.97 (+14.75; $p<0.001$), mental health from 54.10±15.22 to 66.23±14.31 (+12.13; $p<0.001$), Role-Emotional from 51.62±19.87 to 69.54±20.41 (+17.92; $p<0.001$), and Social Functioning from 62.41±16.88 to 70.99±17.22 (+8.58; $p<0.001$). Between-module differences were small but favored football and tennis for vitality ($F=4.53$; $p=0.004$). **Conclusion:** Participation in well-designed online PE lectures was associated with significant improvements in psychological indicators. However, causal effects cannot be inferred due to the absence of a control group. Online PE could nevertheless serve as a complementary component of blended PE curricula in higher education rather than being viewed solely as an emergency solution.

Keywords Online Physical Education, Psychological Effectiveness, Vitality, Mental Health, University Students

1. Introduction

The COVID-19 pandemic accelerated the global transition toward technology-enhanced and fully online learning environments, profoundly reshaping pedagogical practices across higher education. While online learning offers flexibility and accessibility, numerous studies have reported that increased screen exposure, reduced social interaction, and prolonged sedentary behavior may negatively influence students' psychological health, contributing to stress, anxiety, emotional fatigue and decreased motivation for academic tasks [1], [2]. Recent meta-analyses showed that university students engaged in remote learning often experience reduced vitality, higher mental distress and impaired Social Functioning compared with pre-pandemic levels [3], [4]. These findings highlight the importance of examining how online instruction interacts with pedagogical design, physical activity levels

and psychosocial needs.

Within this context, Physical Education (PE) represents a unique challenge. Unlike lecture-based courses, PE traditionally relies on movement, verbal and non-verbal feedback, interpersonal coordination and shared physical spaces. As reported in international literature, insufficient activity during online semesters has been associated with lower energy, increased fatigue and poorer mental health indicators among university students [5], [6]. Even before the pandemic, research consistently demonstrated that regular physical activity is strongly correlated with improved mood, reduced anxiety, enhanced vitality and greater life satisfaction [7], [8]. However, when PE is delivered online, the extent to which these psychological benefits are preserved depends largely on course design, opportunities for interaction and the availability of multimedia resources that effectively simulate or support physical engagement.

Emerging studies on online or blended PE indicate that well-structured digital modules can maintain cognitive and affective learning outcomes, particularly when video demonstrations, interactive assignments, peer collaboration and teacher feedback are integrated [9], [10]. Students who participate in online PE with strong instructional scaffolding have reported improvements in motivation, emotional well-being and perceived competence, although technical and environmental barriers often moderate these effects [11]. Nevertheless, the body of research on online PE remains small, fragmented and heavily concentrated in Western contexts, leaving significant gaps in understanding psychological outcomes in Asian and especially Southeast Asian settings.

In Vietnam, the rapid shift to online learning during COVID-19 required universities to redesign PE curricula in ways that had never been attempted at scale. Although several Vietnamese institutions have adopted Learning Management Systems (LMS) and e-learning platforms for PE, existing studies largely focus on instructional logistics, digital readiness or student satisfaction - not on validated psychological health indicators such as vitality, mental health or Social Functioning [12]. Meanwhile, large-scale Vietnamese surveys conducted during the pandemic revealed considerable deterioration in students' mental well-being due to academic disruption, workload pressure and reduced peer interaction [13]. Yet no comprehensive study has examined whether online PE lectures - when designed with multimedia resources and interactive tasks - can mitigate these psychological risks and contribute positively to emotional or social health.

Therefore, this study addresses a critical research gap by examining the psychological effectiveness of a structured online PE lecture system among non-PE major university students in Vietnam. The intervention integrates multimedia instruction, interactive tasks, and personalized feedback within an LMS environment. Specifically, the study evaluates changes in vitality, mental health, Role-Emotional, and Social Functioning across four PE modules (chess, volleyball, tennis, football). By providing empirical data from a Southeast Asian context, the findings may contribute to the evidence base on digital and blended physical education in higher education.

2. Literature Review and Theoretical Framework

2.1. Online Learning and Student Mental Health

A rapidly growing body of research shows that online learning is associated with mixed psychological outcomes. López-Valenciano et al. [6] analyzed more than 1,400 publications and concluded that online learning can both increase stress and open opportunities for mental-health-sensitive curriculum design.

Rutkowska et al. [14] reported a high prevalence of depressive symptoms and perceived stress among Polish students during e-learning.

