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Effects of an online mindfulness intervention on anxiety levels of basic education teachers: Randomized trial

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Conflict of Interest: None declared.

Abstract

This study aimed to test the efficacy and sustained effect (follow-up) of a brief, asynchronous mindfulness and self-compassion intervention, lasting four weeks, in reducing anxiety, stress, and depression levels in basic education teachers. The intervention was made available through the *Neurosaúde* app, developed as part of this work to serve as the platform for the intervention. All stages of the research took place in a virtual environment, with thirty participants randomly assigned to either the intervention group or the waitlist control group. Measures were applied to assess levels of mindfulness, self-compassion, anxiety, stress, and depression at pre-intervention, post-intervention, and at the 4-week follow-up. The ANOVA revealed a significant difference in moment vs. group comparisons, with a large effect size ($F(2, 26) = 5.316$; $p = .012$; $\eta^2 = .290$). Multiple comparison analyses (Pairwise) showed that this difference occurred between the pre-intervention ($M = 3.14$; $SD = 1.67$) and post-intervention ($M = 1.55$; $SD = 1.49$) moments for the intervention group, indicating that the intervention was able to significantly reduce ($p = .022$) anxiety levels in this group. Additionally, the study provided valuable insights into the context of basic education teachers. Furthermore, it contributed to the development of engagement strategies that can be applied in future research with this population, while also offering important insights into conducting online research.

Keywords: mindfulness, self-compassion, depression, stress, online intervention

EFEITOS DE UMA INTERVENÇÃO ONLINE DE MINDFULNESS SOBRE OS NÍVEIS DE ANSIEDADE DE PROFESSORES DA EDUCAÇÃO BÁSICA: ENSAIO RANDOMIZADO

Resumo

O objetivo deste estudo foi testar a eficácia e o efeito sustentado (*follow-up*) de uma intervenção breve, assíncrona, de *mindfulness* e autocompaixão, com duração de quatro semanas, na redução dos níveis de ansiedade, estresse e depressão em professores da educação básica. A intervenção foi disponibilizada por meio do aplicativo Neurosaúde, desenvolvido como parte deste trabalho para servir de plataforma para a intervenção. Todas as etapas da pesquisa ocorreram em ambiente virtual, com 30 participantes alocados aleatoriamente no grupo de intervenção ou no grupo controle de lista de espera. Medidas foram aplicadas para avaliar os níveis de *mindfulness*, autocompaixão, ansiedade, estresse e depressão nos momentos pré-intervenção, pós-intervenção e no *follow-up* de quatro semanas. A ANOVA revelou uma diferença significativa nas comparações entre tempo *versus* grupo, com um tamanho de efeito grande ($F(2, 26) = 5,316$; $p = 0,012$; $\eta^2 = 0,290$). As análises de comparações múltiplas (Pairwise) mostraram que essa diferença estava entre o período pré-intervenção ($M = 3,14$; $DP = 1,67$) e o pós-intervenção ($M = 1,55$; $DP = 1,49$) para o grupo de intervenção, indicando que a intervenção foi capaz de reduzir significativamente ($p = 0,022$) os níveis de ansiedade nesse grupo. Além disso, o estudo proporcionou uma compreensão valiosa sobre o contexto dos professores da educação básica e contribuiu para o desenvolvimento de estratégias de engajamento a serem aplicadas em futuras pesquisas com essa população, além de oferecer importantes insights sobre os procedimentos para a realização de pesquisas online.

Palavras-chave: atenção plena, autocompaixão, depressão, estresse, intervenção online

EFECTOS DE UNA INTERVENCIÓN DE MINDFULNESS ONLINE SOBRE LOS NIVELES DE ANSIEDAD DE PROFESORES DE EDUCACIÓN BÁSICA: ENSAYO ALEATORIZADO

Resumen

El objetivo de este estudio fue evaluar la eficacia y el efecto sostenido (seguimiento) de una intervención breve, asincrónica, de mindfulness y autocompasión, con una duración de cuatro semanas, en la reducción de los niveles de ansiedad, estrés y depresión en profesores de educación básica. La intervención se realizó a través de la aplicación Neurosaúde, desarrollada como parte de este trabajo para servir de plataforma para la intervención. Todas las etapas del estudio se llevaron a cabo en un entorno virtual, con treinta participantes asignados aleatoriamente al grupo de intervención o al grupo de control en lista de espera. Se aplicaron medidas para evaluar los niveles de mindfulness, autocompasión, ansiedad, estrés y depresión en los momentos pre-intervención, post-intervención y en el seguimiento de 4 semanas. El análisis

ANOVA reveló una diferencia significativa en las comparaciones entre el tiempo y el grupo, con un tamaño de efecto grande ($F(2, 26) = 5{,}316$; $p = 0{,}012$; $\eta^2 = 0{,}290$). Los análisis de comparaciones múltiples (Pairwise) indicaron que esta diferencia se encontraba entre el periodo pre-intervención ($M = 3{,}14$; $DE = 1{,}67$) y post-intervención ($M = 1{,}55$; $DE = 1{,}49$) para el grupo de intervención, lo que sugiere que la intervención logró reducir significativamente ($p = 0{,}022$) los niveles de ansiedad en este grupo. Además, el estudio proporcionó valiosos conocimientos sobre el contexto de los profesores de educación básica y contribuyó al desarrollo de estrategias de participación para futuras investigaciones con esta población, así como importantes ideas sobre la realización de estudios en línea.

