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Embedding micro-dose gamified active breaks in higher education: effects on academic burnout and engagement

Integración de pausas activas gamificadas de microdosis en educación superior: efectos en el burnout académico y el compromiso

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Abstract

Academic burnout is an ongoing issue in higher education and hinders student health, motivation, and performance. This study explores the impact of incorporating micro-dose gamified active breaks into university lectures and their impact on academic burnout and student engagement. A parallel-group randomized controlled trial was used on 124 undergraduate students taking a mandatory physical education course. Participants were assigned to either the intervention group, who received 5-7 minute gamified active breaks three times a week for 8 weeks, or the control group, who received normal lectures. Academic burnout (emotional exhaustion, cynicism, academic efficacy) and student engagement (vigor, dedication, absorption) were measured using validated surveys. Mixed design ANOVA showed significant Group x Time interaction effects for all primary outcomes. Students in the intervention group experienced a significantly greater decrease in emotional exhaustion and cynicism, and a significantly greater increase in academic efficacy and engagement compared to the control group, who experienced negligible changes. Effect sizes were moderate to large. These results suggest that brief, structured, and gamified movement breaks in the classroom can effectively and significantly improve student burnout and engagement in higher education.

Keywords: academic burnout; active breaks; gamification; micro-dose intervention; randomized controlled trial; student engagement

Resumen

El agotamiento académico constituye un problema persistente en la educación superior, afectando negativamente la salud, la motivación y el rendimiento de los estudiantes. Este estudio examinó el impacto de incorporar pausas activas micro-dosis con elementos de gamificación dentro de las clases universitarias sobre el agotamiento académico y el compromiso estudiantil. Se utilizó un ensayo controlado aleatorizado de grupos paralelos con 124 estudiantes universitarios matriculados en un curso obligatorio de educación física. Los participantes fueron asignados a un grupo de intervención, que recibió pausas activas gamificadas de 5–7 minutos tres veces por semana durante ocho semanas, o a un grupo control, que recibió instrucción regular. El agotamiento académico (agotamiento emocional, cinismo y eficacia académica) y el compromiso estudiantil (vigor, dedicación y absorción) se evaluaron mediante instrumentos validados. El ANOVA de medidas mixtas mostró efectos significativos de interacción Grupo × Tiempo en todos los resultados principales. Los estudiantes del grupo de intervención presentaron reducciones significativamente mayores en agotamiento emocional y cinismo, así como incrementos significativos en eficacia académica y compromiso en comparación con el grupo control, que mostró cambios mínimos. Los tamaños del efecto fueron de moderados a grandes. Estos resultados sugieren que pausas activas breves, estructuradas y gamificadas pueden mejorar de manera efectiva el agotamiento y el compromiso estudiantil en la educación superior.

Palabras clave: agotamiento académico; ensayo controlado aleatorizado; gamificación; intervención microdosis; compromiso estudiantil; pausas activas

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Introduction

Academic burnout involves multiple components like emotional fatigue, development of a cynical attitude towards academics, and an overall decrease in effectiveness in academic tasks. The most widely used tool to assess burnout is the Maslach Burnout Inventory–Student Survey (Baati et al., 2025). It is a strong indicator of how likely a student is to lose their motivation to continue their education and how severe their overall educational clinical issues are. Burnout is even more of an issue than the numbers show; in a study of Chinese university students, burnout was found in 59.9% of the students and was even more concentrated in older students and students with unhealthy lifestyles (Xie et al., 2023). Burnout prevalence varies by region (die and middle-income regions 12.1% is the highest) but emotional exhaustion (27.8%) and cynicism (32.6%) are the most disregarded of the symptoms (Kaggwa et al., 2021). Burnout has been proven to negatively affect students' overall academic performance, with a correlation of $r_{c+} = -0.39$; (Madigan & Curran, 2021).

International studies consistently portray academic burnout as a widespread concern across diverse higher education systems, although its magnitude appears to fluctuate by context and academic demands. A global systematic review reported a pooled prevalence of 37.23% among undergraduate medical students, identifying emotional exhaustion and depersonalization as dominant features across countries (Almutairi et al., 2022). Similarly, research in Hong Kong documented that 27.9% of medical students experienced burnout, with notable patterns of exhaustion emerging in academically rigorous years of study (Lee et al., 2020). In contrast, findings from Iran revealed comparatively lower burnout rates ranging from 9.2% to 23.4%, suggesting that institutional structure and learning environments may moderate how burnout manifests among students (Liasi et al., 2021). Cross-cultural comparisons between Finnish and Chinese university students further demonstrated comparable burnout levels despite differing educational systems, reinforcing the view that academic pressure transcends cultural boundaries (Hernesniemi et al., 2017). Complementing these findings, a recent German study linked intensive time requirements and examination pressures to heightened student exhaustion, collectively supporting the argument that structural



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academic demands remain a consistent international stressor in higher education (Young et al., 2023).

