Psychological effects of different active break modalities during university classes

Efectos psicológicos de las diferentes modalidades de descansos activos durante las clases universitarias

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Abstract

Introduction: Despite growing evidence of the benefits of active breaks, research in university populations remains limited.
Objective: To investigate the impact of various active break types on motivation, attention, mood, and mental fatigue in university students.
Methodology: A quasi-experimental design with repeated pre- and post-test measurements was conducted. Participants were undergraduate students with a mean age of 19.86 years (SD = 1.62). They attended 10 weeks of sessions that either incorporated or omitted short active breaks lasting 3–5 minutes. These breaks included active games, yoga-based stretching, high-intensity interval exercises, and dance routines. The outcomes: mood, mental fatigue, attention, and motivation, were assessed using Visual Analogue Scales administered at three time points during each session. Linear mixed-effects models and Bonferroni-adjusted post hoc comparisons were performed.
Results: Analyses showed significant Condition × Time interactions for motivation ($p<0.001$), attention ($p<0.001$), and mental fatigue ($p=0.003$), but not mood ($p=0.168$). Compared with no active break, dance produced higher motivation and attention and lower mental fatigue at mid-class, with attention remaining higher at the end of the class. Games resulted in higher motivation and attention at both mid-class and end-class. Yoga showed higher motivation and attention at mid-class, whereas HIIT only produced higher motivation at mid-class. No significant differences were found for mood, among active-break modalities, or according to sex.
Conclusion: Active breaks were associated with favourable acute effects on motivation, attention, and mental fatigue during university classes. Although the pattern of significant outcomes varied across modalities, none was significantly superior to the others.

Keywords

Attention; mental fatigue; mood; motivation; university students.

Resumen

Introducción: A pesar de la evidencia sobre los beneficios de los descansos activos, la investigación en universitarios es limitada.
Objetivo: Analizar el impacto de diversas modalidades de descansos activos en la motivación, atención, estado de ánimo y fatiga mental en estudiantes universitarios.
Metodología: Diseño cuasiexperimental de medidas repetidas pre y postest con estudiantes de grado (media = 19.86 años, DE = 1.62). Durante 10 semanas se aplicaron sesiones con o sin descansos activos (3-5 min) de cuatro modalidades: juegos, yoga, HIIT y danza. Las variables se evaluaron mediante escalas visuales analógicas en tres momentos por sesión, analizándose con modelos lineales de efectos mixtos y comparaciones post hoc de Bonferroni.
Resultados: Se hallaron interacciones significativas Condición X Tiempo para motivación ($p < 0.001$), atención ($p < 0.001$) y fatiga mental ($p = 0.003$). En comparación al descanso pasivo, la danza mejoró motivación, atención y fatiga a mitad de clase, manteniendo la atención alta al final. Los juegos aumentaron motivación y atención a mitad y final de la sesión. El yoga incrementó motivación y atención a mitad de clase, y el HIIT solo la motivación en ese momento. No hubo diferencias significativas en estado de ánimo, entre modalidades ni por sexo. Conclusión: Los descansos activos inducen efectos agudos favorables en motivación, atención y fatiga mental en universitarios. Pese a las variaciones en los patrones de resultados entre modalidades, ninguna demostró ser estadísticamente superior a las demás.

Palabras Clave

Alumnado universitario; atención; bienestar; fatiga mental; motivación.

Introduction

Physical activity (PA) is widely recognized as a key factor in promoting physical and mental health across the lifespan (Strain et al., 2024). Evidence in children and adolescents indicates that regular PA is associated with better mental health and may reduce symptoms of anxiety and depression, improve mood, and increase overall life satisfaction (Rodriguez-Ayllon et al., 2019). In educational settings, brief bouts of PA can contribute to improving academic performance (Muntaner-Mas et al., 2024) and classroom behavior (Reyes-Amigo et al., 2025b) among school-aged populations. Active breaks (AB), defined as short periods of PA integrated into academic lessons, have emerged as a practical strategy to counteract the sedentary behaviour often associated with prolonged classroom sessions. A growing body of research supports the benefits of AB in educational settings, particularly in primary education, although evidence has also been reported in secondary schools. In primary school settings, brief classroom-based PA breaks have been associated with better classroom conduct and gains in academic achievement (Watson et al., 2017). Research also suggests benefits for students' attention and motivation (Infantes-Paniagua et al., 2021; Méndez-Giménez et al., 2023). For instance, a systematic review by Daly-Smith et al. (2018) found that AB ranging from 5 to 15 minutes were associated with increased time-on-task in children. Similarly, a meta-analysis by Norris et al. (2020) highlighted the positive effects of physically active learning on both PA levels and academic outcomes in primary school students. However, evidence in the existing literature remains inconsistent, as some interventions have failed to demonstrate improvements in specific academic outcomes, such as mathematics learning (Wang & Chen, 2023). In secondary school populations, benefits of AB on academic performance have likewise been reported (Xu et al., 2023). Despite the extensive evidence supporting the benefits of AB in school age, there is a notable lack of research on their effectiveness in university students (Lynch et al., 2022).

Early adulthood is marked by reduced PA, and university students are especially sedentary, with rising health risks (Kwan et al., 2012; Castro et al., 2020). Long lectures increase fatigue and mind wandering, lowering retention, whereas mid-class active breaks provide relief and support attention and learning (Farley et al., 2013; Kotnik et al., 2024). Incorporating AB into university lectures is a practical and feasible strategy to reduce prolonged sitting among students (Keating et al., 2020), decreasing sedentary behaviour while enhancing PA, alertness, concentration, and overall enjoyment (Peiris et al., 2021). Moreover, students perceive AB as a viable approach for university classrooms, showing high acceptance and recognizing their effectiveness in boosting energy, enhancing the classroom environment, and positively impacting the teaching-learning process (Vidal-Conti et al., 2025). Students preferred lectures with ABs over traditional classes, highlighting their feasibility and positive impact in a large university setting (Hayes, 2024; Garcia-Taibo et al., 2026). Thus, these findings suggest that AB not only support academic success but also contribute to the holistic development of students by promoting mental and emotional health (Lynch et al., 2022).

