Multimodal Assessment of an Ultra-Brief Practice of Progressive Muscular Relaxation Adapted for the Classroom

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Abstract: Progressive muscular relaxation (PMR) is a technique often used in clinical settings for reducing physical symptoms of anxiety and improving well-being. This paper presents a comparison of psychological and physiological effects of an ultra-brief, video-guided PMR activity (uPMR) that has been adapted for classroom settings and a time-matched control activity (CA); and student opinions of uPMR to gauge its acceptability for use in formal educational settings. Forty undergraduate students (18-25 years) from a Spanish university participated in the study in which measures of state anxiety (State-Trait Anxiety Inventory, STAI), affect (Affective Slider, AS), and parasympathetic nervous system (PNS) activity indexed via the heart-rate variability parameter root mean square of successive differences (RMSSD) were conducted. Results show that RMSSD was significantly higher during uPMR than when measured before. The same effects were not found with CA. Additionally, participants rated the design of uPMR more favorably and acceptable for use in formal educational settings than CA. Significant changes in affect and state anxiety; and sustained physiological effects were not detected, suggesting that the brevity of the activity may dampen its effects. The findings related to the physiological effects and student opinions support the notion that uPMR possesses promising characteristics for use in situated teaching and practice of self-regulatory techniques aimed at reducing physiological arousal on an acute basis. Hence, it can be considered an appropriate activity to integrate into technologies that support teachers in creating opportunities for self-regulation in the classroom and guiding students through evidence-based self-regulation practices.

Keywords: Self-regulation, Physiology, Stress, Affect, Progressive muscular relaxation

1. Introduction

“Globally, the mental health of university students is an important public health issue” (Bantjes *et al.*, 2022; p. 809) and cost-effective, sustainable, and scalable interventions are needed. A systematic review of review-level evidence on supporting university student mental health, reports on a wide range of interventions. Some of the interventions with evidence of positive effects on student mental health include skill-training programs with supervised practice, stress management, relaxation training, mindfulness-based interventions, interventions delivered via technology, and settings-based interventions which aim to enhance academic teaching and learning (Worsley *et al.*, 2022).

Stress is a driver of mental health challenges. University students experience high levels of stress which affects their health, academic performance, and longer-term employability (Pascoe *et al.*, 2020). There is a need to educate students about the effects of stress and to introduce them to efficient coping strategies both to support student academic performance and well-being (Vogel & Schwabe, 2016). Relatedly, emotional self-regulation, defined as the ability to influence our own emotions or those of others, is an important self-management skill. It involves recognizing one's emotional state, selecting, and implementing a regulatory strategy to modify it, and monitoring for success in achieving the regulatory goal (McRae & Gross, 2020). Self-regulation strategies such as mindful breathing, progressive muscular relaxation (PMR), and reappraisal can decrease symptoms of anxiety and down-regulate negative emotions (Worsley *et al.*, 2022; Scult *et al.*, 2017).

Building upon the idea that formal educational settings can provide students with safe and situated opportunities for learning and practicing self-regulation, this work contributes to efforts that use technology to increase educator access to resources and techniques that do not require specialized training to teach (i.e., they can be delivered by a non-expert), do not take a long period of time to demonstrate (i.e., they can be integrated into a regular class), and can help educators better provide groups of students opportunities to improve abilities to self-regulate. Along these lines, a digital technology for teaching and learning was developed to support teachers in creating opportunities for self-regulation in the classroom and guiding students through evidence-based self-regulation practices. The application (ClassMood App) involves students reporting their current emotional state and based on an aggregate state of the class, the teacher selects and runs an activity to alter the emotional state of the class (Beardsley *et al.*, 2019). ClassMood App aims to help students become aware of their own emotions and experience actions they can take to regulate them; and also, to become aware of the emotional states of their peers and the overall class – as the classroom emotional climate can affect class performance (Brackett *et al.*, 2011). To increase accessibility, ultra-brief (2 to 3-min), video-guided activities have been integrated into the application. Obradović et al. (2021) found evidence that an ultra-brief (1-min), video-guided deep breathing intervention effectively reduced children's physiological arousal and was an accessible tool that could be used in home, school, or online settings. Activities available in ClassMood App include evidence-based techniques such as mindfulness and breathwork. However, the psychological and physiological effects of ultra-brief variations of these evidence-based techniques is unclear. This work aims to investigate the effects of an ultra-brief, video-guided practice of progressive muscular relaxation (uPMR).

