

# Assessment of the physical education learning environment among Ukrainian university students during wartime: validation of the SAPPE questionnaire and gender-regional analysis

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## Abstract

**Background and Study Aim** The ongoing military conflict in Ukraine has profoundly disrupted university life, limiting students' access to physical activity, altering the educational environment, and increasing psychological stress. These conditions make it essential to understand how students perceive physical education and what factors influence their engagement in physical activity. This study aimed to assess the structure and development of key components of the physical education learning environment among Ukrainian university students during wartime, using an adapted version of the SAPPE questionnaire.

**Material and Methods** The study included 89 university students from Eastern and Western Ukraine and 8 physical education instructors. Data were collected online using the adapted Ukrainian version of the Scale to Assess Perception of Physical Education (SAPPE), which consists of six subscales covering key dimensions of the physical education environment. Reliability and construct validity of the instrument were confirmed through internal consistency analysis and exploratory factor analysis.

**Results** The SAPPE questionnaire demonstrated high reliability (Cronbach's alpha = 0.894) and adequate construct validity, confirmed by interscale correlations and exploratory factor analysis. The identified two-factor structure reflected infrastructural aspects and motivational-personal components of the physical education environment. Regional differences were observed: 78 students scored high on the Classroom Climate subscale, while 40 scored low on Self-Efficacy in PE, indicating uneven perceptions across regions. Gender-based cluster analysis showed no statistically significant differences ( $\chi^2 = 2.905$ ,  $p = 0.234$ ), suggesting similar patterns in male and female responses.

**Conclusions** The adapted SAPPE questionnaire is a reliable and valid tool for assessing university students' perceptions of the physical education environment under wartime conditions. Regional and gender-related patterns, although limited, highlight the need to tailor pedagogical strategies to contextual differences. The instrument may be effectively used for ongoing monitoring and to support targeted interventions aimed at improving student well-being.

**Keywords:** physical education, educational environment, student well-being, self-efficacy, gender and regional differences, wartime Ukraine

## Introduction

The contemporary social and political circumstances resulting from the full-scale war in Ukraine have profoundly affected all aspects of daily life, including the educational sector. Within this context, the system of physical education has proven to be particularly vulnerable, requiring adaptation in both organizational structures and instructional content. In these new conditions, it has become especially important to foster stable

behavioral patterns, promote a positive attitude toward physical activity, and ensure that students perceive the learning environment as safe and supportive. This highlights the urgent need for scholarly assessment of the physical education environment and for the development of reliable instruments to monitor students' perceptions across different regions of Ukraine.

In light of the challenges faced by educational institutions during wartime, researchers have placed particular emphasis on the need to adapt and assess the learning environment, especially in the field of physical education as a critical component

of students' overall well-being. A substantial body of international research underscores the importance of students' perceptions of the educational environment in physical education, particularly in relation to the development of motivation, self-efficacy, and a sustainable attitude toward physical activity [1, 2, 3, 4]. Notably, in China, the Scale to Assess Perception of Physical Education (SAPPE) was developed and validated to evaluate students' perceptions of physical education [5]. Moreover, successful applications of questionnaires adapted to post-conflict and high-stress contexts have also been documented [6, 7, 8].

Motivation and self-efficacy, as conceptualized within self-determination theory, are recognized as key factors influencing students' sustained engagement in physical activity. Under conditions of social stress and instability, these characteristics serve as protective resources that facilitate adaptation and support active behavior. However, empirical studies addressing these constructs in the Ukrainian context remain limited. Recent works by Ukrainian scholars have documented significant challenges in organizing the educational process under martial law, especially during the transition to remote learning in universities located in Eastern Ukraine [9, 10; 11, 12].

An effective approach to studying students' motivation, engagement, and perceptions of the educational environment involves the use of standardized questionnaires and psychometric scales. The application of such instruments provides structured data on students' psycho-emotional states and educational needs. This is particularly relevant during wartime conditions, when the educational system functions under high stress, relies on distance learning, and suffers from limited interaction between students and instructors.

In both international and Ukrainian practice, standardized questionnaires are widely used to assess students' quality of life, stress levels, and psychological well-being, particularly under conditions of armed conflict. These instruments include symptom checklists and coping strategy scales [13], the Perceived Stress Scale (PSS-10) validated for Ukrainian samples [14], and the General Well-Being Index [15]. Similar tools have been successfully applied in other post-conflict regions, such as Uganda and South Africa, to evaluate the impact of physical activity on students' mental health [6, 7, 16].

Within the Ukrainian context, several empirical studies have reported declines in students' motivation, increased stress, and reduced engagement in physical activity during wartime [17, 18]. Monitoring efforts further emphasize the need for adaptive physical education programs that account for the realities of war [19, 20]. Additionally, instruments such as the SF-36 and PSS-10 have

been adapted and used to assess students' quality of life and health status during the conflict [11, 12, 20], reinforcing the relevance of standardized approaches in unstable social conditions.

One validated tool used to assess students' perceptions of physical education is the Scale to Assess Perception of Physical Education (SAPPE) [5]. Initially developed in China, the instrument has demonstrated strong reliability and construct validity. It consists of six subscales that capture key aspects of the educational environment: behavioral dispositions toward physical activity, self-efficacy, attitudes and experiences, knowledge and skills, classroom climate, and infrastructural and normative conditions.

Due to its multidimensional structure, the SAPPE enables identification of specific features in students' perceptions across various educational and cultural settings, including systems undergoing crisis-related transformation, such as Ukraine's higher education sector [11, 12]. Internationally, interest in evaluating physical education outcomes has been reflected in efforts by organizations like SHAPE America, which provides standardized guidelines for assessment [21]. Research from Qatar and Saudi Arabia has highlighted gender- and motivation-related differences in PE perceptions, further supporting the scale's broad applicability [22, 23]. Comparative analyses across countries, including the United States and Finland, also reinforce the cross-cultural relevance of constructs such as motivation and self-efficacy in the field of physical education [1, 2, 24].

Despite the widespread use of standardized scales in international research, Ukrainian studies in this field remain limited. Most validation and applied studies have been conducted in countries with stable educational systems and secure environments, such as China [5], the United States, and Finland [1, 2]. Studies from Qatar and Saudi Arabia have also provided important insights, particularly regarding gender- and motivation-related differences in students' attitudes toward physical education [22, 23].

In Ukraine, the full-scale war has brought about systemic challenges, including decentralized learning, a rapid shift to remote instruction, and elevated psychological stress among students and faculty [9, 10]. Although some instruments assessing stress and well-being have been validated locally [11, 12, 15, 20], and several studies have addressed the impact of physical education on students' psycho-emotional states under crisis conditions [6, 25], a comprehensive tool specifically adapted to evaluate students' perceptions of physical education in the Ukrainian context is still lacking.