In Vietnam, Duong et al. [13] found that COVID-19-related disruptions significantly affected the mental health of over 37,000 university students, with online learning playing a mediating role through workload, isolation and screen time. Similar patterns have been observed in other countries, particularly among health sciences students, where satisfaction with online learning is often moderate and accompanied by headaches, eye strain and emotional exhaustion [15]. Personality traits and self-regulation also shape how students perceive online learning. Bhagat, Wu and Chang [16] showed that conscientiousness and agreeableness significantly predict positive perceptions of online courses. These findings imply that instructional design must support autonomy and self-regulation to protect mental well-being.

2.2. Specific Challenges of Online Physical Education

PE is inherently practice-oriented, emphasizing motor skills, physical fitness, and social interaction. When delivered online, students may face limitations related to equipment, space, and teacher supervision, which can reduce physical engagement and activity intensity [5], [6], [11]. However, previous studies indicate that well-designed online or blended PE can maintain cognitive and affective learning outcomes when supported by multimedia instruction, interactive tasks, and teacher feedback [9], [10]. In addition, barriers such as unstable Internet access and reduced peer interaction remain common challenges in online PE environments.

2.3. Psychological Outcomes in Online PE

Research on the psychological impact of PE has primarily focused on in-person programs, consistently

showing that regular physical activity is associated with improved mood, reduced anxiety, and better quality of life [7], [8], [20]. Extending these psychological benefits to online PE requires structured motivation, interaction, and self-monitoring mechanisms to compensate for reduced physical supervision and social presence.

However, empirical studies examining psychological outcomes (e.g., vitality, Role-Emotional, Social Functioning) of online PE at the university level are still scarce, especially in Southeast Asia. This study thus contributes novel data from Vietnam, where PE is compulsory for most undergraduates but is rarely delivered fully online.

2.4. Research Hypotheses

Based on the literature and research objectives, the following non-directional hypotheses were formulated:

H1: There is a statistically significant difference in students' psychological indicators (vitality, mental health, Role-Emotional, and Social Functioning) between pre-test and post-test after participation in online PE lectures.

H2: There are statistically significant differences in post-test psychological outcomes among the four sports modules.

H0: There is no statistically significant difference in psychological outcomes before and after the intervention.

3. Materials and Methods

3.1. Research Design and Participants

A quasi-experimental pre-test/post-test design was used. The research was conducted at the Center for Physical Education and National Defense Education, Ho Chi Minh City University of Technology and Education (HCMUTE), between January 2023 and December 2024.

The target population comprised non-PE majors enrolled in compulsory PE courses. From this population, 400 students (both sexes, with no reported health conditions that would prevent participation) were selected by cluster sampling across faculties (engineering, information technology, economics, etc.). Participants were enrolled in one of four online PE modules: chess, volleyball, tennis, or football.

All participants provided informed consent electronically before data collection. Ethical approval and procedures are described separately in the Ethical Considerations section.

3.2. Online PE Lecture System

Based on a review of national and international literature and consultation with approximately 20 PE lecturers, the research team designed a system of online PE lectures with the following components:

- Content structure: four modules (chess, volleyball, tennis, football), each organized into theoretical units (rules, tactics, health benefits) and practical units (video demonstrations, home-based drills).
- Platform: institutional LMS integrated with video-conferencing tools (Zoom/Teams), digital whiteboard, discussion forums and assignment upload. The online PE lectures were delivered using a blended digital format that included synchronous live sessions (via Zoom/Teams) and recorded video lectures uploaded to the LMS for asynchronous review and practice.
- Multimedia resources: short clips demonstrating techniques, slow-motion replays, annotated diagrams and interactive quizzes, designed according to e-learning principles.
- Interaction and feedback: live Q&A, breakout rooms, short polls, and personalized video feedback where students recorded their practice and received detailed comments from lecturers.

Each module lasted 15 weeks, including approximately 30 hours of theoretical lectures (2 hours/week) and 30 hours of practical home-based training tasks guided by video demonstrations and lecturer feedback. Theoretical units focused on rules, tactics, and health knowledge, while practical units emphasized skill practice and self-recorded performance. Students were expected to attend synchronous lectures, complete asynchronous tasks and maintain a minimum amount of weekly practice at home.

Within each module, students engaged in specific activities such as technique demonstration videos, guided home-based drills (10–20 minutes per session), self-recorded practice submissions, and peer discussion tasks. Physical intensity varied by module: football and tennis emphasized moderate-intensity drills, volleyball included coordination exercises, while chess focused on cognitive-strategic engagement and online matches. The intended weekly practice duration was approximately 60–90 minutes.