Regarding the types of AB included in studies conducted in university settings, most focused on a single type of PA, typically walking, running or aerobic exercises (Lynch et al., 2022). However, interventions involving activities such as yoga, dance, games, or HIIT are less common. For instance, a yoga-based intervention was found to enhance energy levels and motivation compared to a passive control condition, highlighting its potential benefits (Young-Jones et al., 2022). Similarly, dance-based AB seemed to be an effective way to incorporate PA into the classroom while enhancing students' well-being and attention (Lobach et al., 2024). On the other hand, AB interventions based on high-intensity interval training (HIIT) using calisthenic exercises are scarce in the university context. These interventions, which involve performing different movements (jumping jacks, heel taps, high knees, split jumps, and hamstring kickers) for short periods with rest intervals between exercises, have been shown to improve attention and learning in university students (Fenesi et al., 2018). It is important to highlight that these studies based on yoga, dance and HIIT were limited to a single AB, even without a control group, which weakens their validity. Finally, game-based AB combined with plyometrics have been implemented in primary school students, demonstrating physical and behavioral benefits (Sortwell et al., 2024), while playful games have also been shown to enhance motivation (Mendoza-Muñoz et al., 2022). However, the effects of game-based approaches on university populations remain largely unexplored. Thus, considering the scarcity of studies, the exploratory nature of most research, and the overall low quality, further high-quality research is needed to draw more reliable conclusions (Lynch et al., 2022). Beyond this empirical gap, a theoretical rationale is also needed to explain why different AB modalities might produce distinct effects.

At a general level, AB may transiently influence alertness and cognitive performance through arousal-related and neurochemical mechanisms, although these effects may depend on the intensity, duration, and demands of the activity performed (McMorris, 2016). Therefore, different AB modalities may produce additional and partially distinct effects depending on their specific physiological, cognitive, and affective-motivational demands. Yoga-, dance-, and game-based AB may involve greater cognitive and affective-motivational engagement, although through different pathways. Yoga-based AB may require internally oriented attention, breathing control, body awareness, and emotional regulation, which may help reduce mental fatigue and improve mood (Gard et al., 2014). Dance- and game-based AB may involve more externally oriented and socially embedded cognitive engagement, combining movement with rhythm, coordination, rules, decision-making, memory, and social interaction. Such activities may influence attention and executive functioning more strongly than less cognitively demanding activities because they require attentional control and mental effort (Tomporowski et al., 2015). In addition, playful and socially meaningful AB may enhance motivation by supporting perceived competence, autonomy, and relatedness, as proposed by Self-Determination Theory (Ryan & Deci, 2000). Finally, HIIT-based AB may mainly act through increased physiological activation, which can transiently influence alertness, attention, and executive functioning (McMorris, 2016).

Given the potential benefits of various AB modalities, further research is needed to explore a wider diversity of AB interventions in university settings. Notably, research comparing the effectiveness of different types of AB across all ages is limited, including university populations. Since most studies have evaluated a single modality (e.g., aerobic exercises, yoga, dance), it remains unclear which type is more beneficial. This gap highlights the need for studies that directly compare the effects of different types of AB on university students' cognitive, emotional, and academic outcomes. Understanding the differential effects of various AB interventions is crucial for developing tailored strategies that maximize the benefits for students, especially considering the impact of sedentary behaviour and prolonged cognitive demands on university students' well-being.

The present study aims to assess the effects of different types of AB on university students' motivation, attention, mood, and mental fatigue to identify the most effective strategies for promoting cognitive and emotional well-being in university settings. As a secondary objective, the study aims to determine whether, by the end of the class, the AB condition leads to improved scores across these outcomes compared to the control condition.

Method

Design

A quasi-experimental design with repeated pre- and post-test measurements was implemented. Participants underwent two conditions—control (without AB) and experimental (with AB)—in a randomized order.

Participants

A convenience sample of undergraduate students enrolled in primary school teacher training and sports science programs at the University of the Balearic Islands and Comillas Pontifical University were invited to participate. In total, 96 students took part, comprising 73.6% males and 26.4% females, with a mean age of 19.86 years (SD = 1.62). Most students had a moderate-to-high level of physical activity (6.4% low, 30.4% moderate, 63.2% high) according to the IPAQ results. This study received approval from the Research Ethics Committee of the University of the Balearic Islands.

Intervention

The intervention consisted of implementing an AB around the midpoint of a session, delivered during 10 weeks from March to May 2024. There were two main conditions: sessions with AB and sessions without AB, ensuring a minimum interval of 24 hours between each of them. Active breaks could be of four different types, creating four subconditions: active games, yoga, high-intensity interval training

(HIIT) exercises, and dance. To minimize potential order effects, conditions were counterbalanced: some groups completed the active-break (AB) sessions first and then the control sessions, whereas others followed the reverse sequence (control first, then AB). A 3–5 minute active break was planned for approximately the middle of each session, allowing some flexibility. Teachers could choose the most suitable moment to deliver the PA based on student motivation, the progression of curricular content, and other contextual factors. Short ABs were selected to maximize feasibility in real classroom conditions, as limited lesson time is frequently cited as a major barrier to implementation. This choice was also informed by prior interventions showing positive effects with active breaks of around five minutes (Fenesi et al., 2018).