This gap underscores the need for empirical research using validated instruments that are responsive to regional, social, and wartime

conditions. The influence of the learning environment on students' motivation and behavior during armed conflict remains poorly understood. Factors such as socioeconomic hardship, displacement, disrupted educational pathways, and reduced institutional support may further shape student outcomes. The absence of systematic inquiry into these aspects hinders the development of evidence-based pedagogical models adapted to crisis conditions.

Given these challenges, there is a pressing need to locally adapt and apply a validated scale to assess Ukrainian students' perceptions of the physical education environment.

It was hypothesized that students' perceptions of the physical education learning environment would vary based on regional and gender-related factors due to differences in educational formats, infrastructure availability, and exposure to wartime stressors. Specifically, it was expected that students from Western Ukraine – where offline learning conditions are more stable – would report more favorable perceptions across SAPPE subscales, particularly in classroom climate and self-efficacy. Additionally, motivational and personal aspects were expected to load onto a separate factor, thereby supporting the multidimensional design of the SAPPE scale and confirming its theoretical validity in a conflict-affected context.

The aim of this study was to analyze the structure and level of development of components of the physical education learning environment among Ukrainian university students under wartime conditions using the adapted SAPPE questionnaire.

## Materials and Methods

### *Participants*

The study initially involved 110 students and 10 instructors from Ukrainian universities. Following a preliminary screening and the removal of incomplete or incorrectly completed questionnaires, data from 89 students and 8 instructors representing higher education institutions in Eastern and Western Ukraine were retained for analysis. Participation in the study was voluntary: the survey link was distributed through official university channels and online student groups specifically targeting learners in wartime conditions.

*Ethical Standards.* The study was conducted in accordance with the principles of the World Medical Association's Declaration of Helsinki [26]. The ethical aspects of the research were reviewed and approved by the academic council of [Ivano-Frankivsk National Technical University of Oil and Gas], which determined that formal approval from an institutional ethics committee was not required due to the non-invasive, anonymous nature of the study. Participants were informed in advance about

the purpose and content of the study, provided voluntary informed consent, and were notified of their right to withdraw at any stage without consequences. All data were collected anonymously and processed in compliance with principles of confidentiality.

*Inclusion and Exclusion Criteria.* The inclusion criteria for students were: enrollment at a Ukrainian university, participation in physical education classes, voluntary informed consent, and full and accurate completion of the questionnaire. Instructors were included if they had experience teaching courses related to physical education and had provided explicit consent to participate in the study.

Questionnaires containing missing values in key sections of the SAPPE scale were excluded from the analysis to ensure the reliability of statistical processing. As a result of the preliminary screening, questionnaires from 21 students and 2 instructors were removed from the initial sample.

All six SAPPE subscales were included in the factor analysis to assess the construct validity of the instrument. However, Factor 6 (*Facilities, equipment, and norms [Environmental factor]*) was excluded from the comparative analysis between students and instructors, as well as from the descriptive distribution tables, since it primarily reflects external conditions that vary substantially across different regions of Ukraine. Under the conditions of full-scale war, many sports facilities in Eastern Ukraine were severely damaged or completely destroyed, making an objective comparison of this factor between respondents from different regions impossible. Including this factor could distort the interpretation of the results, as infrastructure assessments in this context depend not on individual perception or behavior but on the physical state of the educational environment, which is beyond the control of the survey participants.

The distribution of students by gender and region, along with mean anthropometric characteristics, is presented in Table 1.

As shown in Table 1, the sample is relatively balanced by gender and region. The mean anthropometric values reflect the expected differences between men and women, which is important to consider in subsequent analyses. The representation of students from different regions also allows for the examination of territorial variations in perceptions of physical education.

The instructor group included an equal number of men and women. Their responses were incorporated into the comparative analysis with student results at the final stage of the study. The group consisted of eight instructors (four men and four women), and their assessments were considered in relation to the student data.

**Table 1.** Socio-demographic characteristics of students by region (n = 89)

Indicator	Eastern Ukraine	Western Ukraine	Total
Number of participants	53	36	89
Men	28 (53%)	21 (58%)	49 (55%)
Women	25 (47%)	15 (42%)	40 (45%)
Mean height of men (cm)	177.2 ± 7.4	179.4 ± 7.7	178.1 ± 7.5
Mean weight of men (kg)	71.3 ± 11.7	75.5 ± 10.4	73.1 ± 11.2
Mean height of women (cm)	168.2 ± 7.0	166.3 ± 5.5	167.5 ± 6.5
Mean weight of women (kg)	61.4 ± 11.4	58.0 ± 7.9	60.1 ± 10.2

### Study Design

The study employed a cross-sectional quantitative design. Its primary objective was to examine the characteristics of students' perceptions of physical education in Ukrainian universities, as well as to identify latent structures and differences among participants. Data collection was conducted using a standardized questionnaire, and subsequent analyses included assessments of reliability and validity, as well as comparative and cluster analyses. Both descriptive and inferential statistical methods were applied to ensure well-grounded conclusions.

*Instrument.* Data were collected using the *Scale to Assess Perception of Physical Education (SAPPE)*. The application of the SAPPE scale is based on the methodology validated in the study by Qin et al. [5] and is consistent with international practice [8]. This approach supports the appropriateness of its use in academic contexts.

Prior to the study, the SAPPE scale was adapted to the Ukrainian context in accordance with international standards: a professional translation from English was carried out, followed by a back-translation conducted by independent experts. The procedures of translation, adaptation, and psychometric testing were selected based on successful experiences of questionnaire adaptation for Ukrainian samples [27, 28], which supports the validity of localizing the SAPPE scale. The consensus version underwent both linguistic and content expert review involving specialists in the fields of physical education and pedagogy.

The SAPPE scale consists of six subscales and includes 20 items rated on a 7-point Likert scale, where 1 indicates "strongly disagree" and 7 indicates "strongly agree." The factors (n = 6) and items (n = 20) of the SAPPE scale (PA – physical activity; PE – physical education) are as follows [5]:

#### *Habituated behavior in PA (Behavioral factor)*

1. Based on the knowledge and skills I have gained in PE, I can be physically active in my community.

2. On campus, I can frequently organise sports competitions or physical activities on my own

initiative with other students, using the knowledge and skills I have gained in PE.

3. Based on the knowledge and skills I acquired in PE, I can perform moderate exercise at home.

#### *Self-efficacy in PE (Personal factor)*

4. At least one sport is one in which I am more proficient than the majority of my classmates.

5. It is easy for me to master the motor skills and the content taught in PE.

6. I am the best performer in PE.

#### *Attitude and experience in PE (Personal factor)*

7. I'm excited in PE.

8. I am able to gain "fun" experiences in PE.

9. I am always focused during PE.

10. I look forward to every PE class.

#### *Skills and knowledge (Environmental factor)*

11. I have learned sports knowledge in PE.

12. I have learned basic exercise and physical training methods in PE.

13. I have learned how to avoid injuries during physical activity through PE.

#### *Classroom climate (Environmental factor)*

14. In PE, I have the same opportunities to practice as other students.

15. The teacher treats every student equally in PE.

16. The PE class environment is relaxed and enjoyable.

*Facilities, equipment, and norms (Environmental factor)*

17. The university provides adequate facilities and equipment for PE.

18. The sports venues are safe and suitable for PE.

19. The PE course has clear requirements and rules.

20. PE equipment is regularly maintained and updated.

#### *Procedure*

The survey was administered online using the Google Forms platform. Participants received the questionnaire link through university mailing lists and student group messengers. Completion of the survey required approximately 10-12 minutes.