PMR is a stress management technique often used in clinical settings that involves the repeated contracting and relaxing of different muscle groups. It has also been used for reducing physical symptoms of anxiety in the general population (Klanin-Yobas *et al.*, 2015), in children (Vagnoli *et al.*, 2019), and among university students (Gallego-Gómez *et al.*, 2019). PMR works by promoting a deep state of relaxation, activating the parasympathetic system (Sakakibara *et al.*, 1994), decreasing cortisol levels (Gallego-Gómez *et al.*, 2019), and decreasing brain activity (Kobayashi & Koitabashi, 2016). A typical PMR intervention consists of multiple 20-min sessions across 7-10 days (Wilczyńska *et al.*, 2019). Several studies of PMR have been run involving university students. Schienle and Unger (2021) studied a 14-day PMR course for university students, in which participants were to practice PMR each day. Participants reported lower levels of arousal, more positive valence, higher relaxation levels after their daily PMR practice and lower stress levels at the end of the course. Pawlow & Jones (2005) ran a single 20 to 25-min PMR practice and compared the effects to a no-treatment control. The authors found that PMR practice lowered levels of heart rate, state anxiety, perceived stress, and salivary cortisol. The authors (Dolbier & Rush, 2012) of a study on a single, 25-min, lying down PMR practice with high stress university students, concluded that PMR can decrease cognitive anxiety, increase mental and physical relaxation, and enhance restorative physiological functioning. The latter is represented by an increase in parasympathetic nervous system (PNS) activity which, in turn, is indicated by changes in heart-rate variability (HRV). Dolbier and Rush (2012, p. 51) write that HRV refers to changes in the time intervals between consecutive heartbeats with greater fluctuation indicating PNS activity, whereas lower fluctuation indicates sympathetic nervous system activity. The latter studies suggest a single, abbreviated practice of PMR can have positive psychological and physiological effects on university students.

Aligning with settings-based interventions that offer skill-training related to stress management with the support of technology, this present study investigates whether uPMR is acceptable for the situated teaching and practice of self-regulation in formal education. To do so, the psychological and physiological effects of uPMR on student anxiety, affect, and parasympathetic nervous system (PNS) activity indexed via the HRV parameter root mean square of successive differences (RMSSD) are assessed in comparison to a time-matched control activity (CA). RMSSD is thought to reflect cardiac vagal activity which depicts PNS contribution to cardiac regulation (Laborde *et al.*, 2017). RMSSD is widely used in emotion regulation studies (Balzarotti *et al.*, 2017) Moreover, student opinions of uPMR are also presented to assess student acceptance of the activity. Hence, there are three hypotheses being investigated in this paper. H1: uPMR will lead to more beneficial physiological effects than a time-matched control activity (CA) as evidenced by a greater increase in HRV (RMSSD) from a comparison of baseline and activity performance periods (Pawlow & Jones, 2005; Nickel *et al.*, 2005; Dolbier & Rush, 2012). The difference in HRV reflects higher post-pre PNS activity. H2: uPMR will lead to more beneficial psychological effects than (CA) as evidenced by lower pre-post ratings of arousal and higher valence (Schienle & Unger, 2021), and lower pre-post ratings of state anxiety (Pawlow & Jones, 2005; Dolbier & Rush, 2012). H3: University students will rate uPMR as more acceptable for use in formal educational settings than a time-matched control activity that involves watching a video documentary.

2. Methodology

2.1 Study Design

The protocol is a conceptual replication of the work by Laborde et al. (2022) that compared the effects of variations of a paced-breathing activity using physiological (HRV, RMSSD) and psychological measures (anxiety, arousal, and valence). Periods of rest, reactivity, and recovery following the 3Rs of HRV (Laborde *et al.*, 2017) underlie the structure of the protocol. Rest is the baseline; reactivity is the change between baseline and the event (i.e., self-regulatory activity); and recovery is the change between the event and a post-event measure. Modifications to the replicated protocol include the use of a Vanilla Baseline (VB) to replace the resting forced relaxation (i.e., as the recovery task). For VB, participants perform a task requiring sustained attention but minimal cognitive load (Jennings *et al.*,1992) to better reflect a students' classroom experience. For this study, participants were asked to count the number of times different colors appeared on a screen. The color changed every 6 s and the task lasted 2 minutes. Further, videos were used to guide participants through the self-regulation activities. This follows the approach of Obradović et al. (2021) to mimic how educators would use materials that have been produced in a scalable manner (i.e., showing students a video adapted for classroom use).

