

Formal versus Informal Mindfulness Practice: Exploring the Technological Gap and Future Research Directions

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Abstract

Mindfulness, a traditional practice rooted in Buddhism, has gained significant attention in research, education, psychology, and technology, with numerous studies demonstrating its benefits for overall well-being. While mindfulness is often associated with formal practices like sitting meditation, it includes much more. Plum Village, a Buddhist monastery founded by Thich Nhat Hanh, the father of mindfulness, emphasises integrating mindfulness into every aspect of daily life, such as walking, washing dishes, listening, and group sharing. Although technologies like mobile apps, web-based tools, and Virtual Reality (VR) have been developed to support mindfulness, they primarily focus on sitting meditation and breath awareness, neglecting the full spectrum of mindfulness practices. This paper reviews the traditional elements missing in current mindfulness technologies, identifying key trends and gaps. We provide an overview of these missing elements and propose future research directions for developing more well-rounded technological mindfulness tools.

1. Introduction

1.1. Background

Mindfulness, which originated from Buddha traditions, has become a major research focus across various fields, with publications in Web of Science growing nearly 30 times, from under 100 in 2000 to 2,808 in 2020 [BS21]. Once confined to spiritual settings, mindfulness is now widely integrated in education, healthcare, and the workplace to enhance mental well-being, reduce stress, and improve cognitive function. It is increasingly recognized as a valuable complement to traditional mental health treatments. Schools implement mindfulness programs to help students manage stress and improve focus [MPF*12], while companies use mindfulness training to boost employee well-being and productivity.

Although mindfulness has become more accessible through digital technologies, including social media designed to enhance connectivity, these technologies can sometimes contribute to loneliness and disconnection. Mindfulness can serve as a counterbalance, fostering mental well-being in our digital age [SKF*20]. However, most mindfulness technologies, including popular apps and VR experiences, are limited to formal practices like sitting meditation and sleep aids, and overlook the broader spectrum of mindfulness practices.

Plum Village (PV), a Buddhist monastery founded by Thich Nhat Hanh, emphasises integrating mindfulness into daily activities—such as walking, eating, listening, communicating, resting, and group sharing, known as “dharma sharing.” These informal practices are essential for holistic well-being but are largely ab-

sent from current digital tools, which tend to focus on narrower aspects like sitting meditation and breath awareness. Research indicates that informal mindfulness practices, which incorporate mindfulness into daily activities, can be more effective than dedicated practice alone [KHCL21].

1.2. Research Focus

This paper aims to identify gaps in current digital mindfulness technologies by analysing key literature and various technological tools. It will focus on the limited inclusion of diverse mindfulness practices, such as walking meditation, mindful eating, and total relaxation, which are central to the Plum Village tradition. The paper will pinpoint which of these techniques are absent from existing technologies and suggest research areas for developing a comprehensive framework for digital tools. The goal is to provide guidance for future research and creating more holistic mindfulness tools.

2. Definitions

2.1. Definition of Mindfulness

Mindfulness has various definitions, often leading to confusion about its true meaning. In traditional Buddhism, it refers to being aware of the present moment through meditation and sensory focus, which helps maintain attention, view experiences without bias, and cultivate acceptance [Chi13]. Thich Nhat Hanh, known as the father of mindfulness, refers to “right mindfulness” as the practice of bringing mindfulness energy into each act of daily life. This approach is at the heart of the Buddha’s teachings for achieving

Informal Practice	Description	Mindfulness Aspects
Mindful Walking	Walking slowly with mindfulness, paying attention to each step and breath.	Movement awareness
Total Relaxation	Deep relaxation techniques, often involving guided body scans	Relaxation, body awareness
Mindful Eating	Eating with full attention to the taste and texture of each bite	Sensory awareness, gratitude
Mindful Listening	Paying full attention to sounds in the environment and being present with them	Sensory awareness
Mindful Communication	Engaging in conversations with full attention, listening, and empathy	Active listening, empathy
Service Meditation	Applying mindfulness principles to work activities, focusing on one task at a time	Presence
Bell of Mindfulness	When hearing the mindfulness bell, stop whatever activities and bring awareness to breathing with ease and enjoyment	Presence, relaxation
Dharma Sharing	Sharing insights and experiences from mindfulness practice within a group	Reflection, community
Lazy Day	A day dedicated to relaxation and self-care without specific agendas or pressures	Rest, self-care

Figure 1: A summary of informal mindfulness practice features

personal transformation [Han98]. Contemporary psychology has adapted mindfulness to enhance self-awareness, manage emotional distress, and develop healthier responses [BLS*04].

