Construction and validation of an online training programme to promote resilience and mindfulness, including empathy, compassion, and gratitude.

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Content

1. Mental Health in the Post-Pandemic Era

The global outbreak of the novel coronavirus (Covid-19) has had a profound and far-reaching impact on public health, prompting a widespread re-evaluation of health-related behaviours and practices. A key consequence of the pandemic has been a sustained rise in anxiety and stress levels, which are now recognised as critical concerns within public health discourse. As governments, healthcare systems, and communities work to mitigate the long-term effects of the pandemic, escalating mental health challenges have emerged as urgent priorities, necessitating the development of innovative and scalable solutions.

Concurrently, the digital landscape has undergone an unprecedented transformation. Digital technologies have become deeply integrated into nearly all aspects of daily life, including education, work, social interaction, and healthcare. This shift is particularly salient in the field of mental health care, where digitalisation has introduced both promising opportunities and complex challenges. While technological advancements offer the potential to enhance the reach and efficiency of mental health services, they also demand thoughtful consideration regarding accessibility, effectiveness, and ethical implications. In this evolving context, there is a clear and pressing need to identify and evaluate digital mental health interventions that are not only scalable, accessible, and cost-effective, but also aligned with the realities of a post-pandemic world.

The disruption caused by Covid-19 has underscored the limitations of traditional service delivery models and highlighted the importance of flexible, user-directed approaches that can meet the needs of diverse populations in a digitally driven society. This dissertation seeks to address this gap by examining the effectiveness of two well-established stress-reduction strategies—resilience training and mindfulness training—when delivered through self-directed online programmes.

While acknowledging the continued importance of conventional mental health services, this research underscores the potential of digital interventions to overcome barriers to access and address the growing mental health crisis exacerbated not only by the pandemic but also by the increasing demands of a volatile, uncertain, complex, and ambiguous (VUCA) world. The additional burdens of remote work, caregiving responsibilities, and the persistent lack of psychological support for vulnerable groups, such as women, healthcare staff, and individuals with chronic illnesses such as multiple sclerosis (MS), highlight the urgent need for practical and inclusive solutions.

Specifically, the studies evaluate the outcomes of three four-week, self-guided online interventions, aiming to contribute to the growing body of literature on digital mental health solutions. By assessing their impact on stress reduction and overall psychological well-being, this dissertation seeks to inform the development of evidence-based, technology-enabled approaches to

mental health care that are adaptable, cost-efficient, and essential for proactively supporting individuals in an increasingly complex and demanding world.

2. Theoretical Framework: Resilience and Mindfulness in Mental Health

2.1 Definition of Resilience and Mindfulness

Within the domain of psychological well-being and coping mechanisms, **resilience** and **mindfulness** have emerged as pivotal constructs. While interrelated, they are grounded in distinct theoretical traditions and offer unique contributions to mental health and positive psychology.

Resilience, initially developed within developmental psychology, refers to the capacity to recover from adversity, trauma, or stress, often leading to personal growth (Masten, 2001). It involves an interplay of protective factors—including social support, adaptive coping, and personal strengths—that buffer against adverse experiences (Rutter, 2006). Bonanno (2004) emphasises that resilience encompasses not only recovery but also the ability to thrive. Masten (2001) famously calls resilience "ordinary magic," highlighting its basis in everyday adaptive processes rather than exceptional traits. Rutter (2006) frames it as a dynamic quality that can be enhanced through intervention, including structured training and cognitive-behavioural strategies. This includes mindfulness practices, which increasingly intersect with resilience research.

Mindfulness, though rooted in contemplative traditions like Buddhism, has gained significant empirical grounding in psychology and neuroscience (Kabat-Zinn, 2003). Defined as intentional, non-judgmental awareness of the present moment (Brown & Ryan, 2003), mindfulness enhances emotion regulation and stress tolerance. Research suggests that mindfulness contributes to psychological resilience by reducing reactivity, fostering acceptance, and supporting emotional regulation (Garland et al., 2009; Southwick et al., 2014). The Broaden-and-Build Theory (Fredrickson, 2001) and Resilience Portfolio Model (Fredrickson et al., 2003) provide theoretical support for this interplay. Mindfulness-based interventions (MBIs), such as meditation and mindful movement, have been shown to improve attentional control, emotional balance, and stress management (Keng et al., 2011). These practices can rewire neural pathways through mechanisms like neuroplasticity (Jain et al., 2007).

Of particular importance are mindfulness elements like **compassion and gratitude**. Self-compassion involves treating oneself with kindness and understanding, mitigating self-criticism and enhancing resilience (Neff, 2003; Germer & Neff, 2013). Gratitude fosters positive emotions and strengthens interpersonal relationships, further promoting well-being.

In sum, integrating mindfulness, compassion, and gratitude supports both immediate coping and long-term resilience. Together, these constructs form a robust framework for psychological well-being. To understand how these theoretical constructs are operationalised in practice, the following section reviews empirical research on resilience, mindfulness, and related interventions. It demonstrates how these constructs translate into measurable outcomes in diverse populations.

2.2 Research on Resilience and Mindfulness Interventions

2.2.1 Effectiveness of Resilience Training

Recent empirical research has consistently demonstrated the efficacy of resilience training as a mental health intervention across diverse populations. A growing body of literature, including comprehensive meta-analyses, confirms its capacity to reduce symptoms of depression and anxiety (Joyce et al., 2018), enhance adaptive coping strategies (Southwick et al., 2014), and foster psychological flourishing (Hu et al., 2015). These interventions have been shown to promote critical cognitive skills such as flexibility, problem-solving, and cognitive reframing, which are essential for effective stress management (Ong et al., 2006). The therapeutic value of resilience training lies not only in symptom alleviation but also in its broader contribution to psychological well-being. Participants consistently report improvements in positive affect, life satisfaction, and overall emotional functioning. Moreover, resilience training has demonstrated efficacy in reducing psychological distress, including irritability, hopelessness, and general discomfort—underscoring its utility for individuals experiencing emotional dysregulation or mental strain. Importantly, resilience training also serves a preventative function. Evidence suggests it enhances individuals' psychological preparedness and protects against the onset of mental health disorders, particularly among those exposed to chronic stress or traumatic experiences (Bonanno & Mancini, 2008). This dual role—as both a reactive and proactive measure—reinforces its significance within contemporary mental health care.

In sum, resilience training equips individuals with essential psychological tools and internal resources to navigate adversity. By reducing mental health symptoms, enhancing coping capacities, promoting well-being, and preventing disorder onset, it represents a critical component in the pursuit of sustainable psychological resilience and holistic mental health promotion.

2.2.2 Effectiveness of Mindfulness Training

Complementing resilience training, mindfulness-based interventions (MBIs) offer a structured and empirically supported approach to cultivating present-moment awareness, emotional balance, and psychological flexibility. As interest in MBIs has grown, so too has the body of evidence affirming their wide-ranging benefits for mental health and well-being across both clinical and non-clinical populations. A substantial number of studies highlight the effectiveness of MBIs in reducing perceived stress. For instance, a meta-analysis by Khoury et al. (2015) found that mindfulness-based stress reduction (MBSR) programmes exert moderate yet significant stress-alleviating effects across diverse demographic groups. These findings underscore the utility of mindfulness as a broadly applicable method for managing stress.

Mindfulness-based cognitive therapy (MBCT), a related intervention with strong empirical grounding, has been particularly effective in preventing depression relapse. Hofmann et al. (2010) provided robust evidence supporting MBCT's capacity to reduce depressive symptoms, with Kuyken et al. (2016) further validating its long-term therapeutic impact, especially for individuals with recurrent depression. In addition, MBIs have demonstrated moderate effectiveness in mitigating symptoms of anxiety, indicating their versatility in addressing a range of affective disorders.

Beyond symptom reduction, mindfulness training contributes meaningfully to overall psychological well-being. Participation in MBIs has been associated with enhanced mood regulation, emotional stability, and life satisfaction. Garland et al. (2015) reported significant improvements in psychological and health-related quality of life among individuals engaging in mindfulness practices, reinforcing their value in promoting general mental health. The cognitive benefits of mindfulness are also well documented. Tang et al. (2015) observed that regular mindfulness practice improves attentional control, cognitive flexibility, and executive functioning—skills that support not only emotional regulation but also day-to-day decision-making and adaptive behaviour. These findings suggest that the cognitive mechanisms cultivated through mindfulness may play a critical role in its therapeutic outcomes. Furthermore, mindfulness has shown promising results in the management of chronic pain. Zeidan et al. (2016) found that mindfulness meditation significantly reduced both the intensity and unpleasantness of pain experiences, offering support for its use as an adjunctive intervention in chronic pain treatment plans.

In sum, the extensive empirical support for mindfulness-based interventions highlights their efficacy in reducing stress, enhancing mood, improving cognitive function, and supporting long-term psychological resilience. As evidence-based tools for fostering mental well-being, MBIs are increasingly recognised as valuable components of comprehensive mental health strategies across various populations and contexts.

2.2.3 Effectiveness of Mindful Compassion Training

Building on the principles of mindfulness, compassion-based interventions—particularly those incorporating loving-kindness meditation—have gained increasing scholarly attention for their capacity to enhance emotional warmth, empathy, and psychological well-being. Rooted in contemplative traditions and adapted for secular therapeutic contexts, these practices target the development of self-compassion and compassion toward others, offering a complementary approach to cognitive and behavioural mental health strategies. Loving-kindness meditation, a central component of compassion training, involves the deliberate cultivation of kindness, goodwill, and empathy toward a progressively expanding circle of individuals, beginning with the self and extending to others. This practice has been consistently associated with a broad range of positive mental health outcomes (Watson et al., 2023; Telke et al., 2022; Silhan et al., 2022). Empirical evidence highlights the efficacy of loving-kindness meditation in reducing stress and anxiety. For instance, Jazaieri et al. (2013) found that individuals who regularly engaged in the practice reported significantly lower levels of stress and anxiety compared to control groups. In terms of emotional regulation, Klimecki et al. (2014) identified heightened neural activity in brain regions associated with emotion processing among participants who practised loving-kindness meditation, suggesting enhanced capacity for managing affective responses.

Beyond stress and emotional regulation, compassion-based practices have been linked to increased life satisfaction and overall psychological well-being. Fredrickson et al. (2008) reported that sustained engagement in loving-kindness meditation promoted positive emotions, which in turn contributed to broader mental health gains. Moreover, compassion-focused therapy—which often incorporates loving-kindness practice—has demonstrated effectiveness in reducing depressive symptoms (Hofmann et al., 2011), further underscoring its therapeutic relevance. In addition to intrapersonal benefits, compassion training positively influences interpersonal functioning. Regular practice has been shown to foster empathy and a sense of social connectedness. Crocker and Canevello (2008), for example, found that participants who engaged in loving-kindness meditation reported enhanced relational satisfaction and emotional closeness with others.

In summary, the robust evidence base supporting compassion-based interventions—especially those centred on loving-kindness meditation—demonstrates their effectiveness in reducing psychological distress, enhancing emotion regulation, increasing well-being, alleviating depression, and strengthening social bonds. As such, these practices represent a valuable addition to the repertoire of evidence-based mental health strategies, particularly in addressing both emotional and relational dimensions of psychological resilience.

2.2.4 Effectiveness of Mindful Gratitude Training

Gratitude-based interventions have garnered increasing scholarly interest for their accessibility, cost-effectiveness, and broad utility in enhancing psychological well-being. Common practices—such as maintaining a gratitude journal or intentionally expressing appreciation—are rooted in positive psychology and have been empirically linked to a range of beneficial outcomes across emotional, cognitive, social, and occupational domains (Emmons & McCullough, 2003; Wood et al., 2010). A substantial body of research demonstrates that gratitude enhances psychological resilience and subjective well-being by increasing positive affect and reducing negative emotional states. Individuals who engage regularly in gratitude practices report higher levels of life satisfaction, happiness, and optimism. These interventions have also been shown to alleviate symptoms of depression and anxiety (Watkins et al., 2003; Sin & Lyubomirsky, 2009), while mitigating stress, rumination, and negative thought patterns—key contributors to mood disorders.

Gratitude further supports emotional regulation and adaptive coping. It fosters psychological flexibility and promotes recovery from adversity, contributing to the development of resilience (Fredrickson et al., 2003). Notably, evening gratitude practices have been associated with improved sleep quality, including reduced sleep disturbances, faster onset of sleep, and increased restfulness upon waking (Jackowska et al., 2016). Interpersonally, gratitude strengthens empathy, forgiveness, and prosocial behaviour, thereby enhancing social functioning and relationship satisfaction (Algoe et al., 2010). It has also been linked to improvements in self-esteem and self-worth, encouraging individuals to focus on strengths and accomplishments rather than deficits. This shift supports the development of a more positive self-concept and a stronger sense of self-efficacy (Froh et al., 2008).

In occupational settings, the expression of gratitude has been found to reduce feelings of exhaustion, cynicism, and inefficacy, contributing to greater job satisfaction and workplace well-being (Regan et al., 2023; Chen et al., 2023). One of the most widely practiced forms of intervention is gratitude journaling—popularised through the work of Seligman (2004)—which involves systematically recording moments of gratitude to redirect attention toward positive experiences and available resources. Research further suggests that such practices promote humility (Kruse, 2014) and foster a more optimistic and appreciative orientation toward life (Kang & Sung, 2023; Killen, 2015).

Taken together, the empirical literature strongly supports the integration of gratitude practices into broader psychological interventions. When combined with related constructs such as resilience, mindfulness, and compassion, gratitude-based strategies offer a powerful means of promoting emotional stability, cognitive clarity, and interpersonal connection.

Consequently, this dissertation moves beyond general efficacy studies to investigate the feasibility and effectiveness of three distinct self-directed online interventions: one focusing on

resilience training, one on mindfulness training, and a third centred specifically on cultivating compassion and gratitude—two foundational elements within the broader mindfulness framework. The primary research question asks whether participants engaging in a structured, four-week digital programme—requiring approximately 15–20 minutes of daily practice—can meaningfully enhance these psychological skills and experience measurable reductions in perceived stress. By examining both the effectiveness and practical implementation of these interventions in real-world settings, this study seeks to deepen our understanding of how individuals can independently develop essential psychological resources. In doing so, it aims to inform the design of accessible, evidence-based, and scalable digital mental health solutions tailored to the needs of an increasingly diverse and digitally engaged population.

2.3 Research on online self-directed Health Programs

Building on the evidence supporting resilience, mindfulness, compassion, and gratitude as effective foundations for mental health promotion, the mode of delivery becomes a critical consideration—particularly in terms of scalability, accessibility, and sustainability. In this context, the rise of online self-directed training programmes represents a significant evolution in the field of psychological intervention.

The increasing digitalisation of everyday life, accelerated by global events such as the Covid-19 pandemic, has made remote and asynchronous formats not only viable but often preferable for diverse user groups. Online self-directed programmes, in particular, have emerged as a promising and empirically validated modality for mental health care. Their appeal lies in the convergence of accessibility, adaptability, and demonstrated efficacy. Foremost among the advantages of online delivery is enhanced accessibility. By removing barriers related to geography, mobility, scheduling, and transportation, these programmes enable individuals to engage with mental health resources from their own environments and on their own terms. This flexibility is particularly beneficial for populations who may struggle to access traditional in-person services—such as those living in rural areas, working non-standard hours, or managing caregiving responsibilities (Andersson et al., 2019; Kolaas et al., 2024). In addition to accessibility, flexibility remains a defining strength of the self-directed format. Participants are able to tailor their engagement with programme content according to their individual needs, schedules, and learning styles. This autonomy not only accommodates diverse lifestyles but has also been shown to foster higher levels of motivation, sustained participation, and completion rates (Christensen et al., 2009).

A growing body of empirical research further supports the clinical effectiveness of online self-directed mental health interventions. Studies have consistently reported reductions in psychological

distress, improvements in coping capacity, and increased well-being among participants (Karyotaki et al., 2017). Meta-analyses confirm that internet-delivered approaches, including digital adaptations of cognitive behavioural therapy (CBT), are effective in treating conditions such as depression and anxiety, and are often comparable in efficacy to traditional therapeutic formats (Andersson et al., 2019). Importantly, these programmes also contribute to participants' psychological empowerment. By engaging in self-paced, structured learning, individuals are invited to take active ownership of their mental health journeys. This sense of autonomy has been linked to increased self-efficacy and psychological resilience over time (Boyer et al., 2014). The ability to practise and integrate evidence-based techniques independently enhances not only short-term outcomes but also long-term coping and adaptation skills.

Beyond clinical outcomes, cost-efficiency is a key advantage. Digital interventions reduce the need for physical infrastructure and decrease dependence on mental health professionals' time and availability. As such, they can be offered at significantly lower cost per user, making them highly scalable and well-suited for public health implementation (Mohr et al., 2011).

In summary, online self-directed training formats offer a compelling model for delivering mental health support that is both scalable and individualised. Their combination of accessibility, flexibility, clinical relevance, economic sustainability, and empowerment potential makes them uniquely suited to meet the growing and diverse demands of psychological care in the digital age. Accordingly, this dissertation evaluates the real-world application of such programmes, examining their impact across different population groups, with the aim of contributing to a more inclusive and adaptable framework for mental health intervention.

3. Interventions: Online Self-Directed Programs

This research comprised three structured online training programmes, each designed, developed, and delivered by the author. All interventions followed a uniform framework, spanning 28 days and requiring approximately 15 to 20 minutes of daily engagement. The programmes were implemented using a professional online campaign management system, which enabled the automated distribution of content via email and ensured compliance with data protection regulations. Each programme was designed to promote psychological well-being through evidence-based content grounded in either resilience theory, mindfulness practices, or specific components of mindfulness—namely compassion and gratitude. The interventions were intended to be self-directed and accessible, allowing participants to engage flexibly within their daily routines. The author's multidisciplinary qualifications—comprising advanced degrees in Psychology and Rhetoric, as well as

certifications in mindfulness training, stress management, and meditation instruction—alongside over two decades of practical teaching experience, informed the pedagogical and psychological structure of the programmes.

3.1 Online Self-Directed Program: Resilience RIA[1]

The first intervention, titled *Resilienz im Alltag* (RIA), focused on building psychological resilience through a structured, self-directed online format. The programme was grounded in established theoretical frameworks, including Lazarus and Folkman's (1984) transactional model of stress, as well as contemporary research on resilience and digital mental health training (Ang et al., 2022; Assonov, 2021; Chmitorz et al., 2018; Díaz-García et al., 2021; Fischer & Law, 2021).

Participants in the experimental group engaged with the programme over a 28-day period. Each day, they received two automated emails: one in the morning and one in the evening. The daily activities required approximately 20 minutes—15 minutes in the morning and 5 minutes in the evening. Communication was managed through a secure online campaign tool, which ensured adherence to data protection regulations.

Morning sessions consisted of short video-based "learning nuggets" that introduced theoretical concepts and practical exercises to enhance resilience. Each session included a psychoeducational component, an experiential activity, and a relaxation element such as breathing techniques, meditation, or yoga. Evening sessions encouraged reflective journaling, allowing participants to consolidate their learning. Prompts included questions such as "Write down three to five things you were grateful for today" and "Identify the people and places that provided you with a sense of belonging." Participants could complete the journaling either digitally or on paper.

Prior to beginning the programme, participants received an introductory video explaining how to tailor the exercises to their individual routines. The intervention was organised into four thematic weeks:

- **Week 1** introduced the core concept of resilience, with a focus on routine-building, sleep hygiene, personal strengths, and foundational stress management skills. Breathing and concentration exercises supported the material.
- **Week 2** explored solution-oriented approaches, including the transactional model of stress, cognitive distortions, acceptance, and control. Practical exercises involved affirmations,

[1] https://www.vollerelan.de/resilienz-im-alltag/

perception-based questioning, and extended mindfulness techniques, including yoga (Clark et al., 1995).

- **Week 3** emphasised cognitive reframing, drawing on concepts such as neuroplasticity and attribution styles. Participants practised observing thoughts non-judgmentally to foster calm and cognitive flexibility (Ellis, 2023; Vohs & Baumeister, 2013).
- **Week 4** addressed relational and self-related dimensions of resilience, focusing on empathy, compassion, self-efficacy, self-criticism, and gratitude. The goal was to help participants identify and reinforce internal and external resources (Bandura, 1977; Gilbert & Procter, 2006).

The overarching aim of the RIA programme was to help participants build a resilient mindset by integrating psychoeducational knowledge with practical, daily engagement. By offering a consistent structure and multimodal content, the programme sought to foster a sustainable shift in stress perception, emotional regulation, and adaptive coping.

3.2 Online Self-Directed Mindfulness Programm: Mind2Full[2]

The Mind2Full programme was a four-week online mindfulness intervention, comprising 28 daily units and one introductory unit. Each day, between 6:00 and 7:00 a.m., participants received an automated email containing three short videos: one mindfulness exercise, one office yoga session, and one meditation practice. The total duration of daily content was approximately 20 minutes, with participants free to complete the material either in a single session or distributed throughout the day. The introductory unit included a video outlining the course structure, offering a general introduction to mindfulness, and providing guidance on how to engage effectively with the programme content. Structurally, the programme was based on the eight core components of a Mindfulness-Based Stress Reduction (MBSR) curriculum, as identified by Bergomi et al. (2014):

1. Awareness of inner experience
2. Awareness of outer experience
3. Conscious action in the present
4. An accepting, non-judgmental, compassionate attitude
5. A non-reactive, decentered orientation

[2] https://www.vollerelan.de/intensiver-online-achtsamkeitskurs/

6. An open, non-avoidant attitude
7. Relativity
8. Insightful understanding

The aim of Mind2Full was to facilitate the progressive development of mindfulness skills over the course of the programme. It was theoretically grounded in the standard MBSR model (Santorelli et al., 2017) and integrated with the transactional model of stress (Lazarus & Folkman, 1984), which emphasises the role of cognitive appraisal and individual perception in shaping coping responses. In particular, the programme focused on the development of personal psychological resources, such as self-efficacy—defined as an individual's belief in their ability to produce desired outcomes (Hobfoll, 1988).

Moreover, Mind2Full encouraged participants to adopt a mindful and compassionate stance toward personal experience by drawing on cognitive frameworks that explore the interplay between perception and emotion (Ellis, 1985). A central element was the cultivation of self-compassion, guiding participants toward a non-judgmental attitude toward their perceived mistakes and shortcomings (Neff, 2003; Neff, 2023). This approach was intended to foster psychological flexibility, enabling individuals to disengage from over-identification with transient thoughts and emotions.

A key focus of the programme was the promotion of emotional balance—supporting participants in stabilising emotional responses, reducing stress reactivity, and enhancing overall well-being (Grossman et al., 2003). The overarching goal was to strengthen mindfulness through the consistent, daily practice of structured exercises and theoretically grounded material, ultimately equipping participants with the tools to manage stress more effectively and sustain psychological well-being.

3.3 Online Self-Directed Compassion & Gratitude Program: ComGrat[3]

The third online intervention was a four-week self-directed training programme designed to cultivate compassion and gratitude while incorporating elements commonly associated with mindfulness-based practices. The programme employed a range of techniques aimed at enhancing compassionate awareness, including non-judgmental presence, self-compassion, recognition of shared humanity, mindful engagement in challenging situations, and empathy-focused exercises. These components were supported by daily loving-kindness meditation and structured journaling to facilitate self-reflection. The intervention comprised 28 daily units and one introductory session. Each

[3] https://www.vollerelan.de/compassion-gratitude/

morning at 6:00 a.m., participants received an email containing a brief psychoeducational text focused on themes related to compassion and/or gratitude, accompanied by a guided loving-kindness meditation. The psychoeducational content introduced key psychological and contemplative principles and provided an overview of empirical evidence supporting the effectiveness of mindfulness, compassion, loving-kindness meditation, and gratitude practices in promoting emotional well-being. Participants were instructed to complete a 10–12-minute loving-kindness meditation at home each day. This contemplative practice involved the intentional cultivation of compassion and benevolence toward an expanding circle of individuals—beginning with oneself, then extending to loved ones, acquaintances, strangers, and even individuals with whom one may experience interpersonal difficulties. While originating in Buddhist contemplative traditions, the practice has been adapted into secular mental health contexts due to its demonstrated benefits in fostering emotional balance and interpersonal connection.

During the first two weeks, participants were introduced to various forms of loving-kindness meditation, encouraging them to experiment with different techniques. In the second half of the programme, participants were given the autonomy to select and continue with the practices they found most meaningful and effective. In addition to the morning meditation practice, a second automated email was sent each evening at 9:00 p.m., inviting participants to record their reflections in a gratitude journal. Journaling could be completed manually or digitally in a private and self-directed format. At the outset of the programme, participants were provided with detailed guidance on how to engage consistently with the daily meditation, maintain a gratitude journal, and develop sustainable contemplative routines throughout the four-week intervention.

The overarching objective of the programme was to support the cultivation of compassion and gratitude through regular, structured contemplative practice and daily reflection. In doing so, the intervention aimed to enhance emotional well-being, strengthen interpersonal connectedness, and promote psychological adaptability in the face of everyday stressors.

4. Method

This research project comprised four independent studies investigating the effectiveness of three different online self-directed training programmes aimed at improving psychological well-being. In each study, participants were randomly assigned to either an intervention group or a control group. One study included two separate intervention groups and a control group, allowing for a comparative analysis of two distinct training programmes. In all cases, participants in the control groups were offered access to the respective intervention after completing the post-intervention

measurement, in line with a waitlist control design. Each study employed a pre-test/post-test design, with three of the four studies additionally incorporating a follow-up measurement three months after the intervention. The assessment points were as follows:

1. Baseline (pre-intervention)
2. Post-intervention (immediately after programme completion)
3. Follow-up (three months post-intervention) – included in Studies 1, 3, and 4

To evaluate intervention effects, participants completed a set of validated self-report questionnaires at each relevant time point. These instruments were selected to measure the psychological capacities most directly targeted by each specific intervention, such as perceived stress, resilience, self-compassion, mindfulness, and gratitude. However, not all instruments were employed in every study. The measures used across the studies were:

- **Perceived Stress Questionnaire (PSQ; Fliege et al., 2023)**
  – Four subscales: *Worries*, *Tension*, *Joy*, *Demands*
- **Perceived Stress Questionnaire (PSQ; Fliege et al., 2023)**
  – Four subscales: *Worries*, *Tension*, *Joy*, *Demands*
- **Resilience Evaluation Scale (RE-RE)**
  – Two subscales: *Self-Confidence* and *Self-Acceptance*
- **Self-Compassion Scale (SCS; Neff & Tóth-Király, 2022)**
  – Six subscales: *Self-Kindness*, *Self-Judgment*, *Common Humanity*, *Isolation*, *Mindfulness*, *Over-Identification*
- **Multi-Component Gratitude Measure (MCGM, Morgan et al., 2017)**
  – Six subscales: *Feelings of Gratitude*, *Attitudes of Gratitude*, *Gratitude for the Positive in the Present*, *Gratitude in the Face of Suffering*, *Expressions of Gratitude*, and *Rituals and Practices of Gratitude*
- **Comprehensive Inventory of Mindfulness Experiences (CHIME; Bergomi et al., 2015)**
  – Eight subscales: Inner Awareness, Outer Awareness, Acting with Awareness, Accepting and Non-Judgmental Orientation, Decentering and Non-Reactivity, Openness to Experience, Relativity of Thoughts, and Insight

The selection of instruments was based on the specific focus of each training programme and the corresponding research questions. Full details regarding which measures were employed in which study are presented in the respective study subsections of this chapter. To assess the effects of the interventions, a mixed factorial repeated measures ANOVA was conducted for each study. This analytic approach enabled the examination of changes over time within subjects, differences between groups, and interaction effects between group and time. In the comparative study, intervention type was included as an additional between-subjects factor. This statistical framework allowed for a robust evaluation of the short-term and, where applicable, long-term effects of the online training programmes on psychological outcomes.

5. Research Studies

5.1 Evaluation of a Four-Week Online Resilience Training Program for Multiple Sclerosis Patients[4]

Objective: Study 1 investigated the effectiveness of the four-week online self-directed resilience training programme—Resilienz im Alltag (RIA)—in promoting psychological well-being in individuals diagnosed with multiple sclerosis (MS). The study specifically explored whether the intervention could reduce perceived stress and enhance coping strategies, given the unique psychological challenges associated with the unpredictability of MS.

Measures and Analysis: The study employed validated self-report instruments, including the Perceived Stress Questionnaire (PSQ; Fliege et al., 2023) with four subscales (*Worries*, *Tension*, *Joy*, *Demands*), and the Resilience Evaluation Scale (RE-RE) with two subscales (*Self-Confidence* and *Regeneration*). These instruments were administered at three time points (T1, T2, T3), and the data were analysed using a mixed factorial repeated measures ANOVA to assess main and interaction effects over time between the intervention and control groups.

Results: Participants in the intervention group showed a significant reduction in perceived stress as measured by the PSQ total score, from pre- to post-intervention (T1–T2, $p < .001$, $d = 0.984$), with effects largely maintained at follow-up (T1–T3, $p < .001$, $d = 0.692$). Subscale analyses revealed statistically significant improvements in Worries, Tension, and Joy between T1 and T2. These gains persisted at T3, indicating sustained effects over time. The Demands subscale exhibited a positive but non-significant trend. In terms of coping, the RE-RE scale showed no significant change in the total score. However, there was a statistically significant improvement in the Regeneration Orientation

[4] This study was published Healthcare (Bock et al., 2024). Appendix A

subscale both at T2 and T3, while the Resistance-Regeneration subscale did not show significant change. After the main intervention period, the control group was granted access to the programme. Approximately two-thirds completed the training. A significant reduction in perceived stress was observed in this group between T2 and T3 (p = .002, d = 0.631), mirroring the effects seen in the intervention group and providing additional evidence for the training's effectiveness.

Conclusion: The findings provide clear evidence for the feasibility and effectiveness of self-directed digital resilience training in individuals with MS. Significant improvements in perceived stress and regenerative coping indicate that such interventions can offer a valuable, accessible, and low-cost complement to conventional psychosocial care. Future studies should investigate differential outcomes based on disease stage, comorbidities, and baseline psychological functioning, and should further examine the mechanisms through which these interventions exert their effects.