2.2 Participants

There were 40 participants (22 female, 18 male) from 18 to 25 years old (M = 19.60 ± 1.64). Psychophysiological data from 7 participants were excluded due to technical issues related to electrode movement on signal integrity (6) and misunderstanding of self-report measures (1). The final sample for the psychophysiological data was 33 participants (18 female, 15 male) from 18 to 25 years old (M = 19.48 ± 1.67). All participants were compensated 15 euros for their participation and gave written informed consent.

2.3 Materials and Measures

In this within-subject design, participants joined two 1-hour laboratory sessions. The sessions followed the protocol shown in Figure 1 in which two self-regulation activities (uPMR or alternatives) and one control activity were performed. Each activity lasted 2 min and there was a 6-min break between the performance of activities. To control for carryover effects between activities, the sessions took place on separate days. The current study presents a comparison of one of the self-regulation activities (uPMR) and a neutral control activity (CA).

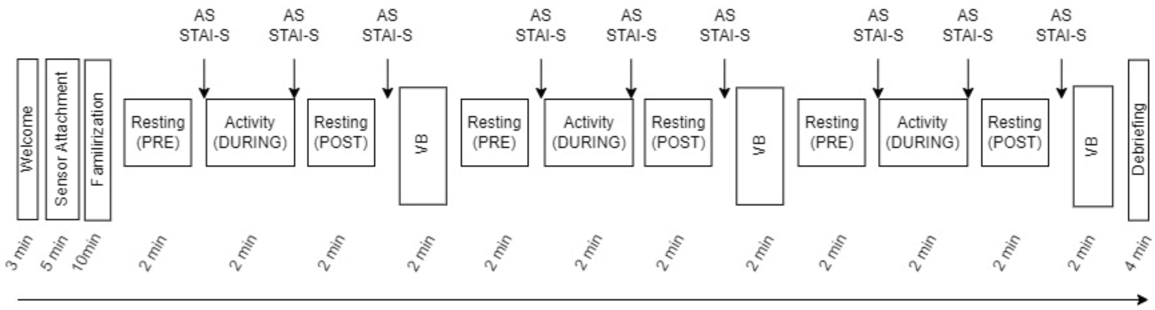

Figure 1. The Experimental Protocol

2.3.1 Ultra-Brief Progressive Muscular Relaxation Activity (uPMR)

A publicly available video (https://youtu.be/CATd9fqb-Mg) that was created in a multidisciplinary European project was used to guide participants through the 2-min uPMR activity. In the video, an animated character leads viewers through a cycle of tensing and releasing muscles starting from the feet, thighs, and hands to the shoulders and face. The video was edited to omit the introduction to PMR and only included a 2-min clip to guide the performance of PMR.

2.3.2 Control Activity (CA)

A 2-min clip from a documentary ("Abenteuer Forschung" [Research Adventures]) on outer space was shown to participants as the control activity. This video was found to have emotionally neutral ratings and was used in a previous study on the autonomic effects of breathing exercises (You *et al.*, 2022).

2.4 Procedure

During the welcome phase, participants were introduced to the sequence of activities (see Fig. 1). Trial tasks and activities were run on PsychoPy (v2021.2.3) and shown to participants on a monitor. As participants completed a survey collecting demographic information and data related to possible confounds (Laborde *et al.*, 2017), sensors were placed on them (sensor attachment phase). During the familiarization phase, the self-report scales (STAI-S, AS), resting task, VB task, and self-regulation activities were introduced, and participants were able to ask questions to clarify tasks. For the resting task, participants were instructed to look at a black screen with a fixed white cross at its center (Parchment *et al.*, 2016). Progression of the trial for the self-report questionnaires was controlled by the participant whereas the resting task, VB task, and activities advanced automatically based on pre-set times. The trial ended with a debriefing phase in which participants completed a survey of their views of the activity, the sensors were removed, and debriefing occurred. Ethical approval was received for the adapted protocol.