2.2. Informal Mindfulness Practice in Plum Village

Mindfulness practices vary across Buddhist traditions, including formal and informal techniques. This diversity extends into Buddhism, psychology, and clinical therapy, as discussed in various studies [CM11, KHCL21]. The Plum Village tradition, founded by Thich Nhat Hanh in 1982, is known for integrating traditional Buddhist teachings with practical daily activities such as mindful breathing, sitting, walking, eating, and dharma sharing. Figure 1 shows the overview of the informal practices. As Europe's largest mindfulness centre, it offers a structured framework for informal mindfulness practices on both individual and collective levels. For this paper, Plum Village serves as a key reference for informal mindfulness practices due to its well-established and systematic approach.

3. Related Work

HCI research on mindfulness technologies has generally received positive feedback, highlighting ease of use, engagement, and benefits like increased relaxation, focus, and self-awareness [THHS19]. Studies have examined technologies such as VR, Augmented Reality (AR), and mobile apps for mindfulness [RS18]. However, most of this research focuses primarily on formal practices like seated meditation and breathwork [CT24, SKF*20, RS20].

Informal mindfulness practices—such as integrating mindfulness into everyday interactions like conversations, handshakes, and washing dishes—have been shown to significantly reduce stress, anxiety, and depression while improving life satisfaction [HWD*14, LL22]. These benefits can last up to 2.5 months after the intervention [STS*20]. Moreover, informal mindfulness practice has a greater quantitative impact than formal practice [KHCL21]. However, current technologies often overlook the broader range of

mindfulness practices, such as mindful eating, total relaxation, collective practice, dharma sharing and dharma talk. Despite some attempts to adapt mindfulness practices to VR and AR, such as walking meditation on smart glasses [TRHZ23], comprehensive integration remains limited. This review identifies these gaps and proposes research areas for developing a framework to incorporate informal mindfulness practices into digital tools. Currently, very few technologies address the full spectrum of mindfulness practices, including both formal and informal techniques.

4. Current Mindfulness Technologies: Coverage and Shortcomings

Recent interest has focused on using technologies—such as VR, AR, and mobile apps—to support mindfulness practices. Studies have examined these technologies' effectiveness, particularly for seated meditation and breathing exercises. For example, Poetar et al. [PBV23] and MA et al. [MZXY23] found that VR environments enhance mindfulness through guided meditation and breathwork, leading to improved mental health, mood, and increased relaxation.

4.1. Formal and Informal Mindfulness Practice

Both formal and informal mindfulness practices positively impact well-being. Formal mindfulness practices are structured activities with set times, such as body scans, sitting meditation, or mindful movement, designed to cultivate mindfulness. Informal mindfulness practices, on the other hand, involve integrating mindfulness into routine daily activities, such as eating mindfully, washing dishes with attention, or practising awareness during everyday tasks [BWvM*18]. Research indicates that informal practices often provide greater benefits for overall well-being compared to formal practices [BWvM*18]. Additionally, individuals who engage in informal mindfulness are more likely to maintain regular practice and experience sustained mindfulness improvements [eMZB*24]. The Plum Village tradition, with its emphasis on informal mindfulness, serves as a valuable key reference for informal practice. Figure 1

provides an overview of its mindfulness practices, which incorporate mindfulness into daily routines such as walking, listening, and eating. The mindfulness bell prompts practitioners to pause and breathe mindfully, and community practices like conversing and Dharma sharing, encouraging both individual and collective spiritual development.