Palabras-clave: conciencia, autocompasión, depresión, estrés, intervención en línea

Although the basic education teacher has historically been a figure of respect and social prominence, the current scenario presents significant challenges for this profession. Generational changes and the constant evolution of society impose additional difficulties, such as student indiscipline, violence, and scarcity of structural resources (Deffaveri et al., 2020; Herman et al., 2020).

Educators face multiple demands from various sources, including students, families that do not collaborate with the educational process, problems with colleagues, and the responsibility of shaping citizens for a constantly transforming society (Deffaveri et al., 2020; Herman et al., 2020). This scenario is aggravated by low remuneration and exhausting work hours, which end up contributing to the illness of teachers in Brazil (Cortez et al., 2017).

As a result, pathological stress has significantly compromised the health of educators, impairing the exercise of teaching and the quality of basic education in Brazil (Jacomini & Penna, 2016). In addition to these factors, studies also highlight a higher prevalence of symptoms of depression, anxiety, and stress among this population (Deffaveri et al., 2020; Silva et al., 2022; Tostes et al., 2018).

Recently, many studies have confirmed the effectiveness of online interventions, equating them to in-person interventions for various populations and psychological conditions, such as social anxiety, generalized anxiety, depression, stress, and panic disorder, among others (Andersson et al., 2018; Kählke et al., 2023; Moshe et al., 2021; Pauley et al., 2021; Polak et al., 2021; Zarski et al., 2024; Zhang et al., 2024). Systematic and meta-analytic reviews have confirmed these positive results in reducing symptoms of anxiety, depression, and stress (Gong et al., 2023; Ye et al., 2022). However, while these interventions are already widely researched in some countries, in Brazil they are still an emerging topic (Dominguez-Rodriguez et al., 2024; Lopes & Berger, 2016).

Although most of these studies have focused on computer-compatible platforms, technological advances have required the adaptation of online interventions. The growing sophistication of smartphones has led many people to replace computers with these devices, and, as a result, researchers have begun to implement and investigate the effects of online interventions via mobile applications, which are gaining prominence today (Marshall et al., 2021; Moshe et al., 2021; Stolz et al., 2018).

In recent years, just like interventions conducted on computers, various modalities of interventions through mobile applications have demonstrated their effectiveness for a wide range of cases and contexts (Andersson, 2018; Flett et al., 2018; J. Huberty et al., 2019). Among these modalities, mindfulness and self-compassion interventions stand out, as they have shown success in reducing levels of anxiety, stress, and depression (Bégin et al., 2022; Economides et al., 2018; Gong et al., 2023; J. Huberty et al., 2019; J. L. Huberty et al., 2022; Moberg et al., 2018).

Mindfulness is defined by Kabat-Zinn (2003) as the awareness that emerges from the practice of intentionally and nonjudgmentally paying attention to the experience of the present moment. The term mindfulness can be understood in various ways: as a mental state, a

personality trait, or a functional practice. Functional mindfulness practices promote the increase of mindfulness states, which, in the long term, contribute to the development of this personality trait and allow individuals to benefit from the advantages associated with mindfulness (Lucena-Santos et al., 2015).

On the other hand, self-compassion is defined by Neff (2003) as an attitude of openness and kindness toward the recognition of one's own suffering, failures, or inadequacies, combined with the awareness that these aspects are part of the universal human experience and that everyone deserves compassion, including ourselves. Self-compassion involves three main components: 1) treating oneself with kindness and understanding, rather than with harsh self-criticism; 2) perceiving one's experiences as part of the broader human experience, and not as something isolated; and 3) being attentive to painful thoughts and feelings without over-identifying with them.

It is important to highlight that, although mindfulness and self-compassion interventions can work together, as in the case of this study, they are distinct strategies. Both are supported by the literature, with several systematic and meta-analytic review studies demonstrating their positive effects in reducing symptoms of depression, anxiety, and stress (Creswell, 2017; Galante et al., 2021; Gu et al., 2015; Jefferson et al., 2020; Kirby et al., 2017; Misurya et al., 2020).

The literature also indicates that untreated mental disorders have a significant negative impact on health, well-being, and productivity. This situation is concerning, as many people do not seek treatment due to barriers such as difficulty of access, social stigma, time, or cost (Hunt & Eisenberg, 2010; Moberg et al., 2018). Therefore, exploring alternatives for the treatment of anxiety, stress, and depression that overcome these obstacles becomes a public priority. This work proposes to address these challenges by using a brief, free, scalable, and accessible intervention through a mobile application.

We highlight that although there are studies proving the effectiveness of online mindfulness and self-compassion interventions for cases of depression, anxiety, and stress, most of these programs still follow long 8-week protocols, which may be unfeasible for those with little time (Bégin et al., 2022). Consequently, investigating the effects of a brief 4-week intervention for basic education teachers becomes particularly relevant.