2.4.1 Dependent Variables

Current state of anxiety was measured using a 6-item, short form of the State-Trait Anxiety Inventory (STAI-S) (Marteau & Bekker, 1992). Student affect was measured using the Affective Slider (AS) which consists of a continuous scale with icon images on either end to measure levels of emotional arousal ("How active do you feel?") and emotional valence ("What is your mood?") (Betella & Verschure, 2016). HRV was computed from the raw electrocardiogram (ECG) signal acquired from a wearable for capturing physiological data during the performance of full-body movements (Sayis *et al.*, 2022). The wearable records the

ECG signal via 5 electrodes (2 on the chest, 2 on the shoulders, and 1 placed on the neck). Data was acquired at a sampling rate of 500 Hz. An event-based synchronization approach was followed to synchronize data sources (Bannach *et al.*, 2009).

2.4.2 Post-Trial Survey

Participants completed a Google form survey with closed-ended and open-ended questions at the end of each laboratory session. This paper reports an analysis of the closed question, a 7-point Likert scale (1: strongly disagree, 7: strongly agree) that gathered student opinions on 11 items for each activity (see Table 2). Also, an analysis of an open-ended question related to the PMR activity that asked participants to specify if there was anything preventing them from relaxing during the activity is presented.

2.5 Data Analysis

The use of physiological (HRV) and self-report measures (AS, STAI-S) follows the approach of (Laborde *et al.*, 2022). ECG signal data were imported into Kubios (version 2.2) and analyzed manually for artifacts. Features were extracted in time and frequency domains and nonlinear indices included in Kubios. Checks for normality and outliers were done. The RMSSD data were non-normally distributed, so a log-transformation was applied (lnRMSSD) consistent with HRV research (Laborde *et al.*, 2017). For AS, valence and arousal data were mostly normally distributed. However, 1 outlier was removed from valence ratings. STAI-S data were non-normally distributed, so log-transformation (lnSTAI-S) was applied. A series of repeated-measures ANOVA with Greenhouse–Geisser correction were conducted with conditions (uPMR vs. CA) and time (PRE, DURING, POST) set as independent variables. HRV data for the full 2-min duration of each period (PRE, DURING, POST) was used. Valence, arousal, level of anxiety were self-report dependent variables, and lnRMSSD was an HRV-dependent variable. Adjustments for multiple comparisons were done with Bonferroni correction. Descriptive statistics were also used for the survey data. A paired-samples t-test was used to determine whether there was a statistically significant mean difference in views toward activities. Statistical analyses were computed using SPSS (v29).

3. Results and Discussion

Descriptive statistics are presented in Fig. 2 for lnRMSSD, Table 1 for AS (arousal and valence) and lnSTAI-S. In all figures, * represents $p \leq 0.05$, ** represents $p \leq 0.01$, *** represents $p \leq 0.001$.

3.1 H1: Physiological Effects of uPMR in Comparison to CA

HRV (lnRMSSD): A repeated-measures ANOVA confirmed that there was no overall significant difference between the two conditions, $F(1, 32) = 3.47$, $p = 0.071$). However, there was a significant interaction effect for condition × time, $F(1.85, 59.48) = 29.08$, $p < 0.001$. Pairwise comparisons revealed higher levels of lnRMSSD during the uPMR condition compared to the levels registered during the CA ($p < 0.001$). Moreover, no statistically significant differences between conditions in lnRMSSD levels during PRE ($p = 0.785$) and POST ($p = 0.229$) were found. Interestingly, pairwise comparisons in uPMR condition showed significantly higher levels in lnRMSSD during the session compared to baseline levels measured prior ($p = 0.044$). Nevertheless, no significant differences in lnRMSSD levels comparing PRE- and POST-measures in uPMR were observed ($p = 0.420$). These results suggest that uPMR increases lnRMSSD levels compared to the CA while the activity is being performed, however this increase does not appear to show long-lasting effects.

Our findings differ from those of Nickel et al. (2005) as the authors found that RMSSD values were higher post-activity following a 25-min PMR practice in a clinical population.