4.2. Analysis of Existing Technologies

Our analysis covered 10 popular mindfulness mobile apps, including well-known options like Headspace, Calm, and Balance, and 9 XR/VR environments to evaluate their incorporation of informal mindfulness practice. We specifically looked at how well these technologies integrate Plum Village practices such as mindful eating, listening, Dharma sharing, and the mindfulness bell. While not all the practices are directly implemented, the essential concept of embedding mindfulness into daily activities is central. For example, mindfulness bells can be implemented as reminders for users to pause and breathe throughout the day.

Figure 2 shows how mindfulness apps, such as Headspace and Calm, incorporate both formal and informal practices, including sitting meditation, mindful eating, and walking. Figure 3 evaluates XR/VR apps and immersive experiences, both temporary and permanent, for their coverage of these same practices.

App	Formal Meditation (sitting, breath, body scan)	Mindful Eating	Mindful Walking	Mindful Listening	Mindful Communication	Total Relaxation/Sleep	Bell of Mindfulness	Dharma Sharing	Lazy Day	Other daily activities
Headspace	✓	✓	✓	✓	✗	✓	✗	✗	✗	✓
Calm	✓	✓	✓	✗	✗	✓	✗	✗	✗	✓
Balance	✓	✓	✓	✗	✗	✓	✗	✗	✗	✓
Ten Percent	✓	✓	✓	✗	✗	✓	✗	✗	✗	✗
The Mindfulness App	✓	✓	✓	✓	✗	✓	✗	✗	✗	✓
7Mind	✓	✓	✗	✗	✗	✓	✗	✗	✗	✓
Insight Timer	✓	✓	✓	✗	✗	✓	✗	✗	✓	✓
Serenity	✓	✗	✓	✗	✗	✓	✗	✗	✗	✓
Meditopia	✓	✓	✓	✓	✗	✓	✗	✗	✗	✗
Balloon	✓	✓	✓	✗	✗	✓	✗	✗	✗	✓

Figure 2: An overview of informal practice features in 10 mindfulness apps

Name	Technology Type	Formal Meditation (sitting, breath, body scan)	Mindful Eating	Mindful Walking	Mindful Listening	Mindful Communication	Total Relaxation/Sleep	Bell of Mindfulness	Dharma Sharing	Lazy Day	Other activities (Yoga or game)
Headspace XR	Mixed reality	✓	✗	✗	✗	✓	✓	✗	✗	✗	✓
Flowborne	Virtual reality	✓	✗	✗	✗	✗	✓	✗	✗	✗	✓
Maloka	Virtual reality	✓	✗	✗	✓	✗	✓	✗	✗	✗	✓
TRPP	Mixed reality	✓	✗	✓	✗	✗	✓	✗	✗	✗	✓
LIMINAL	Virtual reality	✓	✗	✗	✗	✗	✓	✗	✗	✗	✓
Mindway	Virtual reality	✓	✗	✗	✗	✓	✓	✗	✓	✗	✓
ZenVR	Virtual reality	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Room to Breathe (Temporary)	Physical Immersive Experience	✓	✗	✗	✗	✗	✗	✗	✗	✗	✗
Woom Center	Physical Immersive Experience	✓	✗	✗	✓	✗	✗	✗	✓	✗	✓

Figure 3: An overview of informal practice features in 9 mindfulness VR, XR and immersive experiences

4.3. Methodology

This study uses a narrative literature review to examine how technology integrates with informal mindfulness practices, addressing the following research question:

What key elements of informal mindfulness practices are missing in popular mindfulness apps and immersive technologies?

Following the guideline of Kraus et al [KBL*22], this review identifies trends and limitations in current mindfulness technologies and proposes guidelines for future research on integrating informal practices into mindfulness tools. Literature was sourced from Google Scholar, SpringerLink, ACM Digital Library, ResearchGate, and APA PsycNet, covering papers from 2012 to 2024. Keywords included “Mindfulness”, “Meditation”, “App”, “Informal Practice”, “Formal Practice”, “Immersive Technologies”, “Virtual Reality”, and “Mixed Reality” using Boolean operators like “Or” and “And” or refinement. Only English-language articles from psychology, computer science, and mindfulness were included. Mobile apps were selected from the German iTunes app store, focusing on those with over 1,000 ratings and an average rating above 4.0. For VR and XR apps, searches on the Meta Store targeted apps with more than 50 ratings and an average rating above 3.5, due to the emerging nature of these technologies. The review gathered qualitative insights from primary studies, including reviews and case studies, to identify gaps and guide the development of more inclusive mindfulness tools.