Another relevant aspect is the importance of teachers in the educational process and the need for greater investment in research aimed at the health of this population. This study offers a proposal for an accessible tool that can contribute to the improvement of the general health of these professionals, empowering them to face situations that make them more vulnerable to depression, anxiety, and stress (Freitas et al., 2018). Additionally, carrying out this work will help fill the existing gap in national research, especially because publications on online interventions are still gaining ground in Brazil (Dominguez-Rodriguez et al., 2024; Lopes & Berger, 2016), particularly those involving mobile applications.

Considering the above, this work had the general aim of examining the effects of a brief mindfulness and self-compassion intervention, offered asynchronously via mobile application,

on the reduction of symptoms of anxiety, stress, and depression in a sample of basic education teachers.

Method

This study is characterized as a non-blind, waitlist-controlled randomized trial involving Brazilian basic education teachers, conducted in accordance with the guidelines proposed by the Consolidated Standards of Reporting Trials – CONSORT (Schulz et al., 2010). The research was conducted entirely in a virtual environment, from the dissemination, recruitment, and administration of the tests to the intervention itself, which was made available asynchronously via mobile application.

Procedure

Dissemination was carried out directly in 42 schools in the state of Pernambuco and virtually in various social media groups such as Instagram, Facebook, and WhatsApp, where relevant information about the study was provided along with a link directing participants to a registration form generated by Google Forms. The registrants were entered into a waitlist, and at the end of the one-month recruitment period, they were contacted and asked whether they still wished to participate in the study.

Those who were still interested in participating were invited to complete a second online instrument generated by Google Forms containing the consent form, the sociodemographic questionnaire, and the study questionnaires. The participants who completed these instruments were randomized into one of two groups: Group A, which received the mindfulness and self-compassion intervention immediately, and Group B, the waitlist control, which had the opportunity to receive the intervention only after the completion of the follow-up period.

The intervention began on March 6, 2024, and was completed on May 6, 2024, with all activities carried out in a virtual environment through the *Neurosaúde* application. The WhatsApp messaging application served as the means of communication with the participants, using the broadcast list feature.

Communication with participants occurred only at specific moments: (1) during the administration of the primary and secondary outcome instruments, that is, at the beginning, when they received a welcome message and were instructed on how to install the application; (2) at the end of the intervention; and (3) at the conclusion of the follow-up, four weeks after the end of the intervention. For more information, see Figure 1.

Ethical aspects

This study was approved by the Research Ethics Committee of the Health Sciences Center of the Federal University of Paraíba (CEP / CCS – UFPB) through the Certificate of Presentation for Ethical Consideration (CAAE) 70728923.8.0000.5188 and authorization number 6.729.094.

It was also registered on the Brazilian Clinical Trials Registry platform (ReBEC), under the registration code RBR-2fs9kms, available for public access.

Participation was voluntary and conditioned upon reading and consenting to the Informed Consent Form (TCLE), which contains all relevant information about the study. All procedures were conducted in accordance with Resolution No. 466/12, which establishes the ethical aspects of research involving human subjects, and Circular Letter 002/2021, which sets the guidelines for research in virtual environments.

Sample calculation

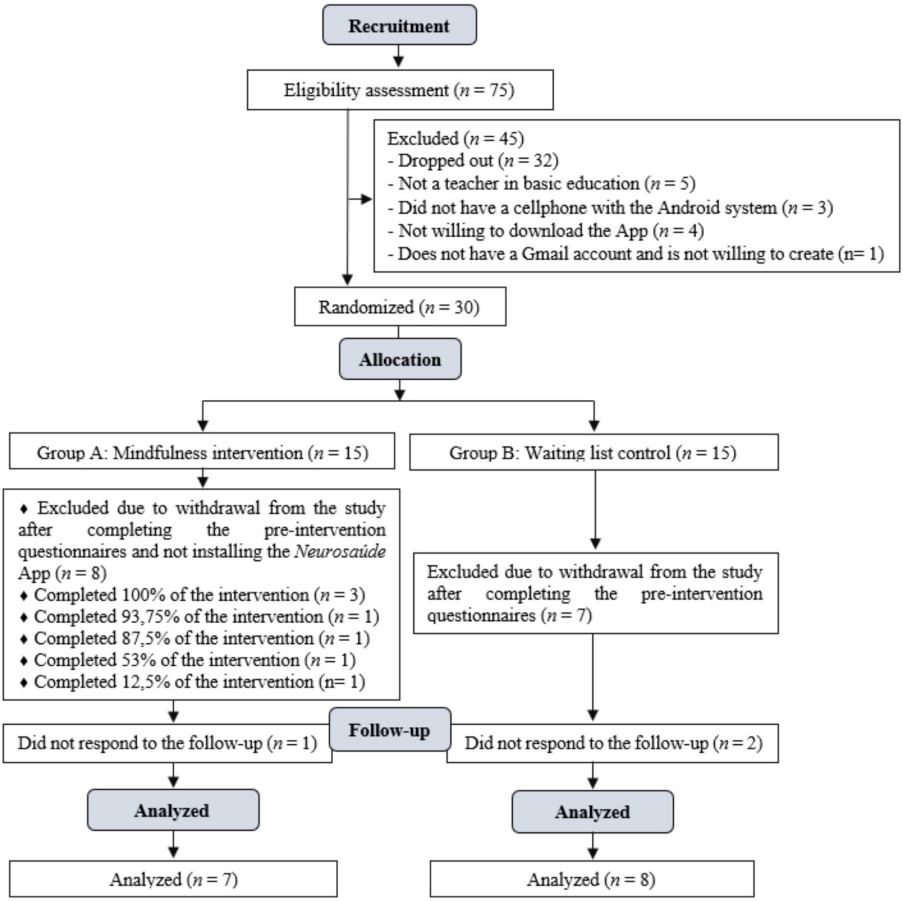
The sample size estimation was performed using the G*Power 3.1.9.7 program (Faul et al., 2009). An a priori power analysis was conducted based on the statistical test for repeated measures ANOVA 2 x 3 (within-between interaction), in which 2 represents the number of groups and 3 corresponds to the repetitions (pre-intervention, post-intervention, and follow-up). An effect size (f = .25) was set with a 5% error (α = .05) and a power of 95% (β = .95). With these parameters, the program suggested a minimum sample of 44 subjects.