Data collection took place between November and December 2024. Respondents were also asked to provide demographic information, including gender, age, height, weight, year of study, and region. The survey results were stored in the form of six factors, which were conditionally designated as columns 9-14 in the response dataset.

9 - Habituated behavior in PA (Behavioral factor)

10 - Self-efficacy in PE (Personal factor)

11 - Attitude and experience in PE (Personal factor)

12 - Skills and knowledge (Environmental factor)

13 - Classroom climate (Environmental factor)

14 - Facilities, equipment, and norms (Environmental factor).

The SAPPE questionnaire was tested for reliability and construct validity. Data collection was conducted in universities located in both Eastern and Western Ukraine. The questionnaire was distributed through online learning platforms and university email channels. Participation was voluntary, and all respondents were informed in advance about the purpose of the study. After data cleaning and the exclusion of incomplete responses, a total of 89 students and 8 instructors were included in the analysis.

#### Statistical Analysis

Data processing and analysis were performed using the Python programming language (version 3.11) with the libraries *pandas*, *scipy*, *matplotlib*, *seaborn*, and *sklearn*. All data were preliminarily checked for missing values and anomalies. The Shapiro-Wilk test was used to assess the normality of variable distributions. Since most variables did not follow a normal distribution, nonparametric methods were applied for group comparisons, specifically the Mann-Whitney U test. This approach is consistent with recommendations for analyzing nonparametric data [29, 30]. Internal consistency of the scales was assessed using Cronbach's alpha. Construct validity was examined through Spearman's correlation analysis between the scales, as well as exploratory factor analysis (EFA) with varimax rotation, following established practices [31, 32]. Cluster analysis was conducted using the K-means method, with prior standardization of scale data. The optimal number of clusters was determined using the Silhouette score, which was also applied to evaluate clustering quality [33, 34]. Associations between clusters and socio-demographic characteristics (e.g., gender) were analyzed using Pearson's  $\chi^2$  test. Statistical significance was set at  $p < 0.05$ .

## Results

To evaluate the normality of data distributions across the six SAPPE subscales, the Shapiro-Wilk test was applied. The results demonstrated that,

for both Eastern and Western Ukrainian student samples, the distributions of all subscales deviated from normality (p-values ranged from 0.0000 to 0.0469). This justified the use of nonparametric statistical methods for further data analysis.

The reliability of the SAPPE questionnaire was assessed through Cronbach's alpha, calculated across all subscales (items 9-14). The obtained value of 0.894, with a 95% confidence interval [0.856; 0.925], indicates a high level of internal consistency and thus supports the reliability of the instrument.

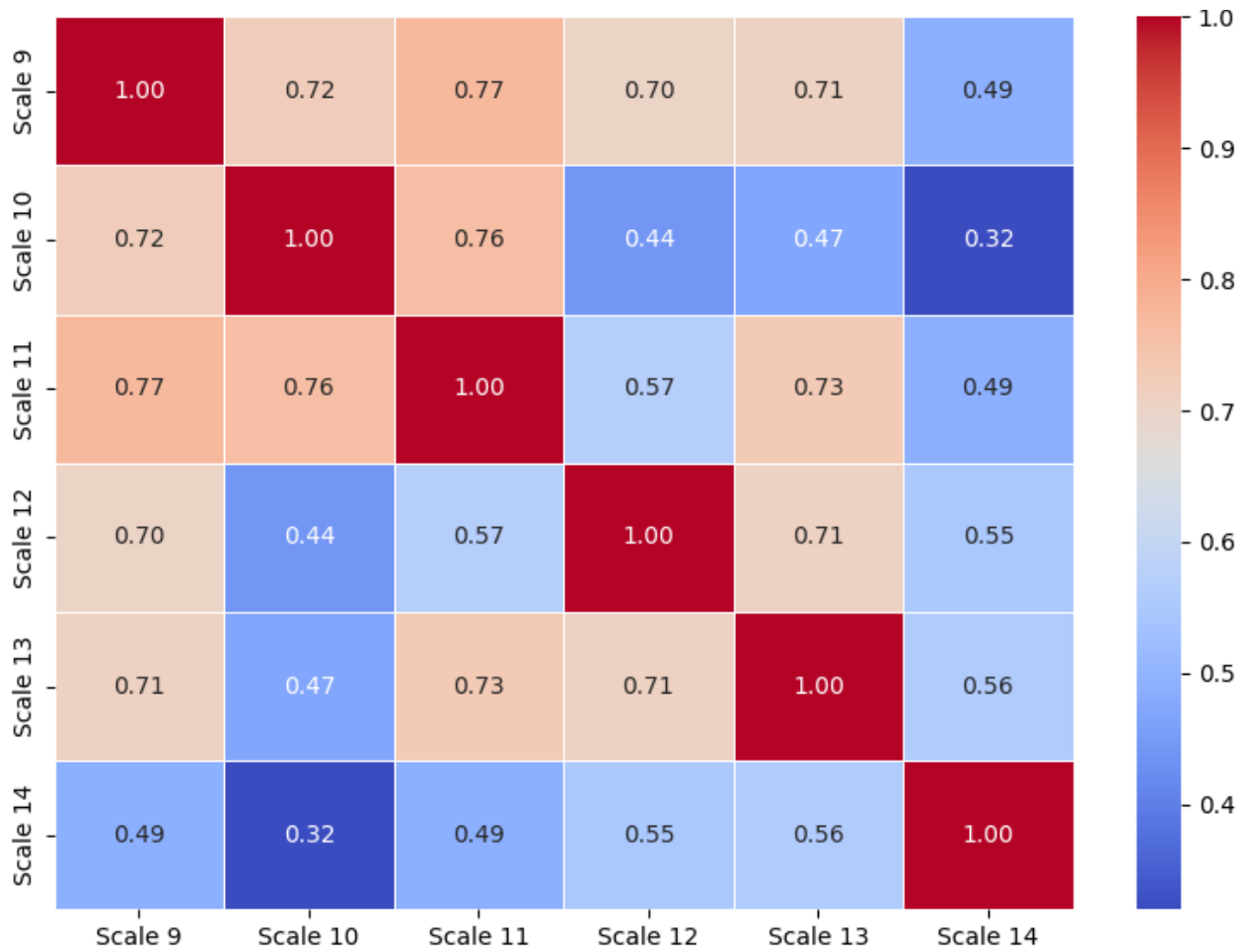
Construct validity was examined through correlation analysis between the subscales (items 9-14) using Spearman's rho ( $\rho$ ) (Figure 1). Correlation coefficients ranged from 0.32 to 0.77, reflecting moderate to strong positive associations among the subscales. All p-values were statistically significant ( $p < 0.05$ ), confirming internal consistency among indicators that capture various aspects of physical activity, attitudes toward physical education, and the learning environment. These findings support the structural validity of the instrument at the level of interscale relationships.