Key intervention parameters included exercise duration, intensity, and type, together with practical considerations. The ABs were designed to engage large muscle groups and provide meaningful cardiorespiratory stimulation within a brief time window, while remaining feasible in the classroom. Exercises were kept simple and adaptable to ensure that: (a) execution did not disrupt delivery of the active break, (b) activities were inclusive regardless of students' fitness level, prior experience, or clothing, and (c) no changes to the overall class structure were required. Activities included dancing, games, yoga, and functional movements (e.g., squats, lunges, jumping jacks). In some cases, short support videos were used to guide delivery, whereas in others, verbal instructions were considered sufficient. Following multiple revisions and a small pilot test, the final intervention protocol was established (Vidal-Conti et al., 2025). The researcher supervised the most demanding movements to ensure correct technique and prioritize safety.

Data collection

A total of 753 observations were recorded. The distribution of observations across conditions was unequal (57.6% with AB; 42.4% control without AB). To address this imbalance and within-subject dependency, advanced multilevel modelling was applied. The distribution of records by AB's type was 152 active games (20.2%), 87 yoga (11.6%), 83 HIIT (11.0%) and 112 dance (14.9%).

To assess the dependent variables, a Visual Analogue Scale (VAS) was administered at three distinct time points: the beginning, middle, and end of the class session. In sessions where active breaks were incorporated, the VAS was administered immediately following the break. The VAS consisted of four key dimensions: Motivation (defined as the willingness to actively participate in a task), Attention (the capacity to focus on a single activity), Mood (the experience of constructive emotional states), and Mental Fatigue (a state induced by prolonged periods of cognitively demanding activity).

The VAS comprises a straight line with anchored endpoints that indicate the two extremes of the construct being measured (Wewers & Lowe, 1990). Each VAS scale was scored on a range from 0 to 10, yielding a mean score between 0 and 10 for each construct. The decision to utilize single-item VAS instead of multi-item inventories was based on the need to capture acute state-dependent fluctuations while minimizing participant burden and the risk of "survey fatigue," which can interfere with the primary experimental task. In the assessment of primary subjective experiences such as fatigue and mood, single-item scales have demonstrated high face validity and are considered a "gold standard" due to their sensitivity to subtle changes in intensity (Wewers & Lowe, 1990). To ensure the psychometric integrity of these measures, divergent validity was assessed by examining the intercorrelations between the four scales (Table 1). The observed correlations were low-to-moderate (ranging from r = -0.20 to r = 0.65), indicating that although the constructs are functionally related, they represent distinct psychological dimensions. While internal consistency (e.g., Cronbach's alpha) is not applicable to single-item measures, the theoretical independence of these constructs justifies their use as separate indicators of the participants' internal state.

Table 1. Item Reliability Statistics

	X	SD	r
Motivation	5.85	1.89	0.651
Attention	5.94	1.79	0.561
Mood	6.52	1.82	0.628
Mental fatigue	5.54	1.86	-0.202

Abbreviations: X=Mean; SD=Standard Deviation; r= Item-rest correlation.

The self-administered short version of the International Physical Activity Questionnaire (IPAQ) was used (Craig et al., 2003). The physical activity levels provide valuable information about the characteristics of the studied population, allowing for contextualization of the results and confirming that there were no significant differences ($p > 0.05$) between the group of students from primary school teacher training and sports science programs.

Data analysis

Data was analysed using linear mixed-effects models (LMM) to account for the repeated-measures structure of the data (sessions nested within participants). Participant ID was included as a random intercept to model within-subject dependency. Fixed effects included condition (no active break, games, yoga, HIIT, dance), time (baseline, midclass, endclass), sex, and the interaction between condition and time. Given the unequal sex distribution, sex was included as a fixed factor in all main statistical models to examine potential moderation effects. Additionally, exploratory sex-disaggregated analyses were conducted to assess whether the pattern of results differed between males and females. For the mixed models, F-values, degrees of freedom, p-values, and partial eta-squared (ηp^2) effect sizes were reported to facilitate interpretation of the magnitude of observed effects.

When significant condition × time interactions were observed, post hoc pairwise comparisons were conducted using estimated marginal means (EMMs) with Bonferroni adjustment for multiple comparisons. These analyses examined changes over time within each condition as well as differences between conditions at each measurement point. Mean differences, standard errors, and adjusted p-values were reported.

A power analysis was conducted using GPower 3.1.9.4 as an approximation to the linear mixed-effects modelling approach. Because GPower does not directly estimate power for LMMs with repeated observations nested within participants, the analysis was based on a repeated-measures ANOVA framework for the within–between interaction. Assuming five conditions, three repeated measurement points, $\alpha = 0.05$, power = 0.80, an average correlation of 0.50 among repeated measures, and a non-sphericity correction of $\varepsilon = 0.75$, the minimum sample size required to detect a medium condition × time interaction effect ($f = 0.25$) was $N = 55$. The final sample of 96 participants exceeded this requirement.

This modelling approach allows for the inclusion of unbalanced data across conditions and varying numbers of observations per participant without inflating Type I error rates. Effect sizes were calculated using standardized beta coefficients and marginal R^2 values. Statistical significance was set at $p < .05$. Analyses were conducted using Jamovi 2.3.2.1 with the GAMLj module.

Results

The study evaluated the effects of an AB intervention program on university students, focusing on four key dimensions: motivation, attention, mood, and mental fatigue, evaluated at baseclass, midclass, and endclass. The intervention included four types of AB: games, yoga, HIIT, and dance, which were compared to sessions without AB. By midclass, sessions with AB showed notable improvements compared with sessions without AB; by the end of the class, these positive effects were sustained, with AB consistently outperforming sessions without AB across all variables (Table 2).