Participants

The research sample consisted of 30 adults randomly divided into two groups (Figure 1). The included participants had to meet the following criteria: (1) be Brazilian; (2) be a basic education teacher; (3) have internet access and a cellphone with the Android system; (4) be willing to download and use the application; (5) score higher than 0 on the symptoms of depression, anxiety, and stress measured by the subscales of the Depression, Anxiety, and Stress Scale (DASS-21) (Vignola & Tucci, 2014). Participants who did not have a Gmail account and were unwilling to create one were excluded.

Figure 1

CONSORT flowchart



Randomization and Blinding

Randomization was carried out by an individual external to the research who had no contact with the participants and was blind to the study's hypotheses. Participants were allocated in a 1:1 ratio. Once this stage was completed, the list with the participants' allocation was sent to the researcher responsible for the study, who, in turn, informed the participants of their condition (Group A or B) and provided further instructions.

The type of control group used in this study (waitlist control) does not allow for participant blinding, as they are aware of the condition to which they are assigned. However, we emphasize that the researcher who evaluated the questionnaires and also conducted the statistical analyses had no direct contact with the participants, as communication with participants occurred only

through standardized messages via WhatsApp broadcast lists. We also highlight that the mindfulness instructor responsible for delivering the intervention was blind to the participants' performance throughout the study and had no direct contact with them, as the interaction with participants took place solely through pre-recorded audio and video materials.

Instruments

As the primary outcome, a statistically significant decrease was expected in anxiety, stress, and depression levels as measured by the Depression, Anxiety, and Stress Scale (DASS-21).

DASS-21

It consists of 21 items, each using a Likert-type scale ranging from 0 (did not apply at all) to 3 (applied very much or most of the time). The instrument was adapted and validated for Brazil by Vignola & Tucci (2014), with a Cronbach's alpha of .92 for the depression subscale, .86 for the anxiety subscale, and .90 for the stress subscale, indicating good internal consistency.

As the secondary outcome, a statistically significant increase was expected in mindfulness and self-compassion levels, measured respectively by the Five Facet Mindfulness Questionnaire (FFMQ) and the Self-Compassion Scale (SCS).

FFMQ

It was translated and validated by Barros et al. (2014) with good results in internal consistency analysis (.81). Composed of 39 items in which responses range from 1 (never or rarely true) to 5 (almost always true) on a Likert-type scale. The five measured facets are: Observe; Describe; Act with awareness; Nonjudging of inner experience; and Nonreactivity to inner experience.

SCS

It is composed of 26 items with responses ranging on a Likert scale from 1 (almost never) to 5 (almost always). It includes 6 factors: self-kindness, self-criticism, common humanity, isolation, mindfulness, and over-identification. It was translated and validated for Brazil by De Souza & Hutz (2016), with good internal consistency results (.92).

Mindfulness and self-compassion intervention

A brief mindfulness and self-compassion intervention was used via mobile application, which had been developed and tested in prior research by the authors of the current article, showing promising results as a protective factor against anxiety in university students during the Covid-19 pandemic period (Silva et al., 2023). The intervention used in this study has a duration of 4 weeks, consisting of 4 videos of approximately 30 minutes along with practice audios and supporting texts that are released weekly through the application. The follow-up period was

established as the 4 weeks following the intervention. For more information about the intervention, we recommend accessing the mentioned work (Silva et al., 2023).

The *Neurosaúde* application

The application used in this study was built based on the application "*Neurosaúde: Redução de Estresse e Ansiedade*" developed in a previous study (Silva et al., 2023). The new version of the application was developed and improved from December 2022 to December 2023. Several improvements suggested by users (collected through questionnaires on their experience with the application) and by the study's reviewers were implemented, and for this reason, the application had to be completely rebuilt using a different programming language (Java for back-end, XML for front-end), which allowed these modifications both in terms of functionality and graphic design.

We highlight that the application was designed for mobile phones with the Android operating system and is currently available for download on the Play Store, where it can be found by searching for the term "*Neurosaúde*."