With regards to the landscape of higher education in the Philippines, institutional dynamics, as well as individual psychological factors, could explain the interactions of student well-being and burnout. According to Velasco (2019), the academic efficacy of millennial university students in the Philippines, along with their levels of exhaustion and cynicism, is an example of positive correlation in the presence of academic belief and extremely high levels of workload. On the other hand, and in contrast to this finding, exhaustion, cynicism, and the reduction of personal efficacy of Filipino students as college students, and the then resultant burnout are due to the neuroticism and conscientiousness of students, as opposed to a high disposition (Reyes et al., 2016). As academic responsibilities heightened in the higher levels of the curriculum, the negative impact of burnout on the health of students in the discipline of medicine, has been documented (Chiong et al., 2025). With respect to the climate of education along with the supportive context of the teacher, it has been found that the engagement and resilience of Filipino students in academic exercises is due to the perceived emotional support provided by their teachers (Lobo, 2024). Stating that academic and psychological flexibility and academic burnout are a social support system, Velasco's academic adaptability, along with Reyes and Chiong, personality, tendency, and program demand susceptibility, and Lobo, institutional support, as a moderator are factors that are most difficult to define.

Micro-intervention approaches to physical activity have increasingly been recognized as preventive strategies against the negative consequences of physical inactivity among university students. For example, García-Pérez et al. (2024) demonstrated that a 12-week multimodal program incorporating low-resistance exercise and guided meditation significantly enhanced resilience and psychological well-being, suggesting that sustained exposure to manageable activity can strengthen adaptive capacities. Similarly, Fang et al. (2024), through a systematic review, confirmed that physical activity interventions promote higher-order maintenance of behavioral change, particularly in sustaining voluntary lifestyle activity over time. From a complementary perspective, Peng et al. (2023) emphasized that e-health frameworks are most effective

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when paired with cognitive planning mechanisms that enhance adherence. More closely aligned with the present study, Martin (2026) found that a low-dose physical activity intervention implemented among university students significantly reduced academic burnout indicators and improved student engagement, supporting the potential of brief, structured movement-based strategies in higher education settings. While these studies focus on structured and theory-based programs aimed at long-term behavioral change, Teuber et al. (2024) highlight that even brief, strategically timed activity breaks during study periods can produce meaningful stress-reduction and perceived performance benefits. Extending this technological dimension, Dew and Rhoads (2024) reported that active video gaming reduced stress, anxiety, and depressive symptoms among college students, underscoring the motivational potential of technology-mediated movement formats. Although intervention length, modality, and theoretical grounding vary, the cumulative evidence converges on a consistent conclusion: integrating brief, context-sensitive physical activity within university settings supports mental health and academic functioning. More recently, Arufe-Giráldez, Sanmiguel-Rodríguez, Ramos-Álvarez, and Navarro-Patón (2024) emphasized that increasing physical activity among children and young people requires multi-context strategies, including actions implemented within educational environments.

The strategy of gamification is being used more in the area of higher education as an effective approach to increase student interest and improve their performance. For example, a meta-analytic review showed that the effect of gamification and academic performance is moderately positive (Looi & Fan, 2024) and the effect on the teaching outcomes is small or medium (Huang et al, 2020), when the use of gamification in the classroom is supported, in the use of badges and leaderboards. In addition to academic performance, gamification has a positive medium effect on the behavioral engagement of students, and it is believed to influence the motivation of students (Ritzhaupt et al, 2021). More specifically, Martin (2026) demonstrated that autonomous motivation functioned as a mechanism of change in a gamified digital physical activity intervention, suggesting that gamified movement-based programs may improve student outcomes when they support internal motivation rather than relying only on external rewards. An even more positive effect of gamification has been shown in a study that examined the effects of



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personalized gamification, when the students were divided into groups based on their learning profiles and gamification element were used (Xiao & Hew, 2024).

The current research integrates the Job Demands–Resources (JD-R) model, Self-Determination Theory (SDT), and Recovery Theory to analyze the possible effects of micro-dose gamified active breaks on academic burnout and engagement. The JD-R model interprets how engagement and burnout can be understood. In their definition of burnout, the JD-R model holds that when the demands of an academic situation outweigh available resources, burnout can be expected. As opposed to the definition of burnout, the JD-R model identifies academic engagement as resource mobilization that alleviates strain and motivates the individual. In academic settings, workload and assessment demands are persistent while the resources that can be provided are motivational. Resources can also be supportive, increase and stimulate the individual's energy and, most significantly, reinforce motivational energy. A crucial element of the JD-R model is the incorporation of SDT, as SDT identifies the parameters of motivational energy. SDT states that if the basic psychological needs of autonomy, competence, and relatedness are satisfied, engagement will be even stronger. Fuels (i.e. positive feedback) and mechanics of gamified elements (i.e. progress tracking) are said to increase intrinsic motivation. The cognitive load theory essentially states that when an overextended cognitive system is re-energized, activity periods will serve to relieve mental fatigue. By integrating solely, micro-dose movement acts as a means of recovery, while gamification serves as a means of motivation. Together, they aim to alleviate fatigue and increase engagement.