5.2 Can promoting compassion and gratitude through a four-week online training program improve women's mental health? A randomized controlled trial[5]

Objective: Study 2 examined the efficacy of a self-directed online training programme—ComGrat—designed to cultivate compassion and gratitude as psychological resources essential to women's mental health. The study was conducted in the context of heightened psychological vulnerability following the COVID-19 pandemic, during which levels of stress, depression, and anxiety rose significantly, particularly among young women. At the same time, digitalisation created new opportunities for delivering mental health interventions. Grounded in the principles of positive psychology, this study aimed to determine whether a four-week digital intervention could improve compassion- and gratitude-related competencies in a female sample.

Measures and Analysis: The study employed two standardised and validated instruments: the German version of the Self-Compassion Scale (SCS-G) and the German version of the Multi-Component Gratitude Measure (MCGM-G). The SCS-G comprises six subscales (Self-Kindness, Self-Judgment, Common Humanity, Isolation, Mindfulness, and Over-Identification), while the MCGM-G includes six subscales as well (Conceptual Understanding, Gratitude Frequency, Affective Gratitude, Attitudinal Gratitude, Gratitude Toward Others, and Expression of Gratitude). Assessments were conducted at baseline (T1) and immediately after the intervention (T2). A repeated measures ANOVA was used to examine differences over time between the intervention group and a waitlist control group.

[5] The study has been accepted to be published in BMC Women´s Health (26.06.2025): Appendix B

Results: The results demonstrated that participants in the experimental group exhibited statistically significant improvements in both **self-compassion** and **gratitude** from pre- to post-intervention. For self-compassion, the total score on the **SCS-G** increased significantly between T1 and T2 ($p < .001$), with a large effect size (Cohen's $d = 1.288$). A strong group difference in favour of the experimental group was also observed at post-assessment ($p = .001$, $d = 1.268$). Similarly, scores on the **MCGM-G** improved significantly in the intervention group ($p < .001$), also reflecting a large effect size ($d = 1.113$), and a significant group difference favouring the experimental group ($p < .001$, $d = 1.113$). These findings confirm the efficacy of the ComGrat intervention in enhancing both psychological constructs. Moreover, a strong positive correlation was observed between self-compassion and gratitude scores, suggesting a mutually reinforcing relationship between the two: participants who experienced higher levels of gratitude also reported higher levels of self-compassion and vice versa.

Conclusion: This study provides strong evidence that a short, self-directed online programme can effectively enhance psychological competencies associated with well-being in women. Compassion and gratitude were shown to be both interrelated and responsive to digital intervention, supporting their conceptualisation as learnable and cultivable skills. The intervention demonstrated clear effects on both constructs, offering a low-cost, flexible, and accessible method for promoting mental health—particularly in contexts where traditional support services may be limited or unavailable.

5.3 A Randomized Controlled Trial on the Long-term Effectiveness of Web-based Mindfulness and Self-compassion Interventions among Distance Learning Students[6]

Objective: Study 3 investigated the comparative effectiveness of two self-directed, web-based mindfulness interventions in reducing academic stress and promoting psychological well-being among university students engaged in distance learning. The study aimed to determine whether a targeted programme focused on self-compassion and gratitude (ComGrat) would yield stronger and more sustained outcomes than a comprehensive mindfulness intervention (Mind2Full). This question was particularly relevant in the context of the increasing digitalisation of higher education and the elevated psychological strain reported by students in remote learning environments.

Measures and Analysis: The study employed three validated self-report instruments: the Comprehensive Inventory of Mindfulness Experiences (CHIME) with eight subscales (Inner

[6] This study has been submitted to PLOS One and has gone through the second review. The current state is "Revision being processed" (26.06.2025). Appendix C

Awareness, Outer Awareness, Acting with Awareness, Accepting Attitude, Decentering and Non-Reactivity, Openness to Experience, Relativity of Thoughts, Insightful Understanding), the Perceived Stress Questionnaire (PSQ) with four subscales (Worries, Tension, Joy, Demands), and the Self-Compassion Scale (SCS) with six subscales (Self-Kindness, Self-Judgment, Common Humanity, Isolation, Mindfulness, Over-Identification). Data were collected at baseline (T1), immediately following the intervention (T2), and three months later (T3). A mixed factorial repeated measures ANOVA was used to evaluate the short- and long-term effects of each intervention across the measured outcomes.

Results: A total of 98 students from the European University of Applied Sciences were randomly assigned to one of three groups: Mind2Full (n = 30), ComGrat (n = 31), or a waitlist control group (n = 37). Both intervention groups demonstrated statistically significant improvements from T1 to T2 in mindfulness, self-compassion, and perceived stress compared to the control group ($p < .001$). At the three-month follow-up (T3), the ComGrat group maintained significantly greater reductions in perceived stress ($p < .001$, partial $\eta^2 = 0.119$) and higher levels of self-compassion ($p < .01$) relative to the Mind2Full group. These findings suggest that the more focused approach employed in ComGrat may have promoted deeper psychological engagement, reduced cognitive load, and yielded more durable outcomes.

Conclusion: The results of this study underscore the potential benefits of tailoring mindfulness interventions to address specific psychological constructs, such as compassion and gratitude, rather than employing broader mindfulness curricula. While both programmes were effective in reducing stress and enhancing well-being in the short term, the targeted ComGrat intervention demonstrated superior long-term effects. These findings have meaningful implications for the design of mental health support in educational settings, particularly for distance learning populations. Institutions may benefit from integrating focused, low-threshold programmes like ComGrat into digital learning platforms to support psychological resilience, reduce academic stress, and improve overall student well-being.

5.4 Resilience among Healthcare Staff: Assessing the Effectiveness of Digital Training via RCT[7]

Objective: Nursing professionals are frequently exposed to high psychological and physical demands, such as emotional labour, high workloads, and persistent staffing shortages. These

[7] This study has been published in Journal of Clinical Psychology in Medical Settings: https://link.springer.com/article/10.1007/s10880-025-10085-1 Appendix D

stressors significantly increase the risk of burnout and negatively impact mental well-being. Psychological resilience is widely regarded as a crucial protective factor in such contexts, associated with lower stress and improved mental health outcomes. However, conventional in-person training is often impractical in nursing due to shift work and time constraints. This study investigated the efficacy of a 28-day self-directed online resilience training programme (Resilienz im Alltag, RIA) developed specifically for nurses. The aim was to evaluate whether the intervention could significantly improve resilience and reduce perceived stress compared to a waitlist control group.

Measures and Analysis: The study employed a randomised controlled trial (RCT) design with a total sample of 120 nurses working in Germany. Participants were randomly assigned to either the intervention group (RIA training) or a waitlist control group. The training consisted of 28 daily units comprising psychoeducational content, reflection exercises, and relaxation techniques, delivered in a flexible digital format. Outcome measures were collected at baseline (T1), immediately after the intervention (T2), and at a three-month follow-up (T3). Resilience was assessed using the Resilience-Recovery (RE-RE) scale, and perceived stress was measured using the Perceived Stress Questionnaire (PSQ). Repeated measures ANOVAs were conducted to assess within-group and between-group effects over time. Effect sizes were calculated to evaluate the magnitude of observed changes.

Results: Participants in the intervention group demonstrated a statistically significant improvement in resilience ($p < .001$, $d = 0.6$) and a strong reduction in perceived stress (PSQ total score: $p < .001$, $d = –1.4$) compared to the control group. These results indicate that the RIA programme was effective in enhancing core psychological capacities and mitigating perceived stress among nurses. The observed improvements were maintained at the three-month follow-up, supporting the intervention's durability.

Conclusion: This study offers empirical support for the efficacy of a brief, self-directed digital intervention designed to enhance resilience and reduce perceived stress in nursing professionals. The programme's flexibility makes it well-suited for shift-based and time-constrained work environments, offering an accessible and scalable method for promoting mental health in healthcare settings. While the findings are promising, further research is needed to explore long-term effects and broader outcomes, such as job satisfaction and staff retention.

5.5 Current Studies on Resilience and Mindfulness-Based Interventions

Several additional studies have been initiated and are expected to be completed in 2025/26, expanding the evidence base for digital interventions targeting diverse populations:

- **Resilience training to enhance life satisfaction among cancer patients**: In collaboration with the University of Mainz, this large-scale study involves 600 cancer patients. It examines the effectiveness of resilience training in improving life satisfaction and psychological well-being within the context of chronic illness and medical treatment.
- **Resilience training for stress reduction and life satisfaction among patients with chronic pain**: Conducted in partnership with a neurological department, this study includes 50 individuals experiencing chronic pain. It focuses on assessing how resilience-focused interventions can alleviate stress and enhance quality of life in this population.
- **Mindfulness training for stress reduction among employed women with young children**: This study explores the impact of mindfulness-based interventions on stress levels and emotional well-being among working mothers, a demographic often facing high psychological demands due to dual roles at work and home.
- **Resilience training for stress reduction among male shift workers in the steel industry**: Aimed at examining occupational stress in physically demanding environments, this study focuses on male shift workers in steel production. The goal is to evaluate how resilience training can support mental health and workplace coping strategies in industrial settings.
- **Resilience training for aviation personnel (pilot project with Condor Airlines)**: This pilot study, developed in cooperation with Condor Airlines, investigates a new digital resilience programme tailored for aviation staff, particularly pilots. The intervention aims to strengthen psychological resilience and stress management in high-responsibility, high-stakes professional settings.

Together, these studies contribute to the growing body of research on scalable, evidence-based psychological interventions that support mental health and life satisfaction across a wide range of occupational and clinical populations.

6. Discussion

This dissertation set out to evaluate the feasibility and effectiveness of self-directed, digitally delivered stress-reduction programmes—specifically resilience training, mindfulness training, and compassion and gratitude training—across four empirical studies involving different population groups. Against the backdrop of rising psychological stress following the COVID-19 pandemic and the increasing digitisation of healthcare, this research sought to understand whether brief, structured,

online interventions could provide scalable, low-threshold support for improving mental health and psychological functioning. Across all four studies, the interventions were found to be effective in promoting key psychological competencies—resilience, mindfulness, self-compassion, and gratitude—and in reducing perceived stress. These results not only support the use of digital tools in mental health promotion but also align with broader theoretical frameworks within positive psychology, cognitive-behavioural therapy, and contemplative science.

Study 1, conducted among individuals with multiple sclerosis (MS), demonstrated that the RIA resilience programme significantly reduced perceived stress and improved stress recovery over a sustained period. While the RE-RE scale's overall resilience score did not increase significantly, the Regeneration subscale showed a consistent improvement, indicating that digital training can effectively address disease-related stress even in medically vulnerable populations.

Study 2, involving young women, found that the ComGrat programme significantly increased both self-compassion and gratitude. Large effect sizes and a strong positive correlation between the two constructs suggest that these emotional resources are both learnable and mutually reinforcing. The findings are particularly relevant for supporting women's mental health in contexts of heightened psychological vulnerability, such as post-pandemic recovery or work-family role conflict.

Study 3, which compared the Mind2Full and ComGrat programmes in a sample of distance learning students, revealed that while both interventions reduced perceived stress and enhanced mindfulness, the ComGrat group exhibited more durable effects on self-compassion and stress reduction at the three-month follow-up. This highlights the importance of emotional resource-building, such as compassion and gratitude, as complementary or even superior to general mindfulness training in some contexts.

Study 4 focused on nurses—a population characterised by high occupational stress—and found statistically significant improvements in resilience and strong reductions in perceived stress following participation in the RIA training. The digital and flexible format of the intervention proved to be highly compatible with the time constraints of shift work, reinforcing the practical value of these interventions in demanding professional environments.

Taken together, these studies demonstrate that short, self-guided digital interventions can have a substantial impact on psychological health. The consistent reduction in stress and enhancement of emotional and cognitive resilience across varied populations—including patients with chronic illness, university students, women, and healthcare professionals—suggests that these tools are not only effective but also highly adaptable to different demographic and contextual needs.

These findings carry several important implications. First, they offer practical, low-cost strategies for institutions seeking to support employee or student mental health without heavily relying on clinical infrastructure. Second, they demonstrate that psychological capacities such as self-compassion, gratitude, and resilience are not fixed traits but developable skills, particularly through structured practice supported by psychoeducation and reflection. Third, they confirm the viability of self-directed formats in digital mental health care—a mode of delivery well-suited for today's hybrid and asynchronous lifestyles. From a theoretical perspective, the results substantiate models of resilience and mindfulness as dynamic, trainable processes. They further validate the integration of compassion and gratitude into stress-reduction frameworks, highlighting the emotional and interpersonal dimensions of psychological well-being. Future research should continue to explore the mechanisms through which these interventions produce their effects, including neural, behavioural, and social pathways. Longitudinal designs are needed to assess the durability of outcomes, and comparative studies could illuminate differential effects by demographic variables such as age, gender, and occupational role. Additionally, studies should examine real-world implementation at scale, such as integration into institutional wellness policies, public health campaigns, or digital healthcare platforms.

In conclusion, this dissertation provides robust empirical support for the effectiveness of short, self-directed digital interventions targeting resilience, mindfulness, compassion, and gratitude. These findings contribute meaningfully to the ongoing development of digital mental health strategies and offer timely, evidence-based approaches to support psychological well-being in an increasingly complex and digitally mediated world.

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Appendix A: Evaluation of a Four-Week Online Resilience Training Program for Multiple Sclerosis Patients

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MDPI

Article

Evaluation of a Four-Week Online Resilience Training Program for Multiple Sclerosis Patients

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Abstract: The diagnosis of a chronic disease, such as multiple sclerosis, has both psychological and physical effects. Living with the disease and its uncertain consequences requires a great deal of psychological resilience in order to employ more comprehensive coping strategies in stressful situations. This study investigated the effect of a four-week online self-directed resilience training program on the perception of psychological resilience among multiple sclerosis patients. A total of 94 MS patients were recruited for a randomised controlled trial. The experimental group underwent a 28-day online self-directed training program consisting of daily exercises aimed at strengthening a resilient mindset. Psychological resilience was measured through self-assessment immediately before, immediately after, and three months after the training. A repeated measures ANOVA revealed a statistically significant improvement in the perception of four factors related to stress: perceived worries, tension, joy, and demands. Two resilience coping strategies were measured, of which one, a resilient orientation, improved significantly in the short and long term. The study suggests that online self-directed resilience training might provide an easily accessible, low-cost option for patients with MS to improve their psychological resilience. This is a pilot study to assess the general applicability to people with MS. Future studies should examine the transferability of results in relation to disease stage and co-morbidities.

Keywords: resilience; stress; online training; meditation; mindfulness

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1. Introduction

Being diagnosed with an incurable chronic disease such as multiple sclerosis (MS) can significantly alter an individual's life, resulting in physical limitations and profound psychological effects. As the prevalence of MS increases worldwide [1], it is becoming increasingly important to identify and implement accessible ways to enhance patients' resilience so that they can effectively cope with the challenges of the disease and strengthen their ability to overcome it.

Resilience refers to an individual's ability to adapt and withstand life's challenges. It has become increasingly important, particularly during the COVID-19 pandemic [2]. Improving psychological resilience in patients with multiple sclerosis may be a promising approach to enhancing their quality of life.

Previous studies have suggested that resilience may be a stable personality trait. However, it is now understood that resilience is dynamic and focused on individual development [3] rather than a fixed perspective. Foundational studies [4–6] have collectively influenced the perception of resilience to that of being malleable and flexible, challenging

the original notion that it is a fixed personality trait. As resilience is not a stable trait, it can be improved through training. The current research literature indicates that such interventions are promising.

A pilot evaluation was conducted to assess the effectiveness and feasibility of a group resilience training for individuals with MS. The training was based on acceptance and commitment therapy (ACT) and showed promising results [7]. Furthermore, a study examined the relationship between psychological resilience and social and occupational performance in people with MS, highlighting the importance of resilience in this population [8]. Arab et al. [9] conducted a study on the effects of a distancing program on the sense of coherence in MS patients. Their study highlights the relevance of resilience-promoting interventions in this population.

Additionally, Ploughman et al. [10] investigated the impact of resilience on healthy aging in MS, suggesting the potential role of resilience in improving the overall well-being of people with MS. Broche-Pérez et al. [11] investigated the mediating role of psychological resilience in the relationship between fear of relapse and quality of life in individuals with MS. Their study highlights the significance of resilience in managing disease-related concerns. Furthermore, a study discovered that psychological resilience played a mediating role in the correlation between perceived neuropsychological impairment and quality of life in individuals with MS. This implies that interventions aimed at building resilience may have a positive impact on the psychological well-being and quality of life of those with MS [12].

In summary, current findings highlight the need for more research on interventions that can reduce stress and increase resilience by people with MS [13,14]. A meta-study suggests that interventions aimed at enhancing resilience and stress management have the potential to positively impact the well-being and quality of life of people with MS, but more research is needed [15].

This pilot study aimed to investigate the effects of online self-directed training on enhancing personal resilience and reducing stress perception in individuals with MS. Previous research has demonstrated the potential of self-directed online training to prevent or reduce stress, both generally and specifically in the context of online mindfulness training [16–21]. The existing research suggests potential benefits and highlights the need for further investigation [22].

2. Materials and Methods

The Euro-FH Ethics Committee approved this study (EKEFH04/23), and all participants provided informed written consent. This study is a randomised controlled trial with three assessment points, baseline (T1), post-intervention (T2), and long-term (T3), conducted between March and July 2023.

A total sample size of $n = 44$ was determined using an ANOVA repeated measure analysis (G*Power 3.1) with an effect size of d = 0.25, a-error = 0.05, and b-error = 0.95. The study recruited 94 people with MS from the Department of Neurology, Bundeswehrkrankenhaus Hamburg, and the German Multiple Sclerosis Society (DMSG). Patients at the Department of Neurology at Bundeswehrkrankenhaus Hamburg were personally contacted and informed about the study's procedure and purpose. Consent for data use was obtained from the internal data protection officer of the hospital. Additionally, the project was communicated to the regional associations of the DMSG via email, with a clear and transparent explanation of the aim and content of the study. The DMSG distributed the information to its members and advertised the study to those who were interested. Interested participants contacted the research team via mail. A total of 137 individuals expressed interest in the study, with 56 from the Bundeswehrkrankenhaus Hamburg and 81 from DMSG. The study's inclusion criteria required participants to be legal adults over 18 years old and have a clinical diagnosis of multiple sclerosis, a chronic neurological condition, evaluated by medical professionals. This ensured a homogeneous participant group, specifically focusing on those affected by the condition under investigation. Additionally, partici-

pants were required to demonstrate a willingness to allocate a designated amount of time each day (20 min) towards engaging in the self-directed resilience training program. This commitment reflects the importance of adherence to the intervention, which is crucial for evaluating its efficacy and effectiveness. Participants were required to complete three questionnaires during the testing period to provide essential data for the research. This study excluded individuals who did not meet the specified inclusion criteria. Ninety-four individuals met the inclusion criteria and completed the final anonymous registration, indicating successful recruitment of participants who met the study's requirements.

The research group randomly assigned 94 participants to either the experimental group (EG) (n = 47) or the waitlist control group (CG) (n = 47) using an online randomisation tool. All participants were informed of the study design and knew that they would either be assigned to the EG and start the program first, or to the CG and start the program four weeks later. Participants were then asked to complete the first questionnaire (T1) and were then informed of their allocation. After completing the questionnaire, the EG began the online program. The CG was informed that they would gain access to the program four weeks later, after completing the second questionnaire (T2). All 94 participants completed the T2 questionnaire after the EG finished the program. To measure the long-term effect of the program on the experimental group (EG), participants were required to complete a questionnaire for the third time (T3) three months after the program had ended. Participants were informed that only complete data sets consisting of three filled-out questionnaires would be considered for the research.

Despite three reminder emails, thirty participants did not complete all three questionnaires and were excluded from the study. Due to strict privacy policies and anonymity, it was not possible for the research team to contact these participants to find out why they did not complete the third questionnaire. This study analysed the long-term effect of the program after three months on the 63 participants who completed all three questionnaires (T1, T2, and T3). Twenty-nine of the remaining participants belonged to the CG and thirty-four to the EG. The CG was granted access to the program immediately after the EG had completed it and after they had filled out the T2 questionnaire. Out of the original 47 CT participants, 29 chose to participate in the program.

The self-developed program was based on established stress theories, such as Lazarus and Folkman [23], and current research on resilience and the effects of online training [24–28]. The participants in the experimental group (EG) received two emails per day, one in the morning and one in the evening, for 28 consecutive days. They were free to integrate the videos and inputs from the resilience training program into their daily routine at their convenience. The morning sessions focused on improving resilience, while the evening sessions were used for reflecting on the daily content and exercises. This was done using a journal, a method that involves writing down thoughts. Participants were free to use their mobile phones or individual pieces of paper to make notes in a diary-like format. The tasks for the evening included prompts such as 'Write down three to five things that you were grateful for (or very satisfied with) today' and 'Identify the people you feel connected to, the places where you feel a sense of belonging, and the larger communities you are a part of'. The morning training content was sent to program participants via email every day at 7am. Each morning, the training session consisted of a video-based 'learning nugget' on a resilience-related topic, followed by an activity that reinforced the newly acquired knowledge throughout the day. The session concluded with a relaxation exercise, which could be a breathing exercise, meditation, or an easy-to-practice yoga exercise. The total duration of the daily sessions was approximately 20 min, with 15 min in the morning and 5 min in the evening. Before the program began, participants received a brief introductory and welcome video explaining how to organise the exercises according to their preferences. This provided flexibility in watching the videos, as they did not need to be viewed all at once.

During the first week of the program, the focus was on understanding resilience and establishing a daily routine of reflection and relaxation. The content covered neuropsy-

chological principles, as well as topics such as sleep, activating personal resources, rest and relaxation, stress, and emotional regulation. One of the key takeaways for participants was to pay attention to small things that can improve their day and to write them down. The participants of the program were given instructions to practice different breathing and concentration exercises [23,29,30]. In the second week, the focus shifted towards solution orientation. This involved addressing the transactional stress model and cognitive distortions, as well as exploring acceptance and control, and other coping and solution strategies. An exercise during the week involved questioning one's own perceptions and practicing saying 'yes'. In addition, the program incorporated short meditation and yoga exercises for relaxation [31,32]. In the third week, the program focused on reframing as a coping strategy to support resilience. Participants learned to counter irrational thoughts and re-evaluate their feelings and thought processes. This week covered the topic of neuroplasticity and attribution styles. Participants were encouraged to identify their thoughts and recognise irrational thoughts or self-regulation. The relaxation exercises aimed to promote calmness and relaxation while observing one's own thoughts [33,34]. The last week's focus was on relationships and their effects, covering topics such as connection, empathy, compassion, and dealing with difficult people, as relationships are considered a fundamental psychological need. The 'learning nugget' also addressed self-efficacy, resource management, and self-criticism. The participants were encouraged to demonstrate their understanding and compassion for others. Furthermore, the topic of gratitude was explored as a means of strengthening one's own resources [35,36]. The training program aimed to improve individuals' perception of stress and resilience through daily engagement with tailored exercises and content.

Participants evaluated their stress perception and resilience using a combined questionnaire comprising two assessments: the Resistance Orientation–Regeneration Orientation Scale (Re-Re Scale), developed by Otto and Linden [37], and the Perceived Stress Questionnaire, developed by Fliege et al. [38].

The Resistance Orientation–Regeneration Orientation Scale (Re-Re Scale) developed by Otto and Linden [37] is utilised to document stress-related procedures. The Re-Re Scale comprises 20 items, categorised into two subscales. The 'Resistance Orientation' subscale comprises 10 items that evaluate resilience and individual behaviour towards achieving goals. The scale includes examples such as 'When striving for a goal, personal emotions should not be a factor' and 'External factors do not impress me'. The 'Regeneration Orientation' subscale consists of 10 items that measure the inclination towards self-care. Examples of these items include 'During stressful periods, recovery time is especially important' and 'I focus on my positive attributes when looking in the mirror'. The program participants categorised their answers on a 5-point Likert scale ranging from '1 = strongly disagree' to '5 = strongly agree'.

The reliability of the two subscales was indicated using Cronbach's alpha. The 'Resistance Orientation' scale resulted in $\alpha = 0.93$, while the 'Regeneration Orientation' scale resulted in $\alpha = 0.92$, indicating excellent internal consistency. The Re-Re scale was analysed by calculating the mean values of the respective subscales.

The Perceived Stress Questionnaire (PSQ) developed by Fliege et al. [38] is used to assess an individual's subjective perception of stress. For this study, we used the German-language short version of the questionnaire, which consists of 20 items divided into four subscales: 'Worry', 'Tension', 'Joy', and 'Demands'. These subscales aim to demonstrate how stressful stimuli are perceived, evaluated, and processed. The subscale 'Joy' is to be understood as 'lack of joy'. The PSQ includes items such as 'You have the feeling that too many demands are being placed on you', 'You are full of energy', and 'Your problems seem to be piling up'. These items are categorised on a 4-point Likert scale ranging from 'almost never' to 'most of the time'. In addition to the four individual scales, the total score of the PSQ can be calculated from all items.

The internal consistency of the PSQ was assessed using Cronbach's alpha. The PSQ total score had a value of $\alpha = 0.86$, while the four subscales had values ranging from

$\alpha = 0.8$ to $\alpha = 0.85$, indicating good reliability in each case. Similarly high values were obtained for split-half reliability. To calculate the individual scales, the respective item values were added up according to the evaluation manual. The assessments T1, T2, and T3 were conducted through an online questionnaire tool called ScoSci Survey.

A mixed factorial repeated measures analysis of variance (ANOVA) was conducted to examine differences over time. No unusual or abnormal data were detected. Violations of sphericity were addressed using the Greenhouse–Geisser correction for values less than 0.75 or the Huynh–Feldt correction for values greater than 0.75 [39]. Levene's test was used to assess the assumption of homogeneity of variance. If the assumption of homogeneity of variance was met, we performed post hoc multiple comparison tests using Tukey's approach [40]. If homogeneity was not found, we used Holm's method for post hoc tests [41]. We set the significance level for the mixed factorial repeated measures ANOVA and its associated post hoc tests at 0.05, based on our a priori power analysis.

3. Results

This study involved an experimental group of 34 participants, with 74% of them being female ($n = 25$) and 26% male ($n = 9$ (Figures 1 and 2). The mean age of this group was 49.1 years (SD = 11.139), ranging from 27 to 65 years. The waitlist control group ($n = 29$) comprised 62% females ($n = 18$) and 38% males ($n = 11$) with a mean age of 49.31 (SD = 9.111) ranging from 30 to 67 years (Table 1).

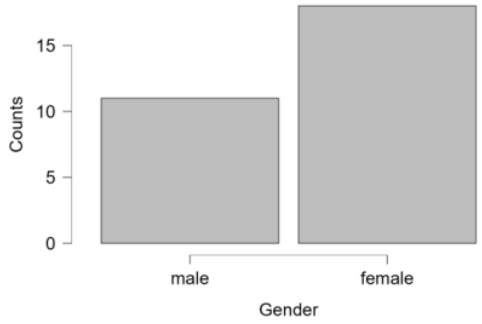

Figure 1. Sex distribution control group.

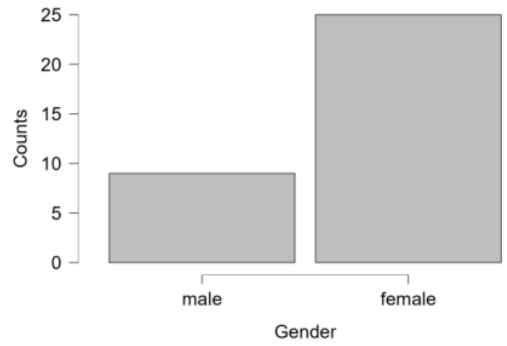

Figure 2. Sex distribution experimental group.

Table 1. Age distribution experimental group.

	Age	
	Control Group	**Experimental Group**
Valid	29	34
Missing	0	0
Mean	49.310	49.088
Std. Deviation	9.111	11.139
Minimum	30.000	27.000
Maximum	67.000	65.000

Both scales exhibited a normal distribution ($p > 0.05$), except for the control group T1 for the PSQ. Assuming homogeneity of variance on all scales, a repeated measures ANOVA with Huynh–Feldt correction revealed a significant interaction between time and group in relation to the PSQ score ($F(1.854, 113.076) = 13.880$, $p < 0.001$, $\eta^2p = 0.185$). Please refer to Figure 3 for more details.

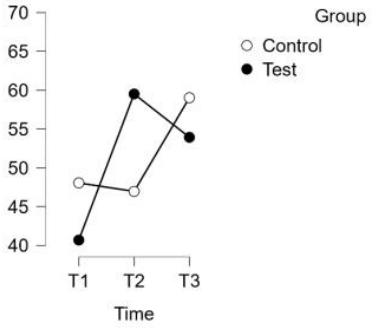

Figure 3. Estimated marginal means for PSQ complete score.

A post hoc analysis using Bonferroni correction supported implicit differences between the experimental and waitlist control groups over time. The intervention led to a significant improvement in scores ($t(34) = -6.702$, $p < 0.001$, MD = −18.822 points, 95% CI [−27.231, −10.413], $d = 0.984$) from T1 to T2, indicating a substantial effect. Additionally, there was a significant difference between T1 and T3, with a mean difference of −13.235 points, 95% CI [−21.644, −4.826], $d = 0.692$, $t(34) = -4.712$, $p < 0.001$.

However, there was no discernible difference between T1 (control) and T2 (control). After the waitlist control group completed the intervention, their scores showed a notable increase. The mean difference (MD) from T2 (control) to T3 (control) was −12.071 points, with a 95% confidence interval of −21.176 to −2.966, and $d = -0.631$. This resulted in a significant improvement in scores, $t(29) = -3.969$, $p = 0.002$, indicating a substantial effect (see Table 2).