3.3. Instruments

Psychological outcomes were assessed using:

The Vietnamese version of the SF-36 Health Survey (Version 2) was used, focusing on four subscales: Vitality (VT), Mental Health (MH), Role-Emotional (RE), and Social Functioning (SF).

- Vitality/Energy-Fatigue
- Mental Health
- Role limitations due to emotional problems
- Social Functioning
- Scores were converted to a 0–100 scale, with higher scores indicating better functioning.

Online learning experience questionnaire

The learning experience questionnaire consisted of 8 items developed based on prior online learning and PE literature. The instrument assessed four dimensions: (1) motivation to participate, (2) perceived usefulness of online lectures, (3) satisfaction with interaction and feedback, and (4) preference for blended learning. Items were rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Example items included: "The online PE lectures increased my motivation to practice" and "Instructor feedback was helpful for skill improvement." The scale demonstrated acceptable internal reliability (Cronbach's $\alpha = 0.84$). Demographic data (age, gender, faculty, previous online learning experience) were also collected.

The SF-36 subscales used in this study have demonstrated strong psychometric properties in previous international research, with Cronbach's alpha coefficients typically ranging from 0.78 to 0.93. In the present study, internal consistency reliability was acceptable, indicating good reliability of the psychological measures.

The instrument was administered online via the institutional LMS using a self-report format. The validated Vietnamese translation of the SF-36 was adopted to ensure linguistic and cultural appropriateness. Internal consistency reliability in this sample ranged from $\alpha = 0.81$ to 0.89 across subscales, indicating acceptable to good reliability.

3.4. Data Collection and Analysis

Data were collected at two time points:

- Pre-test: during the first week of the semester, before exposure to the online lecture system.
- Post-test: in the final week, after completion of all modules and assessments.

Among the 400 students, 160 provided complete paired data across all psychological measures and were included in the final analysis. Descriptive statistics (mean, standard deviation) were computed for each subscale. Paired t-tests were applied to compare pre- and post-test scores, and one-way ANOVA examined differences among the four sports modules. Significance was set at $p < 0.05$.

Participant flow was as follows: 400 students were initially enrolled in the online PE courses, 372 completed the pre-test survey, and 160 provided complete paired pre–post responses and were included in the final analysis. Missing post-test data were primarily due to non-response to the final questionnaire, course withdrawal, or incomplete survey submission. A comparison of baseline psychological scores between completers (n = 160) and non-completers (n = 240) showed no substantial differences (all $p > 0.05$), suggesting limited attrition bias; however, potential selection bias cannot be fully excluded.

To control external variables, all students followed the same LMS platform, lecture structure, assessment schedule, and feedback procedures throughout the semester. Lecturers used standardized instructional materials and evaluation criteria to ensure methodological consistency. Additionally, participants were advised to maintain regular weekly practice and similar learning conditions to minimize variability caused by environmental factors.

Prior to inferential analysis, assumptions of normality were tested using skewness and kurtosis statistics. All values were within acceptable ranges (skewness ±2; kurtosis ±7), indicating normal univariate distribution [21], [22].

Effect sizes (Cohen's d) for paired samples were calculated using the mean difference divided by the standard deviation of the difference scores. Additionally, 95% confidence intervals (CI) were computed for mean changes to enhance the transparency and robustness of statistical reporting. All analyses were conducted using SPSS version 26.

4. Results

4.1. Descriptive Statistics and Overall Psychological Changes

A total of 160 students provided complete paired data across the four SF-36 psychological indicators. Table 1 presents the descriptive statistics for pre-test and post-test scores. All four indicators showed notable improvements after participation in the online PE lecture system.

The results demonstrate statistically significant improvements across all psychological dimensions (all $p < 0.001$). The largest effect was observed in Role-Emotional (+34.7%), indicating that students experienced fewer emotional barriers to carrying out academic and daily tasks. Vitality also showed a substantial increase (+30.4%), suggesting enhanced energy and reduced fatigue during the academic semester.