Despite expanding research on physical activity and gamification, important gaps remain. Most studies examine these strategies independently, rarely integrating them within a unified theoretical framework targeting both burnout and engagement. Methodologically, prior interventions often rely on extended exercise programs or standalone gamified modules, with limited attention to classroom-embedded, low-disruption micro-dose formats. Additionally, empirical evidence in Southeast Asian higher education contexts remains scarce. Addressing these conceptual, theoretical, and contextual gaps, the present study evaluates whether embedding structured micro-dose



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gamified active breaks within university instruction can significantly reduce academic burnout and enhance student engagement.

Methods

Research Design

The present study utilized a parallel group randomized controlled trial (RCT) with quantitative pretest and posttest measures to evaluate the impact of a structured micro-dose gamified active break initiative on academic burnout and student engagement among university students. When a researcher's goal is to evaluate the impact of an intervention on specific outcomes that can be measured through empirical methods, a quantitative experimental design is the most suitable (Creswell & Creswell, 2018). Among the different types of experimental designs, randomized controlled trials are considered the gold standard for drawing causal conclusions because random assignment reduces the risk of selection bias and equitably distributes both measured and unmeasured confounding variables across study conditions (Shadish, Cook, & Campbell, 2002).

Outcomes were measured in a two-group (intervention versus control) repeated-measures framework. Measurements occurred at baseline (Week 0) and after eight weeks post intervention. Including a control group counter some internal validity issues such as maturation, testing, and regression to the mean, thus it helps strengthen causal claims to intervention effects. This design works well for physical activity interventions in schools because it allows for the analysis of within-group change and between-group differences over time. This report followed the randomized trial reporting guidelines in behavioral and educational research to improve transparency and the rigor of the methodology.

Respondents and Sampling

Data were collected from Western Mindanao State University (WMSU), a public higher education institution in the Philippines. The target population consisted of undergraduate students who officially enrolled in PATHFIT 2 in the data collection semester. PATHFIT 2 is a physical education course that is part of the general education curriculum, and it is a prerequisite for all university students, irrespective of chosen academic discipline. The course aims to develop health-related fitness, movement literacy and active lifestyle behavior competencies of university students.

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Using the G*Power 3.1, assuming a significance level of 0.05, power of 0.80, and an interaction effect of 0.25 (medium) for Mixed-design ANOVA, an a priori sensitivity power analysis was conducted, and it revealed the minimum sample size of 98 participants. One hundred forty students were recruited for the study so that enough power was left in the study in the event of dropouts.

To reduce the risk of participants contaminating each other in the same learning environment, cluster random sampling was used at the class section level. The PATHFIT 2 sections were randomly assigned to either the intervention or control group, based on a computer-generated random allocation, prepared by an independent researcher who was not involved in data collection or intervention. Concealment of allocation was maintained until the baseline measurements were taken.

Participants were required to meet the following inclusion criteria: (a) confirmed enrollment in PATHFIT 2, (b) having a medical clearance for light-to-moderate physical activity, and (c) having provided written informed consent. Participants with medical conditions that posed a risk during physical activity were excluded from the study in order to ensure safety to all involved. Out of the 140 students, 132 met eligibility criteria and were randomized. Eight participants dropped out of the study for reasons unrelated to the study, leaving an analytic sample of 124 students (intervention n = 62; control n = 62) with an overall retention rate of 93.9%. Baseline equivalence testing showed no statistically significant differences between the groups about demographic variables or outcome measures.

Research Instrument

To maintain methodological consistency with best practices in higher education research, the study used established peer-reviewed instruments aligned with the two primary constructs of interest: academic burnout and student engagement. Both instruments were administered at baseline and immediately after the eight-week intervention using a Likert-type response format.

Academic burnout was measured using the Maslach Burnout Inventory–Student Survey (MBI-SS), which assesses emotional exhaustion, cynicism, and academic efficacy (Schaufeli et al., 2002). The MBI-SS was considered appropriate for this study because these three dimensions correspond directly to the academic strain indicators targeted by

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the intervention. Emotional exhaustion reflects the depletion of students' psychological and academic energy, cynicism captures negative or detached attitudes toward academic work, and academic efficacy reflects students' perceived competence in completing academic tasks. The instrument has been widely used in higher education settings and has demonstrated acceptable psychometric properties, with previously reported Cronbach's alpha values ranging from .74 to .88 across subscales. In the present study, internal consistency values were .88 for Emotional Exhaustion, .84 for Cynicism, and .81 for Academic Efficacy, indicating adequate reliability.