4.4. Results

The analysis revealed that both mobile apps and XR/VR technologies effectively cover formal mindfulness practices such as sitting meditation, breath awareness, and body scans. However, there is a notable gap of including informal mindfulness practices. Figure 2 analyses 10 popular mindfulness apps. All 10 apps incorporate formal techniques like sitting meditation, breath awareness, and body scans. 9 apps include mindful walking and eating, and 8 apps also feature other activities such as yoga and exercise. However, only 4 apps offer mindful listening, and just 1 app includes the concept of a lazy day. None of the apps provide features for mindful communication, the mindfulness bell, or Dharma sharing. Figure 3 evaluates 9 XR/VR apps and immersive experiences. All of the research apps and immersive experiences cover formal mindfulness practices. 7 of the 9 apps integrate other activities such as yoga or games, and 6 of the 9 feature total relaxation or sleep. Only 2 apps include mindful listening, mindful communication, or Dharma sharing. Only 1 app includes mindful walking. None of the XR/VR apps or immersive experiences cover mindful eating, the mindfulness bell, or the concept of a lazy day.

In summary, while formal mindfulness practices are well-represented, both mobile apps and XR/VR technologies lack coverage of informal practices. Mobile apps offer a broader range of daily mindfulness activities but lack features for mindful communication, the mindfulness bell, and Dharma sharing. XR/VR technologies show even less coverage of informal practices, with gaps in mindful eating, walking, the mindfulness bell, and the lazy day concept. This result highlights the need for digital tools to better integrate informal mindfulness techniques.

4.5. Evaluation

The sources were systematically selected using major academic databases such as Google Scholar, Springer Link, ACM Digital Library, and ResearchGate, to provide a comprehensive overview of mindfulness technologies. Only well-rated apps and VR technologies were included to ensure relevance and quality. The review identified gaps between formal and informal mindfulness practices in digital tools, cross-referencing these with established mindfulness frameworks from the Plum Village tradition. This approach ensured that the findings were grounded in authentic practices, with validity assessed through consistency across different studies.

5. Discussion

5.1. Barriers to Informal Mindfulness Integration

Our analysis reveals that while technologies support formal mindfulness practices, they largely overlook informal ones. This focus on formal practices is partly due to their easier implementation and measurement. Mobile apps and XR/VR technologies excel in delivering these structured practices but struggle with integrating informal practices. Their design is primarily audio guides and visual content [DWL21]. It works well for formal practices but is less effective for informal ones [LCG24].

Informal mindfulness practices, such as mindful eating or communication, require real-time, contextual awareness that digital platforms find challenging to replicate. These practices involve sensory interactions and real-world applications, which are difficult to simulate in virtual environments. These practices are dynamic and involve users' engagement, making them challenging to incorporate into apps or VR systems, which are typically designed for more structured interactions [KSF*22].

Technological constraints amplify the challenge. While devices can track basic physiological metrics such as heart rate and skin conductance, current technologies often lack the ability to measure and respond to subtle and dynamic aspects of emotional states and sensory experiences. Creating an interactive environment that supports practices like mindful communication or Dharma sharing requires advanced technology capable of facilitating meaningful interactions, something current tools struggle to achieve.

The market demand for formal practices, coupled with their familiarity and established frameworks, makes them a safer and more cost-effective choice for developers. Formal practices align well with existing digital tools and user expectations, whereas informal practices involve more uncertainty and higher development costs. Additionally, formal practices have broad appeal and established frameworks, making them a safer choice for developers. Informal practices, by contrast, involve higher development costs and more complex interactions, making them less attractive from a market and resource perspective. The market's preference for formal practices might be driven by their simplicity, established frameworks, and lower costs, making them a safer choice for developers compared to developing more complex and costly informal practices.