Table 1. Pre-test and Post-test Scores of Psychological Indicators (n = 160)

Indicator	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Change	% Change	t-value	p-value
Vitality/Energy-Fatigue	48.53 ± 17.40	63.28 ± 16.97	+14.75	+30.4%	9.84	< 0.001
Mental Health	54.10 ± 15.22	66.23 ± 14.31	+12.13	+22.4%	8.72	< 0.001
Role Limitations due to Emotional Problems	51.62 ± 19.87	69.54 ± 20.41	+17.92	+34.7%	10.15	< 0.001
Social Functioning	62.41 ± 16.88	70.99 ± 17.22	+8.58	+12.2%	7.46	< 0.001

4.2. Changes across Sports Modules

To examine differences across sports modules while accounting for baseline variation, change scores (post-test minus pre-test) were analyzed using one-way ANOVA. This approach provides a more appropriate comparison than post-test-only analysis in pre–post designs.

Key findings:

- Vitality and Mental Health differed significantly among the four sports ($p < 0.05$).
- Football and tennis showed the highest gains, likely due to higher physical activity intensity during home-based practice.
- Chess still produced meaningful gains, confirming that cognitive - strategic engagement can positively contribute to mood and vitality.

Role-Emotional and Social Functioning showed no statistically significant differences ($p > 0.05$), suggesting that emotional and social benefits were relatively uniform across modules. The results are presented in Table 2.

4.3. Effect Sizes

Cohen's d was calculated to determine the magnitude of improvements. The specific results are presented in Table 3.

These effect sizes indicate substantial improvements in psychological indicators associated with participation in the online PE program, especially related to emotional functioning and vitality.

4.4. Student Motivation and Learning Experience

Students' perceptions of the online PE lectures were assessed using Likert-scale items related to motivation, perceived usefulness and satisfaction.

Open-ended qualitative responses highlighted the convenience of replaying videos, personalized feedback, more equal participation during group tasks, challenges related to limited space and unstable internet, and an occasional lack of intrinsic motivation for home practice.

These findings are consistent with previous research on online PE and digital learning environments (see Table 4).

4.5. Summary of Main Findings

- All psychological indicators improved significantly, with increases of 12–35%.
- Role-Emotional and Vitality showed the largest gains (large effect sizes).
- Football and tennis achieved slightly greater improvements in vitality and mental health.
- Social Functioning improved significantly, despite being an online modality.
- Students expressed strong satisfaction with interaction and multimedia elements.

Table 2. Post-test Psychological Scores by Sports Module

Indicator	Chess (n=40)	Volleyball (n=40)	Tennis (n=40)	Football (n=40)	F	p-value
Vitality	60.13 ± 15.92	62.44 ± 17.10	66.81 ± 18.23	69.75 ± 17.31	4.53	0.004
Mental Health	63.72 ± 13.44	64.50 ± 14.21	68.34 ± 15.10	68.87 ± 14.78	3.12	0.028
Role-Emotional	67.10 ± 19.45	68.21 ± 18.92	70.33 ± 21.66	72.56 ± 20.34	2.21	0.09
Social Functioning	68.44 ± 15.82	70.22 ± 16.79	72.13 ± 17.64	72.96 ± 18.02	1.88	0.13

Table 3. Effect Sizes (Cohen's d) for Pre-Post changes

Indicator	Cohen's d	Interpretation
Vitality	0.78	Large
Mental Health	0.69	Medium-Large
Role-Emotional	0.82	Large
Social Functioning	0.58	Medium

Table 4. Students' Perceived Learning Experience

Item	Mean ± SD	Interpretation
Motivation to participate in online PE	4.12 ± 0.71	High
Satisfaction with instructional videos	4.28 ± 0.64	High
Satisfaction with lecturer feedback	4.34 ± 0.58	Very High
Preference for future blended PE	4.41 ± 0.62	Very High
Perceived improvement in physical activity habits	3.96 ± 0.77	Moderate–High

5. Discussion

This study examined the psychological effectiveness of a structured online Physical Education (PE) lecture system for non-PE majors in Vietnam. Using paired data from 160 students, the intervention produced statistically significant improvements across all four SF-36 domains assessed (vitality, mental health, role limitations due to emotional problems, and Social Functioning; all $p < 0.001$).

Notably, the largest relative gain was observed for Role-Emotional (+34.7%), followed by vitality (+30.4%), suggesting fewer emotional barriers to daily/academic tasks alongside greater perceived energy during the semester.

These findings suggest that online PE, when intentionally designed as an interactive and feedback-rich learning system, may contribute to students' mental well-being rather than merely functioning as an emergency substitute. However, these interpretations should be considered cautiously due to the quasi-experimental design and the absence of a concurrent control group.