Data analysis procedures

The data were analyzed using the SPSS software, version 24.0, and for all tests the significance threshold was set at $p < .05$. It should be highlighted that the missing data referring to the follow-up questionnaires were imputed using the expectation-maximization (EM) algorithm, which is an iterative method for estimating parameters in statistical models (IBM Corp., 2016).

The normality of the variables was verified based on the significance of the Shapiro-Wilk test, the homogeneity of variances was calculated using Levene's test, and the assumption of sphericity was tested using Mauchly's test of sphericity.

In order to meet the prerequisites of normality to perform parametric analysis, the data related to the anxiety, depression, and stress scores measured by the DASS-21 were transformed using the square root method. Mixed ANOVA tests (within-between interaction) were used, with the variable "group" having two levels (mindfulness and self-compassion intervention and waitlist control group) as the between-group factor, and the variable "moment" with three levels (pre, post, and follow-up) as the within-group factor. The Bonferroni post-hoc test was used to determine where the differences identified by the ANOVA were located.

Finally, the effect size was determined using eta squared (η^2), applying the conventional values of .01, .06, and .14, which correspond to small, medium, and large effects, respectively (Lenhard & Lenhard, 2017), and the difference between the groups for the DASS-21 scores at the beginning of the intervention was tested using Student's t-test.

Results

Of the 15 participants whose data were analyzed (Figure 1), there was a predominance of females (86.7%), cisgender individuals (73.3%), and mixed-race individuals (80.0%). Ages

ranged between 28 and 48, with a mean of 39 (*SD* = 8) for Group A; and between 26 and 66, with a mean of 47 (*SD* = 13) for Group B. Despite the differences in mean ages between the groups, no significant differences were found ($t(13) = -1.435$; $p = .175$). Regarding the field of work, the majority worked in high school education (93.3%) and all worked in public schools (100%). With respect to educational level, 86.6% had completed postgraduate studies. There was a predominance of individuals residing in the state of Pernambuco (93.3%), who only worked (60.00%), with a family income between 3 and 4 minimum wages (46.6%), married or in a stable union (53.4%), and with children (53.3%). For more details, see Table 1.

Table 1

Sociodemographic profile of the participants (n=15)

Variable	Categories	Group A (n= 7)		Group B (n= 8)	
		f	%	*f*	%
Sex	Male	0	0	2	13.3
	Female	7	46.7	6	40.0
Gender	Cisgender	6	40.0	5	33.3
	Other	1	6.7	2	13.3
	Prefer not to say	0	0	1	6.7
Color or race	White	2	13.3	1	6.7
	Mixed	5	33.3	7	46.7
Education	Undergraduate degree	1	6.7	0	0
	Incomplete postgraduate degree	1	6.7	0	0
	Completed postgraduate degree	5	33.3	8	53.3
State of residence	Pernambuco	6	40.0	8	53.3
	Rio Grande do Sul	1	6.7	0	0
Employment status	Only work	3	20.0	6	40.0
	Study and work	4	26.7	2	13.3
Work area	Elementary education	1	6.7	0	0
	High school education	6	40.0	8	53.3
Marital status	Single	1	6.7	2	13.3
	Married or in a stable union	4	26.7	4	26.7
	Divorced or separated	2	13.3	2	13.3
Family income	Between 1 and 2 minimum wages	1	6.7	3	20.0
	Between 3 and 4 minimum wages	2	13.3	5	33.3
	Between 5 and 6 minimum wages	3	20.0	0	0
	Between 9 and 10 minimum wages	1	6.7	0	0
Number of children	0	4	26.7	3	20
	1	3	20	2	13.3
	2	0	0	2	13.3
	3 or more	0	0	1	6.7

Primary outcome

To verify possible differences between the groups at the pre-intervention moment, the Student's *t*-test was applied, which, despite the difference between the means (Table 2), did not

find significant differences for anxiety levels ($t(13) = 1.349$; $p = .200$), stress ($t(13) = 1.110$; $p = .287$), or depression ($t(13) = 1.689$; $p = .115$). The results of the mixed ANOVA (between- and within-group comparisons) for the anxiety, depression, and stress scores measured by the DASS-21, as well as the means and standard deviations measured throughout the study (pre-intervention, post-intervention, and follow-up), are presented in Table 2.

Table 2

Means of anxiety, stress, and depression and comparison results (n=15)