5.2. Limitations in Methodology

The review primarily focused on popular mobile apps and XR/VR technologies, which may not represent the full spectrum of available mindfulness tools. The evaluation of these technologies was based on available literature and app descriptions, which may not capture the full user experience. Furthermore, our analysis was limited to technologies available in English and popular in Western contexts, potentially overlooking valuable practices and tools from other cultures or languages. These factors may affect the generalizability of our findings. However, focusing solely on well-rated apps and VR technologies might miss emerging technologies that cover the broader range of mindfulness practice, leading to a potentially incomplete understanding of available options. The reliance on the Plum Village tradition could narrow the analysis, missing informal practices from other mindfulness traditions. Additionally, without practical experimentation or user feedback, the conclusions about the limitations of current technologies may lack real-world validation.

The current focus on formal mindfulness practices in technology highlights a bias towards structured and measurable activities. Informal practices, which are essential for daily mindfulness, are not well represented. The findings suggest a need for technology that includes both formal and informal mindfulness practices. Future development should aim to blend informal mindfulness with technology.

5.3. Propose Areas for Framework Development

To enhance the integration of mindfulness practices in digital technologies, several key areas for framework development should be considered. Frameworks should aim to feature both formal and informal mindfulness practices, including techniques for embedding mindfulness into everyday activities to expand the range of mindfulness applications. Real-time contextual feedback is essential, using sensors or data to provide guidance that adapts to the user's environment and activities. Interactive approaches, such as providing visual feedback and multisensory features, have been explored in studies, but they mainly focus on games and formal mindfulness practices [SKJ15]. Jacek, et al. analyzed various interactive technologies for mindfulness, including wearables, games, apps, VR, and installations that provide bio-feedback like heart rate, skin temperature, and facial recognition. Their focus is on the lack of ethical and spiritual dimensions rather than informal practice perspectives. While their paper suggests design guidelines such as emotional design, personalized feedback, goal tracking, and engaging game elements, these features are still largely absent in current mindfulness technologies [SKJ17]. Frameworks could also feature dynamic content that adjusts to individual needs and emotional states, enhancing personalisation. Advanced technologies should aim to better simulate sensory experiences and embodied practices to connect digital mindfulness with real-world experiences. Additionally, frameworks should support social aspects of mindfulness, developing virtual environments that allow users to engage in mindful communication Dharma sharing and group practices with family, friends, or even strangers, could help users maintain a sense of community and support. [SKJ17]. Practical reminders and prompts can help users incorporate mindfulness into their daily routines. Includ-

ing diverse mindfulness traditions and cultural practices could also ensure a more comprehensive and inclusive approach.

6. Future Exploration

One direction for future research is integrating biofeedback and artificial intelligence (AI) into mindfulness apps and immersive technologies like VR and XR. Biofeedback provides real-time data on physiological processes such as heart rate, breathing, and muscle tension to enhance self-awareness. By incorporating biofeedback sensors into mindfulness technologies, users could receive personalised feedback during their practices. AI could further refine these systems by adjusting mindfulness exercises based on real-time user data. For instance, AI could analyse biofeedback to detect heightened stress or difficulty relaxing, then suggest or modify practices to better suit the user's current state. This adaptive approach could significantly improve the effectiveness of mindfulness practices. The combination of biofeedback and AI has the potential to create a more personalised and responsive mindfulness experience. Further research could explore how immersive technologies like VR and AR can replicate or enhance community-based mindfulness practices, which are key to sustaining a mindfulness routine [BWvM*18].

7. Conclusion

Our research has exposed the gaps in how current mindfulness technologies address informal practices, which are crucial for a complete mindfulness experience. While formal practices are well-supported by mobile and VR/XR technologies, everyday mindful activities like mindful eating and communication are often overlooked. This limitation restricts the potential of these tools to fully support users' mindfulness journeys.

Integrating both structured and everyday mindfulness practices into digital tools can significantly enhance users' daily mindfulness routines. By bridging this gap, we can transform digital tools into more effective resources for enhancing well-being and fostering community connections. Such advancements will not only enhance individual mindfulness but also help address larger social challenges, such as isolation and lack of connection. Moving forward, research and development should focus on creating technologies that support a full spectrum of mindfulness practices, including community building and personal growth. This approach could better align digital tools with the diverse needs of users and promote a more connected and mindful society.

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