Table 2. Descriptive statistics of study variables by condition and time.

	Without AB		With AB (games)		With AB (yoga)		With AB (hiit)		With AB (dance)	
	X	SD	X	SD	X	SD	X	SD	X	SD
Motivation										
Baseclass	6.39	2.03	6.57	1.75	6.44	2.14	6.33	2.12	6.09	2.14
Midclass	5.91	1.96	7.42	1.54	6.81	1.18	6.87	1.66	6.99	1.74
Endclass	5.85	2.12	6.63	1.58	6.23	1.62	6.45	1.69	6.55	1.89
Attention										
Baseclass	6.36	1.90	6.64	1.81	6.55	2.04	6.47	2.08	6.07	2.06
Midclass	5.90	1.81	7.02	1.39	6.76	1.22	6.59	1.62	6.82	1.61
Endclass	5.52	1.97	6.24	1.74	5.99	1.73	5.82	1.73	6.30	1.67
Mood										

Baseclass	6.66	2.01	7.03	1.99	6.99	2.01	6.85	2.17	6.68	1.99
Midclass	6.41	1.86	7.39	1.68	7.16	1.32	6.86	1.73	7.22	1.86
Endclass	6.23	1.95	7.02	1.52	6.62	1.62	6.62	1.55	6.98	1.76
Mental fatigue										
Baseclass	5.40	1.87	5.79	1.84	5.63	1.73	5.49	2.00	5.61	1.83
Midclass	5.38	1.88	4.96	2.12	4.65	1.62	4.98	1.93	4.58	2.01
Endclass	6.04	1.83	5.81	1.68	5.42	1.90	5.71	1.95	5.50	2.01

Values shown are mean and standard deviation for each outcome variable. Abbreviations: AB=Active Break; SD=Standard Deviation; X=mean; hiit=high intensity interval training.

At baseline, no significant differences were observed between conditions (Table 3), with the exception of mood and mental fatigue. Participants allocated to the games AB condition exhibited significantly higher baseline values compared with the no AB group for mood (Estimate = 0.509, SE = 0.201, p = 0.012) and mental fatigue (Estimate = 0.562, SE = 0.225, p = 0.013). No other significant baseline differences were detected.

Table 3. Parameter estimates for simple effects of condition (type of break) for each variable at baseclass.

			95% Confidence Intervals			
	Estimate	SE	Lower	Upper	t-value	p-value
Motivation						
Games - No AB	0.296	0.204	-0.105	0.697	1.448	0.148
Yoga - No AB	0.015	0.287	-0.548	0.578	0.052	0.958
HIIT - No AB	-0.148	0.285	-0.708	0.411	-0.521	0.603
Dances - No AB	-0.244	0.234	-0.702	0.214	-1.044	0.297
Attention						
Games - No AB	0.326	0.197	-0.060	0.712	1.658	0.097
Yoga - No AB	-0.046	0.276	-0.588	0.496	-0.166	0.868
HIIT - No AB	-0.050	0.274	-0.588	0.487	-0.184	0.854
Dances - No AB	-0.340	0.225	-0.781	0.100	-1.515	0.130
Mood						
Games - No AB	0.509	0.201	0.114	0.904	2.526	0.012
Yoga - No AB	0.290	0.283	-0.265	0.845	1.026	0.305
HIIT - No AB	0.075	0.281	-0.476	0.625	0.265	0.791
Dances - No AB	0.085	0.230	-0.367	0.536	0.368	0.713
Mental Fatigue						
Games - No AB	0.562	0.225	0.120	1.004	2.494	0.013
Yoga - No AB	0.153	0.289	-0.415	0.720	0.527	0.598
HIIT - No AB	0.150	0.287	-0.413	0.714	0.523	0.601
Dances - No AB	0.153	0.236	-0.310	0.617	0.648	0.517

Abbreviations: AB=active break; SE=standard error.

Linear mixed-effects modelling showed a significant condition (type of active break) and time (baseline, midclass, endclass) interaction for motivation (p < 0.001), attention (p < 0.001), mental fatigue (p = 0.003) but not for mood (p = 0.168). Sex was not a significant moderator of the intervention effects (all interaction terms p > 0.05), indicating that the pattern of psychological responses to active breaks was comparable between males and females despite the unequal distribution (Table 4).

Table 4. Effects of the AB intervention

	Fixed effects tests			Model fit	
	F	df	p-value	R^2	p-value
Motivation					
Condition x time	4.971	8	<0.001	0.077	<0.001
Sex x condition x time	0.451	8	0.891		
Attention					
Condition x time	3.458	8	<0.001	0.066	<0.001
Sex x condition x time	0.446	8	0.894		
Mood					
Condition x time	1.458	8	0.168	0.071	<0.001
Sex x condition x time	0.613	8	0.768		
Mental fatigue					
Condition x time	2.96033	8	0.003	0.176	<0.001
Sex x condition x time	1.48369	8	0.158		

Abbreviations: F=test value; df=degrees of freedom; R^2=mixed-model effect size; Condition=type of active break.