To further assess the factor structure of the questionnaire, an exploratory factor analysis was conducted using the principal components method with varimax rotation. The analysis included subscales 9-14, which reflect different components of students' attitudes toward physical education and their perceptions of the learning environment. The results indicated that, according to Kaiser's criterion (eigenvalue  $> 1$ ), it would be appropriate to retain only one factor. However, the scree plot (Figure 2) displayed a clear inflection between the first and second components, suggesting the possible presence of two latent factors.

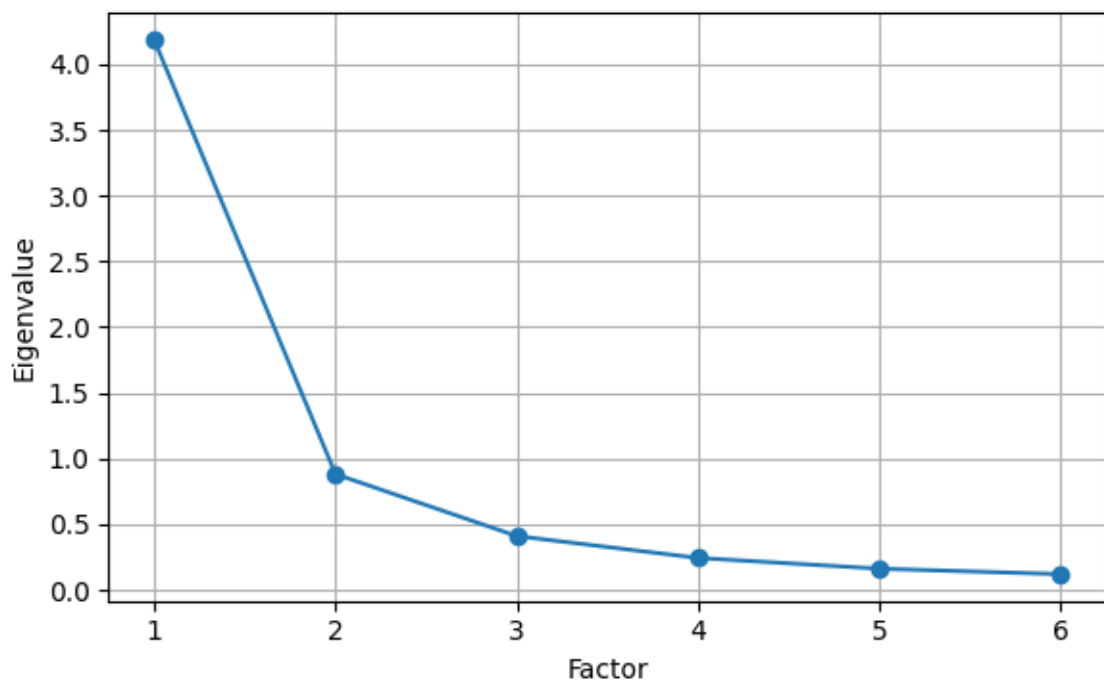
In Figure 2, the first factor (eigenvalue = 4.19) accounts for the largest portion of variance, while the second factor (eigenvalue = 0.88) represents a less substantial component. The scree plot supports the conclusion that two components may adequately explain the structure of the questionnaire.

Regarding factor loadings, most subscales demonstrated values above 0.40, confirming their contribution to the explanation of the latent structure. The first factor group (items 12-14) primarily described infrastructural and organizational conditions, whereas the second group (items 9-11) was focused on motivational and personal components.

Thus, the construct validity of the questionnaire is supported by two complementary methods. First, Spearman's correlation analysis revealed significant associations among all subscales ( $\rho$  ranging from 0.32 to 0.77,  $p < 0.05$ ), indicating high consistency and homogeneity of the measured constructs. Second, exploratory factor analysis confirmed a two-factor structure, reflecting both personal and infrastructural aspects of attitudes toward physical



**Figure 1.** Spearman Correlation Matrix for SAPPE Scales with Student Data from Eastern and Western Ukraine. Note.  $p < 0.05$



**Figure 2.** Eigenvalue plot for determining the optimal number of factors

education. Together, these findings demonstrate the theoretical soundness and internal coherence of the applied instrument.

Thus, the SAPPE questionnaire, adapted for the Ukrainian sample, demonstrated high internal consistency, with an overall Cronbach's alpha of 0.894 (95% CI: 0.856-0.925), indicating strong reliability of the instrument. Construct validity was confirmed through correlation analysis among the subscales ( $\rho = 0.32-0.77$ ,  $p < 0.05$ ) and exploratory factor analysis, the results of which revealed a two-factor structure with eigenvalues of 4.19 and 0.88.

To assess differences in the perception of physical education between students and instructors, scores on five SAPPE subscales were analyzed. The Mann-Whitney U test was applied, as the distributions of the indicators did not meet the criteria for normality (Table 2).

The results (Table 2) indicated no statistically significant differences between student and instructor scores across all SAPPE subscales ( $p > 0.05$ ). The largest divergence was observed for Subscale 1, where instructors demonstrated a tendency toward higher ratings of students' habituated behavioral patterns (median = 19.5 vs. 17.0;  $p = 0.1068$ ;  $r = 0.163$ ); however, this difference did not reach statistical significance. For the remaining subscales (2, 3, 4, and 5), median values were similar across the groups, and the effect sizes suggested weak or very weak differences ( $r < 0.13$ ). These findings suggest a general alignment in perceptions of the key components of physical education between students and their instructors.

To examine the structure of interrelationships among the five SAPPE subscales in the student

sample, Spearman's rank-order correlation coefficient was applied to assess the direction and strength of associations between the scales. All obtained coefficients were statistically significant ( $p < 0.001$ ), indicating stable positive correlations across the subscales. The values of Spearman's correlation coefficients ( $\rho$ ) are presented in Figure 3.

The strongest association (Figure 3) was observed between Subscales 1 and 3 ( $\rho = 0.77$ ), indicating a close link between habituated behavioral patterns and a positive attitude toward physical education classes. Substantial correlations were also found between Subscales 3 and 5 ( $\rho = 0.73$ ), 1 and 2 ( $\rho = 0.72$ ), and 4 and 5 ( $\rho = 0.71$ ). These results confirm the interdependence of components that shape positive perceptions of physical education and provide further support for the construct validity of the SAPPE questionnaire.