However, the pattern of results found in our study are similar to the ones observed in You et al. (2022) where the increase in lnRMSSD was also found during a brief (17-min), video-guided paced-breathing activity, but not maintained after the intervention. Other studies did not show changes in physiological measures such as heart rate, HF-HRV or respiration after a brief PMR training (Smith & Norman, 2017). Our results confirm a significant increase in PNS activity associated with the relaxation response during uPMR performance (Hoffman *et al.,* 1982). Nevertheless, cardiac vagal activity recovered to baseline after practice. A possible reason could be that participants move immediately after the activity to answer the self-report surveys, causing PNS activity to decrease. A more likely explanation is that the intervention time was too brief to have a longer lasting impact on PNS activity. Moreover, muscle relaxation, in general, might have greater muscular effects and smaller autonomic effects than other relaxation methods such as finger temperature biofeedback and/or autogenic training (Lehrer *et al.*, 1994).

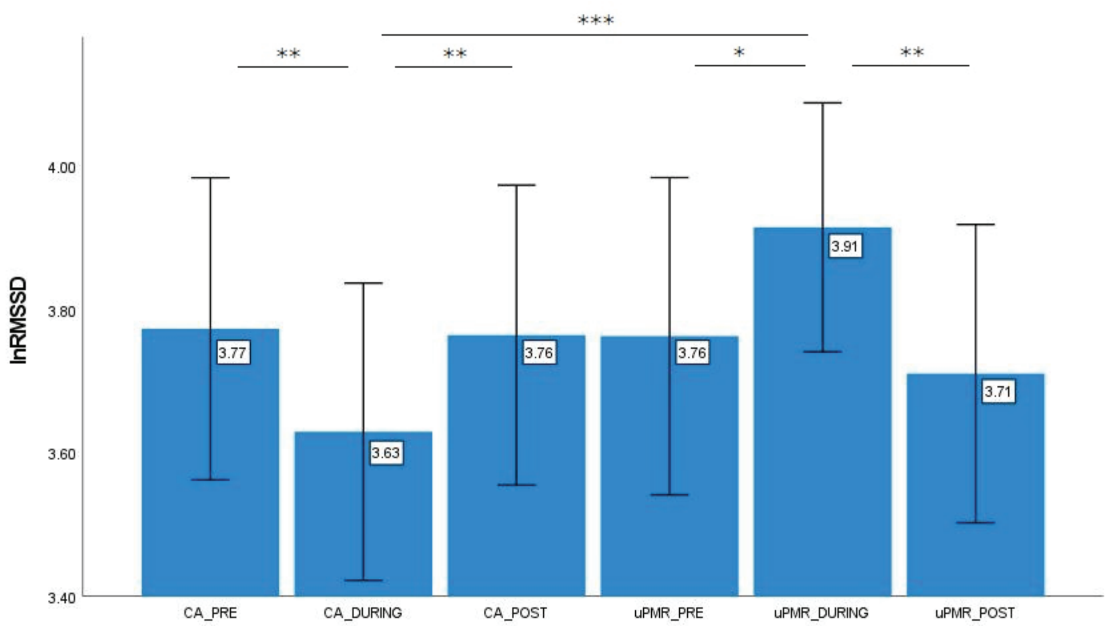

Figure 2. Descriptive Statistics (lnRMSSD)

3.2 H2: Psychological Effects of uPMR in Comparison to CA

Affect (AS): Regarding emotional arousal, there was no significant main effect of condition, $F(1, 32) = 1.036$, p =0.316; no interaction effect for condition × time, $F(1.62, 51.83) = 1.306$, $p = 0.275$. While uPMR DURING and POST values were lower than PRE levels, the differences were not significant, whereas CA POST values were significantly lower than PRE levels ($p = 0.001$). Also, a significant reduction in self-ratings of emotional arousal from DURING (immediately after the end of the activity performance) to POST (after a 2-min rest period) was observed in both uPMR ($p = 0.05$) and CA ($p = <0.001$). Regarding emotional valence, there was no significant main effect of condition, $F(1, 32) = 0.136$, $p = 0.715$. There was a significant interaction effect for condition × time, $F(1.80, 57.84) = 4.28$, $p = 0.022$. Pairwise comparisons revealed that PRE valence levels differed between conditions ($p = .049$). No significant difference in valence levels was found in DURING ($p = 0.823$) and POST ($p = 0.085$) levels. Given the lower valence baseline (PRE) in uPMR, results suggest that uPMR had a more positive effect on valence. In other words, uPMR may have brought participants to a higher valence state from PRE to DURING ($p = 0.568$) while CA worked in the opposite direction with negative effects on valence from PRE to DURING ($p = 0.630$) and DURING to POST ($p = 0.034$). The CA was a non-stimulating activity that consisted of watching a video and remaining passive. This could be the reason participant levels of arousal decreased and they switched to a more negative valence state (i.e., increased boredom).