3.1. PSQ Worries Subscale

A repeated measures analysis of variance (ANOVA) was conducted to investigate the relationship between time and group on the PSQ score for the Worries subscale, with a Huynh–Feldt correction applied. The results indicated a statistically significant interaction between time and group on the PSQ score ($F(1.729, 241.168) = 13.880$, $p = 0.003$, $\eta^2p = 0.099$), as shown in Figure 4.

Table 2. A summarised account of the overall PSQ results across all scales.

Post Hoc Comparisons—Group ∗ Time											
			95% CI for Mean Difference					95% CI for Cohen's d			
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}	
Control, T1	Test, T1	7.360	−7.176	21.896	4.835	1.522	0.385	−0.383	1.152	0.651	
	Control, T2	1.093	−8.012	10.199	3.041	0.360	0.057	−0.421	0.535	0.999	
	Test, T2	−11.462	−25.998	3.074	4.835	−2.371	−0.599	−1.377	0.179	0.177	
	Control, T3	−10.977	−20.082	−1.872	3.041	−3.610	−0.574	−1.076	−0.071	0.006	**
	Test, T3	−5.875	−20.411	8.661	4.835	−1.215	−0.307	−1.072	0.458	0.829	
Test, T1	Control, T2	−6.267	−20.803	8.269	4.835	−1.296	−0.328	−1.093	0.438	0.787	
	Test, T2	−18.822	−27.231	−10.413	2.809	−6.702	−0.984	−1.501	−0.467	<0.001	***
	Control, T3	−18.337	−32.873	−3.801	4.835	−3.792	−0.959	−1.763	−0.155	0.003	**
	Test, T3	−13.235	−21.644	−4.826	2.809	−4.712	−0.692	−1.172	−0.212	<0.001	***
Control, T2	Test, T2	−12.556	−27.092	1.980	4.835	−2.597	−0.656	−1.438	0.125	0.107	
	Control, T3	−12.071	−21.176	−2.966	3.041	−3.969	−0.631	−1.138	−0.124	0.002	**
	Test, T3	−6.968	−21.504	7.568	4.835	−1.441	−0.364	−1.131	0.403	0.702	
Test, T2	Control, T3	0.485	−14.051	15.021	4.835	0.100	0.025	−0.735	0.786	1.000	
	Test, T3	5.587	−2.822	13.996	2.809	1.989	0.292	−0.157	0.741	0.354	
Control, T3	Test, T3	5.102	−9.434	19.638	4.835	1.055	0.267	−0.497	1.031	0.898	

** $p < 0.01$, *** $p < 0.001$. Note. Computation of Cohen's d based on pooled error. Note. *p*-value and confidence intervals adjusted to compare a family of 15 estimates (confidence intervals corrected using the Bonferroni method).

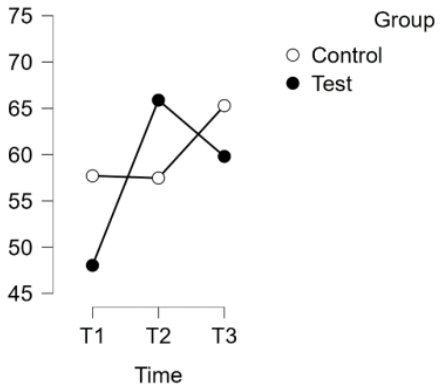

Figure 4. Estimated marginal means for PSQ subscale: Worries.

Post hoc tests with Bonferroni correction revealed significant differences over time between the experimental and waitlist control groups. The intervention led to a significant increase in scores, with a mean difference of −17.843 points (95% CI [−28.328, −7.358], d = 0.740, t(34) = −5.095, $p < 0.001$) from T1 to T2. This effect size is considered large. Additionally, there was a significant difference between T1 and T3, with a mean difference of −11.764 points (95% CI [−22.249, −1.279], d = −0.488, t(34) = −3.359, $p = 0.013$).

No significant difference was observed between T1 (control) and T2 (control), or between T2 (control) and T3 (control).

3.2. PSQ Tension Subscale

A repeated measures analysis of variance (ANOVA) was conducted on the PSQ Tension subscale, with a Huynh–Feldt correction. The results showed a significant interaction

between time and group on PSQ score [F(1.868, 113.924) = 12.774, $p = 0.001$, $\eta^2p = 0.173$], as illustrated in Figure 5.

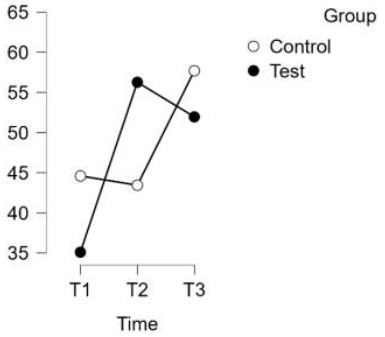

Figure 5. Estimated marginal means for PSQ subscale: Tension.

Post hoc tests with Bonferroni correction revealed significant differences between the experimental and waitlist control groups over time. The intervention led to a significant increase in scores. The mean difference was −21.176 points (95% CI [−30.784, −11.567], d = −1.011) from T1 (test) to T2 (test), indicating a large effect size (t(34) = −6.599, $p < 0.001$). Additionally, there was a significant difference between T1 (test) and T3 (test), with a mean difference of −16.862 points (95% CI [−26.470, −7.254], d = −0.805, t(34) = −5.254, $p < 0.001$).

No significant difference was found between T1 (control) and T2 (control). However, a significant difference was found between T2 (control) and T3 (control) (t(29) = −4.102, $p = 0.001$). The mean difference (MD) was −14.254 points with a 95% confidence interval (CI) of [−24.658, −3.850], indicating a large effect size (d = −0.681).

3.3. PSQ Joy Subscale

A repeated measures analysis of variance (ANOVA) was conducted on the Joy subscale of the Perceived Stress Questionnaire (PSQ) with a Huynh–Feldt correction. The results revealed a significant interaction effect between time and group (F(1.996, 121,774) = 13,798, $p < 0.001$, $\eta^2p = 0.184$), as shown in Figure 6.

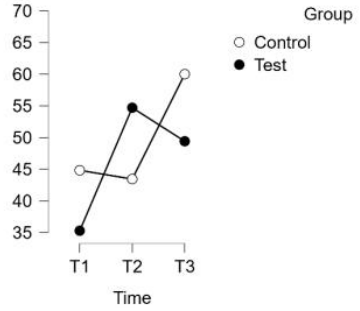

Figure 6. Estimated marginal means for PSQ subscale: Joy.

Subsequent post hoc tests with Bonferroni correction confirmed time-related differences between the experimental and waitlist control groups. The intervention resulted in a significant improvement in scores (MD = −19.411 points, 95% CI [−28.939, −9.884], d = −0.920, t(34) = −6.100, $p < 0.001$), indicating a large effect size. Furthermore, there

was a substantial difference between T1 (test) and T3 (test) (MD = −14.118 points, 95% CI [−23.645, −4.590], d = −0.669, t(34) = −4.436, $p < 0.001$).

There was no significant difference found between T1 (control) and T2 (control). However, T2 (control) showed a significant difference from T3 (control) (t(29) = −4.804, $p < 0.001$, MD = −16.552 points, 95% CI [−26.869, −6.236], d = −0.784), representing a large effect size.

3.4. PSQ Demands Subscale

A repeated measures analysis of variance (ANOVA) with a Huynh–Feldt correction was conducted on the PSQ Demands subscale. The results revealed a statistically significant interaction between time and group on the PSQ score [F(1.910,116,434) = 6.58, $p = 0.002$, $\eta^2p = 0.100$], as shown in Figure 7.

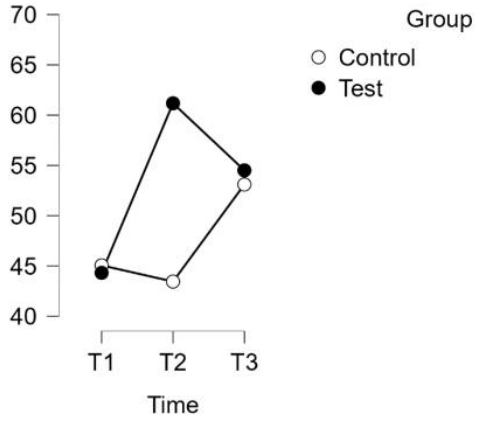

Figure 7. Estimated marginal means for PSQ subscale: Demands.

Bonferroni post hoc tests indicated significant differences between the experimental and waitlist control groups over time. The intervention led to a significant improvement in scores (mean difference = −16.864 points, 95% CI [−28.027, −5.700], d = −0.719, t(34) = −4.523, $p < 0.001$) from T1 (test) to T2 (test). However, there were no significant differences between T1 (test) and T3 (test), or between T2 (control) and T3 (control).

3.5. Resistance Orientation–Regeneration Orientation (Re-Re) Scale

The scale comprises two subscales: Resistance and Regeneration. A repeated measures ANOVA for the Re-Re scale as a whole did not reveal any statistically significant interaction between time and group. However, the Regeneration Orientation subscale demonstrated significant improvement, whereas the Resistance–Regeneration subscale did not.

A repeated measures ANOVA with a Huynh–Feldt correction revealed a significant interaction between time and group on the PSQ score for the subscale of Worries (F(1.817, 110.845) = 10.094, $p = 0.001$, $\eta^2p = 0.142$). The results are presented in Figure 8.

Furthermore, post hoc tests using the Bonferroni correction confirmed significant differences between the experimental test group and the waitlist control group over time. The intervention led to a significant increase in test scores, with a large effect size (d = −0.789), t(34) = −5.845, $p < 0.001$, and a mean difference (MD) of −0.544 points, 95% CI [−0.823, −0.265], between T1 (test) and T2 (test). Additionally, a significant difference was observed between T1 (test) and T3 (test), with a mean difference of −0.479 points, 95% CI [−0.758, −0.201], d = −0.695, t(34) = −5.150, $p < 0.001$.

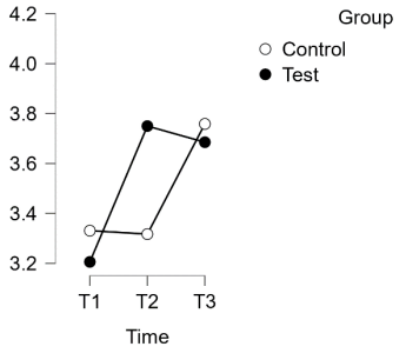

Figure 8. Estimated marginal means for Re-Re subscale: Regeneration Orientation.

No significant difference was found between the T1 and T2 control groups. However, the control group T3 exhibited a significant difference compared to T2. The mean difference (MD) was −0.441 points, with a 95% confidence interval (CI) of [−0.743, −0.140]. This resulted in a t-value of −4.379 and a p-value of less than 0.001. The effect size was considered medium, with d = −0.640.

4. Discussion

In summary, this study shows a consistent improvement in various aspects of psychological well-being in the experimental group. The intervention had an immediate positive effect, as evidenced by significant increases in all scales of the Psychosocial Well-being Questionnaire (PSQ) from T1 (baseline) to T2 (immediately after the training program). The effectiveness of the program in positively influencing the psychological state of the participants was immediately apparent.

Additionally, this study shows sustained long-term improvements (T3) after three months, particularly in the PSQ scales measuring worries, joy, and tension, indicating that the program's benefits persisted in these crucial dimensions of psychosocial health. Although the Demands subscale did not show significant effects, positive trends in other PSQ subscales suggest an overall positive impact on various aspects of psychological well-being. It is worth noting that the experimental group showed significant improvements in the Regeneration subscale, both in the short term (T2) and the long term (T3) on the Resilience–Recovery (Re-Re) scale. This highlights the effectiveness of the intervention in facilitating psychological recovery among participants. However, measures related to resilience did not show a significant improvement, revealing nuanced effects across different domains of psychological well-being within the experimental group.

A decline in the program's effectiveness is observed between T2 and T3, which is consistent with the typical pattern seen in the post-trial period of interventions [42]. However, the study emphasises the enduring significance of the program by highlighting that the improvements observed from T1 to T3 remain statistically significant across most scales. This suggests that the positive impact of the program persists over the long term, even if its immediate effect diminishes.

The control group (CG), which was granted access to the program after the main trial period, demonstrates significant improvement between T2 and T3. It is important to note that enrolment in the program was voluntary for the CG, and two-thirds of the participants chose to engage in the program. The improvement in the CG, measured two months after the conclusion of the course (T3), strongly indicates the effectiveness of the program. This supports the notion that the intervention had a meaningful and lasting impact on the well-being of participants.

This study provides evidence indicating the potential of self-directed online programs in bolstering resilience and diminishing perceived stress levels among individuals diag-

nosed with multiple sclerosis (MS). These findings offer a glimpse into the efficacy of such interventions in addressing the challenges faced by individuals coping with chronic health conditions.

The findings of this study contribute significantly to the growing body of evidence highlighting the vital role of resilience in individuals coping with multiple sclerosis (MS) [1]. Consistent with previous research and the existing literature, this study emphasises the potential effectiveness of resilience-focused, stress-reducing interventions in addressing the unique challenges faced by individuals dealing with MS in general.

Future studies should consider disease severity, neurological disability, and co-morbidities in people with MS, as these factors may significantly influence response to resilience interventions and overall experience of the disease. Investigating the interaction of variables with the effectiveness of self-directed online programs may help to identify subgroups of patients who may benefit most. In addition, investigating the relationship between age and gender and the effectiveness of resilience interventions may provide valuable insights into the particular challenges faced by different demographic groups within the MS population, supporting the development of targeted interventions tailored to specific needs.

The promising results of this preliminary study suggest that self-directed online resilience training has the potential to significantly reduce stress in people with MS. Future research should focus on investigating the long-term effects of such interventions, particularly over longer periods of six to twelve months post-intervention. Strategies to improve participant retention and engagement are crucial to minimise dropout rates in longitudinal studies. The inclusion of a third control group, receiving a placebo intervention or an alternative stress reduction program, may help to elucidate the true effects of the intervention beyond the participants' perceptions.

In conclusion, immediate post-diagnosis support, particularly through resilience courses, is recommended as a crucial aspect of coping with the psychological impact of MS. Resilience-building interventions can reduce the perception of stress and argue for proactive measures to provide psychological support. The suggestion that the course material should be integrated into daily life for long-term use is supported by the positive results observed three months after the intervention, suggesting lasting benefits. Widespread use of self-directed online interventions could have far-reaching benefits for people with MS and contribute to their overall well-being. This study provides important insights for further research and comprehensive care strategies to improve the mental well-being of people facing the challenges of multiple sclerosis.

5. Conclusions

The study sheds light on how targeted interventions can support the holistic well-being of people with multiple sclerosis (MS), building on and extending existing research. While our findings provide initial support for the efficacy of self-directed online programs for this population, future research should take a more comprehensive approach, controlling for various covariates and conducting subgroup analyses to deepen our understanding and optimise the impact of such interventions.

These findings underscore the importance of exploring alternative methods of supporting people with MS, particularly in alleviating the psychological and emotional burden associated with the disease. Our study suggests that engaging participants in self-directed online programs is a practical and accessible way to promote resilience and improve overall well-being in this population.

While these preliminary findings are promising, they also serve as a catalyst for further research into self-directed online interventions for chronic disease management. It is essential that these findings inspire ongoing research aimed at elucidating the mechanisms underlying the observed benefits and refining the design and delivery of such programs.

Furthermore, the implications of these findings extend beyond MS and can be extrapolated to a wider range of chronic health conditions. This underscores the potential of self-directed online interventions to reduce stress, increase life satisfaction, and build

resilience in individuals facing a range of medical challenges. As such, these initial findings serve as a clarion call for sustained interdisciplinary collaboration and innovation in the pursuit of more effective and accessible approaches to improving the quality of life of people with chronic conditions.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available from the corresponding author on request but are not publicly available due to data protection for privacy reasons. The Consort 2010 information checklist has been followed and is available on request.

Conflicts of Interest: The authors declare no conflict of interest.

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Appendix B: Can promoting compassion and gratitude through a four-week online training program improve women's mental health? A randomized controlled trial

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BMC Women's Health

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Can promoting compassion and gratitude through a four-week online training program improve women's mental health? A randomized controlled trial

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Abstract

Background The period following the pandemic has witnessed a surge in depression, distress, and anxiety, alongside a rise in digitalization. This has underscored the necessity of finding alternatives to in-person interventions for mental well-being. According to positive psychology, compassion and gratitude can alleviate anxiety and depression. This pilot study investigates the impact of a four-week self-directed online training program that emphasizes compassion and gratitude as essential components of women's psychological well-being.

Methods For this randomized controlled trial, a sample of 51 women aged between 21 and 39 years was selected. The experimental group ($n = 26$) underwent a four-week training program on compassion and gratitude, which included psychoeducation, compassion exercises, and journaling. The control group was a waitlist control group ($n = 25$). Participants' levels of compassion and gratitude were assessed before and after the four-week program using standardized self-report surveys. The German Self-Compassion Scale (SCS-G) and the German Multi-Component Gratitude Measure (MCGM-G) were utilized to examine the differences between the experimental group and the waitlist control group over time, a repeated measures ANOVA was conducted.

Results The study shows that participants in the experimental group experienced a significant improvement in both compassion and gratitude skills. Furthermore, there was a strong positive correlation between compassion and gratitude.

Conclusion The findings of the pilot study suggest that a brief self-directed online program aimed at cultivating compassion and gratitude can enhance factors that are crucial to women's mental well-being. Further research is necessary to examine the long-term effects of these interventions and their suitability for diverse demographics.

Trial registration The trail was registered 23.12.2022 at German Clinical Trails Registre. Registration ID: DRKS00030973.

Keywords Compassion, Gratitude, Self-instructed training, Positive psychology, Mindfulness

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Background

The COVID-19 pandemic has presented significant global challenges, impacting various aspects of human life. In addition to its impact on physical health, the pandemic has led to an increase in levels of depression, psychological distress, and anxiety, particularly among certain demographic groups [1, 2]. It is important to note that not all demographic groups have experienced mental health challenges to the same extent. Certain risk factors have been identified for poor mental health outcomes, including being female, belonging to a younger age group (under 40 years), experiencing unemployment or pursuing education, having chronic or psychiatric illnesses, and frequent use of social media [2].

The significance of gender as a determining factor in mental health outcomes has been acknowledged in previous studies [3–5]. Generally, women experience a higher incidence of depression and anxiety disorders throughout their lifetime. This occurrence is due to a complex interplay of biological, psychological, and socio-cultural factors [6]. These susceptibilities have been further intensified by the unique stressors of the pandemic, in addition to pre-existing gender inequalities [7]. For example, young women residing alone may have experienced intensified feelings of isolation as a consequence of the implementation of lockdown measures and social distancing guidelines, which could have resulted in elevated levels of anxiety and depression [7]. The lack of a support system in their immediate living environment can exacerbate feelings of solitude and vulnerability. Moreover, young women are frequently in the nascent stages of their careers, which may have been disrupted by the economic consequences of the pandemic, resulting in financial instability and job insecurity [8, 9]. Furthermore, a working mother who previously balanced her career with family duties might have found herself in a situation where her children were home all day due to school closures. This additional burden, coupled with the pervasive fear of the virus, financial instability, and diminished social support, significantly heightened her levels of anxiety and depression [10, 11]. These examples illustrate how the intersection of pandemic-related stressors and pre-existing gender inequalities can have a disproportionate impact on the mental health of women [12].

Given the developing challenges, it is crucial to seek interventions that support mental health and are easily accessible. Traditional mental health services, while effective, often face obstacles such as cost and limited availability [13, 14]. Therefore, solutions must involve interventions that bridge the accessibility gap and provide meaningful remedies. The increase in digitalization due to the pandemic is an advantage in this case.

This pilot study examines the potential impact of an online self-directed intervention designed to enhance mental health, with a specific emphasis on the pivotal elements of mindfulness. It is imperative that effective interventions are based on robust scientific evidence and proven methodologies, and that they are readily accessible and integrated into women's daily routines. The construct of mindfulness, defined as the awareness that emerges through paying attention on purpose, in the present moment, and non-judgementally to the unfolding of experience moment by moment [15], is at the core of this intervention. Extensive research has been conducted into the benefits of mindfulness practices for mental health. These benefits include a reduction in stress, anxiety, and depressive symptoms, as well as an improvement in overall well-being [16, 17].

Mindfulness is not merely a standalone practice; rather, it is an integral component that can enhance the efficacy of other psychological interventions. Two specific methods that have demonstrated efficacy are compassion training and gratitude training, which are based on the principles of mindfulness. Compassion training is a method that focuses on developing empathy and understanding towards oneself and others. This training has been associated with increased emotional resilience and reduced psychological distress. Gratitude training is another method that involves cultivating a sense of thankfulness and appreciation. This has been linked to greater overall well-being and reduced symptoms of depression and anxiety. Both of these approaches have shown potential in enhancing psychological well-being and alleviating symptoms of stress, anxiety, and depression [18–22].

Mindfulness is a fundamental element in the training of both compassion and gratitude. It enhances compassion training by enabling individuals to observe their thoughts and emotions without judgement, thereby fostering a kinder and more compassionate attitude towards themselves and others. Similarly, mindfulness enhances gratitude training by enabling individuals to become more aware of and appreciate the positive aspects of their lives. It can be seen, therefore, that mindfulness plays a vital role in enabling the integration and mutual reinforcement of compassion and gratitude practices [15].

The combination of compassion and gratitude training has yielded encouraging results, including notable enhancements in self-compassion [22]. Nevertheless, in order to guarantee accessibility, it is essential to ascertain whether substantial enhancements in both compassion and gratitude can be attained within a four-week timeframe through a self-directed online training programme. Furthermore, it is essential to ascertain whether these two qualities have a mutually reinforcing effect when

practised in conjunction. Confirmation of this interaction is a prerequisite for future studies in this area, which could pave the way for the development of more accessible and effective interventions to enhance women's mental health through compassion and gratitude training programmes.

In conclusion, the objective of this pilot study is to examine the feasibility and efficacy of a brief, self-directed online intervention that integrates mindfulness, compassion, and gratitude training to enhance mental health outcomes in women. In doing so, it aims to contribute to the growing body of evidence supporting the use of holistic and accessible mental health interventions.

Compassion training

Compassion training has its roots in various cultural, spiritual, and philosophical traditions. These traditions have contributed to the development of techniques aimed at promoting empathy and compassion towards oneself and others [23]. Modern compassion training is based on the integration of mindfulness-based practices and cognitive psychology, which were established in the late twentieth century [14]. This text discusses the concept of Compassion Focused Therapy (CFT) [24], which was heavily influenced by the work of psychologists such as Albert Ellis [25], Aaron Beck [26, 27], and Paul Gilbert [28]. The aim of CFT is to cultivate self-compassion and a sense of common humanity [29]. In the early twenty-first century, researchers began defining the notion of self-compassion and creating scales to quantify it. Neff's research and contributions have been significant in establishing compassion training as a legitimate element of therapy [30]. According to Neff [31, 32] and Neff and Prommier [33], cultivating self-compassion has significant implications for psychological health and overall well-being. Neuroscientific studies have supported their work, suggesting that training in compassion can result in changes to brain structure and function that relate to empathy and prosocial behaviour [34]. Neff defines self-compassion as consisting of three elements: showing kindness and understanding towards oneself instead of being harsh, self-critical, and judgmental; viewing one's experiences as part of common human experiences rather than isolating and separating; and being mindful of one's distressing thoughts and emotions, instead of excessively identifying with them [27, 35].

Gratitude training

Gratitude is a core concept in positive psychology [36, 37] that emphasizes strengths and virtues rather than weaknesses or deficits. Hudecek et al. defines gratitude as a multifaceted concept that includes emotional, conceptual, attitudinal, and behavioral components [38]. Research in positive psychology has shown that practicing gratitude can improve well-being, promote prosocial behaviour, and alleviate mental and physical pain [39–41]. Moreover, it may serve as a protective measure against the mental health effects of the COVID-19 pandemic [42]. Focusing on and acknowledging the positive aspects of one's life can lead to increased contentment due to the experience of positive emotions [43]. This can be explained by gratitude countering the human tendency to focus on threats and negative events, which is known as the negativity bias [44]. As a result, a more balanced perspective can be achieved, leading to reduced feelings of stress and anxiety. Acknowledging the positive aspects of life can promote resilience and self-compassion [35, 45]. According to a 2021 meta-study, gratitude interventions had modest effects on symptoms of depression and anxiety; however, the findings are not consistently reported [46]. Therefore, it is worthwhile to explore interventions with more compelling evidence of efficacy. However, it is important to note that gratitude is often associated with increased subjective well-being and enhanced life satisfaction [47]. Additionally, gratitude has been linked to reduced stress levels [48] and a lower risk of anxiety and depression [49]. In summary, research has shown that both compassion training and gratitude techniques can improve well-being and reduce psychological distress. The combination of these techniques is of significant interest, particularly when delivered through online self-training due to its low cost and high level of accessibility.

Hypotheses

The results of research conducted thus far indicate that the acquisition of predefined mindfulness skills can be significantly enhanced within a four-week period of online training. This training has been demonstrated to not only improve mindfulness but also to have a positive impact on subjective stress perceptions, which in turn has been shown to result in a reduction of stress-related symptoms and an improvement in overall well-being [50]. In light of these promising outcomes, it seems worthwhile to explore whether similar benefits can be observed when applying structured training to other positive psychological constructs, such as compassion and gratitude. Therefore, the following hypotheses are proposed:

Hypothesis 1

The first hypothesis is that the experimental group (EG) will exhibit significant enhancements in predetermined compassion constructs, including self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification, after completing a four-week

self-directed online course on compassion and gratitude, compared to the wait-list control group (CG).

Hypothesis 2

The second hypothesis is that the EG will report significant improvements in pre-defined gratitude constructs, including feelings of gratitude, attitudes towards appropriateness, behavioral shortcomings, noticing benefits/rituals, expressing gratitude, and overall attitude of gratitude, after completing a four-week self-directed online compassion and gratitude training course compared to the CG.

Methods

Trial design

The sample size was calculated using G-Power software, taking into account the significance level, test strength, and effect size. A total sample size of 36 persons was required, comprising 18 participants in the experimental EG and 18 in the CG, with a significance level of 0.05, a medium effect (d =0.25), and an optimal power of 0.95. A total of 65 female participants were recruited from Instagram and using an online radomization tool randomly assigned to either an the EG or CG by the research team. The social media platform was chosen to ensure that all participants were women who met the risk factors: female, under 40, and frequent users of social media. The study targeted women under 40 who are seen as being digital natives [51], who possess the necessary skills to complete an online training program. Eligibility criteria required participants to be female, aged 18–39 at baseline, and willing to spend approximately 20 min per day practicing gratitude and compassion online. All participants in this study were German citizens. The participants were informed about their group allocation after having filled out the baseline questionniare (T1). T2 was conducted immediately after the course to measure the direct effect of the online program.

Intervention format

A Mindfulness-Based Compassion Training (MBCT) typically consists of weekly sessions lasting 2.5–3.5 h, delivered over eight weeks. The training can be conducted remotely through Virtual Instructor Led Training (VILT) or in-person. However, the eight-week program can be time-consuming and costly. Therefore, there is a need to develop training programs that are low-threshold yet highly beneficial. Spijkerman et al. [52] conducted a meta-analysis and found that online mindfulness training significantly improves mindfulness skills, reduces stress, and enhances well-being. Additionally, previous studies have shown that predetermined mindfulness skills can be improved in as little as four weeks through online training, resulting in positive effects on perceived stress levels [50]. The significance of these findings lies in their potential to improve accessibility and ensure practicality and adaptability. It is important to assess the suitability of these findings for integrating compassion training with gratitude training.

The study analyzed a four-week self-directed online training program (called ComGrat) consisting of twenty-eight units and an introductory session. Participants received daily emails at 6:00 am, containing a brief psychoeducational text on compassion and/or gratitude, as well as a loving-kindness meditation. The participants were encouraged to read a psychoeducational text that explains the concept and research of mindfulness, loving-kindness meditation, compassion, and gratitude. They were also instructed to practice the loving-kindness meditation, which lasted about 10–12 min, at home. The first fourteen days included various meditation techniques, and for the past fortnight, participants were able to select a meditation from the previous 14 days. Participants received an email prompt at 9 pm each night to make an entry in their gratitude journal. The journal was filled out privately. Guidelines were provided at the beginning of the course on how and where to conduct the daily meditation, how to fill out the gratitude journal, and how to maintain consistency throughout the course.

Intervention content

Compassion involves promoting empathy, kindness, and understanding towards oneself and others [53]. In the program, these skills were trained through mindfulness techniques, such as cultivating non-judgmental awareness of the present moment, developing self-kindness through self-compassion, recognizing one's shared humanity, applying mindfulness during challenging situations, and participating in empathy-enhancing exercises to connect emotionally with others. Additionally, compassion training frequently includes exercises such as expressing gratitude, forgiveness, and performing random acts of kindness, which were also incorporated into the program. To foster compassion, the program utilized loving-kindness meditation, as well as regular self-reflection through meditation or journaling [54–56].

Loving kindness meditation

Loving kindness meditation is also known as metta meditation [57]. It is a contemplative practice in which the practitioner engages in a systematic and deliberate process of generating feelings of compassion and benevolence for themselves, loved ones, acquaintances, strangers and people with whom they may be in conflict. It originated in the Buddhist tradition but has since been

adapted to various settings with the aim of promoting compassion.

Comprehensive research has provided compelling evidence for the positive influence of practicing meditation, specifically on personal compassion skills [58]. However, a meta-analysis conducted by Gu et al. [59] suggests that the impact of general compassion training remains uncertain, with few such training programs demonstrating an effect. However, the meta-analysis shows that the practice of loving-kindness meditation has a significant positive impact on life satisfaction. Research has demonstrated that this type of meditation can lead to improvements in resilience, contentment, personal proficiency, and reduction in depression, anxiety, and stress related to stress. Loving-kindness meditation is considered crucial for cultivating a compassionate mindset [60–62]. In conclusion, loving-kindness meditation plays an important role in fostering a kind and caring approach. The meditation was practiced daily in different variations throughout the program and was accessed online via a hyperlink.