Motivation

Changes in motivation over time differed across conditions. At midclass, games (M = 7.42, SD = 1.54), dance (M = 6.99, SD = 1.74), yoga (M = 6.81, SD = 1.18), and HIIT (M = 6.87, SD = 1.66) all demonstrated higher mean motivation scores compared to sessions without active breaks (M = 5.91, SD = 1.96). Motivation declined in the no-break condition from baseline (M = 6.39) to midclass (M = 5.91), whereas it increased in all active break conditions. In the no AB group, motivation significantly decreased from baseline to mid-class (Estimate = −0.403, SE = 0.175, $p = 0.021$) and from baseline to end-class (Estimate = −0.383, SE = 0.180, $p = 0.033$). In the games condition, motivation significantly increased at mid-class compared with baseline (Estimate = 1.062, SE = 0.245, $p < 0.001$), whereas no significant change was observed at end-class. Similarly, the dance condition showed significant increases in motivation both at mid-class (Estimate = 1.250, SE = 0.284, $p < 0.001$) and at end-class (Estimate = 0.625, SE = 0.282, $p = 0.027$) relative to baseline. No statistically significant changes were observed in the yoga or HIIT conditions at either time point (all $p > 0.05$), (see figure 1).

A significant Condition × Time interaction was observed ($F(8) = 4.971$, $p < 0.001$), with a marginal R^2 of 0.077, indicating that approximately 7.7% of the variance in motivation was explained by the fixed effects. Sex did not significantly moderate the interaction ($F = 0.451$, $p = 0.891$).

Post hoc pairwise comparisons for motivation showed significant differences between the no active break condition and all active break conditions at midclass. Specifically, motivation scores were significantly higher following Games (mean difference = -1.512, $p < 0.001$), Yoga (mean difference = -0.906, $p = .009$), HIIT (mean difference = -0.962, $p = 0.004$), and Dance (mean difference = -1.086, $p < 0.001$) compared with the no active break condition. No significant differences were observed among the active break modalities themselves. At the end of class, motivation remained significantly higher only in the Games condition compared with the no active break condition (mean difference = -0.777, $p = 0.014$), whereas differences between the no active break condition and Yoga, HIIT, or Dance were no longer significant. Furthermore, no significant differences were found among the active break modalities at the end of class (Table 5).

Table 5. Post Hoc condition * time in motivation.

Time	Condition	vs	Condition	Difference	SE	t	$p_{bonferroni}$
Midclass	No AB	-	Games	-1.512	0.196	-7.705	<0.001
	No AB	-	Yoga	-0.906	0.231	-3.923	0.009
	No AB	-	HIIT	-0.962	0.233	-4.128	0.004
	No AB	-	Dance	-1.086	0.212	-5.115	<0.001
	Games	-	Yoga	0.605	0.262	2.310	1.000
	Games	-	HIIT	0.549	0.264	2.080	1.000
	Games	-	Dance	0.425	0.246	1.731	1.000
	Yoga	-	HIIT	-0.056	0.291	-0.193	1.000
	Yoga	-	Dance	-0.179	0.274	-0.655	1.000
	HIIT	-	Dance	-0.123	0.276	-0.447	1.000
Endclass	No AB	-	Games	-0.777	0.203	-3.825	0.014
	No AB	-	Yoga	-0.374	0.236	-1.588	1.000
	No AB	-	HIIT	-0.595	0.243	-2.456	1.000
	No AB	-	Dance	-0.698	0.217	-3.217	0.138
	Games	-	Yoga	0.402	0.265	1.518	1.000
	Games	-	HIIT	0.181	0.271	0.668	1.000
	Games	-	Dance	0.078	0.249	0.316	1.000
	Yoga	-	HIIT	-0.221	0.296	-0.746	1.000
	Yoga	-	Dance	-0.323	0.276	-1.173	1.000
	HIIT	-	Dance	-0.102	0.282	-0.364	1.000

Abbreviations: Condition=type of active break; AB=active break; SE=standard error; t=test value

Attention

Changes in attention across time varied by condition. Attention decreased over time in sessions without active breaks (baseline M = 6.36; midclass M = 5.90; endclass M = 5.52). In contrast, games (midclass M = 7.02) and dance (midclass M = 6.82) showed improvements at midclass relative to baseline. In the no AB group, attention significantly decreased from baseline to mid-class (estimate =

−0.439, SE = 0.169, p = 0.009) and from baseline to end-class (estimate = −0.719, SE = 0.174, p < 0.001). In the dance condition, attention significantly increased at mid-class compared with baseline (estimate = 1.000, SE = 0.275, p < 0.001), whereas the change observed at end-class did not reach statistical significance. No statistically significant changes in attention were observed in the games, yoga, or HIIT conditions at either time point (all p > 0.05), although a non-significant positive trend was noted at mid-class in the games condition (p = 0.077).

A significant Condition × Time interaction was also observed for attention (F (8) = 3.458, p < 0.001), with R^2 = 0.066. No significant three-way interaction with sex was found (F = 0.446, p = .894).

Post hoc pairwise comparisons for attention revealed significant differences between the no active break condition and several active break conditions at midclass. Specifically, attention scores were higher following Games (mean difference = -1.113, p < 0.001), Yoga (mean difference = -0.862, p = 0.010), and Dance (mean difference = -0.919, p < 0.001) compared with the no active break condition. No significant differences were observed between the different active break modalities (all p = 1.000). At the end of class, attention remained significantly higher in the Games (mean difference = -0.711, p = 0.027) and Dance (mean difference = -0.770, p = 0.022) conditions compared with the no active break condition, whereas no differences were found between Yoga, HIIT, and the other active break modalities (Table 6).

Table 6. Post Hoc condition * time in attention.