To identify latent profiles of students based on their perceptions of physical education, a cluster analysis was conducted using the five SAPPE subscales. The k-means procedure was applied after prior z-transformation of the data. Evaluation of clustering quality using the silhouette metric indicated that the optimal solution was achieved at  $k = 3$  (Figure 4). Table 3 presents the median values for each SAPPE subscale across the three identified clusters.

Analysis of median values across the SAPPE subscales allowed for the identification of three typological student profiles (Table 3). The clustering revealed differences in attitudes, self-efficacy, knowledge, skills, and perceptions of the learning environment, reflecting the heterogeneity of the student population in the context of physical

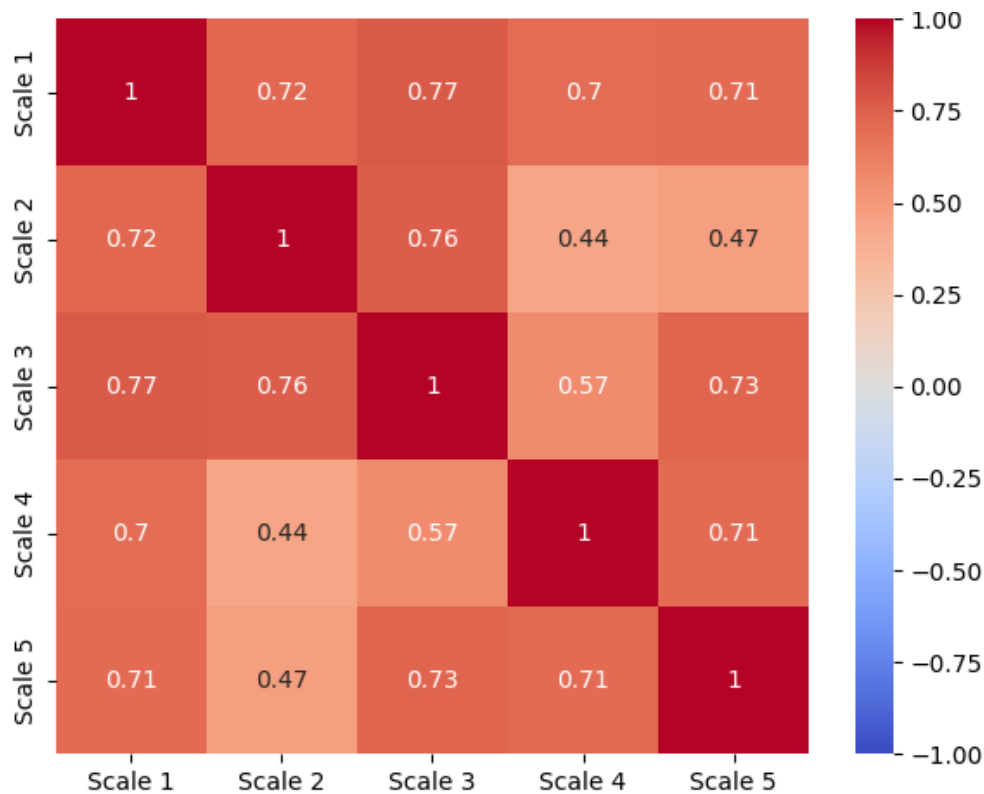
**Table 2.** Comparison of student and instructor scores across SAPPE subscales

Scale no.	Factor	Median (students)	IQR (students)	Median (instructors)	IQR (instructors)	p-value	Effect size (r)
1	Habituated behavior in PA	17.0	6.0	19.5	1.5	0.1068	0.163
2	Self-efficacy in PE	14.0	8.0	17.5	3.0	0.2185	0.125
3	Attitude and experience in PE	23.0	9.0	24.0	2.0	0.3605	0.093
4	Skills and knowledge	18.0	4.0	17.5	1.75	0.7960	0.027
5	Classroom climate	19.0	6.0	19.5	3.25	0.5156	0.065

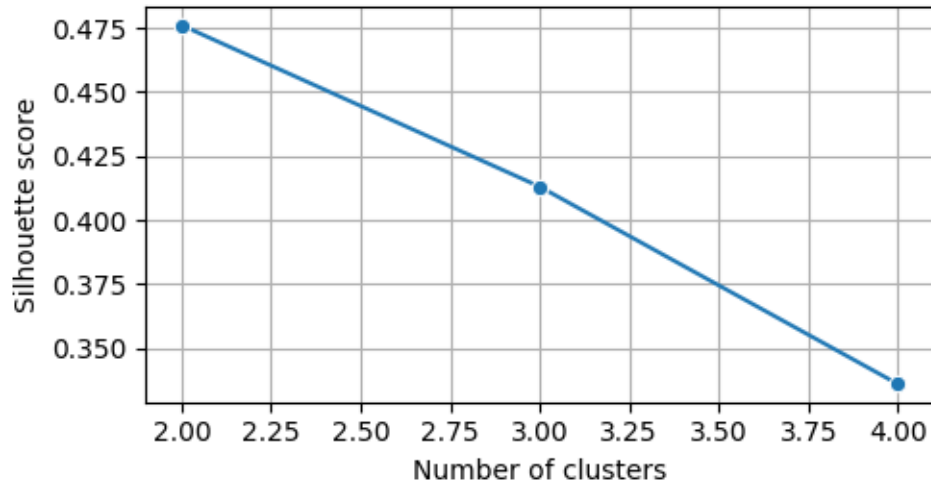
Note: IQR – interquartile range; r – effect size.

**Table 3.** Median values for SAPPE subscales across identified student clusters

Cluster / Subscale no.	1	2	3	4	5
0	13.0	9.5	16.0	15.0	15.5
1	19.5	18.0	25.0	18.0	20.5
2	9.0	7.0	7.0	8.0	8.0



**Figure 3.** Matrix of pairwise Spearman rank correlation coefficients among SAPPE subscales in the student sample. Note:  $\rho$  – Spearman’s coefficient; all correlations statistically significant at  $p < 0.001$ .



**Figure 4.** Evaluation of clustering quality using the silhouette metric

education.

- *Cluster 1* ( $n = 54$ ): Students with high scores across all SAPPE components. These participants demonstrated a positive and stable attitude toward physical education, strong self-efficacy, well-developed knowledge and skills, and a favorable perception of the classroom climate. This profile indicates high intrinsic motivation and active engagement in the educational process.
- *Cluster 0* ( $n = 30$ ): Students with moderate scores.

- Their attitudes toward physical education can be described as neutral or moderately positive. Levels of self-efficacy and habituated behaviors were less developed compared to Cluster 1. This profile suggests potential for pedagogical support and motivation enhancement.
- *Cluster 2* ( $n = 5$ ): The smallest group, characterized by low scores across all scales. This may indicate weak motivation, limited engagement, or negative experiences with the physical education system. Such students may

require special attention from instructors and potentially individualized support strategies.