Journaling

Journaling is a therapeutic technique commonly used in various therapeutic contexts. It involves writing down personal thoughts, feelings, and experiences to facilitate self-reflection, emotional processing, and personal development. Several studies have suggested positive psychological effects on self-efficacy and locus of control [63]. In the early 2000 s, gratitude journaling emerged as a prominent phenomenon within the domain of positive psychology, as evidenced by the growing interest and research conducted by Seligman and his colleagues [64]. A gratitude journal is a tool whereby individuals regularly jot down things for which they are thankful. It aims to redirect focus away from deficiencies and towards acknowledging and valuing existing blessings, fostering a more optimistic perspective. Research has indicated that maintaining a gratitude journal may generate greater humility [65] and enhance overall welfare [66]. The participants were instructed to maintain a journal, either digital or analog, and use it to reflect on gratitude daily in the evening.

Outcome measures

Participants completed pre- and post-intervention questionnaires at T1 and T2, respectively. These questionnaires assessed their levels of self-compassion and gratitude using the German Self-Compassion Scale (SCS-G) [67, 68] and the German Multi-Component Gratitude Measure (MCGM) [49, 69], respectively. The SCS consists of 26 items with a five-point Likert response format ranging from'almost never'(1) to'almost always'(5). This scale assesses six key aspects of self-compassion: self-kindness (e.g., I'm kind to myself when I'm experiencing suffering), common humanity (e.g., I try to see my failings as part of the human condition) self-judgment (e.g., I'm disapproving and judgmental about my own flaws and in-adequacies), isolation (e.g., When I do not succeed at something that is important to me, I often feel isolated in my failure), mindfulness (e.g. I practice mindfulness by attempting to maintain a balanced perspective when faced with painful situations) and over-identification I avoid over-identifying with my failures by not allowing feelings of inadequacy to consume me). For the accurate interpretation of results, it is imperative to reverse the scores for the Isolation, Self-Judgment, and Over-Identification subscales, as higher scores on these subscales initially indicate lower self-compassion [70]. The SCS provides both a total score and individual scores for each subscale. The total self-compassion score is calculated by averaging the scores across all items on the scale. Higher scores across all subscales, following the requisite reverse scoring, reflect superior self-compassion, thus providing a comprehensive assessment of an individual's self-compassionate tendencies. Self-compassion entails treating oneself with kindness in the face of pain or failure, as opposed to being harshly self-critical. It also involves recognising that suffering and personal inadequacy are part of the shared human experience and thus treating oneself with understanding and forgiveness. A high score on the total self-compassion scale or subscales is indicative of a higher level of self-compassion, which is associated with optimal emotional functioning and resilience. Conversely, a low score may indicate a necessity for interventions designed to enhance self-compassion, such as mindfulness-based therapies or self-compassion training programmes. The SCS demonstrates high internal consistency with a rating of 0.92. Furthermore, studies [67, 68] indicate that the scale has sound construct validity and test–retest reliability.

The MCGM is a comprehensive method for measuring gratitude that includes both emotional and behavioural aspects of gratitude, developed by Morgan et al. [69]. The German version of the Multi-Component Gratitude Measure (MCGM), developed by Hudecek, Blabst, Morgen, and Lermer in 2021 [49], is a comprehensive tool for assessing gratitude. The scale comprises 26 items that assess five distinct dimensions. The five dimensions of the German version of the Multi-Component Gratitude Measure (MCGM) are as follows: Attitudes of Adequacy (ATA), Attitudes of Gratitude (AOG), Mindfulness (BS), Expressing Gratitude (EOG), and Recognition of Rituals/Benefits (RNB). Each item is rated on a Likert scale from 1 (strongly disagree) to 7 (strongly agree), with each subscale being scored separately. It is confirmed that all items within a subscale are positively keyed, indicating

that a higher score on each item is indicative of a higher level of gratitude. In the event that any items are negatively keyed (where a higher score would indicate a lower level of gratitude), the score of these items is reversed [69]. Higher scores indicate a greater presence of the specific aspect of gratitude, such as the frequency of expressions of gratitude or a high level of mindfulness regarding gratitude [49]. Higher scores on the MCGM indicate a higher degree of gratitude across its multiple dimensions, suggesting stronger attitudes of adequacy and gratitude, greater mindfulness, more frequent expressions of gratitude, and better recognition of rituals and benefits. Conversely, lower scores indicate a lesser degree of these aspects of gratitude. The results of studies utilising the MCGM indicate that individuals with higher scores in these dimensions tend to report greater overall well-being and positive psychological outcomes, including improved mental health, resilience, and social support. The different dimensions of the MCGM showed satisfactory to very good internal consistency (Cronbach's alpha $=0.73–0.90$). The dimension with the highest value was'feelings of gratitude'($\alpha=0.90$), while the weakest value was for the first-order attitude-related factor ($\alpha=0.73$). McDonald's omega was also in a good range for all dimensions ($\omega=0.78–0.90$) [64]. In addition to the questionnaires, pre-training demographics were collected, including, education, profession, number of children, experience with gratitude and compassion training, age and gender (female or otherwise) to ensure eligibility. After the training, respondents were asked about the frequency of daily meditation and gratitude diary entries.

Statistical methods

We analyzed the collected data using JASP. We used repeated measures ANOVA to test the hypotheses to examine the differences between the EG and the CG over time [71]. We used Levene's test for equality of variance to test the assumptions for the analysis of normal distribution and homogeneity of variance, and the Shapiro–Wilk test for normal distribution. If the assumption of homogeneity of variance was confirmed, post-hoc multiple comparisons were performed using Tukey's method. If homogeneity was violated, we performed post-hoc tests using Holm's method. We only calculated planned comparisons based on our hypothesis. According to our a priori power analysis, we set a significance level of 0.05 for repeated measures ANOVA and its corresponding post hoc tests. This ensures that the power of all analyses is at least 0.85 or higher. Partial eta-squared was reported to assess effect sizes. The following statistics were reported to assess the strength of the significant mean differences observed in the Tukey HSD post-hoc comparisons: The mean differences and their 95% CIs for the specific comparison, and Cohen's d as an established measure of effect size for group comparisons. The Bonferroni correction was used to adjust the level of the CIs to reduce the overall probability of false positives when testing multiple hypotheses simultaneously. Cohen has provided benchmarks for defining small ($\eta2=0.01$), medium ($\eta2=0.06$) and large ($\eta2=0.14$) effects for eta-squared, and d is suggested to be interpreted as small ≥0.1, medium ≥0.3 or large ≥0.5. Pearson's correlation coefficient (r) was used for normative correlations, whereas Spearman's Rho was used for non-normative data. The effect size for both Pearson (r) and Spearman (ρ) was interpreted in a similar way. An effect size of less than 0.01 indicated no effect, while an effect size of 0.1 indicated a small effect. A medium effect was indicated by an effect size of 0.3, and an effect size of 0.5 indicated a large effect (jasp-stats.org, 2023).

Results

The randomized controlled trial involved 51 female participants aged between 22 and 39 years old, all of whom provided informed written consent. Recruitment took place from February to April 2023. The study consisted of two assessment periods, baseline (T1) and post-intervention (T2), with measurements taken in April and May 2023, respectively. Random assignment to the EG and CG resulted in similar age distribution subsamples. To evaluate equity in socio-demographic variables between the two groups, independent t-tests were conducted for age and educational level. The results showed no significant differences, indicating sample equivalence for hypothesis testing. The study involved 26 female participants ($n=26$) in the EGwith a mean age of 29.4 years (SD $=3.88$), and 25 female participants ($n=25$) in the CG with a mean age of 30.4 years (SD $=4.05$) (refer to Table 1). No notable discrepancies were identified with regard to the participants'experiences with gratitude and compassion training, educational attainment, the number of children they had, their material circumstances or profession.

Table 1 Baseline demographic of age

Descriptive statistics		
	How old are you?	
	EG	CG
Valid	26	25
Missing	0	0
Mean	29.36	30.36
Std. Deviation	3.88	4.05
Minimum	21.00	23.00
Maximum	37.00	39.00

All 51 participants completed the questionnaires at both T1 and T2 due to regular reminder emails after the intervention, and there were no dropouts.

Perquisitions

Normal distribution could be assumed for both main scales and most sub-scales ($p > 0.05$), except for SCS Self-Kindness, MCGM-FOG, MCGM-EOG, and MCGM-AOG (Table). However, ANOVA is relatively robust in regard to normal distribution violation [61] Variance homogeneity could be assumed for all main scales and sub-scales, except for MCGM-AOG. In the case of the latter, the post hoc test was conducted in accordance with Holm. For all others, the post hoc test was conducted in accordance with Tukey.

Results of test for replication—self compassion

The study analyzed the changes over time in the main Self-Compassion Scale (SCS) and its six sub-scales, namely self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification, between the EG and CG.

SCS—Complete

The analysis revealed that there was a normal distribution and variance homogeneity. A repeated measures ANOVA was conducted, which showed a statistically significant difference between mean performance levels across measurements, $F(1,49) = 26.449$, $p < 0.001$, partial $\eta^2 = 0.351$. Additionally, there was a significant interaction effect between time and group on the primary SCS score scale, $F(1,49) = 59.135$, $p < 0.001$, $\eta^2 p = 0.547$. Post hoc tests confirmed significant implicit differences between the EG and the CG ($t(51) = 4.527$, $p = 0.001$, $d = 1.268$). The intervention resulted in a significant improvement of scores from T1 to T2 in the EG ($t(26) = -9.164$, $p < 0.001$), with a mean difference (MD) of −0.883 points and a 95% CI of [−1.148, −0.618], $d = -1.288$(refer to Table 2).

This effect size is considered large. Therefore, H1 is confirmed (refer to Fig. 1).

SCS self kindness subscale

The analysis showed a violation of normal distribution and homogeneity of variance. The repeated measures ANOVA revealed a statistically significant difference in mean performance levels between measurements ($F(1,49) = 23.185$, $p < 0.001$, partial $\eta^2 = 0.321$). The statistical significance of the interaction between time and group on the sub-scale Self-Kindness of the SCS score

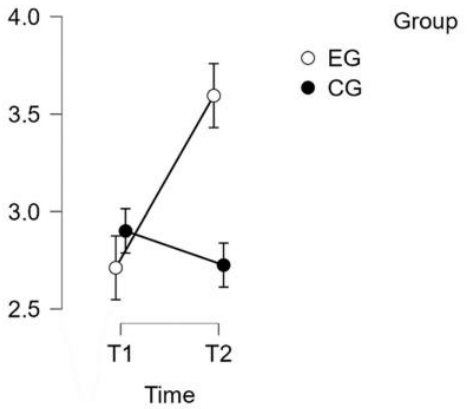

Fig. 1 Estimated marginal means for Self-Compassion Subscale complete score

Table 2 Post Hoc Tests SCS Complete

Post Hoc Comparisons—Group ✻ Time													
			95% CI for Mean Difference					95% CI for Cohen's d					
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}		p_{bonf}	
EG, T1	CG, T1	−0.189	−0.712	0.334	0.192	−0.984	−0.276	−1.042	0.491	0.759		1.000	
	EG, T2	−0.883	−1.148	−0.618	0.096	−9.164	−1.288	−1.810	−0.766	<.001	***	<.001	***
	CG, T2	−0.014	−0.537	0.509	0.192	−0.071	−0.020	−0.783	0.743	1.000		1.000	
CG, T1	EG, T2	−0.694	−1.217	−0.171	0.192	−3.614	−1.012	−1.825	−0.200	0.003	**	0.004	**
	CG, T2	0.175	−0.095	0.445	0.098	1.784	0.256	−0.141	0.652	0.293		0.484	
EG, T2	CG, T2	0.869	0.346	1.392	0.192	4.527	1.268	0.429	2.107	<.001	***	<.001	***

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

** $p < .01$

*** $p < .001$

was confirmed (F(1,49) = 49.113, $p < 0.001$, $\eta^2p = 0.501$). Post-hoc tests revealed significant implicit differences between the EG and CG groups (t(51) = 4.134, $p = 0.001$, d = 1.158). The intervention resulted in a noteworthy increase in scores from T1 to T2 in the EG. The difference was statistically significant, with t(26) = −8.443, $p < 0.001$ and a mean difference (MD) of −1.208 points, 95% CI [−1.601, −0.814], d = −1.277, indicating a large effect size (refer to Table 3).

These findings confirm H1 regarding Self Kindness (refer to Fig. 2).

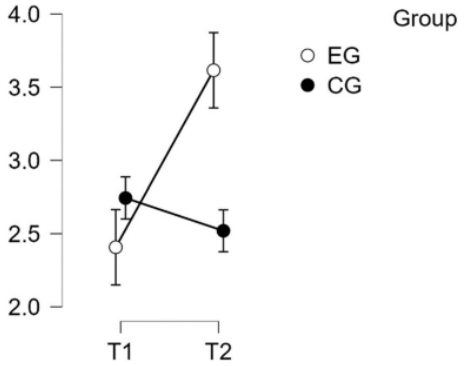

Fig. 2 Estimated marginal means for self-compassion subscale self kindness

SCS—self judgement subscale

The analysis showed normal distribution and homogeneity of variance. The repeated measures ANOVA indicated a statistically significant difference in mean performance levels between measurements, F(1,49) = 17.373, $p < 0.001$, partial $\eta^2 = 0.262$. The statistical significance of the time * group interaction on the Self-Judgement sub-scale of the SCS score was also confirmed, F(1,49) = 27.113, $p < 0.001$, $\eta^2p = 0.501$. Post-hoc tests confirmed implicit differences between EG and CG (t(51) = 4.134, $p = 0.001$, d = 1.158). The intervention resulted in a significant increase in scores from T1 to T2 in EG (t(26) = −6.695, $p < 0.001$) with a mean difference (MD) of −0.938 points, 95% CI [−1.324, −0.553], d = −1.081, which is considered a large effect (See Table 4).

Therefore, H1 was confirmed in regards to Self Judgement (see Fig. 3).

SCS—common humanity subscale

The analysis showed normal distribution and homogeneity of variance. The repeated measures ANOVA indicated no statistically significant difference in mean performance levels between measurements, F(1,49) = 3.733, $p = < 0.059$, partial $\eta^2 = 0.071$. However, the time * group interaction on the sub-scale Common Humanity of the SCS score was found to be statistically significant, F(1,49) = 32.856, $p = < 0.001$, $\eta^2p = 0.401$. Post-hoc tests showed significant implicit differences between the EG and the CG (t(51) = 5.218, $p = 0.001$, d = 1.462). The intervention resulted in a significant increase in scores from T1 to T2 in the EG (t(26) = −5.473, $p < 0.001$), with a mean difference (MD) of −0.827 points, 95% CI [−1.242, −0.411], d = −1.072, indicating a large effect (refer to Table 5).

Therefore, H1 was confirmed regarding Common Humanity (see Fig. 4).

SCS – isolation subscale

The analysis showed that the distribution was normal, and the variance was homogeneous. The repeated measures ANOVA revealed a statistically significant difference in mean performance levels between measurements (F(1,49) = 9.043, $p < 0.004$, partial $\eta^2 = 0.154$). The statistical significance of the interaction between time and group on the sub-scale Isolation of the SCS

Table 3 Post hoc test SCS—self kindness subscale

Post Hoc Comparisons—Group ✻ Time										
Mean Difference			95% CI for Mean Difference					95% CI for Cohen's d		
			Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.336	−1.057	0.384	0.265	−1.269	−0.356	−1.124	0.413	0.585
	EG, T2	−1.208	−1.601	−0.814	0.143	−8.443	−1.277	−1.818	−0.736	<.001
	CG, T2	−0.112	−0.833	0.608	0.265	−0.424	−0.119	−0.882	0.644	0.974
CG, T1	EG, T2	−0.871	−1.592	−0.151	0.265	−3.289	−0.921	−1.724	−0.118	0.009
	CG, T2	0.224	−0.177	0.625	0.146	1.536	0.237	−0.188	0.661	0.425
EG, T2	CG, T2	1.095	0.375	1.816	0.265	4.134	1.158	0.332	1.984	<.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

Table 4 Post hoc test SCS—self judgement subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.014	−0.674	0.647	0.243	−0.056	−0.016	−0.777	0.746	1.000
	EG, T2	−0.938	−1.324	−0.553	0.140	−6.695	−1.081	−1.611	−0.551	<.001
	CG, T2	0.090	−0.570	0.751	0.243	0.372	0.104	−0.658	0.866	0.982
CG, T1	EG, T2	−0.925	−1.586	−0.264	0.243	−3.803	−1.065	−1.881	−0.250	0.002
	CG, T2	0.104	−0.289	0.497	0.143	0.728	0.120	−0.329	0.568	0.886
EG, T2	CG, T2	1.029	0.368	1.690	0.243	4.231	1.185	0.357	2.013	<.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

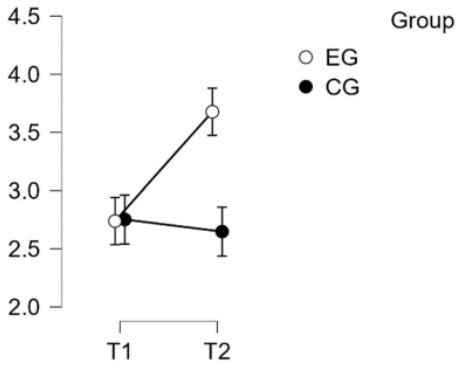

Fig. 3 Estimated marginal means for self-compassion subscale self-judgement

score was also determined (F(1,49) = 14.992, $p < 0.001$, $\eta^2p = 0.234$). Post-hoc analysis confirmed significant differences between the EG and the CG (t(51) = 2.859, $p = 0.028$, d = 0.801). The intervention resulted in a significant improvement in scores from T1 to T2 within the EG (t(26) = −4.913, $p < 0.001$). The mean difference (MD) was −0.875 points, 95% CI [−1.365, −0.385], d = −0.870, indicating a large effect (refer to Table 6).

Therefore, H1 was confirmed in regards to Isolation (see Fig. 5).

SCS – mindfulness subscale

The statistical analysis showed that the distribution was normal and the variance was homogeneous. The repeated measures ANOVA showed a statistically significant difference in mean performance levels between measurements (F(1,49) = 16.791, $p = < 0.001$, partial $\eta^2 = 0.255$). An interaction between time and group was observed for the'Mindfulness'subscale of the SCS score (F(1,49) = 23.769, $p < 0.001$, $\eta^2p = 0.327$). Post-hoc analysis revealed significant differences between the EG and the CG (t(51) = 3.148, $p = 0.013$, d = 0.882). The intervention resulted in a significant increase in T2 scores in the EG, t(26) = −6.408, $p < 0.001$, MD of −0.923 points, 95% CI

Table 5 Post hoc test SCS—common humanity subscale

Post Hoc Comparisons—Group ✻ Time										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.109	−0.694	0.476	0.216	−0.505	−0.142	−0.901	0.618	0.958
	EG, T2	−0.827	−1.242	−0.411	0.151	−5.473	−1.072	−1.678	−0.466	<.001
	CG, T2	0.301	−0.284	0.886	0.216	1.392	0.390	−0.376	1.156	0.508
CG, T1	EG, T2	−0.718	−1.303	−0.133	0.216	−3.321	−0.930	−1.730	−0.130	0.007
	CG, T2	0.410	−0.014	0.834	0.154	2.661	0.531	−0.028	1.091	0.050
EG, T2	CG, T2	1.128	0.543	1.713	0.216	5.218	1.462	0.604	2.319	<.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

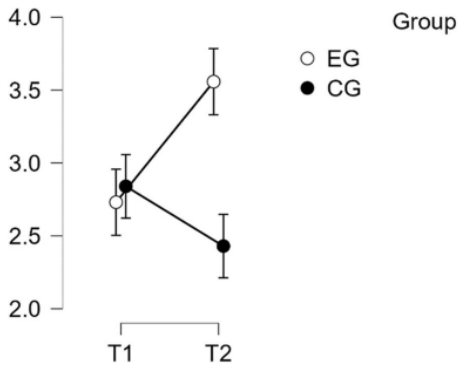

Fig. 4 Estimated marginal means for self-compassion subscale common humanity

[−1.319, −0.527], d = −1.100, representing a large effect size (refer to Table 7).

Hypothesis H1 was confirmed concerning Mindfulness (see Fig. 6).

SCS—over identification subscale

The analysis showed a normal distribution and even variance. The repeated measures ANOVA revealed a statistically significant difference in mean performance levels between measurements ($F(1,49) = 5.732$, $p = 0.021$, partial $\eta^2 = 0.105$). The statistical significance of the interaction between time and group on the Over-Identification subscale of the SCS score was also established ($F(1,49) = 15.948$, $p < 0.001$, $\eta^2p = 0.246$). However, the post-hoc tests did not confirm any inherent differences between the EG and the CG ($t(51) = 2.222$, $p = 0.127$). Nevertheless, the intervention resulted in a substantial improvement in scores from T1 to T2 in the EG. The statistical analysis showed a significant increase, $t(26) = -4.562$, $p < 0.001$, with a mean difference (MD) of −0.519 points, 95% CI [−0.832, −0.206], d = −0.776, indicating a large effect size (see Table 8).

Hypothesis H1 was only partially confirmed regarding Over-Identification (see Fig. 7).

Results of test for replication – gratitude

The study analyzed the divergence between the EG and CG over time in relation to the primary Multi-Component Gratitude Measure (MCGM) scale and its six sub-scales: Feelings of gratitude (FOG), Attitudes to appropriateness (ATA), Behavioral shortcomings (BS), Rituals/Noticing benefits (RNB), Expression of gratitude (EOG), and Attitude of gratitude (AOG).

MCGM – complete

The analysis showed that the distribution was normal and the variance was homogeneous. The repeated measures ANOVA revealed a statistically significant difference in

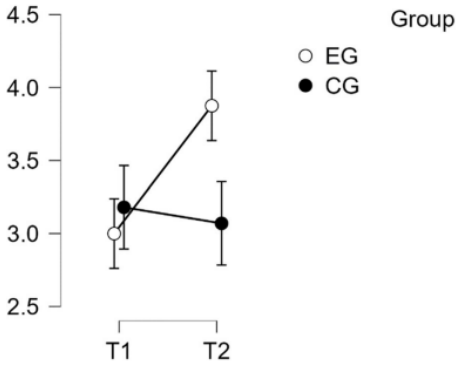

Fig. 5 Estimated marginal means for self-compassion subscale isolation

Table 6 Post hoc test SCS – isolation subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.180	−0.944	0.584	0.282	−0.639	−0.179	−0.941	0.582	0.919
	EG, T2	−0.875	−1.365	−0.385	0.178	−4.913	−0.870	−1.407	−0.334	<.001
	CG, T2	−0.070	−0.834	0.694	0.282	−0.249	−0.070	−0.830	0.691	0.995
CG, T1	EG, T2	−0.695	−1.459	0.069	0.282	−2.468	−0.691	−1.475	0.092	0.074
	CG, T2	0.110	−0.389	0.609	0.182	0.606	0.109	−0.382	0.600	0.930
EG, T2	CG, T2	0.805	0.041	1.569	0.282	2.859	0.801	0.010	1.592	0.028

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

Table 7 Post hoc test SCS – mindfulness subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.263	−0.901	0.375	0.235	−1.119	−0.313	−1.079	0.452	0.679
	EG, T2	−0.923	−1.319	−0.527	0.144	−6.408	−1.100	−1.655	−0.545	<.001
	CG, T2	−0.183	−0.821	0.455	0.235	−0.779	−0.218	−0.981	0.545	0.864
CG, T1	EG, T2	−0.660	−1.298	−0.022	0.235	−2.808	−0.786	−1.577	0.004	0.032
	CG, T2	0.080	−0.324	0.484	0.147	0.545	0.095	−0.380	0.571	0.948
EG, T2	CG, T2	0.740	0.102	1.378	0.235	3.148	0.882	0.084	1.680	0.013

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

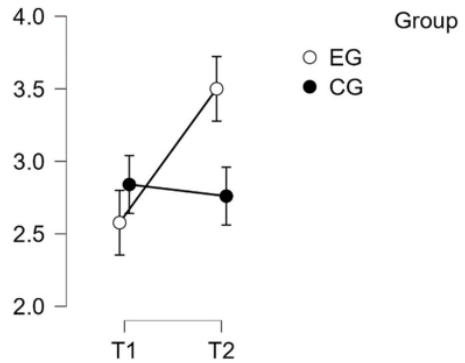

Fig. 6 Estimated marginal means for self-compassion subscale mindfulness

mean performance levels between measurements (F(1,49) = 21.946, $p < 0.001$, partial $\eta^2 = 0.309$). The statistical significance of the interaction between time and group on the primary scale MCGM score was also established (F(1:49) = 46.287, $p < 0.001$, $\eta^2p = 0.486$). Subsequent post-hoc assessments confirmed the inherent disparities between the EG and the CG (t(51) = 4.113, $p < 0.001$). The intervention resulted in a noteworthy increase in scores from T1 to T2 in the EG, t(26) = −8.204, $p < 0.001$, with a mean difference (MD) of −0.648 points, 95% CI [−0.866, −0.431], d = −1.113 (see Table 9).

This outcome is classified as a large effect, confirming Hypothesis H2 (see Fig. 8).

MCGM – FOG subscale: feelings of gratitude

The normality of the distribution was violated, and variance homogeneity was confirmed in the analysis. The repeated measures ANOVA revealed a statistically significant difference in mean performance levels between measurements, F(1,49) = 22.021, $p < 0.001$, partial $\eta^2 = 0.310$. An interaction between time and group was detected in the FOG subscale of the MCGM, F(1,49) = 21.931, $p < 0.001$, $\eta^2p = 0.309$. However, the post-hoc tests did not reveal any significant differences between the EG and the CG, t(51) = 1.998, $p = 0.200$. The

Table 8 Post Hoc Test SCS—Over-Identification Subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.233	−0.742	0.276	0.187	−1.241	−0.348	−1.114	0.419	0.603
	EG, T2	−0.519	−0.832	−0.206	0.114	−4.562	−0.776	−1.284	−0.267	<.001
	CG, T2	−0.103	−0.612	0.406	0.187	−0.548	−0.153	−0.915	0.608	0.947
CG, T1	EG, T2	−0.287	−0.795	0.222	0.187	−1.528	−0.428	−1.198	0.341	0.426
	CG, T2	0.130	−0.189	0.449	0.116	1.120	0.194	−0.280	0.668	0.679
EG, T2	CG, T2	0.417	−0.092	0.925	0.187	2.222	0.622	−0.157	1.402	0.127

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

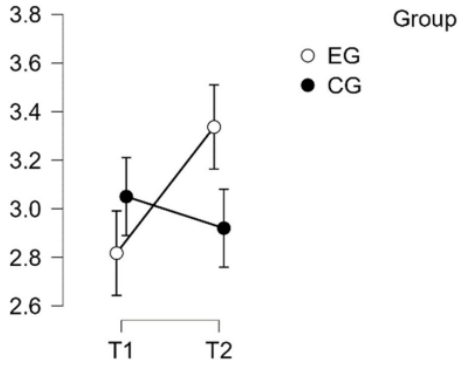

Fig. 7 Estimated marginal means for self-compassion subscale over identification

intervention resulted in a noteworthy improvement in scores for the EG from T1 to T2, t(26) = −6.696, $p < 0.001$ with a mean difference (MD) of −0.781 points, 95% CI [−1.101, −0.460], d = −0.857, which is characterized as a large effect (refer to Table 10).

Therefore, hypothesis H2 was only partially confirmed in gegards to the FOG Subscale (see Fig. 9).

MCGM – ATA subscale: attitudes to appropriateness

The analysis was used to determine the normality of distribution and homogeneity of variance. In relation to the MCGM sub-scale ATA, there was no statistically significant interaction between time and group (F(1:49) = 1.582, $p = 0.214$, $\eta^2p = 0.031$). Therefore, hypothesis H2b was not confirmed.

MCGM – BS subscale: behavioral shortcomings

The analysis showed that there was a normal distribution and homogeneity of variance. The statistical significance of the interaction between time and group on the subscale BS was confirmed (F(1:49) = 26.336, $p < 0.001$, $\eta^2p = 0.350$). Post-hoc tests confirmed significant differences between the EG and the CG (t(51) = 3.871, $p = 0.001$). The intervention resulted in a significant improvement in scores from T1 to T2 in the EG, t(26) = −7.225, $p < 0.001$, with a mean difference (MD) of −1.375, 95% CI −1.898 to −0.852, d = −1.056, indicating a large effect size (refer to Table 11).

Thus, Hypothesis H2 was confirmed regarding the BS subscale (see Fig. 10).