	Anxiety		
Moments	**Pre, *M* (*SD*)**	**Post, *M* (*SD*)**	***Follow-up*, *M* (*SD*)**
Group A	3.14 (1.67)	1.55 (1.49)	2.25 (1.73)
Group B	1.94 (1.77)	2.50 (1.68)	3.03 (0.77)
Within-group comparison			
(Moment) *F*, *p*, η^2	(F(2. 26) = 1.610; p = .219; η^2 = .110)		
(Moment*Group) *F*, *p*, η^2	(F(2, 26) = 5.316; p = .012; η^2 = .290)		
Between-group comparison			
Groups *F*, *p*, η^2	(F(1, 13) = 0.069; p = .797; η^2 = .005)		
	Stress		
Moments	**Pre, *M* (*SD*)**	**Post, *M* (*SD*)**	***Follow-up*, *M* (*SD*)**
Group A	4.05 (1.24)	3.20 (1.31)	3.29 (1.16)
Group B	3.07 (2.03)	3.58 (1.67)	3.63 (0.44)
Within-group comparison			
(Moment) *F*, *p*, η^2	(F(2, 26) = 0.064; p = .938; η^2 = .005)		
(Moment*Group) *F*, *p*, η^2	(F(2, 26) = 1.363; p = .274; η^2 = .095)		
Between-group comparison			
Groups *F*, *p*, η^2	(F(1, 13) = 0.033; p = .859; η^2 = .003)		
	Depression		
Moments	**Pre, *M* (*SD*)**	**Post, *M* (*SD*)**	***Follow-up*, *M* (*SD*)**
Group A	3.47 (1.29)	2.60 (0.87)	3.32 (0.75)
Group B	2.04 (1.89)	2.87 (1.52)	2.96 (0.98)
Within-group comparison			
(Moment) *F*, *p*, η^2	(F(2, 26) = 0.463; p = .634; η^2 = .034)		
(Moment*Group) *F*, *p*, η^2	(F(2, 26) = 1.627; p = .216; η^2 = .111)		
Between-group comparison			
Groups *F*, *p*, η^2	(F(1, 13) = 1.720; p = .212; η^2 = .117)		

Note. M: mean, *SD*: standard deviation, *F*: ANOVA result, *p*: significance, η^2: effect size.

As it can be seen in Table 2, in the within-group comparisons, no significant impacts of the moment factor were found for anxiety scores (F(2, 26) = 1.610; p = .219; η^2 = .110), stress

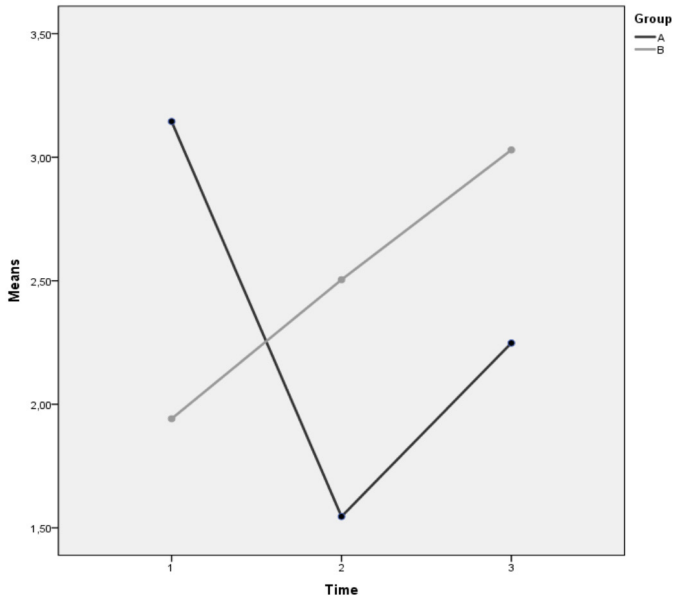
($F(2, 26) = .064$; $p = .938$; $\eta^2 = .005$), or depression ($F(2, 26) = 0.463$; $p = .634$; $\eta^2 = .034$), obtaining, respectively, medium, small, and small effect sizes. In the moment versus group comparison, a significant impact was found for anxiety ($F(2, 26) = 5.316$; $p = .012$; $\eta^2 = .290$), with a large effect size, while no significant differences were found for stress ($F(2, 26) = 1.363$; $p = .274$; $\eta^2 = .095$) or depression scores ($F(2, 26) = 1.627$; $p = .216$; $\eta^2 = .111$), both showing moderate effect sizes.

Regarding the between-group comparisons, no significant impacts of the group were found on anxiety ($F(1, 13) = 0.069$; $p = .797$; $\eta^2 = .005$), stress ($F(1, 13) = 0.033$; $p = .859$; $\eta^2 = .003$), or depression scores ($F(1, 13) = 1.720$; $p = .212$; $\eta^2 = .117$), demonstrating, small, small, and large effect sizes, respectively. Considering the statistically significant difference described in the previous paragraph in the moment versus group comparison for anxiety scores, the Bonferroni post-hoc test was used to identify where this difference was located.

The multiple comparison (pairwise) analyses between the moment versus group factors did not find significant differences between groups A (intervention) and B (control) regarding the moments (pre-intervention, post-intervention, follow-up). However, a significant difference ($p = .022$) was found in group A between the pre-intervention and post-intervention moments, indicating that there was a significant decrease in anxiety scores, as shown in Figure 2.

Figure 2

Result of the mixed ANOVA – Anxiety



Secondary outcome

Regarding the mindfulness scores measured by the FFMQ, the Student's *t*-test was used to verify possible differences between the groups at the pre-intervention moment. No significant differences were found for the total score ($t(13) = -0.849$; $p = .398$) or for any other subscales of the questionnaire. No significant differences were found between the groups for any of the comparisons (within-group or between-group) performed by the ANOVA.

Regarding the self-compassion scores measured by the SCS, the Student's *t*-test was used to verify differences between the groups at the pre-intervention moment. No significant differences were found for the total score ($t(13) = -0.898$; $p = .386$) or for any other subscales of the questionnaire. No significant differences were found between the groups for the SCS scores in any of the comparisons (within-group or between-group) performed by the ANOVA.