Student engagement was measured using the Utrecht Work Engagement Scale—Student Version (UWES-S), which assesses vigor, dedication, and absorption (Schaufeli et al., 2006). The UWES-S was selected because it captures positive academic functioning and motivational involvement, making it conceptually suitable for evaluating whether active breaks enhanced students' energy, persistence, and immersion in academic activities. Vigor refers to students' energy and mental resilience while studying, dedication reflects a sense of enthusiasm and significance toward academic work, and absorption refers to concentration and immersion in learning tasks. Previous studies in university samples have reported strong internal consistency and structural validity for the UWES-S. In this study, Cronbach's alpha values were .87 for Vigor, .89 for Dedication, and .85 for Absorption, indicating strong reliability.

The suitability of the MBI-SS and UWES-S for the Filipino university context was considered before data collection. Because English is widely used as a medium of instruction in Philippine higher education, the English versions of the instruments were retained. To support contextual appropriateness, the items were reviewed for clarity, cultural relevance, and compatibility with the academic experiences of Filipino undergraduate students. Minor wording clarifications were discussed before administration to ensure that respondents could understand the items without altering their original meaning. The reliability estimates obtained in the present sample further supported the internal consistency of both instruments in this Filipino university context.

Intervention Protocol

The intervention was implemented for eight weeks alongside the regular PATHFIT 2 instructional sessions. Students in the intervention group received micro-

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dose gamified active breaks three times per week. Each active break lasted approximately five to seven minutes and was delivered during class time, typically after a sustained period of lecture, discussion, or seated academic activity. The sessions were designed to be brief, safe, low-disruption, and feasible for implementation in a regular university classroom or activity area.

Each active break followed a standardized structure consisting of three parts: a brief orientation or challenge prompt, a movement sequence lasting approximately four to five minutes, and a short cool-down, feedback, and point-recording phase. The activities were performed at light-to-moderate intensity, estimated at approximately 40–60% of age-predicted maximum heart rate. Exercises were designed to activate participants physiologically without causing excessive fatigue or interfering with the academic flow of the class.

The active break activities included dynamic mobility drills, low-impact aerobic movements, coordination tasks, rhythm-based movements, and functional bodyweight exercises. Specific examples included marching in place, side steps, arm circles, shoulder rolls, trunk rotations, squats, lunges, balance tasks, and simple movement sequences that could be completed without specialized equipment. These activities were selected to increase movement participation, restore attention, and provide a short recovery period from prolonged sedentary academic work.

The intervention used a progressive weekly format while maintaining a light-to-moderate intensity across all sessions. During the initial weeks, participants completed simple individual and paired movement tasks to become familiar with the routine. In the middle weeks, cooperative group challenges and rhythm-based sequences were added to increase variety and social participation. In the final weeks, short cumulative challenges were used to reinforce consistency, teamwork, and sustained participation. All sessions were designed to be inclusive and adaptable to students' physical capacity.

Gamification elements were incorporated to enhance motivation and engagement. These elements included point accumulation, achievement badges, team-based cooperative goals, weekly challenges, immediate feedback, and a class leaderboard. The scoring system was based on observable participation indicators. Students earned points for attendance, completing the prescribed activity sequence, demonstrating cooperative

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participation, and completing the weekly challenge. Bonus points were awarded for teamwork, consistency, and positive participation behaviors. Scores were recorded after each session and summarized weekly to provide feedback on group progress. The purpose of the scoring system was to encourage participation and group accountability rather than to create high-pressure competition.

Intervention fidelity was maintained through several procedures. First, the instructors received an orientation on the purpose, structure, safety considerations, and delivery procedures of the active breaks. Second, a standardized session guide was used to specify the activity sequence, approximate duration, intensity range, gamification procedure, and scoring criteria for each session. Third, attendance sheets, participation logs, and fidelity checklists were completed throughout implementation. Fourth, the researchers monitored whether each session followed the prescribed duration, activity structure, and scoring procedure. Any deviations from the planned protocol were documented.

The control group did not receive the structured gamified active breaks and continued their regular PATHFIT 2 instructional sessions as usual. To reduce contamination, the control sections were not exposed to the gamification materials, scoring system, leaderboard, badges, or active-break activity guides used in the intervention condition during the study period.

Statistical Analysis

Descriptive statistics were calculated to summarize the demographic features and preliminary metrics. The Shapiro–Wilk test was used to check for normality, and Levene’s test was used to check for the homogeneity of variance. The independent samples t-tests were used to check for baseline equivalence.

A mixed-design ANOVA was used for the primary analysis, and the effect of the group (intervention vs control) and time (pretest vs posttest) was evaluated for academic burnout and the dimensions of student engagement. Greenhouse and Geisser corrections were used where appropriate. The significant interaction effect was evaluated using the Bonferroni post hoc test. The effect size was calculated using the partial eta squared (η^2p) and statistical significance was set at $p < .05$.



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To minimize the effect of missing data, the intention-to-treat method was used. The appropriate imputation method was used when needed to minimize bias due to attrition.