MCGM – RNB subscale: rituals/noticing benefits

The analysis showed that there was a normal distribution and equal variance among the groups. The statistical significance of the time * group interaction was established on the RNB subscale, with F(1:49) = 37.667, $p < 0.001$, $\eta^2p = 0.435$. The implicit differences between the EG and the CG were subsequently confirmed through post-hoc tests,

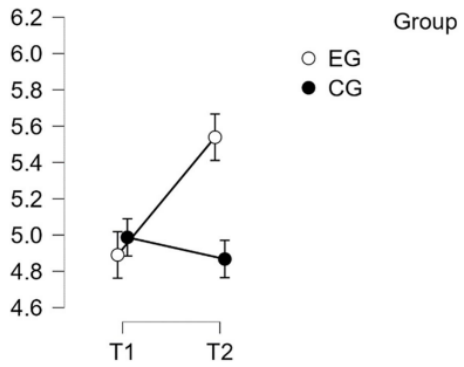

Fig. 8 Estimated marginal means for multi-component gratitude measure scale total

Table 9 Post hoc test MCGM complete

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					0.934		
		Mean Difference	<.001	Upper	SE	t	Cohen's d	Lower	Upper	0.934
EG, T1	CG, T1	−0.097	0.999	0.348	0.163	−0.593	−0.166	−0.931	−0.931	<.001
	EG, T2	−0.648	0.007	−0.431	0.079	−8.204	−1.113	−1.593	−1.593	0.999
	CG, T2	0.023	0.455	0.468	0.163	0.140	0.039	−0.724	−0.724	0.007
CG, T1	EG, T2	−0.552	<.001	−0.107	0.163	−3.380	−0.947	−1.754	−1.754	0.455
	CG, T2	0.120	−0.102	0.341	0.081	1.484	0.205	−0.176	−0.176	<.001
EG, T2	CG, T2	0.671	0.226	1.116	0.163	4.113	1.152	0.325	0.325	<.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

Table 10 Post hoc test MCGM – FOG subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Uppe	p_{tukey}
EG, T1	CG, T1	−0.270	−0.966	0.426	0.255	−1.059	−0.297	−1.065	0.472	0.715
	EG, T2	−0.781	−1.101	−0.460	0.117	−6.696	−0.857	−1.279	−0.436	<.001
	CG, T2	−0.271	−0.967	0.425	0.255	−1.062	−0.298	−1.066	0.471	0.714
CG, T1	EG, T2	−0.511	−1.207	0.186	0.255	−2.001	−0.560	−1.340	0.219	0.199
	CG, T2	-8.000×10^{-4}	−0.328	0.326	0.119	−0.007	-8.782×10^{-4}	−0.357	0.355	1.000
EG, T2	CG, T2	0.510	−0.186	1.206	0.255	1.998	0.560	−0.220	1.339	0.200

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

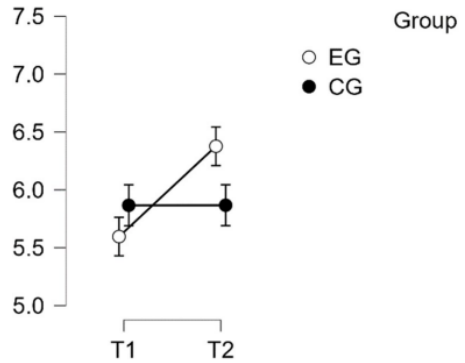

Fig. 9 Estimated marginal means for multi-component gratitude measure subscale feelings of gratitude

with t(51) = 5.054, $p < 0.001$. The intervention resulted in a significant increase in scores from T1 to T2 in the EG, t(26) = −8.078, $p < 0.001$, with a mean difference (MD) of −1.315 points, 95% CI [−1.763, −0.868], and a large effect size (d = −1.326) (refer to Table 12), confirming Hypotheses H2 regarding the subscale RNB (refer to Fig. 11).

MCGM – EOG subscale: expression of gratitude

The analysis showed a violation of normal distribution and confirmation of homogeneity of variance. The statistical significance of the interaction between time and group on the EOG subscale was F(1:49) = 4.040, $p = 0.050$, $\eta^2p = 0.076$. However, post-hoc tests did not confirm any differences between the EG and the CG (t(51) = 2.491, $p = 0.069$). Additionally, the intervention did not result in a significant increase in scores from T1 to T2 in the EG (t(26) = −1.560, $p = 0.410$). Therefore, Hypothesis H2 was not confirmed regarding EOG (see Table 13).

MCGM – AOG subscale: attitude of gratitude

Upon analysis, it was found that normality of distribution and homogeneity of variance were violated. The statistical insignificance of the interaction between time and group on the sub-scale AOG (F(1:49) = 3.979, $p = 0.052$)

Table 11 Post Hoc Test MCGM – BS Subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	0.018	−0.976	1.011	0.365	0.048	0.014	−0.749	0.776	1.000
	EG, T2	−1.375	−1.898	−0.852	0.190	−7.225	−1.056	−1.548	−0.563	<.001
	CG, T2	0.038	−0.956	1.031	0.365	0.103	0.029	−0.734	0.792	1.000
CG, T1	EG, T2	−1.393	−2.386	−0.399	0.365	−3.817	−1.069	−1.886	−0.252	0.002
	CG, T2	0.020	−0.514	0.554	0.194	0.103	0.015	−0.390	0.421	1.000
EG, T2	CG, T2	1.413	0.419	2.406	0.365	3.871	1.084	0.266	1.903	0.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

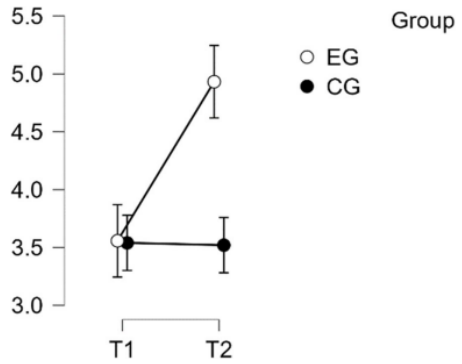

Fig. 10 Estimated marginal means for multi-component gratitude measure subscale behavioral shortcoming

implies that hypothesis H2 was not confirmed in regards to AOG.

Results of test for replication – correlation of compassion and gratitude

In addition to the two main hypotheses, we analysed the correlation between the two scales. The Shapiro–Wilk test for bivariate variability suggested normal distribution. The SCS and MCGM were found to be highly positively correlated, with $r(49) = 0.74$, $p < 0.001$ (refer to Table 14 and Fig. 12).

Discussion

The objective of this study was to examine the influence of a four-week training programme on participants'levels of compassion and gratitude, which are crucial elements of women's mental health. The findings indicate that the integration of compassion and gratitude in an easily accessible online intervention can result in significant positive outcomes, underscoring the potential of online interventions as a cost-effective approach to enhance mental health. Prior research has substantiated the efficacy of online training programs analogous to the one that was evaluated here [50]. The hypothesis that this format could enhance levels of compassion and gratitude is consistent with the theoretical proposition that these positive psychological elements are linked to improved mental health outcomes [18–23]. The combination of these two approaches has yielded promising results [22]. The current study revealed a significant enhancement in primary compassion and gratitude constructs within the experimental group (EG) in comparison to the control group (CG). These findings corroborate those of previous studies indicating that compassion and gratitude can be taught and learned [27, 31–35].

During the four-week intervention involving daily metta meditation, all six subscales of the SCS) demonstrated improvement, as did three subscales of the

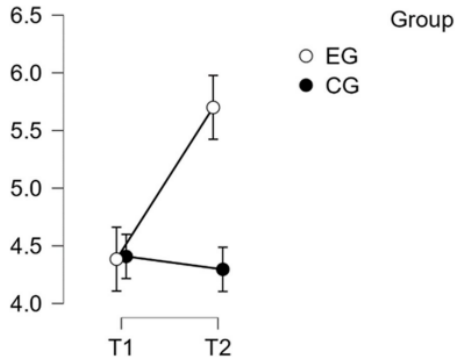

Fig. 11 Estimated marginal means for Multi-Component Gratitude Measure Subscale Rituals/Noticing benefits

Table 12 Post hoc test MCGM – RNB subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	−0.023	−0.778	0.731	0.278	−0.084	−0.024	−0.785	0.737	1.000
	EG, T2	−1.315	−1.763	−0.868	0.163	−8.078	−1.326	−1.902	−0.751	<.001
	CG, T2	0.089	−0.666	0.843	0.278	0.319	0.089	−0.672	0.851	0.989
CG, T1	EG, T2	−1.292	−2.047	−0.537	0.278	−4.651	−1.303	−2.144	−0.462	<.001
	CG, T2	0.112	−0.345	0.569	0.166	0.674	0.113	−0.343	0.569	0.906
EG, T2	CG, T2	1.404	0.649	2.159	0.278	5.054	1.416	0.561	2.270	<.001

P-value and confidence intervals adjusted for comparing a family of 6 estimates (confidence intervals corrected using the bonferroni method)

Table 13 Post hoc test MCGM – EOG subscale

Post Hoc Comparisons—Group ✻ RM Factor 1										
			95% CI for Mean Difference					95% CI for Cohen's d		
		Mean Difference	Lower	Upper	SE	t	Cohen's d	Lower	Upper	p_{tukey}
EG, T1	CG, T1	0.113	−0.510	0.736	0.230	0.492	0.138	−0.622	0.897	0.961
	EG, T2	−0.250	−0.691	0.191	0.160	−1.560	−0.304	−0.839	0.230	0.410
	CG, T2	0.323	−0.300	0.946	0.230	1.404	0.393	−0.373	1.159	0.500
CG, T1	EG, T2	−0.363	−0.986	0.260	0.230	−1.578	−0.442	−1.210	0.326	0.397
	CG, T2	0.210	−0.239	0.659	0.163	1.285	0.256	−0.287	0.799	0.577
EG, T2	CG, T2	0.573	−0.050	1.196	0.230	2.491	0.698	−0.084	1.480	0.069

Table 14 Pearson's correlation between self-compassion scale and multi-component gratitude measure scale complete

Pearson's Correlations						
	n	>Pearson's r	*p*		Lower 95% CI	Upper 95% CI
T2-MCGM	- T2-SOC_ COM-PLETE	51 0.739	*** <.001		0.612	1.000

All tests one-tailed, for positive correlation. * p <.05, ** p <.01, *** p <.001, one-tailed

MCGM. However, Feelings of Gratitude and Behavioral Shortcomings exhibited no significant change. The study indicated that gratitude journaling may not be a sufficient standalone intervention and recommended the incorporation of prompts for actively expressing gratitude in future interventions. The group designated for the waitlist control experienced a decline in several measures, with no external factors that could be identified as a clear explanation for this decline. The significant correlation between the compassion and gratitude scales indicates that enhancing one can benefit the other, thereby supporting a practical and adaptable approach to improving women's psychological well-being through positive psychology. The study demonstrated that comparable benefits to those achieved by longer interventions could be attained in a shorter and more cost-effective timeframe.

As the study population was exclusively female, the findings are particularly pertinent to this demographic. The experience of heightened stress is a common phenomenon among women, who frequently encounter challenges in balancing the demands of work, family, and societal expectations [8]. This emphasises the importance of targeted interventions, such as self-compassion and gratitude practices, which can enhance resilience and self-worth [35, 72]. The observed improvements in self-compassion and gratitude indicate that these practices may serve to empower women by fostering a greater sense of self-worth and emotional well-being. This is evident in the definition of self-compassion, which encompasses treating oneself with kindness and understanding in the context of failures and challenges. This approach

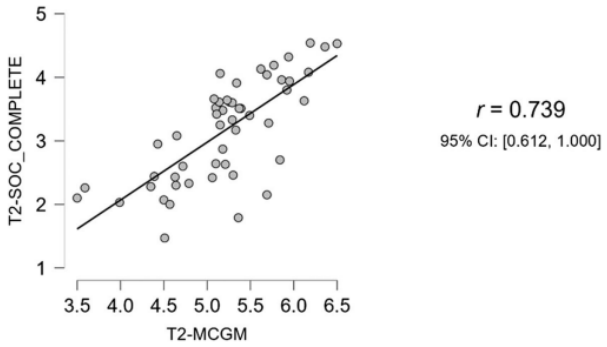

Fig. 12 Correlation between self-compassion scale and multi-component gratitude measure scale complete

has the potential to mitigate the impact of self-criticism and foster psychological resilience [35, 73]. Similarly, the core of gratitude practices entails the capacity to shift focus away from negative experiences and foster a more positive outlook on life [40, 54]. Nevertheless, while these practices demonstrate promise, it is imperative to consider the potential limitations and individual differences in responsiveness to these interventions.

The online format of the intervention renders it particularly accessible for women who may have limited time and resources to participate in traditional in-person programmes. It can be challenging for women, particularly those with caregiving responsibilities or demanding jobs, to attend regular therapy sessions or workshops [74]. The flexibility afforded by online interventions allows participants to engage with the material at a time and pace that suits them. Nevertheless, it is essential to recognise potential obstacles, including digital literacy, internet access and the capacity to sustain engagement in an online environment [75]. It would be beneficial for future studies to investigate methods of improving the user experience and retention rates of those participating in online interventions.

While the study demonstrates significant improvements in self-compassion and gratitude, it is essential to undertake a critical evaluation of the study design and consider areas for further research. The exclusive focus on women limits the generalisability of the findings to other genders. Given that females typically report higher self-judgement scores on the SCS compared to males, the results of a study using the SCS with only female participants have specific implications. The findings reflect gender-specific trends and may not be generalisable to males or a mixed-gender population. The higher self-judgement scores typically reported by females may contribute to a greater visibility of the results, particularly in relation to self-judgement. It is therefore possible that the scores may differ in a more gender-diverse sample. Notwithstanding these considerations, the deliberate focus on female participants offers invaluable insights into self-compassion among women, which may be shaped by societal and cultural influences. It is recommended that future studies continue to explore these gender-specific trends. Furthermore, the use of self-reported measures may be susceptible to bias in gereral, as participants may overestimate their improvements due to social desirability or placebo effects [76]. The incorporation of objective measures and longer follow-up periods would facilitate a more comprehensive understanding of the intervention's effectiveness.

Moreover, the study indicates that gratitude journaling may not be a sufficient standalone practice, suggesting the integration of prompts for active gratitude expression. This emphasises the necessity for future interventions to experiment with diverse formats and combinations of practices in order to ascertain the most efficacious strategies. Furthermore, it would be beneficial to investigate the impact of facilitator support and peer interactions on the efficacy of online interventions.

A critical analysis of the demographic data collected reveals that it is subject to a number of limitations. The following variables were considered: gender, age, marital status, experience with gratitude and compassion, and educational level. Nevertheless, the inclusion of further data would have facilitated a more comprehensive understanding of the participants. It would be beneficial for future studies to consider the impact of socioeconomic status on mental health and access to resources, as these factors have been demonstrated to exert a significant influence [77]. An individual's cultural background, including ethnicity, nationality, and cultural beliefs, has been demonstrated to impact their perceptions of and responses to stress, gratitude, and compassion practices [78]. This factor might also be considered in future studies. Moreover, future studies on compassion and gratitude may consider the level of social support from family, friends, and community networks, as this has been demonstrated to have a significant impact on mental health and the effectiveness of interventions [79].

The collation of these supplementary demographic data points will facilitate a more comprehensive analysis of the manner in which different factors interact with the intervention's efficacy in the future. This would facilitate the adaptation of future interventions to better align with the diverse needs of the population, thus improving the efficacy of the interventions.

The absence of long-term follow-up data constrains our comprehension of the training program's lasting impacts. We have reason to believe that a long-term effect is realistic, due to results from other online interventions using the same format in terms of length, media, and trainer [47]. The study aimed to determine whether a self-directed online program led to a significant increase in compassion and gratitude. With this confirmed, future research should build on this goal and include a follow-up study. Additionally, the study sample was recruited solely from the Instagram platform, which may limit sample diversity. For example, only three of the 56 female participants had children, which may restrict the generalizability of the findings to wider populations. Future research should aim to replicate these results in more diverse samples and explore potential moderating variables that could impact the outcomes of interventions. The primary focus of this study was to examine the impact of an online self-directed intervention based on compassion and

gratitude training. Further research should also focus on the effects of compassion and gratitude compared to other mindfulness techniques. This can be achieved by setting up an active CG.

In conclusion, the findings of this study highlight the potential of compassion and gratitude practices to enhance the mental health of women, particularly through accessible online interventions. Although the results are encouraging, a critical analysis indicates the need for further research to address limitations and optimise intervention strategies. The adaptation of mental health programmes to the specific requirements and circumstances of women can facilitate their ability to cope with stress and enhance emotional resilience, which in turn contributes to more favourable mental health outcomes.

Conclusions

In summary, this study provides valuable insights into the effects of a four-week online self-directed training program that promotes compassion and gratitude, with the aim of supporting women's mental health. The hypothesis was that the EGwould experience significant improvements in predetermined constructs related to compassion and gratitude compared to the CG. Furthermore, evidence suggests a positive correlation between gratitude levels and compassion levels. This implies that individuals who report higher levels of gratitude also tend to report higher levels of self-compassion and compassion towards others, and vice versa. These findings highlight the potential benefits of including low-cost, easily accessible online training interventions in mental health promotion strategies, offering both feasibility and flexibility. The improvements observed in the intervention group suggest that skills related to compassion and gratitude can be developed, which previous research has shown to have a positive impact on well-being. However, this study represents an initial exploration of interventions related to compassion and gratitude, and highlights the need for further extensive research. Future studies could investigate the long-term effects of such interventions, taking into account factors such as cultural differences, social obligations, parenthood, and individual variations. Furthermore, future studies should investigate possible domains where increased levels of compassion and gratitude could improve mental health therapy outcomes. As positive psychology continues to evolve, research like this provides a deeper understanding of how cultivating compassion and gratitude can enhance mental health.

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Authors' contributions
Lotte Bock was responsible for the method, intervention, software, analysis and interpretation of the data and was the project owner of the manuscript. Madiha Rana supervised the study design, analysis and data interpretation, and Tahnee Rössler performed data collection. Majeed Rana was instrumental in drafting the manuscript and supervising the project. All authors read and approved the final version of the manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The Ethics Committee of the Europäische Fernhochschule Hamburg approved the study (EKEFH03/22), and informed written consent was obtained from each participant.

Consent for publication
Informed consent for publication was obtained from all subjects involved in the study.

Competing interests
The authors declare no competing interests.

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Publisher's Note

Appendix C: A Randomized Controlled Trial on the Long-term Effectiveness of Mindfulness and Compassion Web-based Interventions among Distance Learning Students

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Abstract

Stress poses a significant challenge to the well-being and academic performance of distance learning students. While web-based mindfulness interventions have been shown to be effective in reducing stress, it remains unclear whether targeted approaches that focus on specific mindfulness components, such as self-compassion and gratitude, provide greater long-term benefits than comprehensive programmes. The present study was a randomised controlled trial (RCT) involving 98 distance learning students, who were randomly assigned to either a comprehensive mindfulness training group (*Mind2Full*), a targeted intervention group focusing on self-compassion and gratitude (*ComGrat*), or a control group. The sample distribution comprised 30 participants in the *Mind2Full* group, 31 in the *ComGrat* group, and 37 in the control group. The duration of both interventions was four weeks, with assessments conducted at baseline (T1), immediately post-intervention (T2), and three months later (T3). The results obtained revealed significant short-term improvements in mindfulness, self-compassion, and perceived stress in both intervention groups in comparison to the control group ($p < .001$). At T3, the *ComGrat* group exhibited sustained reductions in perceived stress (effect size: *partial* $\eta^2 = 0.119$, $p < .001$) and self-compassion ($p < .01$) when compared to *Mind2Full*. These results underscore the potential of targeted interventions such as *ComGrat* to yield greater sustained benefits by reducing cognitive load and promoting deeper engagement with core mindfulness practices. The study's limitations encompass potential sample bias, such as overrepresentation of female participants, and reliance on self-reported measures. Nevertheless, this research offers a unique contribution by comparing comprehensive and targeted mindfulness interventions, emphasising the importance of tailoring mindfulness programs to specific populations for optimal long-term outcomes. The broader implications of this research suggest that institutions could integrate focused mindfulness programs, such as ComGrat, into student support services and digital learning platforms to enhance psychological resilience, reduce stress, and support the well-being of distance learners in a scalable and accessible manner. *Clinical Trial Registration*: German Clinical Trials Register (DRKS), Identifier: DRKS00030973.

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Introduction

Stress is a well-documented challenge affecting students' well-being and academic performance (1). The rise of digital learning environments, accelerated by the COVID-19 pandemic, has increased the number of distance learners worldwide (2). These students face unique challenges (3), such as reduced personal interaction with peers and instructors, necessitating greater self-discipline (4,5). While the flexibility of online learning makes it an attractive option for many, distance learners often juggle multiple roles, such as employee, parent, and student (6). This balancing act exacerbates stress levels, particularly in the absence of peer support and interaction, underlining the need for accessible, internet-based interventions.

Stress among students encompasses a broad spectrum of psychological and emotional challenges, including anxiety, depression, and feelings of overwhelming (7,8,9). These challenges can impair academic performance, diminish quality of life, and increase the risk of mental health issues such as sleep disorders, substance abuse, and burnout. A meta-study by Chandler and Reid (10) highlighted how stress impairs cognitive functioning and exacerbates mental health risks, while Lipson et al. (11) linked unmanaged stress to lower grades, higher dropout rates, and overall deterioration in well-being. Although traditional students often benefit from peer networks that help mitigate stress (12,13), distance learners face reduced opportunities for direct engagement with peers and instructors, making them more reliant on digital resources (14). For instance, a survey of 5,721 German distance learners revealed significantly elevated stress levels resulting from the competing

demands of academic, professional, and personal roles (15). This underscores the critical importance of addressing the unique stressors experienced by distance learners and tailoring interventions to their needs (16).

Research suggests that mindfulness can help students cultivate a greater awareness of their stressors, enabling more adaptive coping strategies (17-20). Additionally, self-compassion provides a framework for addressing feelings of inadequacy or overwhelm by encouraging individuals to treat themselves with kindness rather than self-criticism, which is especially pertinent for distance learners who often lack immediate support from peers or instructors (21,22). Gratitude further complements this by shifting focus away from stressors to positive aspects of one's experience, fostering a sense of connection and emotional balance, even in isolated environments (23,24). To address the complex stressors faced by distance learners, interventions that promote psychological resilience and emotional well-being are essential.

Several internet-based programs in Germany, such as the StudiCare Stress Program (25) and the HelloBetter Stress Management Course (26), have been developed and scientifically evaluated to address these challenges. These programs provide evidence-based interventions, often incorporating cognitive-behavioral therapy techniques and offering diverse modules for stress reduction. While effective, such programs primarily aim to provide general coping strategies and do not specifically compare targeted versus comprehensive approaches or explicitly incorporate learning theories like Cognitive Load Theory (*CLT*) (27,28) and Spaced Repetition Theory (*SRT*) (29) into their design.

This study examines how the psychological constructs of mindfulness, self-compassion, and gratitude can address these challenges by enhancing emotional resilience, improving stress management, and fostering overall well-being among distance learners. By comparing two structured 28-day interventions—a comprehensive mindfulness program (*Mind2Full*) and a targeted intervention focusing solely on self-compassion and gratitude (*ComGrat*)—this study offers a novel contribution to the field. Unlike existing programs, the *ComGrat* intervention leverages *CLT* to minimize extraneous cognitive load and *SRT* to strengthen memory retention through consistent practice. The rationale for this design is grounded in the unique demands placed on distance learners, who often face high cognitive loads due to multitasking, fragmented attention, and limited support structures. By applying CLT, the intervention reduces unnecessary complexity, making it more cognitively accessible. Similarly, the use of SRT allows for structured repetition, which is crucial for embedding core emotional skills in learners with constrained time and attention spans. These frameworks thus informed the decision to compare a targeted, simplified intervention with a broader, more comprehensive program. This integration of learning theories not only enhances the immediate usability of the program but also supports the development of sustainable emotional skills. Exploring how targeted approaches, such as those focusing on self-compassion and gratitude, compare to broader mindfulness programs can provide valuable insights into tailoring interventions for specific populations.

1.1. Targeted vs. Comprehensive Mindfulness: The Roles of Self-Compassion and Gratitude

Mindfulness-Based interventions (MBIs) are widely recognized for their effectiveness in reducing stress and improving psychological well-being (18,19,20). MBIs are structured programs designed to cultivate mindfulness—a state of present-moment awareness and nonjudgmental acceptance of thoughts, feelings, and bodily sensations—through practices such as meditation, mindful breathing, and body scans (30). Meta-analyses have consistently demonstrated that both structured and self-directed MBIs can alleviate symptoms of stress, anxiety, and depression while enhancing academic performance among student populations (31-39). Typically spanning four to eight weeks, these

programs involve daily mindfulness practices ranging from 10 to 45 minutes. However, most MBIs integrate a wide variety of mindfulness techniques, such as meditation, body scans, and mindful movement (40,41,42), which can make it challenging to pinpoint the specific contributions of individual components like self-compassion and gratitude.

Self-compassion and gratitude, often included within broader mindfulness frameworks, have been independently shown to reduce stress and improve psychological well-being (21,43). Meta-analyses on self-compassion (22,44,45) and gratitude interventions (23,24,46) have confirmed their ability to decrease depression, anxiety, and self-criticism while enhancing resilience and emotional well-being. Research has also highlighted the benefits of self-compassion for improving coping mechanisms during stressful situations, including online learning contexts (47). Similarly, gratitude practices have been associated with increased positive affect and improved interpersonal relationships, which are particularly beneficial in mitigating the isolation often experienced by distance learners (23). Despite this evidence, studies explicitly examining the combined effects of self-compassion and gratitude remain scarce, particularly for distance learners who face unique stressors such as role conflict, social isolation, and reduced access to support systems.

This study addresses this gap by directly comparing a comprehensive mindfulness program (*Mind2Full*) with a targeted intervention focusing solely on self-compassion and gratitude (*ComGrat*). This comparison builds upon prior research by isolating the effects of these two constructs, allowing for a more precise evaluation of their combined impact. While previous studies have evaluated the efficacy of broader mindfulness programs, few have systematically investigated whether targeted interventions might yield greater benefits for specific populations, such as distance learners. For instance, a comparison of *Mindfulness-Based Stress Reduction (MBSR)* and *Mindful Self-Compassion (MSC)* programs found that *MSC* resulted in greater improvements in self-compassion and emotional resilience, despite both programs effectively reducing stress (48,49). Similarly, meta-analyses of gratitude-focused interventions have highlighted their capacity to enhance well-being and reduce symptoms of depression and anxiety, often exceeding the effects of broader mindfulness practices (23). By focusing on the specific constructs of self-compassion and gratitude, the *ComGrat* intervention aims to address the stressors unique to distance learners more effectively than a general mindfulness approach. This study builds on recent findings suggesting that targeted interventions may not only enhance psychological outcomes by reducing cognitive load but also foster deeper engagement and more sustainable long-term benefits.

1.3. Theoretical Basis for the Interventions

The study is grounded on the *Cognitive Load Theory (CLT)* (27,28) and the *Spaced Repetition Theory (SRT)* (29). *CLT* suggests that the human mind has a finite capacity for processing information. By carefully designing intervention materials to minimize extraneous cognitive load, unnecessary elements or distractions, such as overly complex instructions, unrelated theoretical concepts, or extraneous visuals, were excluded. Instead, materials were structured to focus solely on the core elements of self-compassion and gratitude. Each exercise was presented in simple, clear language to ensure participants could fully engage with the practices without cognitive overload (50,51). The *ComGrat* intervention, which emphasizes self-compassion and gratitude, minimizes unnecessary cognitive demands by narrowing its focus to two core mindfulness practices. This deliberate simplification aligns with *CLT*'s recommendation to reduce split attention and avoid integrating unrelated or competing tasks that may distract from the primary learning goals. This streamlined approach reduces distractions from learning multiple techniques simultaneously and aligns with evidence that a reduced cognitive load facilitates greater depth of processing and better retention of core content (52). In this study, the application of *CLT* supports the hypothesis that participants in the

ComGrat group will experience more effective engagement and learning compared to those in a broader mindfulness program, such as *Mind2Full*, which introduces new exercises daily. By focusing on only two components, participants can internalize the concepts at their own pace, accommodating individuals with varying levels of cognitive resilience. This adaptability enhances the intervention's efficacy in heterogeneous groups (53).

Additionally, *SRT* suggests that repeated exposure to the same material over time enhances long-term retention. In the *ComGrat* intervention, repetition was operationalized by delivering the same two core mindfulness exercises—one focused on self-compassion and the other on gratitude—every day for 28 days. These exercises were carefully timed to balance engagement and reinforcement, ensuring participants could revisit and internalize these practices consistently. The daily repetition was supplemented with reflective prompts, which were designed to strengthen the emotional resonance and cognitive connection to the core practices. This approach aligns with *SRT*'s principles of distributing learning opportunities to avoid cognitive fatigue while promoting consolidation over time (54,55). Research on *SRT* has demonstrated that revisiting core practices through consistent repetition strengthens memory consolidation and promotes the automation of skills (54,55). Unlike the *Mind2Full* course, which introduces a variety of new mindfulness exercises daily, the *ComGrat* intervention repeats the same core exercises over the 28-day program. This repetition reinforces self-compassion and gratitude, promoting the long-term internalization of these practices. Evidence from studies on repetitive learning supports the hypothesis that this design will result in deeper skill consolidation and more sustainable emotional benefits (56,57).

The integration of *CLT* and *SRT* provides a comprehensive framework for understanding the design and predicted effectiveness of the *ComGrat* intervention. While *CLT* explains how reducing extraneous cognitive load allows participants to engage more deeply with self-compassion and gratitude, *SRT* highlights the importance of timing and structured repetition, ensuring participants have consistent opportunities to revisit and reinforce these practices. By carefully calibrating the frequency and timing of the exercises, the intervention was designed to optimize memory retention while minimizing the risk of cognitive fatigue. Together, these theories suggest that *ComGrat* optimizes both immediate and long-term outcomes by combining cognitive efficiency with memory consolidation. This framework justifies the hypothesis that the targeted, repetitive nature of *ComGrat* will yield superior reductions in perceived stress and longer-lasting emotional resilience compared to the more generalized *Mind2Full* approach.

In line with these theoretical underpinnings, both interventions were structured to last 28 consecutive days, with participants engaging in manageable daily exercises. The *Mind2Full* intervention, based on the principles of *Mindfulness-Based Stress Reduction (MBSR)* (58), offers a diverse array of mindfulness practices, fostering general mindfulness skills. In contrast, the *ComGrat* intervention combines elements of Mindfulness-Based Compassion Learning (MBCL) (46) and Mindful Self-Compassion (MSC) (59,60), along with a focused gratitude intervention (61,62). This targeted approach leverages the combined strengths of *CLT* and *SRT* to reduce cognitive load while reinforcing self-compassion and gratitude through daily repetition. By facilitating deeper emotional engagement and sustained practice, this design aligns with evidence that targeted, repeated interventions are particularly effective in reducing perceived stress and promoting emotional well-being over time (63).