Time	Condition	vs	Condition	Difference	SE	t	$p_{bonferroni}$
Midclass	No AB	-	Games	-1.113	0.188	-5.927	<0.001
	No AB	-	Yoga	-0.862	0.221	-3.901	0.010
	No AB	-	HIIT	-0.688	0.223	-3.084	0.217
	No AB	-	Dance	-0.919	0.203	-4.521	<0.001
	Games	-	Yoga	0.250	0.251	0.998	1.000
	Games	-	HIIT	0.424	0.253	1.681	1.000
	Games	-	Dance	0.194	0.235	0.826	1.000
	Yoga	-	HIIT	0.174	0.278	0.626	1.000
	Yoga	-	Dance	-0.056	0.263	-0.214	1.000
	HIIT	-	Dance	-0.230	0.264	-0.872	1.000
Endclass	No AB	-	Games	-0.711	0.194	-3.661	0.027
	No AB	-	Yoga	-0.463	0.226	-2.055	1.000
	No AB	-	HIIT	-0.296	0.232	-1.275	1.000
	No AB	-	Dance	-0.770	0.208	-3.709	0.022
	Games	-	Yoga	0.248	0.254	0.978	1.000
	Games	-	HIIT	0.415	0.259	1.602	1.000
	Games	-	Dance	-0.058	0.238	-0.247	1.000
	Yoga	-	HIIT	0.167	0.284	0.591	1.000
	Yoga	-	Dance	-0.306	0.264	-1.162	1.000
	HIIT	-	Dance	-0.474	0.270	-1.760	1.000

Abbreviations: Condition=type of active break; AB=active break; SE=standard error; t=test value

Mood

Mood showed a slight descriptive decrease over time in the no-AB condition (baseline M = 6.66; midclass M = 6.41; endclass M = 6.23). In contrast, small descriptive increases were observed at midclass in some active break conditions, particularly games (midclass M = 7.39) and dance (midclass M = 7.22). However, the Condition × Time interaction for mood did not reach statistical significance, indicating that changes in mood over time did not differ significantly between conditions. The three-way interaction with sex was also not significant. Therefore, post hoc pairwise comparisons for mood were not interpreted, and the descriptive patterns observed should be interpreted cautiously as they do not provide evidence of statistically significant condition-specific effects on mood.

Mental fatigue

Mental fatigue increased over time in the no-break condition (baseline M = 5.40; endclass M = 6.04). In contrast, all active break conditions presented reductions at midclass, particularly dance (M = 4.58) and yoga (M = 4.65). In the no AB group, mental fatigue significantly increased from baseline to end-class (estimate = 0.720, SE = 0.172, p < 0.001), whereas no significant change was observed at mid-class. In contrast, significant reductions in mental fatigue at mid-class were observed in the games (estimate = −0.915, SE = 0.245, $p < 0.001$), yoga (estimate = −0.895, SE = 0.343, $p = 0.009$), and dance conditions (estimate = −0.889, SE = 0.269, $p < 0.001$) compared with baseline. No significant changes were detected at end-class in these conditions. No statistically significant changes in mental fatigue were observed in the HIIT condition at either time point (all $p > 0.05$).

For mental fatigue, the Condition × Time interaction was significant ($F(8) = 2.96$, $p = 0.003$), with the largest effect size observed ($R^2 = 0.176$). The three-way interaction with sex was not significant ($F = 1.48$, $p = 0.158$).

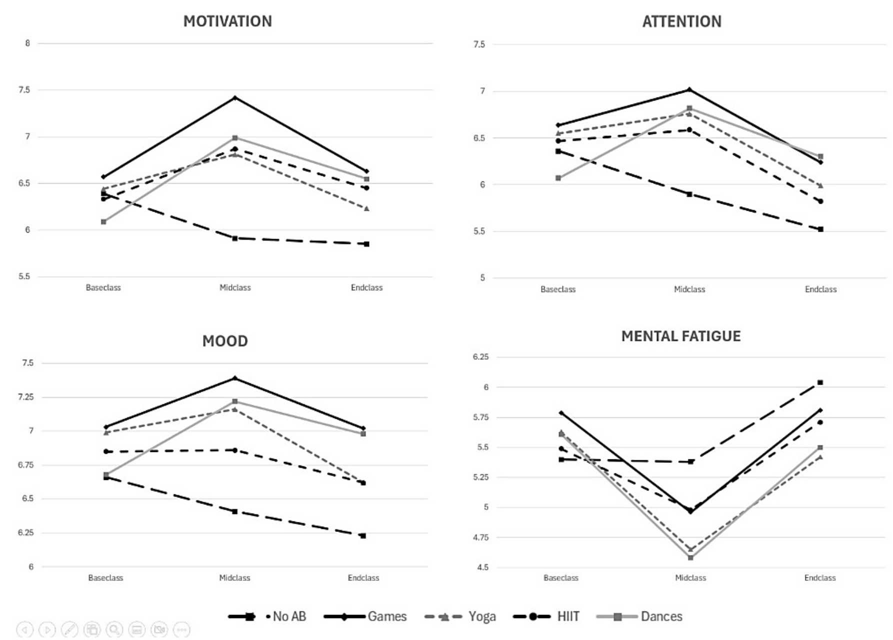
Post hoc pairwise comparisons for mental fatigue showed few significant differences between conditions. At midclass, mental fatigue was significantly lower in the Dance condition compared with the no active break condition (mean difference = 0.800, $p = 0.017$). No significant differences were observed between the no active break condition and Games, Yoga, or HIIT. Furthermore, no significant differences were found among the active break modalities themselves. At the end of class, no significant differences were detected between the no active break condition and any active break modality, nor among the active break modalities. Overall, these findings suggest that only the Dance active break produced a short-term reduction in mental fatigue compared with no active break, whereas the different active break modalities did not significantly differ from one another.

Table 7. Post Hoc condition * time in mental fatigue.