The identified profiles should be considered in the development of differentiated teaching approaches, adaptation of programs, and the creation of a supportive learning environment, particularly under wartime conditions and associated constraints.

To assess potential differences between clusters by student gender, Pearson’s  $\chi^2$  test was applied. The distribution of students by gender across the identified clusters is presented in Table 4.

**Table 4.** Distribution of students by gender across identified clusters

Cluster	Men (1)	Women (2)
0	16	14
1	32	22
2	1	4

Note: expected values according to Pearson’s  $\chi^2$  test: Cluster 0: 16.5 men and 13.5 women; Cluster 1: 29.7 men and 24.3 women; Cluster 2: 2.8 men and 2.2 women

The results of Pearson’s  $\chi^2$  test indicated no statistically significant differences between clusters by student gender:  $\chi^2 = 2.905$ ,  $p = 0.2340$ ,  $df = 2$ . This finding suggests that the distribution of students across clusters was not dependent on gender.

To further analyze the characteristics of SAPPE

components, students were categorized into levels of expression for each of the six subscales. The analysis was conducted for the entire sample as well as separately by gender. A three-level classification was applied: low, medium, and high, based on the total scores for each subscale (Table 5).

As shown in Table 5, high-level scores predominated across all subscales, particularly for Subscales 5 (*Classroom climate*) and 4 (*Skills and knowledge*). Male students demonstrated slightly higher levels across most subscales; however, the differences between genders were not pronounced. The lowest number of low scores was recorded for Subscale 4, suggesting good mastery of the educational material in the field of physical education.

To assess general trends in students’ perceptions of physical education and related infrastructure, descriptive statistics ( $M \pm SD$ ) were calculated for the SAPPE subscales (Table 6). To evaluate the statistical significance of differences between groups, the Mann-Whitney U test was applied, with medians and effect sizes additionally reported.

The data presented in Table 6 indicate that male students consistently scored slightly higher across all subscales compared to female students. The largest difference was observed for Subscale 3 (21.6 in men vs. 19.9 in women), suggesting a more positive experience of participation in physical

**Table 5.** Distribution of students by levels of SAPPE subscales (total and by gender)

Scale no.	Subscale name	Low (all)	Medium (all)	High (all)	Low (men)	Medium (men)	High (men)	Low (women)	Medium (women)	High (women)
1	Habituated behavior in PA	3	24	62	2	11	36	1	13	26
2	Self-efficacy in PE	14	35	40	8	18	23	6	17	17
3	Attitude and experience in PE	5	24	60	3	11	35	2	13	25
4	Skills and knowledge	1	17	71	0	7	42	1	10	29
5	Classroom climate	2	9	78	1	4	44	1	5	34

Note: (All) = men + women; levels determined by total scores: low = lower quartile, medium = interquartile range, high = upper quartile.

**Table 6.** Mean values and standard deviations for SAPPE subscales among students (n = 89)

Scale no.	All (M ± SD)	Men (M ± SD)	Women (M ± SD)
1	16.4 ± 4.1	17.0 ± 3.9	15.7 ± 4.2
2	13.9 ± 5.0	14.2 ± 4.9	13.6 ± 5.1
3	20.8 ± 5.9	21.6 ± 5.8	19.9 ± 5.9
4	16.7 ± 3.6	17.1 ± 3.2	16.1 ± 4.1
5	17.8 ± 3.8	18.2 ± 3.5	17.2 ± 4.1

Note: All = men + women.

education classes among men. Similar trends were also evident in the other subscales, with men reporting stronger habituated behaviors, higher self-efficacy, and a more favorable perception of the classroom climate.

To assess gender-based differences across the five SAPPE subscales, the Mann-Whitney U test was applied, as the distributions did not meet the assumptions of normality. The results are presented in Table 7.

Analysis of Table 7 showed that men had slightly higher median values across all subscales compared to women; however, none of the differences reached statistical significance ( $p > 0.05$  in all cases). The largest discrepancy was observed for Subscale 3, where the effect size was  $r = 0.178$ , suggesting a weak tendency toward a more positive experience of physical education among men. In contrast, for Subscale 2, the medians were identical, and the effect size was minimal. These findings indicate a range of shared characteristics in perceptions of physical education between men and women, with only minor differences observed in certain aspects.

For a more detailed interpretation of the results, students were further categorized by levels of expression (low, medium, high) for each of the six subscales. The highest proportion of students scoring at the high level was observed for Subscale

5 (78 students), while the lowest proportion was recorded for Subscale 2 (40 students). These differences suggest varying degrees of perception of the learning environment and motivation among the participants.

For a more detailed analysis, the distribution of levels of SAPPE component development was compared between students from Eastern and Western Ukraine (Table 8).

The data presented in Table 8 show that in both Eastern and Western Ukraine the majority of students achieved high levels across the key components, particularly on Subscales 5 and 4. At the same time, certain differences were observed: for example, students from Eastern Ukraine demonstrated a higher proportion of respondents scoring at the high level on Subscale 5, whereas in Western Ukraine more students reached high levels on Subscales 4 and 2. These differences may be explained both by objective characteristics of the educational environment and by students' subjective orientations, which vary depending on the region of residence and study.

For a more in-depth analysis, mean values and standard deviations for each of the six SAPPE subscales were calculated separately for students from Eastern and Western Ukraine, taking gender into account (Table 9). These data make it possible

**Table 7.** Gender differences across SAPPE subscales (Mann–Whitney U test)

Scale no.	Median (men)	Median (women)	p-value	Effect size (r)
1	18.0	16.0	0.1336	0.158
2	14.0	14.0	0.5708	0.060
3	23.0	22.0	0.0923	0.178
4	18.0	16.5	0.3273	0.103
5	20.0	19.0	0.2642	0.116

**Table 8.** Distribution of students from Eastern and Western Ukraine by levels of SAPPE component development

Scale no.	Low (all)	Medium (all)	High (all)	Low (men)	Medium (men)	High (men)	Low (women)	Medium (women)	High (women)
<b>Eastern Ukraine</b>									
1	0	15	38	0	7	21	0	8	17
2	6	24	23	2	13	13	4	11	10
3	2	14	37	1	6	21	1	8	16
4	0	11	42	0	5	23	0	6	19
5	0	7	46	0	3	25	0	4	21
<b>Western Ukraine</b>									
1	3	9	24	2	4	15	1	5	9
2	8	11	17	6	5	10	2	6	7
3	3	10	23	2	5	14	1	5	9
4	1	6	29	0	2	19	1	4	10
5	2	2	32	1	1	19	1	1	13

Note: The table presents the absolute number of students at low, medium, and high levels across the five SAPPE subscales, including breakdown by gender.

to identify specific differences in the perception and experience of physical education among groups exposed to varying social and educational conditions.