While changes from baseline (PRE) to immediately after activity performance (DURING) did suggest higher arousal and more positive affect in the uPMR condition, these changes were not significant. Thus, our findings differ from those of Schienle and Unger (2021) in which university students reported significantly lower arousal and more positive affect after daily 10-min PMR exercises. A possible explanation is that participant familiarity in performing PMR and activity duration are important factors related to generating changes in affective states.

State anxiety (lnSTAI-S): There was no significant main effect of condition, $F(1, 32) = 0.109$, $p = 0.743$; no interaction effect for condition × time $F(1.83, 58.55) = 0.832$, $p = 0.431$. Pairwise comparisons revealed that only uPMR showed a significant reduction in self-ratings of state anxiety from PRE to POST ($p = 0.036$). Significant reductions in state anxiety from DURING to POST were found in both uPMR ($p = 0.05$) and CA ($p = 0.01$). Thus, levels of anxiety did not differ from baseline to the measure immediately after uPMR performance (DURING) but only from baseline to the measure taken after a 2-min rest period (POST). These findings differ partially from those of Pawlow & Jones (2005) in which they compared a single, 20-min PMR practice to a control and found significantly reduced post-activity self-ratings of state anxiety. Thus, it seems the duration of practice is an important factor contributing to the psychological effects of PMR.

In sum, H2 was only partially supported, as there was a significant decrease in levels of anxiety compared to baseline 2 minutes after uPMR training. However, uPMR did not modify valence and it reduced levels of arousal similarly to CA as measured by AS. Also, it should be noted that the level of anxiety measured 2 minutes after and not immediately after uPMR training was lower than baseline while activation of PNS (as indicated by changes in lnRMSSD) was observed during the training and not after. An explanation for this physiological and psychological desynchronization could be that the emotional experience of anxiety seems to be dependent on both autonomic nervous system feedback and the cognitive interpretation of the stimulus that induced these bodily signals (Nummenmaa *et al.,* 2014). In other words, emotional states arise from physiological changes and interoceptive signaling occurs before there is emotional awareness (Critchley & Garfinkel, 2017).

Table 1. *Descriptive Statistics (uPMR vs. CA)*

	Arousal		Valence		lnSTAI-S	
	uPMR	CA	uPMR	CA	uPMR	CA
Pre	2.74 ± 0.82	2.81 ± 0.75	3.44 ± 0.57	3.60 ± 0.48	3.37 ± 0.21	3.35 ± 0.17
During	2.71 ± 0.76	2.95 ± 0.76	3.53 ± 0.53	3.51 ± 0.49	3.38 ± 0.21	3.41 ± 0.19
Post	2.48 ± 0.76	2.47 ± 0.88	3.46 ± 0.49	3.37 ± 0.49	3.32 ± 0.18	3.33 ± 0.17

3.3 H3: Student Opinions Collected from the Post-Trial Survey

Descriptive statistics can be found in Table 2. Across items related to the acceptability of the activity for use in formal educational settings (items 5, 6, 9-11), ratings for uPMR were all above 4 (out of 7) and significantly higher than CA suggesting that participants would accept uPMR for use in formal educational settings. Furthermore, participants found uPMR easy to perform with 2 minutes being rated highly as an appropriate duration. Ratings for items 2-4 (effects on arousal and mood) are in line with the psychophysiological results previously reported. Thus, H3 is confirmed as participants rated uPMR as more favorable and acceptable for use in formal educational settings than CA. A previous study by O'Donnell & Dunlap (2019) also found high acceptance rates of digital audio guided PMR interventions among schoolteachers. Thus, uPMR has the potential to be an accepted activity by both students and teachers. Although, a follow up study with university educators would help confirm this.