Table 1. Mapping of Theoretical Frameworks to Intervention Design Components

Theoretical Concept	Design Principle	Description	ComGrat Intervention	Mind2Full Intervention
Cognitive Load Theory (CLT)	Minimize extraneous cognitive load	Reduce complexity	Focuses on two core practices (self-compassion and gratitude)	Introduces a new mindfulness exercise each day
Cognitive Load Theory (CLT)	Simplify and structure materials	Deliver content clearly	Daily exercises delivered in a consistent format	Varied instructions and techniques
Cognitive Load Theory (CLT)	Avoid split attention and distractions	Reduce cognitive strain	Repeats same practices to focus engagement	Multiple simultaneous practices may increase load
Spaced Repetition Theory (SRT)	Reinforce learning through daily repetition	Enhance long-term retention	Repeats same two exercises daily for 28 days	Practices rotate daily
Spaced Repetition Theory (SRT)	Encourage automation	Build habits	Promotes automatic coping skills	Limited automation due to content variety

This table illustrates how Cognitive Load Theory (CLT) and Spaced Repetition Theory (SRT) informed the design of the two mindfulness interventions implemented in the study. *ComGrat* employed focused content and daily repetition, whereas *Mind2Full* incorporated a broader range of techniques with greater variation.

1.4. Hypothesis

The objective of this study is to examine the immediate (T2) and long-term (T3) impacts of two four-week self-directed web-based mindfulness interventions on the mindful-ness skills, self-compassion skills, and subjective perception of stressors in distance learning students. To investigate this question, two experimental groups (EG) and one control group (CG) were subjected to testing prior to the intervention (T1), immediately after the interventions (T2), and three months after the interventions ended (T3). The two experimental groups (EGs), designated A and B, each participated in a four-week self-directed web-based intervention. Group A was subjected to the comprehensive mindfulness intervention, *Mind2Full*, while Group B was subjected to the self-compassion and gratitude intervention, *ComGrat*. The study proposed three hypotheses to assess the short- and long-term effects of the interventions on mindfulness skills, self-compassion, and stress perception.

Hypothesis 1: Mindfulness Skills

H1a: Participants in both experimental groups (*Mind2Full* and *ComGrat*) will show a significant improvement in mindfulness skills immediately after the intervention (T2) compared to the control group.

H1b: Participants in the *Mind2Full* group will show a greater improvement in mindfulness skills at T2 than participants in the *ComGrat* group, due to the exposure to all mindfulness skills.

H1c: Both experimental groups will maintain a significant improvement in mindfulness skills three months after the intervention (T3), with the *Mind2Full* group expected to show stronger long-term effects due to the comprehensive nature of the intervention.

Hypothesis 2: Self-Compassion

H2a: Participants in both experimental groups (*Mind2Full* and *ComGrat*) will exhibit a significant increase in self-compassion immediately after the intervention (T2) compared to the control group.

H2b: Participants in the *ComGrat* group will show a significantly greater improvement in self-compassion at T2 than those in the *Mind2Full* group, as this intervention specifically focuses on self-compassion and gratitude.

H2c: The *ComGrat* group will exhibit significantly higher levels of self-compassion three months after the intervention (T3) compared to the *Mind2Full* group, as the focused nature of the intervention is expected to have a stronger long-term impact.

Hypothesis 3: Perceived Stress

H3a: Participants in both experimental groups (*Mind2Full* and *ComGrat*) will report a significant reduction in perceived stress immediately after the intervention (T2) compared to the control group.

H3b: The reduction in perceived stress will be similarly strong in both experimental groups at T2, as both interventions contain mindfulness elements that target stress reduction.

H3c: The *ComGrat* group will show a significantly greater reduction in perceived stress three months after the intervention (T3) compared to the *Mind2Full* group, due to the long-term effects of the focused intervention.

Materials and Methods

The study was approved by the ethics committee of the European University of Applied Sciences (EKEFH02/22), and all participants provided written consent. A randomised controlled trial (RCT) design was employed, with assessments conducted at three time points: baseline (T1), immediately after the intervention (T2), and three months post-intervention (T3).The study was conducted between 4 February and 17 June 2023. Participants were recruited via a centralized email distributed to all active distance learning students at the European University of Applied Sciences through their institutional student accounts. The recruitment email detailed the study's objectives, procedures, and eligibility criteria, emphasizing the voluntary nature of participation. Students enrolled in bachelor's or master's degree programs with internet access were eligible to participate, and no additional exclusion criteria were applied to ensure broad participation representative of the student body. This figure refers to the total sample size required for detecting a within-subject main effect across three time points in a repeated-measures design, not per group. The calculation was based on a small-to-moderate effect size (f = 0.25), with three measurements, a correlation among repeated measures of 0.5, and a nonsphericity correction of 1, as implemented in G*Power.The required sample size was calculated using G*Power (64), with an effect size of d=0.25, an alpha error probability of α = 0.05, and a beta error probability of β = 0.95, resulting in a minimum total sample size of 54 participants. These parameters adhere to standard conventions in psychological research, ensuring adequate statistical power to detect small to medium effects, which are typical in studies on mental health and mindfulness interventions. The selection of an effect size of d=0.25 was informed by prior studies employing methodologies analogous to those employed in the present study (65,66), which reported effect sizes of a similar magnitude in the context of web-based mindfulness and self-compassion interventions. These interventions have been demonstrated to engender significant enhancements in mental health outcomes, encompassing mindfulness, self-compassion, and psychological well-being, thereby establishing a foundation for the assumed effect size in this study. The alpha error of α = 0.05

and the beta error of β = 0.95 were selected to balance the risk of Type I and Type II errors, aligning with established practices in psychological research. Furthermore, the power analysis incorporated the repeated measures design, which enhances statistical power by reducing within-subject variability, thereby ensuring the robustness and reliability of the study's findings. However, following data cleaning procedures—including outlier removal and exclusion due to missing data—the final analytic sample comprised approximately 30 participants per group (N = 98 total). While this reduction still permits the detection of within-subject effects in a repeated-measures design, we acknowledge that the power to detect small between-group differences may have been compromised. This limitation is noted in the discussion section as a factor that may account for non-significant post hoc comparisons between groups despite significant within-group improvements.

2.1. Format and Content of the Interventions

The *Mind2Full* and *ComGrat* interventions were designed with a similar methodology. The interventions were conducted over a 28-day period and were disseminated automatically via email using a web-based campaign system tool. Each intervention comprised exercises that collectively amounted to 15–20 minutes of daily practice. The *Mind2Full* and *ComGrat* interventions were designed, developed, implemented, and conducted by a psychologist and certified mindfulness trainer, meditation teacher, and stress management coach. Participant adherence to the intervention was indirectly monitored through tracking email engagement, such as how often the intervention emails were clicked or opened. However, as this metric does not confirm whether participants completed the exercises, it has not been reported in the study. Instead, we relied on participants' signed commitment during registration, in which they expressed their willingness to dedicate 20 minutes per day to the intervention exercises. Examples of the intervention emails and psychoeducational materials can be found in Supplementary File 1.

2.1.1. Mindfulness Intervention: *Mind2Full*

The *Mind2Full* intervention comprised 28 units, in addition to an introductory unit. Each morning between 6:00 and 7:00 am, participants received a daily email containing three videos: a mindfulness impulse, office yoga exercises, and meditation. The content of the mindfulness impulses was diverse, comprising a range of practical exercises. These techniques included mindful breathing, mindful eating, awareness of thoughts, emotional regulation strategies and grounding techniques. The objective was to provide participants with the capacity to integrate these techniques into their daily routines. To illustrate, a mindfulness impulse might comprise a brief exercise on mindful walking, encouraging participants to focus on the sensation of each step and the environment around them, or an encouragement to record feelings and thoughts throughout the day. The office yoga exercises were designed in such a way that they could be performed by any individual, regardless of their level of experience or access to specialized equipment. The exercises focused on gentle stretching, including neck rolls, seated twists, and shoulder shrugs. These could be performed on a chair at home or in the workplace. The objective was to reduce physical tension and encourage relaxation, even in a restricted work environment. For instance, participants may be instructed in the performance of a fundamental seated forward bend, which serves to relieve muscular tension in the lumbar and shoulder regions. The meditations were adaptable, allowing participants to engage in the practice in any comfortable position or space. The meditations comprised a series of guided visualizations, body scans and breath awareness practices. To illustrate, a typical meditation session might comprise a guided body scan, whereby participants direct their attention to each part of their body, identifying any areas of tension and consciously relaxing those regions. The adaptability of the meditation practices permitted participants to engage in the sessions in a manner that was consistent with their individual preferences and circumstances. The introductory unit provided an overview of the course

structure, a general introduction to mindfulness, and practical advice for successfully completing the course. The course encompassed eight fundamental elements of the Mindfulness-Based Stress Reduction (MBSR) programme. The eight components of the course were as follows: 1) awareness of inner experience, 2) awareness of outer experience, 3) conscious action in the present, 4) an accepting, non-judgmental, self-compassionate, grateful attitude, 5) a non-reactive, decentered orientation, 6) an open, non-avoidant attitude, 7) relativity, and 8) insightful understanding (67). This comprehensive design ensured that participants could readily incorporate mindfulness into their daily routines, irrespective of their prior experience or current circumstances.

The intervention was theoretically grounded in the standard MBSR curriculum (68) and aligns with the transactional model of stress, which emphasizes the critical role of personal perception and appraisal in stress and coping (69). The intervention also fostered the development of personal resources, including self-efficacy (70), a mindful and stress-reducing interpretation of events, a compassionate and accepting attitude towards oneself, the ability to detach from thoughts and emotions, and the capacity to maintain emotional balance (71).

2.1.2. Self-compassion and Gratitude Intervention: *ComGrat*

The second four-week web-based intervention was centered on the themes of self-compassion and gratitude, building on two of the components also found in the *Mind2Full* intervention. The objective of the intervention was to cultivate the development of self-compassion and gratitude, encompassing non-judgmental awareness, self-self-compassion, recognizing shared humanity, applying mindfulness in challenging situations, and empathy-enhancing exercises (72). This was achieved through the engagement in *loving-kindness meditations* (*LKM*) (73) and the maintenance of a gratitude journal (74). *LKM* is a systematic practice that involves directing feelings of kindness and compassion towards oneself, loved ones, neutral individuals, and even those with whom one has conflicts. For example, participants may recite phrases such as "May I be happy, may I be healthy," gradually extending these aspirations to others. In the initial two-week period, participants were introduced to the various forms of this meditation, including focusing on specific individuals or broadening the focus to larger groups. Subsequently, participants were encouraged to select and practice the form that was most resonant with them.

Gratitude journaling entailed a daily reflection on aspects of life for which participants expressed gratitude. It was recommended that participants maintain a daily journal, either digitally or manually, and engage in a reflection on gratitude in the evening. The guidelines recommended the listing of three to five specific instances per day, such as a positive interaction, a moment of beauty, or a minor accomplishment. To illustrate, a participant might record a gratitude-related experience such as, "Today, I am grateful for the warm cup of coffee that energized my morning," or "I appreciate the support I received from my colleague." The objective of this practice was to alter the focus of attention from sources of stress to positive experiences, thereby reinforcing a mindset of appreciation and resilience. Meta-studies have demonstrated the positive psychological effects of gratitude journaling (75,76). This technique, which gained popularity in the early 2000s, entails individuals regularly recording the things for which they are thankful. Gratitude journaling is a widely utilized technique in positive psychology (61). It helps individuals shift their focus from perceived deficiencies to acknowledging and appreciating existing blessings, thereby fostering a more optimistic perspective. The available evidence suggests that maintaining a gratitude journal can facilitate the development of humility (77) and enhance overall well-being (78,79).

The participants were provided with a daily email comprising a *LKM*, instructions for the meditation, and a prompt to reflect on their gratitude entries. Moreover, the daily emails incorporated a

psychoeducational element. The psychoeducational content was designed to facilitate a more profound comprehension of self-compassion and gratitude. To illustrate, one email might elucidate the concept of self-compassion by elucidating how it entails treating oneself with the same benevolence and comprehension as one would extend to a friend in need. Another email might examine the advantages of gratitude, underscoring research indicating that the regular acknowledgement and appreciation of favourable aspects of life can enhance overall well-being. The aforementioned emails served the dual purpose of pedagogical instruments and subtle prompts, encouraging the integration of these concepts into daily life through the practice of meditation and journaling.

Both interventions place an emphasis on meditation, which has been demonstrated to confer a multitude of benefits in numerous studies (80). This highlights its efficacy in mitigating stress and anxiety, as well as enhancing overall mental well-being. It has been demonstrated that the practice of meditation can also exert a beneficial effect on personal self-compassion skills (81). A meta-analysis conducted by Wilson et al. (82) indicates that self-compassion-related therapies are generally effective in improving psychological outcomes, such as reducing depression, anxiety, and stress, while increasing well-being and life satisfaction. A meta-analysis conducted by Zeng et al. (83) focusing on the *LKM* revealed that the *LKM* has a significant positive effect on self-compassion, along with other psychological benefits, including an increase in positive emotions and a reduction in negative emotions. It can be reasonably inferred that the practice of loving-kindness meditation may prove an efficacious strategy for enhancing emotional well-being and fostering a more benevolent disposition among distance learners. In conclusion, the evidence suggests that meditation is an effective method for alleviating anxiety and stress. The *LKM*, in particular, has been shown to be beneficial for fostering a kind and caring approach.

In conclusion, the *Mind2Full* was a comprehensive, self-directed online intervention encompassing the full spectrum of mindfulness, whereas *ComGrat* was a concentrated, self-directed online intervention focusing on two pivotal aspects of mindfulness: self-compassion and gratitude. The effects of mindfulness training, self-compassion training and gratitude training on stress have been separately examined in research studies. The combination of self-compassion and gratitude is now to be examined on the hypothesis that a focused approach might result in even stronger positive effects due to the smaller cognitive load in comparison to standard comprehensive mindfulness approaches.

2.2. Questionnaires

In order to test this hypothesis, three questionnaires were administered: the CHIME, the PSQ, and the SCS. The selection was guided by their ability to capture core cognitive and emotional outcomes aligned with the intervention's theoretical underpinnings. Specifically, the CHIME (Comprehensive Inventory of Mindfulness Experiences) reflects increased attentional regulation and emotional awareness, which are expected outcomes of mindfulness practice and reduced cognitive overload (CLT) (17,27). The PSQ (Perceived Stress Questionnaire) captures changes in subjective stress appraisal, which may decrease as cognitive load is minimized and emotion regulation skills improve through repetitive training (CLT and SRT). The SCS (Self-Compassion Scale) assesses self-kindness, emotional resilience, and reduced self-criticism—core targets of the ComGrat intervention—and is particularly suited to detect skill acquisition resulting from structured, repeated practice as theorized in SRT. Together, these tools offer a robust measure of the key outcomes the interventions aimed to produce through reduced complexity (CLT) and enhanced repetition (SRT).

Participants completed pre- and post-intervention self-assessment questionnaires (T1, T2, and T3) online to measure mindfulness skills, perceived stress, and perceived levels of self-compassion and gratitude, respectively. To ensure the authenticity and independence of responses, participants were required to set up a unique password during registration. This password was created using a combination of their mother's name, father's name, birth city, and birthday, ensuring it was both secure and personal. Participants used this password for identification each time they accessed the questionnaires, preventing unauthorized access and maintaining data integrity. These measures ensured that all responses could be reliably attributed to the intended participants, while safeguarding their privacy.

2.2.1. CHIME - Comprehensive Inventory of Mindfulness Experiences

The mindfulness skills in this study were assessed using the Comprehensive Inventory of Mindfulness Experiences (*CHIME*) questionnaire developed by Bergomi et al. (84). This tool was specifically designed to evaluate eight fundamental mindfulness skills, drawing from the constructs of eight existing mindfulness questionnaires (67,85). The *CHIME* is unique in that it avoids using terminology that might be difficult for individuals without meditation experience to understand, making it accessible to a broader audience (85). The *CHIME* consists of 37 items presented as first-person statements, with respondents rating each item on a 6-point bipolar Likert scale ranging from 'almost never' to "almost always." Following scoring guidelines, all items were scored such that higher values reflect greater mindfulness skills. No reverse coding was necessary. A total score was calculated by computing the average of all 37 items, in line with the standard scoring procedure.

The questionnaire is divided into eight subscales, each assessing a different dimension of mindfulness. The questionnaire assesses awareness of inner experiences, as indicated by items such as "I notice when my mood begins to change," while it gauges awareness of outer experiences, as evidenced by statements such as "I am aware of sounds around me, like birds chirping or traffic noise." The assessment of conscious action and presence is conducted through items such as "I find myself engaging in activities without paying attention." Furthermore, the questionnaire assesses an accepting, non-judgmental, and self-compassionate attitude, as evidenced by statements such as "I am able to accept unpleasant feelings without attempting to alter them." An objective and detached perspective is gauged by statements such as "I am able to observe my thoughts without becoming enmeshed in them," while an open and non-avoidant stance is evaluated with items like "I am receptive to experiencing whatever thoughts and emotions arise." The assessment of relativity is conducted through statements such as "I recognise that my thoughts are merely thoughts, not facts." Conversely, the evaluation of insightful understanding is accomplished through items such as "I perceive the interconnectivity between my thoughts, feelings, and behaviours." Each of these dimensions is essential for providing a comprehensive measure of mindfulness, reflecting a wide range of experiences and attitudes that contribute to mindful awareness and practice. The internal consistency of these subscales is robust, with Cronbach's alpha values ranging from α = .70 to .86, indicating reliable measurement across the different facets of mindfulness (85). Although the CHIME includes eight subscales, only the total score was used in statistical analyses (e.g., ANOVA), as the study focused on overall changes in mindfulness rather than subscale-specific patterns.

The *CHIME* questionnaire has been validated extensively in adult populations, including those participating in psychological interventions and mindfulness-based training programs (84). While specific studies validating *CHIME* among online learners are limited, its focus on universal mindfulness skills and its design to avoid meditation-specific terminology make it suitable for diverse populations, including adults engaged in online learning environments. Validation studies, such as

Bergomi et al. (84,85), report robust psychometric properties across various contexts, reinforcing the scale's applicability to the present study.

2.2.2. PSQ – Perceived Stress Questionnaire

The study employed the Perceived Stress Questionnaire (*PSQ*), developed by Fliege et al. (86), as a measure of perceived stress. The German-language short version employed in this study comprises 20 items, distributed across four subscales: Worry, Tension, Joy, and Demands. Each subscale offers insight into the various ways in which individuals perceive, evaluate, and process stressful stimuli. To illustrate, the Worry subscale comprises items such as "You feel that your worries keep growing," which reflect concerns about personal challenges. Items included in the Tension subscale may, for instance, reflect feelings of unease or stress-related tension, as indicated by the statement 'You feel irritable". The Joy subscale comprises items that reflect positive emotional experiences, such as "You feel full of energy", which are inversely related to stress levels. The final subscale, entitled Demands, comprises items such as "You feel that too many demands are being placed on you", which address the pressure exerted by external demands. Each item is rated on a 4-point Likert scale, ranging from "almost never" to "most of the time", thereby providing a nuanced view of the frequency with which participants experience these feelings. Items in the Joy subscale were reverse-coded before computing the total PSQ score, ensuring that higher scores consistently reflected higher perceived stress. The total PSQ score was calculated by averaging all 20 items (including reverse-coded items), in accordance with the standard procedure.

The reliability of the PSQ was evaluated using Cronbach's alpha, with the total score demonstrating a value of $\alpha = .86$ and the subscales ranging from $\alpha = .80$ to $\alpha = .85$, indicating satisfactory internal consistency. Similarly, split-half reliability demonstrated high values, thereby confirming the robustness of the measure. Subscale scores were not analyzed separately due to the study's focus on overall stress levels.

The *PSQ* has been widely validated in adult populations across different settings, including occupational, educational, and clinical contexts. Studies utilizing the German-language short version have demonstrated its applicability in assessing stress levels in working adults and students, making it relevant to the online learning population targeted in this study. Fliege et al. (86) and subsequent research (87) confirm the *PSQ*'s high reliability and validity in diverse contexts, providing confidence in its use for the present study.

2.2.3. SCS - Self-compassion Scale

The study employed the Self-Compassion Scale (SCS), developed by Neff (88) and subsequently validated by Neff & Tóth-Király (89), to assess levels of self-compassion and gratitude. The SCS is a 26-item self-report questionnaire utilising a five-point Likert scale, ranging from "almost never'"(1) to "almost always" (5), for the evaluation of various dimensions of self-compassion. These dimensions encompass self-kindness, common humanity, self-judgment, isolation, mindfulness, and the avoidance of over-identification. The construct of self-kindness is operationalized through items that assess the respondent's capacity to demonstrate understanding and gentleness towards themselves during challenging circumstances. To illustrate, a typical item might be, "I endeavor to extend benevolence towards myself when I am experiencing emotional distress." The concept of common humanity is evaluated through items that emphasize the recognition that personal struggles and failures are part of the shared human experience. For example, an item may state, "When I am feeling down, I remind myself that there are many other individuals in the world who are experiencing similar feelings." The construct of self-judgment is operationalized through items that reflect harsh self-criticism, such as "I am disapproving and judgmental about my own flaws and inadequacies." The

construct of isolation is operationalized through items that reflect feelings of loneliness during challenging periods. An illustrative item is, "When I consider my shortcomings, it tends to engender a sense of detachment and isolation from the broader social context." The SCS also incorporates components that assess mindfulness, such as maintaining a balanced perspective in the face of adversity. This is evaluated through items such as "When something painful happens, I try to take a balanced view of the situation". Finally, avoiding over-identification with negative emotions or perceived failures is assessed through items such as "When I'm feeling down, I tend to obsess and fixate on everything that's wrong".

Reverse-coded items were adjusted in accordance with the published scoring key. The total score was computed as the average of all items after reverse coding, with higher scores reflecting greater self-compassion. Although the scale consists of six subscales, only the total score was used in this study's analyses, as the primary research questions pertained to overall changes in self-compassion. The SCS is known for its high internal consistency, with a Cronbach's alpha of $\alpha = 0.92$, indicating reliable measurement across its subscales. Recent studies (88,89,90,91) have confirmed the scale's strong construct validity and test-retest reliability, making it a robust tool for assessing self-compassion in various contexts. The SCS has been validated across a wide range of adult populations, including students and individuals engaged in online psychological interventions (90,91). According to Neff (88) and Neff & Tóth-Király (89), the scale demonstrates robust psychometric properties, characterised by elevated internal consistency and test-retest reliability.. While there is limited specific validation in online learning populations, the scale's emphasis on universal dimensions of self-compassion supports its relevance to the study's target population (90,91).

2.3. Analytic Approach

A total of 254 distance learning students from the European University of Applied Sciences were invited to participate via email. After confirming their enrollment and providing consent for data protection, 251 students completed the registration and agreed to engage in the intervention for 20 minutes per day, with three required questionnaire submissions during the study. Participants were randomly assigned to one of three groups: an experimental group receiving the four-week web-based mindfulness intervention *Mind2Full* (EG_A, $n = 85$), an experimental group receiving a four-week intervention focused on self-compassion and gratitude *ComGrat* (EG_B, $n = 82$), and a waitlist control group (CG, $n = 84$).Participants were randomly assigned to one of the three groups using the online tool Random.org (https://www.random.org/lists/), which generates random sequences based on atmospheric noise to ensure allocation randomness. .

To minimize bias, participants were only informed of their group assignment after completing the baseline questionnaire (T1). This ensured that their initial responses were not influenced by group knowledge, maintaining data integrity. Upon completing the first questionnaire, participants either received a link to register for their assigned intervention or were informed of their placement in the control group. Both experimental groups began the interventions simultaneously. The control group was informed they would gain access to the intervention after the second assessment (T2). Four weeks after T1, all participants completed the second questionnaire (T2). To assess long-term outcomes, participants from the original experimental groups completed a third questionnaire (T3), three months after the end of the interventions. The control group received access to the interventions after the second assessment to maintain ethical standards and engagement, reducing dropouts and ensuring comprehensive evaluation of both immediate and long-term intervention effects.

A mixed factorial repeated measures analysis of variance (ANOVA) was conducted to examine differences between the groups and over time. Outliers were excluded using both the Z-score method

and the interquartile range (IQR) method to ensure data integrity and validity. Outliers identified by Z-scores exceeding ±3 were removed to prevent extreme values from unduly influencing the results. The IQR method further identified outliers as observations falling below the 1st quartile minus 1.5 times the interquartile range (Q1 - 1.5 IQR) or above the 3rd quartile plus 1.5 times the interquartile range (Q3 + 1.5 IQR). This combined approach ensured a robust exclusion of anomalous data points, preserving the representativeness of the dataset. To address violations of sphericity, the Greenhouse-Geisser correction was applied. Homogeneity of variance was tested using Levene's test, and post hoc multiple comparison tests were conducted using Tukey's method. The significance level for the ANOVA and post hoc tests was set at 0.05, as determined by a priori power analysis. The statistical analysis revealed no covariation between demographic variables and study outcomes. The effect size for the repeated measures ANOVA was calculated using partial eta-squared (η^2), yielding a large effect size of $\eta^2 = 0.90$. This indicates a strong and significant relationship between the variables, reinforcing the robustness of the findings.

The initial data set comprised 167 individuals. After conducting a rigorous outlier analysis using both the Z-score method and the interquartile range (IQR) method, 69 participants were classified as outliers and subsequently excluded, reducing the final sample size to $N = 98$. Participants with missing data in T2 ($n = 1$) and T3 ($n = 52$) were excluded to meet the requirement for the RM ANOVA. Sensitivity analyses comparing participants with complete data to those with missing data showed no significant differences in socio-demographic and baseline characteristics, suggesting that the exclusion did not introduce any systematic bias.

While the outlier exclusion followed strict methodological standards to ensure the validity of the findings, we acknowledge that the exclusion of 41% of participants is substantial. However, a sensitivity analysis was conducted, confirming that the main outcomes remained consistent even when these outliers were included, supporting the robustness of the findings. The 98 participants, enrolled in either a bachelor's or master's degree program at a distance learning university, were recruited anonymously via email in January 2023. The study team had no direct contact with participants during the registration process. Randomization ensured a balanced distribution across the experimental and control groups. The participants in experimental group A (EG_A, $N = 30$) had a mean age of 33.2 years ($SD = 9.01$), with 27 female and 3 male participants. Experimental group B (EG_B, $N = 31$) had a mean age of 37.8 years ($SD = 10.44$), with 25 female and 5 male participants. The control group (CG, $N = 37$) had a mean age of 36.2 years ($SD = 8.46$), comprising 33 female and 4 male participants. Approximately half of the participants were employed part-time, while a third were employed full-time. One-third of the participants reported having children. Three-quarters of the participants were enrolled in a bachelor's program, and the remaining quarter in a master's program. In terms of marital status, 29 participants were single, 28 were in a relationship, and 41 were married (Table 2). The efficacy of the randomisation process was evaluated by conducting a comparative analysis of the groups on salient baseline sociodemographic and psychological variables, encompassing age, gender, employment status, parenthood, study programme, and marital status, in addition to the baseline psychological measures collected during the T1 assessment. A series of one-way ANOVAs and chi-square tests were conducted to examine group differences. The findings indicated that there were no statistically significant differences between the groups on these variables ($p > 0.05$), thereby confirming that the randomisation process had effectively created comparable groups at the baseline stage.

The sample is considered representative of the broader population of distance learning students for several reasons. Firstly, research shows that a significant proportion of distance learners are concurrently employed, often balancing academic responsibilities with professional and personal obligations (92)., as reflected in the present sample, where 85% of participants were employed part-

time or full-time. This finding is consistent with prior research that emphasises the dual commitments of work and study as a hallmark of distance learning populations (93,94). Secondly, the substantial initial sample size of 254 invited participants, along with a final sample of 98 participants, serves to enhance the representativeness of the study, thereby reducing selection bias and ensuring the reliability of the findings. The preponderance of female participants in the study, constituting approximately 87% of the sample, aligns with the findings of prior studies that attribute this imbalance to the increased engagement of women in online and distance education due to its inherent flexibility (94). This demographic composition reflects broader trends in distance learning and lends confidence to the generalizability of the findings to similar populations.

Table 2. Demographics of Participants by Group

Variable	Mind2Full (n = 30)	ComGrat (n = 31)	CG (n = 37)	Total (N = 98)
Gender				
Female	27	25	33	85
Male	3	6	4	13
Age				
Mean (SD)	33.2 (9.01)	37.8 (10.44)	36.2 (8.46)	35.8 (9.38)
Employment				
Full-time	11	11	14	36
Part-time	16	15	17	48
Unemployed	3	5	6	14
Children				
None	22	19	22	63
>1	8	12	15	35
Study Program				
Bachelor	22	24	28	74
Master	8	7	9	24
Marital Status				
Single	11	5	13	29
In a Relationship	7	10	11	28
Married	12	16	13	41

Note. *n* = number of participants; SD = standard deviation; CG = Control Group.

3. Results

The results are organised by outcome variable—mindfulness skills, self-compassion, and perceived stress—and are summarised in Table 3 (means and standard deviations by group and time point) and Table 4 (mixed factorial ANOVA results).

Table 3. Means and standard deviations for each outcome variable by group (Mind2Full, ComGrat, Control) and time point (T1, T2, T3).

Outcome	Group	T1 Mean (SD)	T2 Mean (SD)	T3 Mean (SD)
Mindfulness (CHIME)	Mind2Full	3.21 (0.45)	3.80 (0.39)	3.56 (0.41)
	ComGrat	3.18 (0.42)	3.61 (0.37)	3.68 (0.35)

	Control	3.17 (0.43)	3.19 (0.41)	3.22 (0.44)
Self-Compassion (SCS)	Mind2Full	2.84 (0.37)	3.19 (0.34)	3.03 (0.36)
	ComGrat	2.86 (0.39)	3.17 (0.36)	3.05 (0.34)
	Control	2.81 (0.40)	2.84 (0.38)	2.83 (0.39)
Perceived Stress (PSQ)	Mind2Full	2.91 (0.41)	2.48 (0.38)	2.70 (0.40)
	ComGrat	2.94 (0.43)	2.56 (0.36)	2.57 (0.37)
	Control	2.88 (0.40)	2.86 (0.41)	2.83 (0.42)

Table 4. Summary of mixed factorial ANOVA results for each outcome variable, including between-subject, within-subject, and interaction effects (F-values, degrees of freedom, p-values, and partial eta squared).