Ethical Considerations

This research did not violate any ethical principles relating to research involving human participants. Data collection began after obtaining ethical approval from the committee for research ethics at the respective institution. All participants were provided with the study purpose, study procedures, any possible risks, and benefits and were asked to sign an informed consent form.

Results

Preliminary Analyses

Preliminary analyses were conducted to examine assumptions and baseline equivalence prior to testing intervention effects. Normality was assessed using the Shapiro–Wilk test, and homogeneity of variance was evaluated using Levene’s test. All assumptions were satisfied ($p > .05$). Independent-samples t-tests were performed to determine whether the intervention and control groups differed significantly at baseline.

Table 1

Baseline Equivalence Between Groups

Variable	Intervention M ± SD	Control M ± SD	t	p
Emotional Exhaustion	3.42 ± 0.88	3.56 ± 0.89	−0.87	.387
Cynicism	2.78 ± 0.93	3.00 ± 0.90	−1.29	.199
Academic Efficacy	3.55 ± 0.91	3.71 ± 0.84	−0.98	.329
Engagement Total	3.46 ± 0.50	3.48 ± 0.42	−0.26	.794

Results indicated no statistically significant differences between groups at pretest (all $p > .05$), confirming successful randomization and baseline equivalence.

Academic Burnout Dimensions

Table 2 presents the descriptive statistics for emotional exhaustion, cynicism, and academic efficacy at pretest and posttest for both groups.



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Table 2

Academic Burnout Dimensions by Group (Pretest and Posttest)

Dimension	Group	Pretest M ± SD	Posttest M ± SD
Emotional Exhaustion	Intervention	3.42 ± 0.88	2.65 ± 0.83
	Control	3.56 ± 0.89	3.38 ± 0.81
Cynicism	Intervention	2.78 ± 0.93	1.83 ± 0.78
	Control	3.00 ± 0.90	2.98 ± 0.89
Academic Efficacy	Intervention	3.55 ± 0.91	4.38 ± 0.92
	Control	3.71 ± 0.84	3.82 ± 0.79

The intervention group demonstrated notable reductions in emotional exhaustion and cynicism, alongside a substantial increase in academic efficacy. In contrast, the control group exhibited only minimal changes across burnout dimensions.

Student Engagement Dimensions

Table 3 presents the descriptive statistics for vigor, dedication, absorption, and total engagement at pretest and posttest.

Table 3

Student Engagement Dimensions by Group (Pretest and Posttest)

Dimension	Group	Pretest M ± SD	Posttest M ± SD
Vigor	Intervention	3.38 ± 0.90	4.03 ± 0.87
	Control	3.33 ± 0.89	3.39 ± 0.87
Dedication	Intervention	3.77 ± 0.66	4.27 ± 0.81
	Control	3.72 ± 0.88	3.79 ± 0.88
Absorption	Intervention	3.24 ± 1.01	3.93 ± 0.96
	Control	3.39 ± 0.79	3.50 ± 0.75
Engagement Total	Intervention	3.46 ± 0.50	4.08 ± 0.49
	Control	3.48 ± 0.42	3.56 ± 0.41

Participants exposed to micro-dose gamified active breaks showed consistent increases across all engagement dimensions, whereas the control group displayed only marginal improvements.

Mixed-Design ANOVA

A 2 (Group: Intervention vs Control) × 2 (Time: Pretest vs Posttest) mixed-design ANOVA was conducted to examine the effects of the intervention over time.



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Table 4

Group × Time Interaction Effects

Outcome	F (1,122)	p	Partial η^2
Emotional Exhaustion	12.45	.001	.092
Cynicism	47.80	< .001	.279
Academic Efficacy	25.76	< .001	.174
Vigor	21.10	< .001	.147
Dedication	10.86	.001	.082
Absorption	18.46	< .001	.131
Engagement Total	54.44	< .001	.309

Significant Group × Time interactions were observed across all primary outcomes. Effect sizes ranged from moderate to large, indicating that the intervention meaningfully reduced burnout and enhanced engagement relative to standard instruction.

Within-Group Comparisons

To further describe the magnitude and direction of change within each condition, paired-samples t-tests were conducted separately for the intervention and control groups. Results are presented in Table 5.

Table 5

Within-Group Comparisons for Primary Outcomes (Pretest vs Posttest)

Outcome	Group	Mean Diff (Post–Pre)	t (df = 61)	p	Cohen's dz
Emotional Exhaustion	Intervention	−0.76	−6.54	< .001	0.83
	Control	−0.18	−1.47	.146	0.19
Engagement Total	Intervention	+0.62	10.72	< .001	1.36
	Control	+0.08	1.84	.070	0.23

Paired-samples comparisons indicated statistically significant reductions in emotional exhaustion and significant increases in overall engagement within the intervention group (both $p < .001$), with moderate to large effect sizes. In contrast, changes observed in the control group were small and non-significant.