In response to the open question, 11 (27.5%) of participants commented that they had difficulty relaxing during the activity. Thematic coding (Gibbs, 2007) of the reasons given generated 4 codes. Responses referred to a lack of comfort with the activity (2), lack of comfort with the environment (2), problems with the nature of the activity such as it being too long, too isolating, and not relaxing to contract muscles (3), and ruminating while or having general discomfort with relaxation activities which prevents relaxation (4). As an example of the latter, one participant wrote, “It has always been difficult for me this (sic) relaxing activities because I don't feel comfortable.” The reason for the latter responses could be that initial performances of basic types of relaxation activities such as PMR or mindful breathing require effort and attention. This can make the activities less relaxing and/or even increase stress levels. With practice less effort and attention are required, and greater relaxation benefits are realized. This is known as the paradox in relaxation training (Heide & Borkovec, 1983) and is more prevalent in people with higher basal levels of anxiety or anxiety disorders (Kim & Newman, 2019). This paradox may also be a factor that influenced the self-reports for affect and anxiety.

Table 2. *Descriptive Statistics for the Post-Trial Survey Closed-Ended Question: M (SD)*

	uPMR	CA	p-value
1. The activity is easy for me to perform.	6.25 (1.30)	5.58 (1.57)	0.043
2. The activity calms me down.	5.73 (1.55)	3.68 (1.90)	<0.001
3. The activity energizes me.	1.93 (1.29)	2.38 (1.35)	0.098
4. The activity improves my mood.	4.03 (1.39)	3.43 (1.63)	0.041
5. The duration of the activity is appropriate.	5.80 (1.22)	4.98 (1.58)	<0.001
6. I would like to do this activity as part of a class.	4.53 (1.83)	3.25 (2.06)	0.003
7. I would feel embarrassed performing this activity in a class.	2.10 (1.75)	1.68 (1.39)	0.184
8. This activity would help me be more open with others.	2.70 (1.22)	1.95 (1.20)	0.001
9. This is an appropriate break activity to use in an online class.	4.20 (2.10)	2.78 (1.76)	0.002
10. … in an in-person class.	4.58 (1.88)	3.28 (1.77)	0.004
11. … when I study on my own.	4.98 (1.94)	3.20 (1.73)	<0.001

4. Limitations and Future Directions

There are several limitations to this study that can be used as suggestions for future work. (1) The study was conducted in a controlled, experimental setting with individual participants rather than in everyday settings of participants which limits the generalizability of results to real-life settings. (2) Despite the sample size being similar to other physiological studies of self-regulation activities (You *et al.*, 2022; Nickel *et al.*, 2005; Pawlow & Jones, 2005), a larger sample should be considered to account for potential technical issues causing the loss of data. (3) While CA was intended to be a neutral activity and was used as such by You et al. (2022), this study found that it produced significant effects on affect and PNS activity. Different control activities that are more active-neutral (Smith & Norman 2017) or based on leaving free time to the participant (Crocker & Grozelle, 1991) should be considered.

Beyond addressing the limitations, further investigations should explore whether the effects of uPMR differ by gender, ethnicity, and among disadvantaged students. Additionally, to make uPMR more inclusive, future work is needed to identify how to support those not able to relax when performing the activity such as by altering guidance offered or providing additional scaffolding. Finally, microlearning which focuses on delivering small chunks of skills-based, just-in-time learning (Zhang & West, 2020) should be explored as a way of developing student self-regulation competences. For example, ultra-brief self-regulation activities can be taught and practiced in stressful academic situations such as prior to exams and presentations but form part of a longer, cumulative training course on self-regulation skills.

5. Conclusion

Progressive muscular relaxation is an evidence-based intervention for reducing physical symptoms of anxiety and improving well-being. The current study findings suggest that an ultra-brief, video guided PMR activity possesses promising characteristics for use in situated teaching and practice of self-regulatory techniques aimed at reducing physiological arousal (a symptom of anxiety) and stress on an acute basis in university students. Overall, this work aims to support students in developing critical life skills (resilience, self-management, meta-cognition) by identifying evidence-based self-regulation activities appropriate for formal educational settings and supporting educator use of these activities. The latter can be achieved through technologies such as ClassMood App that help teachers create classroom opportunities for guiding students through evidence-based self-regulation practices.

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