Time	Condition	vs	Condition	Difference	SE	t	$p_{bonferroni}$
Midclass	No AB	-	Games	0.420	0.196	2.148	1.000
	No AB	-	Yoga	0.736	0.230	3.196	0.148
	No AB	-	HIIT	0.406	0.233	1.748	1.000
	No AB	-	Dance	0.800	0.212	3.781	0.017
	Games	-	Yoga	0.316	0.261	1.209	1.000
	Games	-	HIIT	-0.013	0.263	-0.052	1.000
	Games	-	Dance	0.380	0.245	1.551	1.000
	Yoga	-	HIIT	-0.329	0.290	-1.137	1.000
	Yoga	-	Dance	0.064	0.274	0.234	1.000
	HIIT	-	Dance	0.394	0.276	1.430	1.000
Endclass	No AB	-	Games	0.242	0.202	1.196	1.000
	No AB	-	Yoga	0.639	0.235	2.719	0.693
	No AB	-	HIIT	0.362	0.242	1.500	1.000
	No AB	-	Dance	0.544	0.216	2.516	1.000
	Games	-	Yoga	0.396	0.264	1.501	1.000
	Games	-	HIIT	0.120	0.270	0.445	1.000
	Games	-	Dance	0.302	0.248	1.219	1.000
	Yoga	-	HIIT	-0.276	0.295	-0.935	1.000
	Yoga	-	Dance	-0.094	0.275	-0.344	1.000
	HIIT	-	Dance	0.181	0.281	0.647	1.000

Abbreviations: Condition=type of active break; AB=active break; SE=standard error; t=test value

Figure 1. Effect of the intervention on psychological variables at midclass and at the end-class, compared with baseclass.



Discussion

The findings of this study provide compelling evidence for the positive effects of AB on motivation, attention, and mental fatigue among university students, whereas effects on mood were not statistically supported. The results align with previous research, suggesting that PA interventions, even in short durations, can enhance cognitive and emotional well-being in academic settings (Janssen et al., 2014). The consistent improvements observed across all AB conditions, particularly in games and dance, underscore the potential of these interventions to counteract the decline in engagement and focus often experienced during prolonged academic sessions.

From baseclass to mid-class, the dance condition showed significant changes in motivation, attention, and mental fatigue, but not in mood. This is consistent with the post hoc comparisons that also showed significant differences between the dance and no-AB conditions in motivation, attention, and mental fatigue. These results are partially consistent with those of Lobach et al. (2024) who found that an 8-minute AB incorporating dance enhanced both mood and attention in university students. This aligns with the broader benefits of dance, as adults who participated in dance-based interventions experienced a reduction in symptoms of depression, anxiety, and stress (Moratelli et al., 2023), with similar effects observed specifically in university students (López-Rodríguez et al., 2017). Dance fosters social connections, enhances well-being, and is highly adaptable to classroom settings. The added benefits of dance may also be attributed to music's ability to enhance physiological arousal and improve subjective experience during exercise (Clark et al., 2015). Moreover, prior research suggests that dance has a unique capacity to elicit positive emotional changes due to its combination of physical movement, rhythmic engagement, and social interaction (Zajenkowski et al., 2014). Requiring no special equipment, it is an accessible and inclusive PA, making it a practical and engaging alternative for students (Tao et al., 2022; Fong Yan et al., 2024).

In the present study, however, because the omnibus Condition × Time interaction for mood was not statistically significant, the positive descriptive pattern observed in the dance condition should be interpreted cautiously and only as a tentative finding, rather than as evidence that dance-based AB significantly improved mood or was superior to the other AB modalities.

The games condition showed significant improvements in both motivation and mental fatigue at midclass. However, post hoc analyses showed a significant difference compared with the no-AB condition only for motivation. These findings suggest that game-based active breaks may foster enjoyment and intrinsic motivation while also helping to reduce mental fatigue. Engaging in enjoyable PA, such as games and dance, may be particularly beneficial for cognitive outcomes, as the positive effects of exercise appear to be closely linked to the enjoyment it provides (Diamond & Lind, 2016).

In the HIIT-based AB condition, no statistically significant changes were observed in any of the outcomes assessed. However, post hoc comparisons showed a significantly greater improvement in motivation in the HIIT-based AB condition than in the no-AB condition. Descriptive data also showed a more positive pattern at mid-class than at baseline, particularly in motivation and mental fatigue, unlike the no-AB condition. To our knowledge, the only study implementing HIIT-based AB in a university setting is that of Fenesi et al. (2018). However, unlike the present study, that research focused specifically on attention, showing higher on-task attention during the lecture in the AB condition than in the control conditions. Other studies conducted with university students have also reported benefits in executive function (Slusher et al., 2018), as well as high levels of satisfaction and enjoyment in response to HIIT (Eather et al., 2019). Taken together, previous research suggests that HIIT-based strategies may be promising in university contexts. Although the present study found a significantly greater improvement in motivation in the HIIT-based AB condition than in the no-AB condition, it did not provide statistically significant evidence of improvements in attention, mood, or mental fatigue.

Regarding the yoga condition, descriptive data indicated improvements across all outcomes assessed. Statistically significant differences were observed only for mental fatigue. Similarly, Blasche et al. (2018), who compared different rest-break interventions during mentally demanding tasks, found that both PA and relaxation exercises were more effective than unstructured breaks in reducing fatigue and increasing vigour. The reduction in mental fatigue in the dance and yoga conditions further supports the idea that AB can mitigate the cognitive load associated with prolonged academic tasks (Boksem & Tops, 2008). However, post hoc comparisons at mid-class showed significantly higher motivation and attention in yoga conditions than in the no-AB condition. This pattern is consistent with previous research in university students, in which a ten-minute yoga video was associated with significant improvements in motivation and energy levels (Young-Jones et al., 2022).