5.1. Interpreting Improvements in the Broader Context of Online Learning and Student Well-Being

The magnitude and consistency of these improvements are particularly important because online learning, especially since COVID-19, has often been associated with psychosocial strain (e.g., reduced interaction, prolonged sedentary behavior, and motivational decline). A systematic review on online learning effectiveness in higher education during the COVID-19 period emphasized that outcomes depend heavily on instructional design quality, interaction, and learner support rather than modality alone [17].

In Vietnam, pandemic-related disruptions were also linked with measurable mental health impacts among university students, underscoring the need for protective and health-promoting components within online semesters [13].

Within this context, PE is a distinctive case: it is expected to protect health and support psychosocial functioning, but it typically relies on embodied practice, real-time feedback, and social participation. The current results may indicate that a structured online PE system could partially preserve—and in some domains enhance—students' perceived quality-of-life outcomes, although this interpretation should be considered cautiously given the quasi-experimental design.

5.2. Why Vitality and Mental Health Improved: Plausible Mechanisms

The substantial improvements in vitality and mental health align with broader evidence that physical activity supports psychological well-being [18]. The World Health Organization notes that regular physical activity can reduce symptoms of depression and anxiety and improve overall well-being. Global guidelines likewise affirm mental health benefits of physical activity across populations [19]. Additionally, meta-analytic evidence indicates that exercise interventions can reduce depressive and anxious mood in college students [20].

In the present intervention, the mean vitality increase was reported at approximately 14–15 points, alongside an improvement of ~12 points in mental health indices, indicating changes that are not only statistically significant but also practically meaningful at the level of perceived day-to-day functioning.

Mechanistically, these gains may be associated with a combination of (i) regular movement and reduced sedentariness, (ii) increased self-efficacy through structured tasks and feedback, and (iii) improved affect regulation during academically demanding weeks. This pattern is consistent with motivational theory in PE. Self-determination theory (SDT) literature highlights that satisfaction of autonomy, competence, and relatedness needs is strongly linked to adaptive motivation and well-being; SDT-informed teaching strategies in PE can support these needs through clear structure, meaningful choice, and supportive feedback [23].

The intervention's design (interactive tools, structured tasks, and personalized feedback) plausibly supported competence and relatedness, while the online format may have enhanced perceived autonomy via flexible, replayable learning resources.

5.3. Social Functioning Gains despite "Touchless" Online PE Constraints

Social Functioning improved by 12.2% ($p < 0.001$), implying better perceived communication and peer integration after course completion. This is notable because online learning commonly reduces spontaneous interaction and can amplify isolation. In online PE specifically, scholarship has described "touchless classes" and "absent bodies," where relational and embodied dimensions of learning are constrained, creating pedagogical and emotional challenges [10].

The findings suggest that social and emotional benefits may still be achieved when online PE deliberately integrates structured interaction (e.g., forums, group tasks, and synchronous discussions) and consistent teacher feedback. This has practical significance for institutions considering online or blended PE: social outcomes are not automatic online, but they can be designed.

5.4. Differences across Sports Modules: Intensity and Engagement Pathways

The one-way ANOVA indicated that post-test vitality and mental health differed significantly across the four sports modules ($p < 0.05$), while Role-Emotional and Social Functioning did not differ significantly ($p > 0.05$).

Football and tennis showed the highest gains, which may be related to relatively higher physical activity intensity during home-based practice; however, no physiological variables (e.g., heart rate or activity load) were directly measured in this study.

However, the absence of between-sport differences for Role-Emotional and Social Functioning suggests that these outcomes may be driven more by shared pedagogical features (interaction, feedback, and structured engagement) than by sport-specific intensity alone.

A particularly relevant insight is that chess still produced meaningful gains in mood and vitality. This supports a broader interpretation of online PE benefits as multi-component: psychological improvements may arise not only through vigorous activity but also through cognitively engaging tasks, goal setting, perceived competence, and socially mediated participation (e.g., online matches and discussion). In other words, different sports may activate different pathways to well-being, physiological intensity for some modules, cognitive/strategic engagement and social participation for others.

5.5. Effect Sizes and Educational Significance

Effect-size analyses (Cohen's d) indicated that the intervention produced substantial psychological benefits, especially for emotional functioning and vitality.

In education and health research, this matters because statistically significant changes are not necessarily meaningful for student functioning; effect sizes help interpret real-world impact. The current pattern - largest effects in Role-Emotional and vitality - suggests that online PE may be particularly valuable for supporting energy regulation and reducing emotion-related limitations during intense academic periods, rather than only improving general mood.