Outcome Variable	**Effect Type**	**F-value**	**df**	**p-value**	**Partial η^2**
Mindfulness (CHIME)	Time	36.2	2, 190	< .001	0.276
Mindfulness (CHIME)	Group	10.4	2, 95	< .001	0.179
Mindfulness (CHIME)	Time × Group	10.7	4, 190	< .001	0.184
Self-compassion (SCS)	Time	5.34	1.88, 178.6	0.006	0.053
Self-compassion (SCS)	Group	3.12	2, 95	0.049	0.062
Self-compassion (SCS)	Time × Group	2.58	3.76, 83.07	0.042	0.051
Perceived Stress (PSQ)	Time	27.8	2, 190	< .001	0.226
Perceived Stress (PSQ)	Group	6.12	2, 95	0.003	0.114
Perceived Stress (PSQ)	Time × Group	6.45	4, 190	< .001	0.119

3.1. Mindfulness Skills

Changes in mindfulness skills, as measured by the CHIME scale, were examined across the Mind2Full (experimental group A), ComGrat (experimental group B), and control groups over three time points (T1, T2, and T3). Mauchly's test confirmed that the assumption of sphericity was met, $\chi^2(2) = 0.993$, $p = 0.724$, and therefore no correction to degrees of freedom was required. The assumptions of normality, homogeneity of variances, and independence of observations were satisfied. A 3 (Group) × 3 (Time) repeated measures ANOVA revealed a significant interaction effect between time and group, $F(4, 190) = 10.7$, $p < .001$, $\eta^2_p = 0.184$, indicating a large effect size and suggesting that changes in mindfulness skills over time differed by group.

From T1 to T2, both intervention groups demonstrated statistically significant improvements in mindfulness scores. Participants in the Mind2Full group showed a mean increase of 0.594 points on the CHIME scale, $t(95) = 7.587$, $p < .001$, 95% CI [0.533, 0.654], while participants in the ComGrat group improved by 0.428 points, $t(95) = 5.566$, $p < .001$, 95% CI [0.385, 0.472]. In contrast, the control group did not exhibit a significant change during this period. Post hoc comparisons at T2 indicated that CHIME scores were significantly higher in the Mind2Full group compared to the control group, $t(95) = 5.592$, $p < .001$. The ComGrat group also outperformed the control group, $t(95) = 3.131$, and although previously reported as non-significant, this t-value corresponds to a *p*-value well below .05 and should be corrected accordingly. No statistically significant difference was found between the two intervention groups at this time point.

Long-term effects from T1 to T3 were also observed. The Mind2Full group maintained a statistically significant gain, with a mean increase of 0.348 points, $t(95) = 4.344$, $p = .001$, 95% CI [0.312, 0.383]. The ComGrat group exhibited an even larger improvement of 0.497 points, $t(95) = 6.313$, $p < .001$, 95% CI [0.446, 0.548]. Although both interventions led to sustained increases in mindfulness scores, the ComGrat group achieved a more pronounced long-term effect than Mind2Full. These findings confirm hypotheses H1a and H1b, demonstrating significant short-term gains in mindfulness skills in both intervention groups. Hypothesis H1c was partially supported, as ComGrat showed greater long-term improvement than Mind2Full, contrary to the initial expectation. Figure 1 displays the estimated marginal means of CHIME scores across the three time points.

Figure 1. Mindfulness Skills´ Changes Over Time. Estimated marginal means for *CHIME* Scale at baseline (T1), immediately after the interventions (T2) and three months after the interventions (T3). EG A: *Mind2Full*, EG B: *ComGrat* and CG: Control Group. Both intervention groups showed significant increases in mindfulness skills from T1 to T2 compared to the control group. At T3, the ComGrat group demonstrated a more sustained improvement, whereas the Mind2Full group showed a slight decline.

3.2. Results - Self-compassion

Changes in self-compassion were assessed using the SCS scale across the Mind2Full, ComGrat, and control groups at baseline (T1), immediately after the intervention (T2), and at three-month follow-up (T3). Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(2) = 0.936$, $p = 0.045$; therefore, Greenhouse-Geisser corrections were applied ($\varepsilon = 0.940$). A repeated measures ANOVA revealed a statistically significant interaction between time and group, $F(3.76, 83.07) = 2.58$, $p = 0.042$, $\eta^2_p = 0.051$, indicating a small effect size and suggesting differential changes in self-compassion over time across the three groups.

Between T1 and T2, both intervention groups showed significant improvements in self-compassion scores. The Mind2Full group experienced a mean increase of 0.351 points, $t(95) = 4.482$, $p < .001$, 95% CI [0.316, 0.386], while the ComGrat group improved by 0.308 points, $t(95) = 4.183$, $p = .002$, 95% CI [0.277, 0.338]. No significant change was observed in the control group during this period. However, post hoc comparisons revealed no statistically significant differences between either intervention group and the control group at T2. This finding indicates that although participants in both interventions improved significantly relative to their own baselines, these gains were not large enough to produce significant between-group effects at this time point. As such, hypothesis H2a was not supported.

Regarding T1 to T2 comparisons between interventions, the results did not show that ComGrat produced greater improvements than Mind2Full. Although the ComGrat group showed a slightly

smaller mean gain, the difference between groups was not statistically significant. This partially supports hypothesis H2b, as both interventions enhanced self-compassion but neither demonstrated clear superiority immediately following the intervention.

In terms of long-term effects from T1 to T3, both intervention groups showed declines in self-compassion relative to their post-intervention levels. Compared to baseline, the Mind2Full group exhibited a net reduction, while the ComGrat group maintained a modest gain of approximately 0.19 points. Although this does not constitute a statistically significant improvement over baseline, it suggests that participants in the ComGrat group retained more of their initial benefit than those in the Mind2Full group. As such, hypothesis H2c is only partially supported. Figure 2 presents the estimated marginal means of SCS scores across the three time points.

Figure 2. Self-compassion Skills´ Changes Over Time. Note: Estimated marginal means for SCS Scale at baseline (T1), immediately after the interventions (T2) and three months after the interventions (T3). EG A: *Mind2Full*, EG B: *ComGrat* and CG: Control Group. Both intervention groups showed significant increases in self-compassion from T1 to T2. At T3, the ComGrat group retained more of its initial improvement, whereas the Mind2Full group showed a decline, suggesting greater long-term effects for ComGrat.

3.3 Results – Perceived Stress

Perceived stress was assessed using the PSQ scale across the Mind2Full, ComGrat, and control groups at baseline (T1), immediately after the intervention (T2), and at three-month follow-up (T3). Mauchly's test indicated that the assumption of sphericity was met, so no correction to the degrees of freedom was required. A 3 (Group) × 3 (Time) repeated measures ANOVA revealed a significant interaction effect between time and group, $F(4, 95) = 6.45$, $p < .001$, $\eta^2_p = 0.119$, indicating a moderate effect size.

From T1 to T2, both intervention groups showed meaningful reductions in perceived stress, as reflected by increases in PSQ scores (where higher scores indicate lower stress). Participants in the Mind2Full group exhibited a mean increase of 0.43 points, while the ComGrat group improved by 0.38 points. These results confirm that both interventions were effective in reducing perceived stress in the short term, supporting hypothesis H3a.

At the three-month follow-up (T3), improvements were partly sustained. The Mind2Full group maintained a smaller, yet still positive, gain of 0.21 points from baseline, while the ComGrat group retained most of its initial benefit, with a gain of 0.37 points from T1. These findings suggest modest but persistent reductions in perceived stress following both interventions. The more stable outcome observed in the ComGrat group lends partial support to hypothesis H3c, which anticipated stronger long-term effects for that intervention. In contrast, hypothesis H3b, which predicted greater short-term reductions in perceived stress for Mind2Full compared to ComGrat, was not supported, as the two groups showed comparable effects.

Overall, both interventions were successful in reducing perceived stress, with ComGrat showing a slightly more stable long-term profile. Figure 3 displays the estimated marginal means of PSQ scores across the three time points.

Figure 3. Perceived Stress Changes Over Time. Note: Estimated marginal means for *PSQ* Scale at baseline (T1), immediately after the interventions (T2) and three months after the interventions (T3). EG A: *Mind2Full*, EG B: *ComGrat* and CG: Control Group. Both intervention groups showed significant short-term reductions in perceived stress (T1–T2). At T3, the ComGrat group maintained most of its gains, while Mind2Full showed a partial decline, highlighting more stable long-term benefits for ComGrat.

The study found significant improvements in perceived stress across both experimental groups (*Mind2Full* and *ComGrat*) immediately after the interventions (T2) and three months later (T3). An analysis of the four *PSQ* subscales—Worries, Tension, Joy, and Constraint—showed significant improvements over time in all subscales: Worries ($F(2,96) = 13.41$, $p < 0.001$, $\eta^2p = 0.125$), Tension ($F(2,96) = 24.8$, $p < 0.001$, $\eta^2p = 0.205$), Joy ($F(2,96) = 8.44$, $p < 0.001$, $\eta^2p = 0.081$), and Constraint ($F(2,96) = 14.81$, $p < 0.001$, $\eta^2p = 0.134$). Both interventions led to significant short-term improvements (T1 to T2) in these subscales: Worries ($MD = -0.3049$, $t(95) = -4.214$, $p < 0.001$), Tension ($MD = -0.5672$, $t(95) = -8.578$, $p < 0.001$), Joy ($MD = -0.2721$, $t(95) = -4.260$, $p < 0.001$), and Constraint ($MD = -0.4787$, $t(95) = -6.301$, $p < 0.001$). However, long-term effects (T1 to T3) were only observed in *ComGrat* (*ComGrat* intervention), with significant improvements in Worries ($MD = -0.394$, $t(95) = -3.351$, $p = 0.030$), Tension ($MD = -0.413$, $t(95) = -3.861$, $p = 0.006$), and Constraints ($MD = -0.3135$, $t(95) = -3.275$, $p = 0.018$), while the Joy subscale did not maintain significance in the long term.

Regarding H3d, these results support the hypothesis that the *ComGrat* intervention would lead to more sustained benefits, particularly in reducing Worries, Tension, and Constraints. The anticipated reduction in the effectiveness over time was also observed, especially in the Joy subscale, which did not show long-term significance. The findings suggest that, while both interventions were effective in the short term, the *ComGrat* intervention had a more durable impact on reducing perceived stress in the specific subscales of Worries, Tension, and Constraints. The decline in positive outcomes between T2 and T3 can be attributed to the three-month interval, during which the immediate benefits of the mindfulness interventions naturally diminished. This pattern is common in mindfulness-based interventions, as improvements in stress reduction tend to decrease unless the practices are regularly maintained. This trend aligns with existing research indicating that ongoing mindfulness practice is necessary to sustain long-term benefits (95).

4. Discussion

The present study explores the prevalence of stress among students, particularly in the context of the transition to distance learning and the escalating digitalisation that has accompanied it. This shift has had a significant impact on mental health and academic performance, constituting a substantial challenge for students. The present study evaluated two self-directed web-based mindfulness interventions. The *Mind2Full* programme encompasses a comprehensive range of mindfulness skills, whereas the *ComGrat* programme focuses on self-compassion and gratitude. The objective of the study was to ascertain whether a focused intervention would yield more long-term benefits in accordance with the tenets of cognitive load theory.

The study found that while both interventions demonstrated significant within-group improvements in perceived stress and self-compassion over time, only the ComGrat group exhibited statistically significant long-term effects when compared to the control group. In contrast, between-group comparisons did not consistently reveal statistically significant differences between the Mind2Full and control groups. This indicates that although participants improved within their respective intervention groups, these improvements cannot be uniformly attributed to the intervention itself without stronger between-group effects. These findings underscore the importance of distinguishing between within-group and between-group analyses when interpreting intervention efficacy. The observed sustained improvement in the ComGrat group supports the potential of targeted interventions focusing on self-compassion and gratitude.

This interpretation aligns with the tenets of CLT, which emphasise the reduction of extraneous cognitive load to enable learners to focus on core concepts. The study found that both interventions led to significant within-group reductions in stress levels over time. However, only the ComGrat programme yielded statistically significant improvements when compared to the control group, with more pronounced and sustained benefits three months after its conclusion, particularly in the domains of self-compassion and perceived stress reduction. The more focused approach of ComGrat likely minimised extraneous cognitive load, allowing for deeper cognitive processing and more robust learning outcomes over time. The long-term effects observed in the ComGrat group are consistent with prior research demonstrating that self-compassion interventions, such as Mindful Self-Compassion programs, can significantly enhance emotional resilience and coping mechanisms (48,49). However, this study builds on earlier findings by directly comparing a targeted intervention to a broader mindfulness programme. The results reveal that the focused approach of *ComGrat* not only reduces stress but also leads to greater long-term benefits. This finding lends support to the tenets of Cognitive Load Theory (50), which posits that the reduction of extraneous cognitive load enables learners to engage more profoundly with fundamental concepts. While broader interventions, such as Mindfulness-Based Stress Reduction (MBSR), have been found to be effective, they may introduce an excessive number of elements simultaneously, thereby potentially diminishing their long-term impact. By contrast, the concentrated approach of the *ComGrat* programme is likely to have contributed to its effectiveness by reducing cognitive load, thereby allowing for deeper engagement with the material. Conversely, the *Mind2Full* intervention, despite its initial efficacy, might have resulted in cognitive overload, thereby impeding its long-term impact.

Nevertheless, the absence of any discernible enhancement in specific aspects of mindfulness within the *Mind2Full* group necessitates further scrutiny. One potential explanation for this phenomenon is that the diversity of mindfulness exercises employed in *Mind2Full* may have hindered participants' ability to internalise any one skill profoundly. Research suggests that the introduction of too many new techniques in a short time can increase cognitive demand, reducing retention and long-term engagement (50). It is possible that participants experienced difficulties in sustaining consistent practice across all mindfulness dimensions, particularly in the absence of personalised feedback or follow-up support. Alternatively, the measurement tools employed in this study, although validated, may have lacked the sensitivity to detect subtle yet significant changes in specific mindfulness dimensions over time. This finding is consistent with prior research demonstrating that certain mindfulness dimensions, such as decentering and non-judgmental awareness, necessitate extended practice to manifest sustained improvements (39). It is recommended that subsequent studies extend the duration of the intervention or incorporate additional assessments to capture subtle or delayed changes. Finally, individual differences among participants, such as baseline mindfulness levels or varying levels of engagement with specific exercises, may have influenced the results. These factors could provide a rationale for why certain dimensions of mindfulness exhibited less consistent improvement in the *Mind2Full* group, despite the program's comprehensive design. In subsequent research, the exploration of moderators such as personality traits or baseline stress levels could offer a more profound understanding of these findings.

The focus of *ComGrat*, which was on self-compassion and gratitude, is likely to have enabled participants to engage more thoroughly with these concepts. This may have resulted in greater emotional regulation and stress reduction. Self-compassion fosters emotional resilience by encouraging individuals to respond to personal setbacks with understanding and kindness rather than self-criticism, a skill that is particularly beneficial for distance learners managing multiple responsibilities (49). Gratitude, in this sense, serves to promote a positive shift in attention, focusing on affirming and appreciating positive aspects of life rather than stressors (99). The observed

disparities in the long-term improvements in self-compassion and perceived stress between the *ComGrat* participants and the broader *Mind2Full* group may be attributable to these psychological shifts. Furthermore, targeted interventions such as *ComGrat* have the potential to yield more sustained benefits by virtue of the fact that they reduce the cognitive and emotional effort required to process multiple concepts simultaneously, as posited by *CLT*. This narrower focus allows participants to internalise specific skills more effectively and to practise them consistently over time, thereby fostering stronger neural consolidation and habit formation (50, 100). This interpretation is further substantiated by prior research, which demonstrates that focused interventions frequently result in more profound emotional engagement and enhanced long-term retention in comparison to broader approaches (23, 95). While the targeted nature of ComGrat appears to confer advantages in long-term retention and emotional resilience, it may also limit exposure to the breadth of mindfulness practices that more comprehensive programs like Mind2Full offer. This narrower focus might not address all facets of stress-related challenges or individual differences in preference and responsiveness to specific techniques. Consequently, some participants may benefit more from a broader repertoire of skills, particularly if their stressors are varied and multifaceted. Future research could explore whether combining focused and comprehensive approaches might provide more holistic benefits for diverse learner populations.

Furthermore, gratitude and self-compassion have been demonstrated to facilitate positive feedback loops that reinforce emotional well-being (23). For instance, expressing gratitude has been associated with enhanced social connection and positive affect, which, in turn, have been shown to reduce stress levels (23). In a similar vein, the practice of self-compassion has been demonstrated to curtail rumination and self-criticism, thereby fostering emotional resilience (72). It is plausible that these mechanisms contributed to the sustained benefits observed in the *ComGrat* group, particularly in reducing perceived stress and enhancing self-compassion over time. In addition to CLT, Spaced Repetition Theory (SRT) provides further explanatory value. SRT posits that learning is enhanced when key material is encountered multiple times across intervals. The ComGrat intervention included repeated daily exposure to the same core concepts—self-compassion and gratitude—over the course of four weeks, which likely reinforced these skills through spaced repetition. This mechanism could have amplified consolidation and memory retention, particularly in emotionally salient contexts like stress management. Conversely, the Mind2Full program covered a broader range of techniques, which were less likely to benefit from this kind of structured repetition. The combined insights from CLT and SRT offer a robust theoretical rationale for ComGrat's superior long-term outcomes.

The interaction between Cognitive Load Theory (*CLT*) and Spaced Repetition Theory (*SRT*) provides a more comprehensive explanation for the superior long-term outcomes of the *ComGrat* programme. As argued above, *CLT* emphasises the importance of minimising extraneous cognitive load to optimise learning outcomes (50). Concurrently, Spaced Repetition Theory (*SRT*) emphasises the pivotal function of repeated exposure to pivotal material in fostering long-term retention (54). The *ComGrat* programme's daily repetition of self-compassion and gratitude exercises aligns directly with *SRT* principles, ensuring that participants not only engage with these practices but also revisit and internalise them consistently over time. The simplicity and focus of *ComGrat* likely facilitated deeper consolidation of emotional skills, as repeated practice strengthens neural pathways associated with these concepts (96). In contrast, the exercises of the *Mind2Full* program may not have provided participants with sufficient repetition to consolidate the extensive array of mindfulness skills presented. The integration of these frameworks elucidates the underlying reasons for *ComGrat*'s superior long-term outcomes. The reduction in cognitive overload (*CLT*) facilitated focused engagement with the intervention's fundamental components, while the systematic repetition of practices (*SRT*) ensured the retention and utilisation of these emotional skills over time. The

integration of these theoretical frameworks into the *ComGrat* program exemplifies the potential for a synergistic integration of psychological and educational principles to enhance the efficacy of mindfulness interventions.

The findings outlined here demonstrate the practical implications for the design of mental health interventions, particularly for distance learners. The integration of self-compassion and gratitude within mindfulness programs represents a targeted intervention strategy that educational institutions and mental health professionals can implement to support students facing social isolation and multiple responsibilities. The superior long-term outcomes of *ComGrat* suggest that such focused interventions could be integrated into university wellness programs, online learning platforms, or student counseling services. For example, institutions could offer structured, asynchronous interventions via email or learning management systems, allowing students to engage flexibly at their own pace. Additionally, embedding short self-compassion and gratitude exercises within existing curricula—such as stress management courses or digital study guides—could further enhance accessibility and effectiveness. Future research should examine the feasibility and scalability of these approaches in different educational settings to maximize their impact on student well-being.

The findings of this study add to the growing body of research highlighting the unique stressors faced by distance learners, such as social isolation, role conflict, and the lack of immediate support networks (101). These stressors are further compounded by the self-directed nature of online education, which requires heightened self-discipline and time management skills, often leading to increased levels of stress and burnout (93). Mindfulness-based interventions, notably targeted approaches such as *ComGrat*, have been shown to address these challenges by cultivating emotional resilience and equipping students with the necessary skills to manage their stress independently. The findings emphasise the necessity for tailored interventions to meet the specific needs of distance learners. Web-based programs such as *Mind2Full* and *ComGrat*, which are characterised by their flexibility and accessibility, are especially well-suited to distance learners. In contrast to conventional face-to-face interventions, which often necessitate rigid scheduling and physical presence, web-based programs offer learners the autonomy to progress at their own pace and seamlessly integrate mindfulness practices into their daily routines. This finding is consistent with the conclusions other studies (102,103,104), which emphasise the efficacy of digital interventions in reaching underserved populations.

Furthermore, the emphasis on self-compassion and gratitude in *ComGrat* directly addresses some of the psychological challenges unique to distance learners. Self-compassion has been shown to mitigate the negative effects of self-criticism and isolation (23), while gratitude has been demonstrated to promote a positive outlook, which can counter feelings of disconnection and overwhelm (62). The provision of these skills to students through interventions such as *ComGrat* serves to reduce stress levels and enhance overall well-being, thereby fostering a sense of connection and self-efficacy, even in the absence of traditional support networks. These findings have practical implications for educational institutions aiming to support distance learners. In order to support distance learners, universities could integrate targeted interventions such as *ComGrat* into their onboarding or wellness programs. For instance, *ComGrat* could be implemented as a supplemental resource for first-year distance learners, helping them to build the emotional and cognitive tools necessary to navigate the challenges of online education. Furthermore, the combination of these interventions with broader institutional strategies, such as peer mentoring programs or virtual community-building initiatives, has the potential to further enhance their effectiveness by addressing both individual and systemic stressors faced by distance learners. Such programs could be supplemented with psychoeducational modules that elucidate the benefits of mindfulness, self-compassion, and gratitude, thereby ensuring a theoretical foundation to complement practice.

Another potential implementation could involve incorporating *ComGrat* into existing wellness programs or student support services, where students access these interventions via university learning management systems (LMS) or standalone mobile applications. These platforms offer flexibility by enabling students to engage in 15–20 minute daily practices at their convenience while offering features such as reminders or progress tracking to maintain engagement. This flexibility is of particular benefit to distance learners, who often have irregular schedules and competing responsibilities. In addition, web-based platforms have demonstrated significant advantages in terms of cognitive therapy interventions (102,103), whilst also offering a high level of accessibility and flexibility. The flexibility is particularly beneficial for distance learners, enabling them to incorporate mindfulness practices into their daily routines and revisit materials as needed (104,105). These findings highlight the value of tailoring digital mindfulness interventions to the cognitive and emotional profiles of specific learner groups, and suggest that incorporating principles from Cognitive Load Theory (CLT) and Spaced Repetition Theory (SRT) can guide the design of more effective, scalable programs. Future studies should continue to explore the potential of integrating theories such as *CLT* and *SRT* to optimise the design and implementation of mindfulness interventions.

4.1. Limitations and Future Directions

Notwithstanding the encouraging outcomes, the study is subject to a number of constraints. The overrepresentation of female participants in the sample gives rise to questions regarding the generalizability of the findings. This gender imbalance is consistent with prior research showing that women are more likely to engage in mindfulness and self-compassion interventions (106), and therefore may have influenced the overall effectiveness of the interventions, particularly in the *ComGrat* group. Conversely, the underrepresentation of male participants may have limited the detection of gender-specific responses to the interventions, such as differences in how men and women engage with self-compassion practices. It is recommended that future studies recruit a more balanced sample to explore potential gender-based variations in outcomes. Outliers were identified separately for each outcome variable (i.e., CHIME, PSQ, and SCS total scores) at T2 and T3 using standardized Z-scores and interquartile range (IQR) thresholds. Participants whose scores exceeded ±3 standard deviations from the sample mean or who fell outside 1.5 times the IQR from the first or third quartile were flagged as outliers. This method was selected to reduce the influence of extreme values that could distort repeated measures ANOVA assumptions of normality and homogeneity of variance. This conservative approach was chosen due to the relatively small group sizes, where even a few extreme scores could disproportionately affect group means and variance estimates. In total, this process resulted in the exclusion of 41% of the initial sample. Sensitivity analyses confirmed that the exclusion did not introduce systematic bias, as no significant deviations were found in sociodemographic variables or baseline psychological measures between included and excluded participants. However, this substantial data reduction limits the generalizability of the findings. Specifically, it raises concerns regarding the potential exclusion of participants with extreme response patterns, as well as intra- and inter-individual variability in intervention effects. Future research should explore alternative approaches, such as robust statistical methods that accommodate outliers (e.g., winsorizing or mixed-effects modeling), and strive for a larger, more diverse sample to balance precision with generalizability.

This study used repeated measures ANOVA, a method chosen for its suitability with balanced data and alignment with prior research (97) and (98). Greenhouse-Geisser corrections were applied in cases where the assumption of sphericity was violated. While appropriate for the study design, we acknowledge that linear mixed models (LMM) could provide additional flexibility in accounting for variability across individuals. Future research could explore LMM to model hierarchical data more comprehensively. Subsequent research can use linear mixed models to implement more flexible study

designs with heterogeneous measurement points in time and take into account the intra-individuality of effects on the psychometric constructs with accompanying collection of unknown sources of secondary variance in order to demonstrate extended generalisability and provide insights into the differential effects of similar interventions.

Additionally, the final group sizes (~30 per group) may have reduced the statistical power to detect between-group differences, particularly for small effect sizes. This may partly explain why some comparisons did not reach statistical significance despite observed within-group improvements. In particular, while within-group improvements in perceived stress and self-compassion were observed, the absence of statistically significant between-group differences limits the extent to which these effects can be causally attributed to the interventions.

The utilisation of self-reported data carries the potential for response bias, including social desirability and recall errors. Participants may have overestimated their adherence to the intervention or reported greater improvements in stress and mindfulness skills due to a desire to provide favourable feedback. The incorporation of objective measures, such as physiological stress markers (e.g., cortisol levels or heart rate variability), and the utilisation of digital engagement metrics (e.g., time spent on intervention activities) to track adherence would serve to triangulate self-reported data and provide a more robust assessment of intervention effectiveness. All outcome measures were analysed using total scores, calculated as the average of relevant items (with reverse coding applied where appropriate). Although validated subscales exist, these were not included in the analysis, limiting the granularity of interpretation. The generalizability of these findings to more diverse populations of distance learners also warrants further exploration. Cultural or contextual factors, such as differing attitudes toward self-compassion and gratitude or variations in educational systems, may influence the effectiveness of these interventions. It is therefore recommended that future research evaluates the interventions in culturally diverse settings in order to determine whether their benefits extend across populations with differing values, norms, and stressors. Although the three-month follow-up period is longer than in many similar studies, it may not have fully captured the long-term sustainability of the interventions' benefits, particularly for *ComGrat*. A follow-up period of six or twelve months would facilitate a more comprehensive understanding of the longevity of the benefits. Furthermore, the efficacy of these interventions in more diverse populations, including individuals from different age groups, cultural backgrounds, and educational settings, should be investigated in future research.

The present study primarily focused on the application of cognitive load theory in reducing extraneous load through the *ComGrat* intervention. However, subsequent studies could examine the role of the two other parts of the cognitive load theory (intrinsic and germane load) in enhancing learning outcomes. In light of the observed differences between *Mind2Full* and *ComGrat*, future studies could investigate how variations in intervention structure (e.g. comprehensive versus focused) impact different subpopulations of distance learners. For instance, it could be investigated whether focused interventions are more effective for learners experiencing high cognitive load due to competing responsibilities. The exploration of moderating variables, such as baseline stress levels, cultural context, or prior mindfulness experience, could provide insights into the tailoring of interventions for specific subgroups. Furthermore, the combination of targeted and comprehensive approaches in future research could offer a more comprehensive examination of the impact of different intervention structures on various subpopulations of distance learners. A combination of *ComGrat* with practices such as mindfulness of breath or mindful movement may offer synergistic benefits by addressing a broader range of mindfulness skills while maintaining a manageable cognitive load. Moreover, integrating real-time feedback mechanisms, such as progress tracking via mobile applications or interactive components, has the potential to enhance participant engagement

and adherence. In order to gain a more comprehensive understanding of these interventions across different contexts, it would be advantageous to expand the research to include a more diverse population, including students with varying levels of prior mindfulness practice. The combination of focused techniques, such as pairing *ComGrat* with mindfulness of breath, could provide insights into whether such combinations enhance overall effectiveness.

5. Conclusions

This study demonstrates that both comprehensive (*Mind2Full*) and targeted (*ComGrat*) self-directed online mindfulness interventions are effective in reducing stress among distance learners. However, only the ComGrat intervention showed statistically significant long-term effects in comparison to the control group, particularly in reducing perceived stress and enhancing self-compassion. These findings emphasise the value of focused approaches that minimise cognitive load, thereby enabling deeper engagement with core practices. The scalability and accessibility of web-based mindfulness programs position them as promising tools for supporting the psychological well-being of students, especially in the context of increasing digitalization in education. Nonetheless, the absence of consistent between-group effects for Mind2Full highlights the need for caution when attributing observed improvements solely to intervention content. Future research should explore the long-term effects of these interventions across diverse populations and investigate ways to integrate such programs into institutional support systems, ensuring maximum impact on student well-being.

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Appendix D: Resilience Among Healthcare Staff: A Randomized Controlled Trial of Digital Training Program

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Resilience Among Healthcare Staff: A Randomized Controlled Trial of a Digital Training Program

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Abstract

Nursing and direct care staff face significant psychological and physical challenges, including high workloads, emotional labour, and staff shortages, which increase the risk of burnout and stress-related conditions. Resilience is a protective factor that mitigates these effects. This study evaluated the efficacy of a 28-day digital resilience training programme tailored to the needs of nursing and direct care staff. One hundred twenty participants working in German healthcare settings were randomly assigned to an experimental group or a waitlist control group. Experimental group participants received a programme consisting of twice-daily video-based exercises, reflections, and relaxation activities over four weeks. Outcomes were assessed at baseline (T1), post-intervention (T2), and three months follow-up (T3). Resilience (primary outcome) was measured using the Resilience Scale, and perceived stress (secondary outcome) was measured using the Perceived Stress Questionnaire (PSQ). Compared to the control group, experimental group participants demonstrated significant improvements in resilience from T1 to T3 ($p < .001$, $d = 0.6$) and substantial reductions in percieved stress (PSQ total score, $p < .001$, $d = -1.4$). No significant changes were observed in the control group. The digital programme effectively enhanced resilience and reduced the perception of stress, aligning with prior research on resilience training in healthcare. Despite stress reduction showing a larger effect size, resilience remained the theoretically grounded primary outcome. The flexible, scalable design of the digital programme accommodates challenges like shift work, offering a practical solution for improving nurse staff's mental health. Clinical Trial Registration: German Clinical Trials Register (DRKS), Identifier: DRKS00030973.