The significantly higher attention observed in the dance, game, and yoga conditions compared with the no-AB condition in the post hoc analyses aligns with studies showing that PA can enhance cognitive functions such as sustained attention and working memory (Hillman et al., 2008). Moreover, one qualitative aspect of PA that has been widely discussed in relation to cognition is its inherent cognitive demand. Regarding modality, cognitively engaging forms of PA (e.g., coordinative exercises, team games) have been identified as key factors in enhancing focused attention in children (Schmidt et al., 2016). This perspective may help explain the significant increase in attention observed in these three conditions compared with the no-AB condition in the post hoc analysis.

Despite the favourable outcomes observed for the AB conditions compared with the control condition, no significant differences were found among the different AB modalities in terms of their psychological effects. This suggests that no single modality can be considered clearly superior and that different types of active breaks may produce broadly comparable short-term benefits. Therefore, the selection of a specific AB modality may be guided by factors such as feasibility, available space and resources, student preferences, and the characteristics of the academic context.

With respect to the secondary objective of examining end-of-class differences relative to the control condition, the results showed that the dance condition maintained a significant improvement in motivation at the end of the class. In addition, post hoc analyses indicated significantly higher end-of-class motivation in the games condition than in the no-AB condition, as well as significantly higher attention in both the games and dance conditions compared with no-AB. Although the remaining end-of-class comparisons did not reach statistical significance, descriptive results generally suggested a more favorable pattern in the active-break conditions. This pattern is consistent with the findings of Blasche et al. (2018), who showed that the positive effects of different break types were mainly short-term and generally did not persist beyond 20 minutes. These findings suggest that, although AB may help attenuate the decline observed over the course of the class, their effects appear to be mainly acute rather than sustained, indicating that they may need to be implemented routinely or repeated periodically to maintain their positive influence on students' psychological functioning over time (García-Taibo et al., 2026).

One of the key strengths of this study is its comprehensive approach to evaluating multiple dimensions of student well-being. Moreover, by assessing these variables at three different time points (baseline, midclass, and endclass), the study provides a nuanced understanding of how AB influence student engagement over the course of a class session. Additionally, the inclusion of diverse types of AB (games, yoga, HIIT, and dance) enables a comparative analysis of their effectiveness, providing practical insights for educators and policymakers. Another strength is that the study's focus on university students addresses a gap in the literature, as much of the existing research on active breaks has been conducted in primary and secondary school settings. Notably, our study demonstrates that brief active breaks of 3–5 minutes were associated with improvements in selected psychological outcomes, particularly motivation and mental fatigue. This is markedly valuable given that one of the main barriers reported by educators is the lack of time for such interventions (Rupp et al., 2025). Finally, in designing the AB, we considered barriers identified in previous research as key obstacles, including lack of space, students' reluctance to participate, organizational social norms, and lecturers' uncertainty about how to implement these strategies effectively (Rupp et al., 2025). However, in the present study, these interpretations should be considered tentative and hypothesis-generating, particularly for outcomes in which statistically significant effects were not observed. Therefore, the current findings should not be interpreted as conclusive evidence of modality-specific effects, but rather as preliminary evidence that may guide future research comparing different active-break modalities more directly.

Furthermore, while the correlation between motivation and attention ($r = 0.651$) was within our predefined threshold for discriminant validity ($r < 0.70$), its proximity to this limit suggests a partial overlap between the constructs. This moderately high correlation may be influenced by the conceptual link between the two variables, but it also reflects a limitation of using single-item scales, which may lack the measurement precision of multi-item instruments to fully differentiate closely related psychological dimensions.

Another limitation is the flexible timing of the active breaks, as teachers were permitted to select the most suitable moment during the class to implement them. While this flexibility introduces an uncontrolled source of variability that may act as a confounding variable, it was permitted to preserve the ecological validity of the study.

An important limitation concerns the unequal sex distribution (73.6% male). Although sex was statistically controlled and no moderation effects were detected, the imbalance may limit generalizability, particularly for modalities such as dance that may be socially gendered. Future research should aim for balanced samples to examine potential sex-specific responses more robustly.

Additionally, although a no-active-break control condition was included, the absence of a passive rest break prevents us from isolating whether the observed benefits derive specifically from physical activity or from interrupting sustained cognitive engagement. Future randomized controlled trials should incorporate three-arm designs (active break vs. passive rest vs. no break) to disentangle these mechanisms. A further limitation relates to the potential for carryover effects between conditions. Although the available evidence suggests that active breaks primarily elicit acute, short-term responses rather than sustained physiological or psychological adaptations (Reyes-Amigo et al., 2025a), and thus carryover effects are unlikely, their presence cannot be entirely excluded. Future studies employing longer washout periods may help to fully rule out residual effects between conditions.

Conclusions

In conclusion, active breaks were associated with improved psychological outcomes in university students compared with no active break condition. At midclass, all active break modalities enhanced motivation, while Games, Yoga, and Dance improved attention, and Dance was the only modality associated with lower mental fatigue. Although some of these benefits persisted until the end of class, particularly for Games and Dance, the magnitude and consistency of the effects diminished over time.

While the different active break modalities showed distinct patterns of benefits relative to the control condition, direct comparisons between active break types did not show significant differences. Therefore, the findings suggest that the implementation of an active break itself may be more important than the specific modality selected. From an applied perspective, incorporating active breaks into university classes may help counteract the psychological demands associated with prolonged sedentary behaviour and sustained cognitive effort, contributing to improved motivation, attention, and mental well-being during class.

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