Analysis of the mean values presented in Table 9 shows that overall, the indicators of both groups are at a comparable level; however, certain trends can be observed:

- Students from Eastern Ukraine reported slightly higher mean values on Subscales 3 and 5, which may reflect a more favorable perception of the learning environment despite challenging external circumstances.
- Students from Western Ukraine showed marginally higher mean values on Subscale 4, particularly among men.
- Gender-based differences persisted in both groups, with men generally scoring somewhat higher across most subscales.

These findings emphasize the importance of considering both regional and gender contexts when developing educational strategies in the field of physical education.

To assess differences in the perception of physical education components between students from Eastern (n = 53) and Western (n = 36) Ukraine,

the Mann-Whitney U test was applied, as the distributions of SAPPE subscales did not meet the assumptions of normality. Table 10 presents the median values for each subscale, along with p-values and effect sizes (r).

Analysis of Table 10 revealed no statistically significant differences between the groups on any of the subscales (p > 0.05 in all cases). However, several tendencies can be noted:

- Students from Eastern Ukraine demonstrated slightly higher median values on Subscales 3 and 5, which may indicate a more positive perception of the educational environment despite the challenging conditions of the region.
- In the Western student group, the median value for Subscale 2 was marginally higher, although the difference was not statistically significant.
- Effect sizes across all comparisons were low (r < 0.2), indicating weak differences between the regions.

Thus, the regional differences in the perception of physical education among Ukrainian university students recorded in this study were not pronounced. Nevertheless, certain aspects warrant further investigation in light of the wartime context.

**Table 9.** Mean values of SAPPE subscales among students from Eastern Ukraine (n = 53) and Western Ukraine (n = 36)

Scale no.	All (M ± SD)	Men (M ± SD)	Women (M ± SD)
<b>Eastern Ukraine (n = 53)</b>			
1	16.7 ± 3.4	17.2 ± 3.2	16.2 ± 3.5
2	14.0 ± 4.9	14.3 ± 4.4	13.6 ± 5.4
3	21.2 ± 5.5	22.1 ± 5.0	20.0 ± 5.8
4	16.9 ± 3.4	16.9 ± 3.1	16.8 ± 3.8
5	17.9 ± 3.5	18.5 ± 3.2	17.2 ± 3.7
<b>Western Ukraine (n = 36)</b>			
1	16.0 ± 5.0	16.8 ± 4.7	15.0 ± 5.3
2	13.8 ± 5.3	14.0 ± 5.7	13.7 ± 4.9
3	20.4 ± 6.5	21.0 ± 6.7	19.6 ± 6.3
4	16.4 ± 3.9	17.4 ± 3.2	15.0 ± 4.3
5	17.5 ± 4.3	17.8 ± 4.0	17.1 ± 4.9

**Table 10.** Comparison of SAPPE subscale medians among students from Eastern and Western Ukraine (Mann–Whitney U test)

Scale no.	Median (East)	Median (West)	p-value	Effect size (r)
1	17.0	17.5	0.8201	0.024
2	14.0	14.0	1.0000	0.000
3	22.0	23.0	0.8669	0.018
4	18.0	18.0	0.6331	0.051
5	19.0	19.0	0.7617	0.032

Note: The table presents medians, p-values, and effect sizes (r) for each of the five SAPPE subscales. The analysis was conducted using the Mann-Whitney U test due to the non-normal distribution of the data.

## Discussion

The aim of this study was to analyze the structure and level of development of components of the physical education learning environment among Ukrainian university students under wartime conditions using the adapted SAPPE questionnaire. The findings revealed a high level of formation of such components as *Classroom Climate* and *Skills and Knowledge*, as well as statistically significant interscale correlations. It was also established that students from Western Ukraine, who study predominantly in offline settings, demonstrate higher scores on most subscales compared to their peers from Eastern Ukraine, who are exposed to the challenges of distance learning and elevated stress levels.

### *Perceptions of the Educational Environment: Cross-National Tools and Regional Implications*

The development and implementation of questionnaires for assessing components of physical education remain an important focus in international research. For instance, in China, the SAPPE scale was validated to measure students' perceptions of the learning environment across six subscales, including behavioral attitudes, self-efficacy, classroom climate, and infrastructure [5]. In other regions, instruments have been designed and adapted to evaluate the quality of physical education, sustainable development, and attitudes toward the use of digital technologies in PE. For example, a scale with eight dimensions for assessing the quality of physical education was developed and validated in Asia [5], while in Spain a tool for evaluating sustainable physical education was introduced [35]. In Germany, a questionnaire on the perception of video-based instruments in PE was validated [36], and in China additional instruments were created to analyze the implementation of school PE programs [37] and to assess the quality of physical education [38]. In Serbia, social, lifestyle, and health-related factors among students were identified [39]. These developments highlight the relevance and diversity of approaches to investigating the educational environment in PE. The results of the present study align with these directions and support the use of the comprehensive SAPPE scale for evaluating factors that influence student engagement.

The combined results confirm that the perception of a positive educational environment, including classroom climate, self-efficacy, and motivation, plays a decisive role in shaping students' sustainable attitudes toward physical activity, as supported by both the present findings and international literature [1, 2, 4]. High scores on the "Classroom Climate" scale, particularly among students from Western Ukraine, may reflect the presence of a favorable learning atmosphere characterized by support from teachers and students. Such conditions foster not

only academic engagement but also strengthen self-efficacy. At the same time, the observed regional differences may be attributed to the specific organization of the educational process: universities in Eastern Ukraine predominantly rely on distance learning due to the ongoing war, whereas in Western Ukraine classes are more frequently held offline. This factor, together with broader social instability, is likely to influence students' perceptions of the learning environment and their level of motivation [9, 10]. These regional differences should be taken into account when interpreting the educational environment and students' engagement in physical activity.

### *Interpretation of Cluster Profiles*

The two-cluster solution derived from the analysis provides insight into distinct patterns of student engagement with physical education during wartime. Students in the first cluster reported high scores in Classroom Climate, Self-Efficacy, and Attitudes toward Physical Education. This profile suggests a group of learners with strong intrinsic motivation and a perception of physical education as a socially supportive and meaningful activity. In contrast, the second cluster was marked by lower levels of self-efficacy and less favorable perceptions of the classroom environment, although slightly higher scores were observed in items related to formal structures and infrastructure. This may reflect a group whose participation is driven more by external expectations or institutional norms than by internalized value. These differentiated patterns align with findings from studies in Saudi Arabia and Qatar, which have reported similar splits in motivational profiles related to gender and perceived competence [22, 23]. For Ukrainian universities, these profiles highlight the need for flexible instructional strategies: one-size-fits-all approaches are unlikely to address the needs of both highly engaged and less motivated students, particularly under conflict-driven educational constraints. These distinct profiles underscore the heterogeneity of student experiences and the need for differentiated pedagogical responses.