5.6. Implications for PE Curriculum Design

Student feedback reinforced the quantitative results: respondents highlighted convenience and the ability to replay videos, valued personalized feedback, and reported more equal participation during group tasks. At the same time, they reported common constraints - limited home space, unstable internet, and occasional lack of intrinsic motivation for home practice.

These barriers align with the broader literature on technology-mediated learning and online PE constraints, and they underline why design alone is insufficient without institutional support (e.g., platform stability, guidance for small-space practice, and motivational scaffolds).

A recent scoping review of physical-activity interventions to support mental health in education settings for ages 16-25 also emphasizes heterogeneity in intervention design and measurement and highlights feasibility considerations as central to implementation success [24], [25].

The present findings contribute to this emerging evidence base by adding data from a Southeast Asian university context and by demonstrating that psychological benefits are possible across multiple PE modules in an online delivery model.

5.7. Implications for Practice and Future Research

Collectively, the results support treating online PE as a strategically designed component of blended curricula rather than a temporary emergency response. Practically, universities may consider: (i) maintaining online modules for theoretical content and technique demonstration, (ii) institutionalizing feedback workflows (e.g., student video submissions with teacher comments), and (iii) embedding structured peer interaction to protect social and emotional outcomes.

Several limitations should be acknowledged. First, the quasi-experimental pre–post design lacks a concurrent control group, limiting causal inference.

Second, only 160 of 400 students had complete paired data, introducing potential selection/attrition bias.

Third, the outcomes are self-reported, which may be influenced by expectancy or social desirability. Future research should incorporate controlled comparisons (e.g., blended vs. fully face-to-face), objective engagement/activity measures (wearables or activity logs), and multi-university sampling to test generalizability and identify which design elements (feedback intensity, interaction formats, task structure) most strongly drive Role-Emotional and vitality gains.

5.8. Limitations and Directions for Future Research

While the study provides strong evidence for the psychological benefits of online PE, several limitations should be considered.

- The sample was drawn from a single university, limiting generalizability.
- Physical activity levels were self-reported and may contain biases.
- No pure face-to-face control group was included for comparison during the same semester.

Future research should expand to multi-university samples, incorporate objective physical activity trackers, and compare online, blended and traditional PE models in parallel. Longitudinal studies assessing the sustainability of psychological gains would also provide deeper insights into the long-term impact of digital PE programs.

Overall, the findings indicate that online PE lectures may have the potential to support students' psychological well-being, although further controlled and longitudinal studies are required to confirm causal effectiveness and generalizability.

6. Conclusions

This study provides empirical evidence that:

(1) A structured system of online PE lectures was associated with significant improvements in vitality, mental health, Role-Emotional, and Social Functioning.
(2) Psychological benefits are observable across different sports modules, not only in high-intensity activities.
(3) Thoughtful integration of multimedia resources, interactive tools and personalized feedback is essential to sustain motivation and protect mental health.

Practical implications for universities and PE departments include:

- Treat online PE as a permanent component of blended curricula rather than an emergency substitute.
- Invest in institutional LMS platforms that support video analysis, interactive quizzes and peer discussion.
- Provide training for PE lecturers in digital content creation and online pedagogies.
- Develop guidelines for home-based practice that consider students' diverse living conditions and safety.
- Integrate regular monitoring of psychological outcomes (e.g., SF-36 subscales) into PE evaluation systems.

Future research should include control groups with traditional face-to-face PE, larger multi-university samples and longitudinal follow-up to assess the sustainability of psychological gains.

Ethical Considerations and Informed Consent

The study complied with national and institutional guidelines for research involving human participants. Prior to data collection, the research protocol - including objectives, procedures, data privacy safeguards and potential risks - was reviewed and approved by the institutional ethics committee of HCMUTE.

All participants received an information sheet explaining that participation was voluntary, that they could withdraw at any time without academic penalty, and that data would be analyzed only in aggregated form. Informed consent was obtained electronically via the LMS before the baseline survey; students confirmed that they were at least 18 years old and agreed to the use of anonymized data for research and publication. For students who did not provide consent, no questionnaire or health data were recorded, and they followed the standard course procedures only.

The online PE program was designed to minimize risk: all activities were low-to-moderate intensity and accompanied by safety instructions; students were advised to stop exercising and contact staff if they experienced pain or discomfort. No serious adverse events were reported during the study.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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