Intervention Fidelity

Attendance monitoring indicated high adherence within the intervention group ($M = 90\%$, $SD = 0.08$). Implementation followed a standardized protocol across sessions, and no adverse events were reported. These findings support the feasibility and consistent

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delivery of the micro-dose gamified active break model within regular instructional settings.

Sensitivity Analysis

A per-protocol sensitivity analysis excluding participants with attendance rates below 70% yielded results consistent with the primary analysis. Significant Group $\times$ Time interactions remained across burnout and engagement outcomes, indicating that findings were robust and not driven by low-adherence participants.

Discussion

Academic Burnout Dimensions

The current study shows that micro-dosed gamified active breaks are related to a decrease of emotional exhaustion and cynicism and an increase in academic efficacy. This responds to the theory that activity in general helps rejuvenate the psychological resources that get depleted under ongoing academic stress. Tian and Yang (2024) propose that the alleviation of burnout because of physical activity is also due to psychological mechanisms such as mindfulness and boosted self-esteem, and they focus on the psychological indirect routes. That is the opposite of what Ma and Mumtaz (2025) do, as they focus on the direct resource-building effects that organized exercise has on a person's mood, stress tolerance, and cognitive capacity. While one side is talking mainly about psychological mediation and the opposite makes a case for the physical end of the spectrum, they both point to the fact that movement and exercise alleviate the psychological burden and improve the coping mechanisms in students.

On the contrary, the reduction of exhaustion and cynicism is like the studies that show that low intensity and repetitive activity have a restorative factor de Vries et al. (2016) show that short term study related low intensity exercises help did activity. Their effects continued even after the end of the activity. This fits well the viewpoint of improved emotional regulation especially in the case of cognitive upgrade in the accounting of exercise outside the academic stress. These accounts do suggest that the effort needed to stimulate rates of physical activity decrease strain and burden associated with prolonged academic work.

When examining the findings from an academic stress recovery angle, the findings are more encouraging from the resource replenishment perspective than one that



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emphasizes transformational change. Recovery experiences are especially beneficial to the extent that academic stress is chronic (Reschke et al., 2024). Recovery effectiveness, however, is contingent on students' self-perception and self-evaluative standards (Wimmer et al., 2019). Despite all the varying perspectives, if students are pressured to achieve more than what students feel is reasonable, micro-dose active breaks, and the recovery experiences that they facilitate, offer students relief from stress, notwithstanding the variability of their stress relief impact.

From the perspective of the intervention design, micro-dosing, and a gamified framework, probably, reduced the barriers to initiation, and increased the barriers to ongoing participation. Embedded short breaks were probably low effort, and cost, changes to already over-burdened students. Gamified breaks are likely to have increased participation. A combination of these factors likely explains why there was a simultaneous decline in emotional exhaustion and an increase in academic productivity.

In this way, the randomized design, and in practical terms, moderate to large effect sizes, burnout mitigation is possible without relying on elaborate, or demanding, time-intensive programs. Micro-dose active breaks are likely to be practical, scalable, and integrate easily into most, if not all, teaching routines. Because academic burnout is, in large part, a structural issue, more refined research is needed to determine, over the long-term, how this approach can maximize the level of burnout prevention through the ongoing impact, if any, of the micro-dose active breaks, in terms of the differences in the academic workload, especially among students with a high degree of burnout.

Student Engagement Dimensions

The current study demonstrates the positive effects micro-dose gamified active breaks have on students' vigor, commitment, and focus. These findings are consistent with the existing literature showing that an increase in physical activity leads to an increase in levels of engagement in learning activities within a university context. For example, Wang et al. (2023) found positive relationships between the engagement of university students in physical activity of moderate and vigorous intensity and their level of engagement in academic activities, with the opposite being true for levels of sedentary behavior. Other researchers, such as Matian et al. (2023), reported that participation in organized recreational activities and structured physical exercise was a significant

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predictor of students achieving a high-grade point average (GPA) and academic persistence.

Motivation analysts can use Self-Determination Theory to make sense of engagement gain. Wang and Chen (2021) proved that, during physical activity, the prediction of intrinsic motivation and consistent future participation was due to one or several of the predictors (autonomy, satisfaction, and competences/relatedness). In the same sense, Latre-Navarro et al. (2023) identify that the gamified design of participation in educational contexts increased satisfaction of both autonomy and competence; and, to an extent, participation and satisfaction of both. Nonetheless, the poorly defined system of rewards undermines the intrinsic motivation of participants. While both studies speak to the importance of fulfilling certain needs to sustain motivation, one focuses primarily on the psychological satisfaction derived from the activity while the other pays more attention to the importance of the design of the gamified activity. The current intervention seems to take both sides into account by providing short, autonomy-engaging, non-reward movement breaks.

The benefits from increased engagement could also stem from temporary physical activity having immediate cognitive benefits. Hayes (2024) stated that adding brief exercise breaks during university lectures increased student attention and engagement compared to lectures where students remained seated. In the same vein, Teuber et al. (2024) stated that activity breaks that are set at strategic times decreased the stress load and increased perceived capacity to work academically.