The means and standard deviations measured throughout the study (pre-intervention, post-intervention, and follow-up) using the FFMQ and the SCS are presented in Table 3.

Table 3

Mindfulness and self-compassion mean scores measured by the FFMQ and the SCS (n=15)

Mindfulness					
Variables	**Groups**	***n***	**Pre, *M* (*SD*)**	**Post, *M* (*SD*)**	**Follow-up, *M* (*SD*)**
Observe	A	7	22.29 (5.97)	20.00 (4.32)	21.94 (4.27)
	B	8	20.00 (8.73)	25.00 (8.50)	22.76 (5.85)
Describe	A	7	22.86 (5.81)	24.57 (8.71)	26.21 (5.10)
	B	8	28.63 (6.16)	29.00 (5.42)	27.93 (7.04)
Act with awareness	A	7	26.86 (10.40)	26.14 (11.44)	25.92 (9.52)
	B	8	32.00 (7.11)	28.63 (8.52)	25.55 (10.25)
Non-judging	A	7	24.86 (4.63)	26.86 (8.63)	30.60 (3.55)
	B	8	28.88 (4.67)	26.00 (5.07)	28.08 (4.79)
Non-reactivity	A	7	18.86 (7.06)	17.57 (6.32)	19.81 (5.75)
	B	8	18.00 (5.37)	18.13 (3.25)	17.15 (2.29)
FFMQ Total	A	7	115.71 (31.67)	115.14 (36.53)	124.47 (24.25)
	B	8	127.50 (20.63)	126.75 (20.08)	121.46 (19.89)
Self-compassion					
Variables	**Groups**	***n***	**Pre, *M* (*SD*)**	**Post, *M* (*SD*)**	**Follow-up, *M* (*SD*)**
Self-kindness	A	7	2.66 (0.81)	3.06 (1.16)	3.29 (0.71)
	B	8	3.03 (1.22)	3.26 (0.43)	2.79 (0.40)
Self-criticism	A	7	2.71 (0.95)	2.71 (1.09)	3.31 (0.79)
	B	8	3.35 (0.60)	3.30 (0.81)	3.22 (0.85)
Common humanity	A	7	2.39 (0.75)	3.07 (1.09)	3.25 (1.07)
	B	8	2.81 (1.03)	3.22 (0.99)	2.83 (0.41)
Isolation	A	7	3.04 (1.13)	3.29 (0.91)	3.30 (0.89)
	B	8	3.44 (1.25)	3.34 (0.95)	3.38 (1.20)
Mindfulness	A	7	3.07 (0.77)	3.32 (1.37)	3.52 (0.95)
	B	8	3.34 (1.23)	3.47 (0.66)	3.14 (0.56)
Over-identification	A	7	2.61 (0.91)	2.71 (1.20)	3.35 (0.98)
	B	8	2.81 (1.23)	3.13 (0.94)	3.20 (0.80)
SCS Total	A	7	2.75 (0.69)	3.03 (1.03)	3.34 (0.74)
	B	8	3.13 (0.96)	3.28 (0.52)	3.09 (0.45)

Discussion

Regarding the primary outcome results, the only significant result found by the ANOVA was the moment versus group comparison, showing a large effect size for anxiety scores ($F(2, 26) = 5.316$; $p = .012$; $\eta^2 = .290$). Multiple comparisons (Pairwise) analyses indicated that this difference occurred between the pre-intervention ($M = 3.14$; $SD = 1.67$) and post-intervention ($M = 1.55$; $SD = 1.49$) moments for group A, indicating a significant decrease ($p = .022$) in anxiety scores for the intervention group between these moments. Although anxiety scores had increased at the 4-week follow-up, the previously acquired reductions remained stable, as there was no significant difference between post-intervention and follow-up moments.

The reductions in anxiety levels found in the intervention group corroborate results from a recent systematic review and meta-analysis (Gong et al., 2023), in which online mindfulness interventions were able to produce significant reductions in anxiety scores. These findings are also consistent with a previous study (Silva et al., 2023) that used the same intervention in a sample of university students. Here, results suggested that the intervention acted as a protective factor against increased anxiety scores among students during the Covid-19 pandemic period, whereas students assigned to the control group showed a continuous and significant increase in anxiety scores.

It should be highlighted that, despite no significant differences in anxiety, depression, and stress scores at pre-intervention, there was a predominance of participants with higher scores in the intervention group for all DASS-21 subscales, which, combined with the sample size, may have impaired the detection of significant differences between groups in the ANOVA comparisons. This is because the intervention would need to have a greater effect on the more severe scores in group A to generate a visibly significant result. We emphasize that, although no significant differences were detected between groups, there was a consistent increase in mean anxiety, depression, and stress scores in the control group, contrasting with decreases observed from pre- to post-intervention in the intervention group, as can be seen in Table 2.

Regarding the secondary outcome results, the ANOVA did not find any significant differences between groups. The hypothesis we propose for these results is similar to that previously indicated: the predominance of participants with higher mindfulness and self-compassion scores in the control group (Table 3), despite the absence of a significant difference, combined with the sample size. A third factor that may be added, and that could have influenced the lack of more significant differences for both primary and secondary outcome results, is the fact that a substantial portion of participants in the intervention group did not complete 100% of the intervention, as shown in Figure 1.