### *International and National Evidence on Physical Education and Student Well-Being*

*International evidence.* Cross-national and local studies consistently emphasize the importance of evaluating the educational and physical education environment in relation to student well-being, particularly under conditions of conflict and social instability. In post-conflict Uganda, participation in sports programs was associated with improvements in both physical fitness and psychological well-being among adolescents [6, 25]. A systematic review conducted by Hamilton et al. confirmed the effectiveness of physical activity interventions in restoring mental health in crisis-affected regions [16].

In South Africa, during the FeesMustFall movement characterized by episodes of unrest and institutional disruption, the educational environment emerged as a key factor influencing students' subjective well-being. This was demonstrated through qualitative methods including photo-elicitation and self-report questionnaires [7, 40]. Other studies in conflict-affected contexts have also highlighted the supportive role of physical education in promoting mental health and encouraging a constructive attitude toward learning [3, 8].

*Ukrainian context and alignment with present findings.*

Comparable patterns have been observed in recent Ukrainian studies. Skrypchenko et al. [17] found that students were able to maintain moderate levels of physical activity during wartime, particularly when supported by flexible learning formats and a positive educational atmosphere. Byshevets et al. [18] demonstrated a statistically significant association between physical activity and reduced symptoms of stress and anxiety, which confirms the value of physical education as a means of psychological support. Rohal et al. [19] identified a decline in motivation to engage in physical activity under martial law, most notably among female students. This trend is reflected in the present study's gender analysis. Kurapov et al. [20] reported a general deterioration in the psycho-emotional state of both students and faculty, which further illustrates the need for adaptive pedagogical approaches during wartime.

Findings from the present study contribute to this body of evidence. Consistent with earlier findings, students in Western Ukraine maintained more positive perceptions of classroom climate and infrastructure. These results affirm the applicability of standardized instruments such as the SAPPE questionnaire in conflict settings. These results reaffirm previously identified links between educational climate and student motivation, even under wartime conditions. The observed regional differences reinforce the necessity of tailoring educational programs to the specific conditions of each region, with careful attention to the effects of armed conflict on both infrastructure and psychological well-being.

*Gender-Specific Patterns in Student Perception*

The observed gender-related differences in the perception of the educational environment among Ukrainian students are consistent with a range of international findings. A study conducted in Qatar demonstrated that boys and girls differed significantly in both physical activity levels and academic performance associated with physical education classes [22]. Lauderdale et al. reported that men exhibited stronger motivation for physical activity, largely driven by internal self-determination factors [24]. Similar results were found among

Chinese students, where gender and self-efficacy significantly influenced both motivation and actual engagement in physical activity [4]. Furthermore, evidence from Saudi Arabia indicated that under online learning conditions, female students reported higher satisfaction of psychological needs, whereas male students more often experienced a lack of motivation [23]. These findings align with the results of the present study, where female students more frequently showed positive evaluations on the "Classroom Climate" and "Self-efficacy" scales, while male students tended to demonstrate moderate or lower scores. This pattern may reflect gender-specific adaptation to the educational environment under wartime conditions. At the same time, other factors not captured in this study, such as students' socioeconomic status, access to sports infrastructure, or the professional training of instructors, could also have contributed to differences in perception.

*Validation Implications and Synthesis of Findings*

The findings support the contextual validity and adaptability of the SAPPE scale as an instrument for assessing students' perceptions of the physical education environment in conflict-affected settings. The scale demonstrated consistent performance in measuring key components such as classroom climate, self-efficacy, and attitudes toward physical activity, even under conditions of educational disruption and psychological stress. This confirms that standardized assessment tools, when appropriately adapted, can yield meaningful data in unstable environments. Furthermore, the results highlight the necessity of flexible and individualized pedagogical strategies to sustain students' engagement and well-being during wartime, reinforcing the value of evidence-based educational monitoring in times of crisis. The SAPPE scale may be integrated into institutional monitoring tools to track student adaptation, inform PE curriculum revisions, and guide targeted interventions across regions.

*Pedagogical Implications in Contexts of Regional Disparities*

The exclusion of Factor 6 (Facilities, Equipment, and Norms) from interregional comparisons highlights a critical pedagogical challenge. The physical conditions under which physical education is delivered differ significantly across Ukraine. In the eastern regions, proximity to the war zone has resulted in the destruction or inaccessibility of sports infrastructure. This situation limits the feasibility of traditional forms of physical activity. To address these disparities, institutions should consider implementing flexible and context-sensitive formats of physical education. These may include home-based training programs, physical activity sessions that require minimal equipment, and digital tools

for monitoring and encouraging participation. At the same time, educators are encouraged to focus on motivational and psychosocial components of physical education. Elements such as self-efficacy and perceived support remain relevant and impactful, even in infrastructure-poor settings. Such tailored strategies are essential to ensure educational equity and to maintain students' well-being in both stable and conflict-affected regions.

#### *Limitations and Directions for Future Research*

Despite the significant results obtained, this study has several limitations. First, the data were collected during an ongoing war, which may have influenced the emotional state of respondents and their perception of the survey questions. Second, the sample included only a limited number of universities, primarily from the eastern and western regions of Ukraine, which restricts the generalizability of the findings to the entire country. Third, although the SAPPE scale has demonstrated validity, it requires further testing across broader social and cultural contexts. These limitations notwithstanding, the findings provide a valuable snapshot of student perceptions during a critical phase of Ukraine's educational restructuring. Future research could focus on longitudinal analyses of changes in perceptions of physical education over time as well as cross-country comparisons with student samples from other crisis-affected settings.

### Conclusions

This study confirmed the contextual validity and internal reliability of the SAPPE scale for assessing perceptions of the physical education environment among Ukrainian university students during wartime. The results demonstrated consistently

high scores on the "Classroom Climate" and "Self-efficacy" subscales. These findings indicate that students were able to maintain positive attitudes toward physical education despite elevated stress and limited access to traditional learning formats. Significant regional variation in responses was also observed. Higher scores reported by students in Western Ukraine suggest that social and organizational factors influence perceptions of the learning environment. These outcomes support the need to adapt educational strategies to local conditions and to apply validated tools for ongoing assessment of the educational context during prolonged emergencies.

### Practical Implications

The SAPPE scale serves as a practical and reliable tool for monitoring students' perceptions of physical education within higher education institutions. It can assist educators, university staff, and policy makers in evaluating student motivation, self-efficacy, and perceived support under various instructional settings. The scale is particularly useful when teaching takes place remotely or when physical infrastructure is limited. Regular use of this instrument may help identify challenges, inform instructional improvements, and support the development of inclusive and resilient physical education programs. The integration of SAPPE-based assessments into institutional practices may contribute to safeguarding student well-being and sustaining engagement during periods of instability.

### Conflict of interests

The authors declare that there is no conflict of interests.

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