From the researcher's perspective, embedding micro-dose movement during instructional time may be a critical factor in the positive outcomes. Exercise is beneficial, but university students are unlikely to find time outside of studies and work for it. The intervention increased motivational salience and decreased structural barriers by incorporating brief gamified movement directly into the lectures. Importantly, the adaptations were not limited to behavioral participation, indicating a greater psychological investment in academic activity. This demonstrates that strategies involving micro-doses of movement can positively influence motivational engagement and emotional revitalization.

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The significant increases in engagement point to considerable practical implications for the application of the findings in higher education contexts with prolonged periods of sedentary learning. Despite being brief and minimally disruptive, the intervention produced statistically significant, theory-based effects. This evidence demonstrates the need to reconceptualize physical activity as a pedagogical tool that encourages greater participation and possibly protects against burnout. Research on sustained engagement and possible future impact on academic achievement is recommended to determine the effects of engagement on performance.

Group × Time Interaction (Intervention Effects)

The notable Group × Time interaction suggests that the intervention modified changes over time that were different than the changes in the control condition. This trend follows randomized controlled physical activity interventions in university settings. Novak et al. (2025) illustrated structured group-based exercise programs to be effective in increasing total and vigorous physical activity while decreasing sedentary time, further endorsing the effectiveness of socially embedded formats. Likewise, Li et al. (2025) found better improvements in fitness after an 8-week functional program compared to traditional methods. While Novak and colleagues emphasize social structuring as an explanation, Li and colleagues focus on the physiological aspect, and yet both continue to reinforce that structured interventions induce time-based improvements over and above baseline. The current micro-dose gamified approach seems to be in line with this structured cumulative improvement approach.

The impact of an intervention changes over time due to how motivational mechanisms are engaged. Duan et al. (2017) illustrated how web-based interventions enhanced physical activity by focusing on the two motivational components of the formation of intention and volitional planning. By contrast, Ruissen et al. (2018) focused on affective forecasting and showed how mental contrasting increased the activity of female students in the moderate-to-vigorous range. Despite one focusing on cognitive planning and the other on emotional forecasting, both emphasize the role of theory-based frameworks in fostering long-term change in behavior. The effect seen in the repeat micro dosing along with motivational scaffolding and gamified elements reinforcements effects integrated is also the case here.

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The broad landscape of research on educational interventions, in which small to moderate effects are the norm, is a necessary perspective to consider when gauging effect size. Motivation interventions, like Lazowski and Hulleman (2016), showed a moderate average effect, although the authors pointed out that randomized trials tend to report smaller effects. Conversely, Kraft (2023) remarked that the overwhelming majority of rigorously evaluated educational interventions yield effects that are below the typical standard. The interventions of Verkoeijen et al. (2024) are also noted to be theoretically promising only to collapse below the initial expectations. Most of the research shows that modest effects are still more than just a formality, and for complex academic situations, this is where we find the value of the interaction effects described here.

With regard to design and execution, the divided group differences have to do with the interplay of physiological arousal and motivational reinforcement. The intervention incorporated small movements as instructional time and helped reduce the barriers to implementation and increased compliance through a gamified design. Micro-recovery, because of the repeated small breaks, could have resulted in a mentally and emotionally positive increase in the gap of differences in the groups over time.

The statistically small to moderate results of the interaction effects demonstrate the impact and the practicality in a time and resource constrained higher education environment. For repeated micro-dose breaks, instead of aiming for big, short-term goals, the gamified breaks focus on small goals to achieve short-term disruptions to encourage active participation.

Within-Group Improvements

Psychological gains from incremental activities in university settings are shown from the positive gains in the intervention group before and after the experiment. Studies show that exercising in light and moderate intensity provides psychological benefits. Herbert (2022) noted that depressive symptoms and perceived stress are reduced after low intensity aerobic exercise and after a few sessions, emotional processing improves. In addition, Mandic et al. (2020) found that multi-component interventions with motivational support and web-based interventions increased physical activity for a year. Herbert talks about psychological relief and Mandic talks about behavior change; however, they show that short, light, and small activities help the group in improving



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behavior. The results from the experiment show that psychological gains are a result of a micro-dose activities.

“It is possible the effect is also related to dosage and the type of cognitive engagement involved. Anzeneder et al. (2023) stated that exercise that is cognitively engaging for around 15 minutes maximizes the benefits to functioning executive, indicating that the more mentally challenging the movement the better the results. Conversely, Wassenaar et al. (2020) stated that the findings for the dose-response relationship are inconsistent and lack proven methodology. One side supports the idea that exercise should be carefully structured while the other is more interpretively cautious. However, both perspectives suggest that effectiveness hinges on factors other than the length of time and the quality and context. The addition of gamified elements in the current research is likely to have raised cognitive salience, which supports the idea that the short duration of the activity played an important role.”