One point worth discussing is the decision to proceed with the study even after it was found that the minimum number of participants suggested by the sample size calculation (44 participants) had not been reached, which is one of the main limitations of the work. During the recruitment period, we noticed, mainly through informal conversations with professionals from the 42 schools in Pernambuco, where recruitment was conducted directly with teachers or the

management team responsible for passing information to the institution's teachers, that most professionals in these institutions were in one of the following situations: (1) holding two employment contracts to obtain better remuneration; or (2) adhering to a full-time work schedule to access the offered bonus. In both cases, the teachers had an exhausting work schedule, a factor previously described in other research (Cortez et al., 2017).

Although the registration period ended with 75 individuals enrolled, when contacted to confirm their continued interest in participating in the intervention, 32 individuals withdrew. The main justification was a lack of time to dedicate to the intervention activities due to exhausting work schedules, as mentioned above, and difficulty balancing these activities with time devoted to family or studies, which can be corroborated by the sociodemographic data from our research, given that 40% of participants both studied and worked.

We can also mention that previous experiences with online interventions carried out with other populations (Silva et al., 2023) showed that when the recruitment period extended for more than one month, interest declined among those who registered early in the recruitment process. The same situation was confirmed in this study, as some participants became impatient toward the end of the recruitment deadline, sending messages urging the intervention to start promptly or, in some cases, even threatening to withdraw due to the delay in starting.

The sum of these factors led us to hypothesize that extending the recruitment period beyond one month would not be a good strategy, as we would lose those already enrolled and would lack resources to achieve greater recruitment reach beyond what was already employed in the 42 schools mentioned above, as well as all the effort expended on social media.

Therefore, due to the difficulty in engaging this population in research requiring a greater time commitment, this study, despite the sample size, provides valuable contributions for the development of engagement strategies and procedures for conducting online research, such as the recruitment time factor mentioned earlier. Regarding engagement, we recommend that future research explore engagement strategies in partnership with the management team so that practices are conducted within the school environment in exchange for teaching hours, as even brief interventions such as the one proposed here are insufficient to promote engagement.

Two other factors that merit discussion are the high attrition rate and the decision not to conduct an intention-to-treat analysis, which can be considered limitations of the study. Although high attrition rates are common in online interventions delivered via mobile applications, ranging from 24% to 53% (Linardon & Fuller-Tyszkiewicz, 2020), we believe that including a large number of participants who did not even install the intervention app, responded only to the pre-intervention questionnaires, and refused any contact attempts after that point would introduce far more bias into the study than excluding them, given that the dropout rate was relatively equal across both groups, as shown in Figure 1.

Had we followed the standard procedure for an intention-to-treat analysis, all missing data for these participants would have been filled using data imputation methods, meaning the majority of the study data would be composed of data that do not actually exist, i.e., data

generated by a computer. Given this, we considered the best alternative was to exclude those participants, but to preserve the fidelity of a real-world situation, we included all intervention group participants who installed the app and had any usage rate, even those with low completion rates (12.5%), as shown in Figure 1.

Although reporting on the app experience was not an objective of this article, the new version of the *Neurosaúde* app functioned perfectly on participants' phones, achieved good acceptance, and allowed researchers to have a complete view of each user's participation level throughout all intervention stages. This information was fundamental for contextualizing the intervention results with the real adherence rate collected by the app. Accordingly, we overcame a limitation in a previous study (Silva et al., 2023), in which participation data depended on weekly questionnaires subject to inaccurate reporting by participants.

Final Considerations

The results found in this research suggest that the four-week online intervention, delivered through the *Neurosaúde* app, was capable of significantly reducing anxiety levels in the intervention group when comparing the pre-intervention moment (M = 3.14; SD = 1.67) to the post-intervention (M = 1.55; SD = 1.49) moment. Although the decrease in anxiety scores was not maintained at the 4-week follow-up, the reduction observed at post-intervention remained stable, as there was no significant difference between the post-intervention and follow-up moments.

This research provided valuable contributions to understanding the context in which Brazilian basic education teachers are situated, as well as to the development of engagement strategies to be used in future research with this population, especially those requiring greater time commitment. Furthermore, important insights were obtained regarding procedures for conducting online research, particularly concerning the recruitment and dissemination period. These factors may facilitate the planning of new research by other investigators, thereby contributing to the advancement of science.

Based on the analysis of qualitative results, we can conclude that the mobile application functioned effectively during the intervention and was well accepted by users, who considered it useful and easy to understand. Therefore, the *Neurosaúde* app and the intervention delivered through it prove to be promising tools for reducing anxiety levels among basic education teachers.

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Contribution of each author to the work:

Leonardo Júnior Souza Silva: Contributed to all stages of the research, including the planning and execution of the study, data analysis, manuscript preparation, writing - original draft, review and editing, development of the application, and submission of the article to the journal.
Luiz Carlos Serramo Lopez: Contributed to data analysis, final revision of the manuscript, and provided specific guidance throughout the research process.