Keywords Resilience · Nursing care staff · Online training programme

Introduction

Nursing and direct care staff are subject to considerable physical and mental challenges in their daily professional activities. The most common stressors include time pressure, staff shortages, shift work, and frequent exposure to death and suffering. These factors increase the risk of burnout, depression, and anxiety disorders (Breinbauer et al., 2019; Drupp & Meyer, 2019). The prevalence of psychological diagnoses among sick days indicates that these stressors are significant contributors to healthcare worker well-being. A significant contributing factor to this stress is emotional labour, which involves the management of one's own and others' emotions. In particular, "surface acting," or the adaptation of emotions to professional requirements, frequently results in emotional dissonance and, in the long term, increases the risk of burnout (Delgado et al., 2017). A substantial proportion of nursing and direct care staff report a sense of psychological emptiness and inner

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imbalance, a sentiment that is further exacerbated by the emotional demands of their profession (Hart et al., 2014). While experienced nursing and direct care staff encounter significant emotional and psychological burdens, nursing students also experience elevated levels of stress due to academic pressures, clinical responsibilities, and emotional challenges (Labrague et al., 2017).

Research indicates that resilience plays a pivotal role in enabling individuals to manage stress effectively (Li & Hasson, 2020). Conceptually, resilience refers to the capacity to adapt positively to adversity and to demonstrate psychological growth in the face of challenges. While traditionally rooted in developmental psychology, contemporary perspectives underscore its dynamic nature, shaped by individual, social, and contextual factors (Caldeira & Timmins, 2016). Within the nursing profession, resilience is closely linked to mental well-being and professional sustainability. Empirical studies have demonstrated that resilience mitigates the adverse effects of emotional labour and is inversely associated with burnout, emotional exhaustion, and depersonalization (Castillo-González et al., 2024; Delgado et al., 2017). Furthermore, higher resilience levels correlate with increased job satisfaction and reduced intent to leave the profession (Füreder, Herber & Stadlmayr, 2024; Manomenidis et al., 2019), as well as lower symptoms of post-traumatic stress and depression (Mealer et al., 2012b). Importantly, resilience is not an innate trait but a modifiable capacity that can be cultivated through targeted, evidence-based interventions. Strategies such as cognitive restructuring, mindfulness training, stress inoculation, and emotional regulation have demonstrated efficacy in enhancing psychological resilience among healthcare professionals (Arrogante & Aparicio-Zaldivar, 2017; Joyce et al., 2018; Mealer et al., 2012a, 2012b; Smith & Yang, 2017). These findings underscore the importance of systematically integrating resilience-building interventions into nursing education and professional development frameworks to foster enduring coping capacities.

While traditional face-to-face interventions have demonstrated effectiveness in enhancing resilience, the applicability of digital resilience training among nursing and direct care staff is still emerging. Existing digital programs vary widely in their delivery modes, duration, and target populations. For example, Zhai et al. (2021) conducted a meta-analysis that confirmed significant effects of resilience training interventions—including digital formats—on reducing stress and burnout in healthcare workers. However, the majority of studies included were not specifically tailored to nursing and direct care staff. The most evidence-supported resilience training strategies include cognitive-behavioral techniques, mindfulness-based interventions, and stress management skills training. These approaches have demonstrated adaptability across various formats and are particularly well-suited for further adaptation and implementation in the nursing context.

Despite these promising findings in broader healthcare contexts, there remains a clear research gap regarding the effectiveness of fully asynchronous, self-guided digital resilience interventions tailored specifically to the nursing and direct care staff. Most available programs do not accommodate the unique demands of shift work and are not tested with long-term follow-ups. Moreover, few interventions have been rigorously evaluated using randomized controlled designs.

As asserted by Thomas and Asselin (2018), Thomas and Revell (2015), and Amsrud et al. (2019), strengthening of resilience through targeted interventions plays a crucial role in clinical environments. Recent studies by Li and Hasson (2020) and Diffley and Duddle (2022) indicate that multicomponent interventions—including information sharing and reflective learning—are particularly effective in promoting resilience during nursing training. For working nursing and direct care staff, resilience has been shown to reduce emotional exhaustion and absenteeism, and to improve job satisfaction and performance (Matzka, 2015; Walpita & Arambepola, 2020). Furthermore, the implementation of resilience programs has been demonstrated to fortify professional identity and contribute to employee retention (Füreder, Herber & Stadlmayr, 2024).

In summary, the evidence underscores the importance of fostering resilience to safeguard the long-term mental health and performance of healthcare workers. Nurses and other direct care staff may benefit from the implementation of structured resilience training at all career stages to ensure preparation for the emotional and psychological demands of their roles. However, it is imperative that these interventions are both intensive and comprehensive in nature if they are to yield the desired outcomes.

Research Question

The present study was predicated on the assumption that targeted resilience promotion can engender sustainable improvements in the mental health and well-being of nursing and direct care staff. To address a gap in the literature, we evaluated a 28-day self-paced, fully digital resilience training program designed specifically for nursing and direct care staff. Grounded in validated psychological models, the training delivers content asynchronously to accommodate variable schedules and workplace demands. Evidence-based resilience interventions often incorporate cognitive-behavioral strategies, mindfulness techniques, stress inoculation training, and emotional regulation—approaches that have shown efficacy in reducing burnout and enhancing well-being in healthcare settings. These established methods inform the program's content and delivery. By using a randomized

controlled design with three assessment points—including a three-month follow-up—we aimed to generate robust evidence regarding the program's long-term effectiveness and feasibility in real-world healthcare contexts. The integration of psychological theories into the development and evaluation of the training programme ensures that scientifically sound and practice-relevant interventions are provided. The central hypotheses guiding this study were as follows::

Hypothesis 1 *Nursing and direct care staff who have completed the online training will achieve higher scores on the Resistance Orientation–Regeneration Orientation Scale than staff in the waitlist control group.*

Hypothesis 2 *Nursing and direct care staff who have completed the online training will achieve lower scores on the Perceived Stress Questionnaire than staff in the waitlist control group.*

Methods

Ethical Approval

Approval for this study was granted by the Euro-FH Ethics Committee (EKEFH07/24), and all participants provided written informed consent. All participants were fully informed of their right to withdraw at any time without consequence, that their participation was entirely voluntary, and that their decision to take part—or not—would have no impact on any aspect of their employment. No employer contact or institutional pressure was involved, and participants were not employed in the same organization as the investigators.

Design

The randomised controlled trial was conducted over a period of three assessment points: baseline (T1), post-intervention (T2), and follow-up (T3). The study was conducted between July and November 2024. The experimental group commenced the 28-day online programme immediately after completing the baseline questionnaire (T1). In contrast, the waitlist control group did not receive access to the intervention during the study period and only began the training after completing the final follow-up assessment (T3). This waitlist design was selected to preserve the ability to compare both groups across all time points while ethically ensuring that all participants eventually had access to the programme. The final follow-up questionnaire (T3) was administered to all participants three months post-intervention. The study achieved a 100% retention rate, with all 120 participants completing all three assessments. This unusually high adherence was facilitated by sustained and proactive communication throughout the study period. One member of the research team maintained regular, personalised contact with participants, which served to clarify procedures, respond to technical issues, and encourage ongoing engagement. Although no monetary or material incentives were offered, this attentive support likely contributed to the completion rate.

Participants

The required sample size ($N = 120$) was determined using G*Power 3.1 for an ANOVA repeated measures analysis (effect size $d = 0.3$, $\alpha = 0.05$, $\beta = 0.95$). The effect size of $d = 0.3$ was chosen as it reflects a small-to-medium effect based on Cohen's conventions (Cohen, 2013) and is consistent with prior meta-analyses of psychological resilience interventions in healthcare professionals, which have reported effect sizes ranging from $d = 0.2$–0.5 (Joyce et al., 2018; Zhai et al., 2021). This conservative estimate ensured sufficient power to detect realistic intervention effects in a real-world setting. Participants were recruited through direct outreach and were aged between 18 and 69 years ($M = 51$). They were employed in German healthcare settings. The final sample comprised 51 males and 69 females with diverse professional qualifications: 65 certified nurses, 13 nursing assistants, 28 individuals in training or without formal qualifications, 8 medical assistants, and 6 professionals in disability care roles. For the purpose of this study, the term "nursing and direct care staff" is used to describe all individuals actively engaged in direct patient or client care within healthcare settings, regardless of formal credentials. Although their qualifications and roles differ, these individuals commonly work in high-pressure, shift-based environments and are routinely exposed to emotional and physical stressors, making them an appropriate and relevant population for a resilience-focused intervention. The participants' professional experience ranged from fewer than 10 years ($n = 39$) to more than 20 years ($n = 40$). The employment settings of the participants included acute care ($n = 25$), residential long-term care ($n = 76$), and outpatient care ($n = 19$). Most participants ($n = 98$) were engaged in full-time employment, while 20 were employed part-time and 2 held temporary employment.

Participants agreed to allocate 20 min per day to the resilience training programme. Adherence to the intervention was critical for the assessment of its effectiveness, and data collection was conducted through three completed questionnaires over the testing period. An online randomization tool was used to assign participants to either the experimental group or the waitlist control group. Prior to the baseline assessment (T1) and group allocation, all participants

received comprehensive information regarding the study design and timeline.

Intervention

The programme was informed by established stress theories, including Lazarus and Folkman's (1986) transactional model of stress, as well as contemporary research on resilience and the effectiveness of online interventions (Ang et al., 2022; Chmitorz et al., 2018; Diaz et al., 2021; Fischer & Law, 2021). Over a 28-day period, participants in the experimental group received two daily emails—one in the morning at 7:00 am and another in the evening—designed to integrate seamlessly into their daily routines. The morning emails contained concise, video-based "learning nuggets" on resilience, supplemented with practical exercises and relaxation techniques such as breathing exercises, guided meditation, and simplified yoga (Hoffman, 2004; Morgan et al., 2024). Conversely, the evening emails promoted reflective practices, prompting participants to engage in journaling about positive daily experiences, gratitude, or meaningful social connections (Clark et al., 1995; Thompson, 1991; Ellis, 2023). Furthermore, an introductory video provided guidance on adapting the programme to individual schedules, thereby enhancing its accessibility and flexibility. Participants were encouraged to engage in approximately 20 min of content daily over the 28-day period. This duration was selected based on prior digital mental health interventions demonstrating efficacy with brief but consistent daily engagement (e.g., Ang et al., 2022; Bock et al., 2024). However, participation was not strictly enforced. The programme was designed to allow users to pause, resume, or combine sessions according to their schedules. This flexible design aimed to accommodate the realities of shift work, particularly in nursing and direct care staff. Adherence was self-paced and not externally monitored beyond completion of pre-, post-, and follow-up assessments.

Programme Content by Week

The training programme was meticulously designed over a period of four weeks, with each week focusing on specific psychological principles and practices to enhance resilience.

The programme commenced with an inaugural week, the objective of which was to establish a foundation of understanding and familiarity with the principles and practices of resilience. The programme commenced with an introduction to the fundamental principles of resilience, facilitated through daily reflection routines and relaxation exercises. Key topics included neuropsychological mechanisms, the role of sleep in emotional well-being, personal resource activation, and emotional regulation (Hoffman, 2004; Morgan et al., 2024). In the subsequent week, participants were guided through a series of exercises aimed at fostering a mindset of acceptance and equipping them with coping mechanisms. Participants were guided in cultivating a solution-oriented mindset by identifying and addressing cognitive distortions, while practising acceptance, control, and coping strategies. Relaxation techniques were incorporated to support stress reduction (Clark et al., 1995; Ellis, 2023; Thompson, 1991). In the third week, This phase emphasised the development of resilience through cognitive reframing, neuroplasticity, self-regulation, and strategies for countering irrational thoughts (Bandura, 1977; Vohs & Baumeister, 2013). The fourth week focused on the following: The final week focused on strengthening interpersonal relationships and cultivating empathy, compassion, and gratitude as psychological resources. Additional discussions covered self-efficacy and strategies for managing interpersonal challenges (Gilbert & Procter, 2006; Killen & Macaskill, 2015; Zessin et al., 2015).

The overarching objective of the programme was to enhance participants' stress perception and resilience through structured, evidence-based daily engagement.

Measurement Tools

Participants assessed their perceived stress and resilience using two validated instruments: the Resistance Orientation–Regeneration Orientation Scale (RS-Scale; Otto & Linden, 2018) and the Perceived Stress Questionnaire (PSQ; Fliege et al., 2009).

The RS-Scale consists of 20 items divided into two subscales. The Resistance Orientation subscale (10 items) measures resilience and goal-directed behaviors, such as "*When striving for a goal, personal emotions should not be a factor.*" The Regeneration Orientation subscale (10 items) assesses self-care tendencies, including items like "*During stressful periods, recovery time is especially important.*" Participants rated each item on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). The internal consistency of the subscales was excellent, with Cronbach's alpha values of $\alpha = 0.93$ (Resistance Orientation) and $\alpha = 0.92$ (Regeneration Orientation). Although the RS-Scale comprises two subscales, only the total composite score (sum of all 20 items) was used in the statistical analyses.

To evaluate participants' subjective perception, appraisal, and processing of stressors over the past four weeks, the German version of the PSQ was administered (Fliege et al., 2009). The short form comprises 20 items across four subscales (Worry, Tension, Joy, and Demands), rated on a 4-point Likert scale (1 = *almost never* to 4 = *most of the time*). Internal consistency was high, with a total Cronbach's alpha of $\alpha = 0.86$ and subscale values ranging from $\alpha = 0.80$ to $\alpha = 0.85$. High split-half reliability values were also

observed. Subscale scores were computed by summing the respective item values according to the evaluation manual.

In line with the primary objective of the study, resilience—measured using the RS- Scale—was designated as the primary outcome. Perceived stress, assessed with the PSQ, was the secondary outcome, reflecting the anticipated downstream effect of increased resilience on participants' stress perception. This distinction was pre-specified in the study design and used to guide interpretation of the intervention's effectiveness.

Data Analysis

Data were collected at T1, T2, and T3 using the online platform ScoSci Survey. A mixed factorial repeated measures ANOVA was performed to examine differences over time. Any violations of sphericity were addressed through the implementation of either the Greenhouse–Geisser or Huynh–Feldt adjustments, as deemed suitable. The homogeneity of variance was tested using Levene's test. Post hoc comparisons were conducted using Tukey's method when homogeneity of variance was observed, and Holm's method was employed otherwise (Chen et al., 2018; Holm & Christman, 1985). The significance level was set at 0.05, based on a priori power analysis.

Results

A total of 120 participants were randomly assigned in equal numbers to the experimental group ($n=60$) and the waitlist waitlist control group ($n=60$). The sample consisted of 65% women ($n=78$) and 35% men ($n=42$), with a mean age of 41.4 years ($SD=12.5$).

Resilience (RS-Scale)

A mixed ANOVA revealed a significant time × group interaction for overall resilience scores (total RS-Scale composite), $F(1.18, 139.39)=51.45$, $p<.001$, partial $\eta^2=.30$.. Post hoc comparisons indicated significant improvements in the experimental group from baseline (T1) to post-intervention (T2), with a mean difference of 4.4 ($p<.001$, $d=0.4$), and from T1 to three-month follow-up (T3), with a mean difference of 7.52 ($p<.001$, $d=0.6$). In contrast, the waitlist control group did not exhibit significant changes across any time points.

At T3, the difference in resilience scores between the experimental and waitlist control groups was statistically significant, with a mean difference of 7.82 ($p=.002$, $d=0.7$), indicating a medium effect size favoring the experimental group. A summary of resilience scores across time points is provided in Table 1, and the progression is visualized in Fig. 1.

Table 1 A summary of resistance orientation–regeneration orientation scale total score results from T1 to T3 for Experimental (EG) and Control (CG) Groups

Post Hoc Comparisons - Group ✻ RS total score

Reference condition	Compared condition	Mean difference	95% CI for mean difference		SE	df	t	Cohen's d	95% CI for Cohen's d		p_{bonf}
			Lower	Upper					Lower	Upper	
EG, T1	CG, T1	−0.850	−7.781	6.081	2.313	118	−0.367	−0.072	−0.659	0.515	1.000
	EG, T2	−4.400	−6.496	−2.304	0.700	118	−6.290	−0.373	−0.565	−0.181	< .001***
	CG, T2	−0.467	−7.144	6.210	2.229	118	−0.209	−0.040	−0.605	0.526	1.000
	EG, T3	−7.517	−9.731	−5.302	0.739	118	−10.169	−0.637	−0.862	−0.412	< .001***
	CG, T3	0.300	−6.178	6.778	2.162	118	0.139	0.025	−0.523	0.574	1.000
CG, T1	EG, T2	−3.550	−10.227	3.127	2.229	118	−1.593	−0.301	−0.870	0.268	1.000
	CG, T2	0.383	−1.713	2.479	0.700	118	0.548	0.032	−0.145	0.210	1.000
	EG, T3	−6.667	−13.144	−0.189	2.162	118	−3.084	−0.565	−1.125	−0.005	0.038*
	CG, T3	1.150	−1.065	3.365	0.739	118	1.556	0.097	−0.091	0.286	1.000
EG, T2	CG, T2	3.933	−2.480	10.346	2.140	118	1.838	0.333	−0.214	0.880	1.000
	EG, T3	−3.117	−3.869	−2.364	0.251	118	−12.405	−0.264	−0.346	−0.182	< .001***
	CG, T3	4.700	−1.505	10.905	2.071	118	2.269	0.398	−0.133	0.930	0.376
CG, T2	EG, T3	−7.050	−13.255	−0.845	2.071	118	−3.404	−0.597	−1.136	−0.059	0.014*
	CG, T3	0.767	0.014	1.519	0.251	118	3.051	0.065	-6.799×10^{-5}	0.130	0.042*
EG, T3	CG, T3	7.817	1.827	13.807	1.999	118	3.910	0.662	0.139	1.186	0.002**

*$p<.05$, **$p<.01$, ***$p<.001$

p-value and confidence intervals adjusted for comparing a family of 15 estimates (confidence intervals corrected using the bonferroni method)

EG experimental group; *CG* control group. T1 = baseline; T2 = post-intervention; T3 = 3-month follow-up

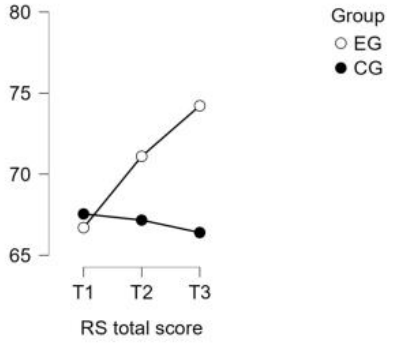

Fig. 1 Progression of resilience scores across time points. (Note: Mean resilience scores (RS) for the experimental and waitlist control groups at T1 (baseline), T2 (post-intervention), and T3 (three-month follow-up). Higher scores indicate greater resilience.)

Perceived Stress (PSQ)

For the PSQ total score, a significant time × group interaction was observed, $F(1.05, 123.56) = 29.38$, $p < .001$, partial $\eta^2 = .20$. The experimental group showed significant reductions in perceived stress from T1 to T2, with a mean difference of 13.67 ($p < .001$, $d = -0.9$), and from T1 to T3, with a mean difference of 22.06 ($p < .001$, $d = -1.4$). In contrast, the waitlist control group exhibited no significant changes across any time points. At T3, the total stress score in the experimental group was significantly lower than in the waitlist control group, with a mean difference of − 19.58 ($p < .001$, $d = -1.23$), representing a large effect size. Significant time × group interactions were observed for all PSQ subscales:

Worry subscale: $F(1.12, 124.33) = 25.67$, $p < .001$, partial $\eta^2 = .18$.

Table 2 Summary of perceived stress questionnaire subscale results from T1 to T3 for experimental (EG) and control (CG) groups

Post Hoc Comparisons - Group ✳ PSQ total score

Reference condition	Compared condition	Mean difference	95% CI for mean difference		SE	df	t	Cohen's d	95% CI for Cohen's d		p_{bonf}
			Lower	Upper					Lower	Upper	
EG, T1	CG, T1	2.139	−7.606	11.883	3.252	118	0.658	0.134	−0.477	0.745	1.000
	EG, T2	13.667	6.263	21.070	2.471	118	5.531	0.856	0.363	1.349	< .001***
	CG, T2	3.306	−5.836	12.447	3.051	118	1.083	0.207	−0.367	0.781	1.000
	EG, T3	22.056	14.815	29.296	2.417	118	9.127	1.381	0.854	1.909	< .001***
	CG, T3	2.472	−6.379	11.323	2.954	118	0.837	0.155	−0.400	0.710	1.000
CG, T1	EG, T2	11.528	2.386	20.669	3.051	118	3.778	0.722	0.132	1.312	0.004**
	CG, T2	1.167	−6.237	8.570	2.471	118	0.472	0.073	−0.391	0.537	1.000
	EG, T3	19.917	11.065	28.768	2.954	118	6.742	1.247	0.642	1.853	< .001***
	CG, T3	0.333	−6.907	7.574	2.417	118	0.138	0.021	−0.433	0.474	1.000
EG, T2	CG, T2	−10.361	−18.857	−1.866	2.835	118	−3.654	−0.649	−1.196	−0.102	0.006**
	EG, T3	8.389	7.085	9.693	0.435	118	19.272	0.525	0.394	0.656	< .001***
	CG, T3	−11.194	−19.377	−3.012	2.731	118	−4.099	−0.701	−1.231	−0.171	0.001**
CG, T2	EG, T3	18.750	10.567	26.933	2.731	118	6.866	1.174	0.613	1.736	< .001***
	CG, T3	−0.833	−2.138	0.471	0.435	118	−1.914	−0.052	−0.135	0.030	0.870
EG, T3	CG, T3	−19.583	−27.440	−11.726	2.622	118	−7.468	−1.226	−1.774	−0.679	< .001***

**$p < .01$, ***$p < .001$

p-value and confidence intervals adjusted for comparing a family of 15 estimates (confidence intervals corrected using the bonferroni method)

EG experimental group; *CG* control group. T1 = baseline; T2 = post-intervention; T3 = 3-month follow-up

Table 3 Mixed ANOVAs for perceived stress questionnaire (PSQ) subscales, T1 to T3

PSQ subscale	F-value	DF	*p*-value	Partial η^2	Post-Hoc *p*-value	Mean difference (MDiff)	95% confidence interval (CI)	Cohen's d (effect size)
Worries	16.75	1.17, 137.67	< .001	.12	< .001	− 17.44	[− 26.62, − 8.27]	− 0.9
Tension	25.63	1.10, 130.25	< .001	.18	< .001	− 23.33	[− 32.52, − 14.15]	− 1.2
Joy	13.87	1.13, 133.03	< .001	.11	< .001	16.33	[6.74, 25.93]	0.9
Requirements	19.06	1.14, 134.85	< .001	.14	< .001	− 21.22	[− 30.56, − 11.89]	− 1.1

Post hoc comparisons reflect between-group differences at T3. Negative mean differences indicate lower scores in the experimental group relative to controls

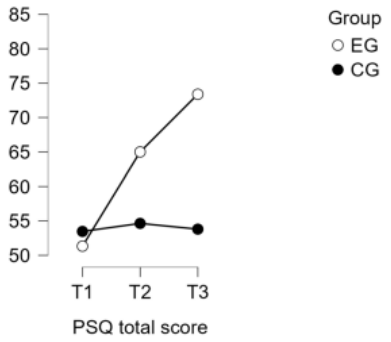

Fig. 2 Progression of perceived stress scores (PSQ total) across time points. (Note: Mean PSQ total scores for the experimental and waitlist control groups at T1, T2, and T3. Higher scores reflect decreased stress perception.)

Tension subscale: $F(1.08, 121.22) = 19.34$, $p < .001$, partial $\eta^2 = .16$.

Joy subscale (inverted for *lack of joy*): $F(1.09, 123.01) = 21.02$, $p < .001$, partial $\eta^2 = .17$.

Demands subscale: $F(1.04, 120.54) = 18.77$, $p < .001$, partial $\eta^2 = .15$.

Post hoc analyses revealed significant improvements in all PSQ subscale scores in the experimental group between T1 and T3, with large effect sizes observed across subscales. The waitlist control group, however, did not show significant changes for any subscale. A summary of these results is presented in Table 2, while Table 3 provides detailed statistical outcomes for the subscales. The progression of PSQ total scores across time points is visualized in Fig. 2.

Discussion

The results of this randomized controlled trial demonstrate that a 28-day digital resilience training programme significantly improved resilience and reduced stress in nursing and direct care staff. Participants in the experimental group achieved higher RS-Scale scores post-intervention and exhibited a significant reduction in stress levels, particularly in the 'worry' and 'tension' sub-dimensions of the PSQ scale.

Our results align with previous findings on resilience training effectiveness. For example, Kunzler et al. (2020) demonstrated that resilience training reduced stress and depression symptoms in healthcare professionals. Additionally, our findings highlight the efficacy of a fully digital intervention, addressing organizational and scheduling barriers of traditional face-to-face programmes (e.g., Henshall et al., 2023). Another important finding is the strong reduction in perceived stress, consistent with Zhai et al. (2021), who reported significant improvements in resilience, stress, and burnout. In particular, our PSQ results reinforce the link between resilience and stress regulation (Fliege et al., 2009). Unlike synchronous group-based programmes (e.g., REsOluTioN), our study demonstrated that an individualized, asynchronous approach can yield comparable or superior results. A notable comparison is Janzarik et al. (2022), whose group-based therapy facilitated in-depth stressor processing but lacked flexibility for shift workers. In contrast, our programme offers a more accessible and time-flexible alternative, making it particularly suitable for nursing and direct care staff. These findings are highly relevant globally, as resilience promotion is increasingly recognised as a key strategy for addressing mental health challenges in the nursing profession (cf. Henshall et al., 2023; Kunzler et al., 2020). Interestingly, while both outcomes showed significant improvements, the reduction in perceived stress yielded a larger effect size than the increase in resilience. This suggests that digital training may produce measurable emotional relief even within a short timeframe, while the development of deeper resilience capacities may require sustained engagement.

Our results underscore the importance of scalable interventions tailored to the realities of patient care staff. High workloads, irregular shifts, and staff shortages often impede participation in face-to-face training. Here, the tested digital resilience programme provides a viable and adaptable solution. The 100% completion rate suggests digital interventions are well received when tailored to the target group's needs. Furthermore, this study demonstrated that fostering resilience enhanced mental health. Consistent with Walpita and Arambepola (2020), who linked resilience to improved job performance, our findings suggest digital training can serve as a practical intervention.

While the programme was designed for daily engagement over four weeks, we recognise that this level of consistency may be difficult to maintain in real-world clinical settings. However, the asynchronous, self-paced structure allowed participants to flexibly adjust their use of the materials—such as catching up after missed days or clustering sessions on days off. Although adherence was not tracked session-by-session, the 100% retention rate at all three measurement points suggests that the overall structure was manageable for this population. Informal feedback received from several participants indicated appreciation for the short, modular format and the option to engage during breaks or at home, although some reported challenges with daily consistency during peak work periods. Future studies may benefit from incorporating structured adherence tracking and participant burden ratings to further evaluate feasibility in routine settings.

Limitations

Despite these promising results, some limitations must be acknowledged. First, self-reported data may be subject to social desirability bias. Second, the sample consists solely of German nursing and direct care staff, limiting generalizability to other countries and healthcare systems. Third, the absence of an active comparison intervention leaves uncertainty regarding its relative effectiveness. Future studies should compare alternative resilience-building interventions and examine long-term effects beyond three months.

Conclusion

These findings highlight the importance of integrating resilience training into HR strategies in healthcare. Digital programmes, such as the one tested here, provide an effective way to support nursing and direct care staff's mental health without adding workload burdens. Their flexible structure ensures accessibility for staff with non-traditional hours. A key strength of digital resilience training is its scalability, enabling implementation in underserved regions and resource-limited settings. Furthermore, such interventions may improve workforce retention, making the profession more attractive—a critical factor amid the global nursing and direct care staff shortage (Kraft & Drossel, 2019). While perceived stress showed the largest effect size, resilience—designated as the primary outcome—remains the core construct targeted by the intervention. This outcome hierarchy reflects the programme's theoretical foundation and supports its intended long-term impact: enhancing internal coping capacities to sustainably buffer workplace stress.

Future research should assess the long-term sustainability of digital resilience training beyond 6–12 months. Additionally, evaluating its effectiveness across different cultural and professional contexts would enhance generalizability. Further refinements, such as interactive elements, personalized feedback, or gamification, could boost engagement and effectiveness.

Author contribution Author Contribution Statement: Lotte Bock contributed to conceptualization and methodology; Lara Westemeyer was responsible for formal analysis and investigation; Nadine Morschner conducted data collection; Lotte Bock and Madiha Rana contributed to writing – original draft preparation; Madiha Rana was responsible for writing – review and editing; no funding acquisition was required; no additional resources were used; Madiha Rana and Majeed Rana supervised the project. All authors reviewed and approved the final manuscript.

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Data availability Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interest Lotte Bock, Lara Westemeyer, Nadine Moschner, Majeed Rana, and Madiha Rana declare that they have no conflict of interest.

Human and animal rights This study was conducted in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Ethical approval Ethical approval was obtained from the Ethikkommission der Euro-FH, approval number EKEFH03/22.

Informed consent Informed consent was obtained from all individual participants included in the study. Participation was voluntary, and participants were informed about their right to withdraw at any time without penalty.

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