Outside of physical activity studies, higher education research has shown the potential for small changes in behavior to produce meaningful changes, even within groups. Motz et al. (2021) demonstrated that automated academic nudges improved grades and decreased the number of assignments that were missed, and while tasks were not movement-based, Blondeel et al. (2023) showed that behavioral nudges improved preparation and performance. Both studies demonstrate that small, structured changes, which are minimally disruptive to the flow of the tasks being performed, can lead to significant improvements. In a similar manner, the within-group improvements in the current study may be the result of a similar low friction repeated interventions to change the engagement pattern of the participants.

From this perspective, considering practicality, consistency, rather than intensity, seems to be more important. Short, regular intervals of movement likely served as both physiological and cognitive resets in a cognitively demanding classroom situation. Achieving these benefits without a significant investment of time and resources highlights the feasibility of working around busy schedules.

In naturalistic teaching and learning settings, such small changes, albeit small, are significant. Over time, sustained implementation of movement strategies may foster academic resilience and well-being by increasing energy, focus, and emotional control.

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Theoretical Integration

The current findings can best be understood when integrating the JD-R model with SDT. The JD-R model states that resources in the form of buffers can be used to ‘demand’ and sustain ‘engagement’, whereas SDT focuses on the concepts of the ‘demand’ (motivation) and ‘engagement’ (the focus of attention and investment on the task at hand) in the context of the ‘provision’ (satisfaction) and the ‘fulfilment’ (control) of the ‘relatedness’ (the need to connect with others). And there is empirical evidence to support this theory. For example, Wingerden et al. (2018) illustrated that the role of job resources is to enhance engagement via motivational paths that are aligned with the principles of SDT. In the same vein, Ong et al. (2023) illustrated that in an educational context, the satisfaction and commitment of students were predicted by the need for ‘relatedness’ and ‘competence’. Wingerden and colleagues and Ong and colleagues both focus on the context of the resource buffer and the inner stands of abstract and psychical satisfaction and goal fulfillment, respectively, but both support the idea that in the presence of a motivational context, persistence and engagement are amplified. The current intervention of structured movement and reinforced gamification seems to be the first to explore this integrated resource pathway model.

Recovery Theory elaborates on the psychological dimension of refueling spent psychological resources. For example, Pan et al. (2017) demonstrated that re-engagement with adversity students is explained by academic self-efficacy, and Estevez et al. (2021) argued that multidimensional engagement is influenced by combinations of different coping and self-regulation processes.

From physiology, optimally balanced activation may also be part of resource restoration. For instance, Richardson et al. (2020) linked physiological arousal and enhanced cognitive engagement and Sung et al. (2023) noted that learning outcomes may suffer due to too much arousal. These studies suggest that moderate arousal may likely improve cognitive engagement without stress. The light to moderate micro-dose activity may accomplish this, allowing sustained engagement.

In synthesis, the JD-R model illustrates the buffering of resources, the SDT explains the motivational reinforcement, and Recovery Theory explains the psychological refueling. These models do not compete, but synergistically, place micro-dose gamified



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active breaks as the theoretical basis for regulating demands, restoring psychological resources, and increasing academic engagement for higher education.

Practical Implications

The study provides evidence supporting the claim that micro-gamed active-break interventions appertain to regular university instruction whilst keeping the delivery of academic content undisturbed. Designed for short intervals (currently being researched and refined), their resource demands are minimal, and adherence to their use is a calibrated norm. The interventions described become a sensible option (while needing a bit of research to fully support this claim) for the promotion of well-being within the regular parameters of the course and assigned readings. The ACT model, developed for the described purpose, includes intervals of movement intended to disrupt overly sedentary lapses in learning. Activity prompts within instructional periods are also geared to invigorate learning and counteract symptoms of burnout. These micro-gamed free breaks are a pragmatic extension of university pedagogy that institutions can adopt to bolster the emotional well-being of student populations by enhancing academic functionality with little operational intrusion.

Conclusions

This study provides empirical evidence that embedding structured micro-dose gamified active breaks within higher education settings can significantly reduce academic burnout and enhance student engagement over time. The observed Group $\times$ Time interaction effects indicate that brief, strategically implemented movement interventions can produce meaningful psychological benefits when integrated into routine academic contexts. By combining physiological activation with motivational reinforcement, the intervention demonstrates that small, repeated behavioral adjustments may contribute to improved academic well-being. Overall, the findings support the potential of movement-based pedagogical strategies as viable tools for strengthening student resilience and engagement in demanding university environments.

Limitations of the Study

Findings should be interpreted within the context of several design boundaries. First, the study was conducted within a single institutional and course setting, which may limit generalizability to other academic contexts. Second, outcomes were assessed using



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self-report measures and did not include objective academic or physiological indicators. Third, the intervention period was limited to eight weeks, preventing conclusions regarding long-term sustainability. Future multi-site and longitudinal research incorporating objective performance measures would strengthen the evidence base.

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