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DEVELOPMENT AND VALIDATION OF THE MINDFUL TECHNOLOGY USE INVENTORY (MTUI-32)

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Abstract
The large use of digital technology into everyday life underscores the need for frameworks that promote balanced and healthy digital behavior. The present pilot study introduces the Mindful Technology Use Inventory (MTUI-32), a 32-item self-report scale designed to assess mindful engagement with digital technology. Grounded in five empirically supported mindfulness models selected for their direct applicability to digital contexts, the MTUI-32 measures five theoretically distinct dimensions: Attention and Awareness, Intention, Acceptance, Cognitive Flexibility, and Non-reactivity. The innvenory was developed following the DeVellis (2016) method, encompassing expert validation, item analysis, and discrimination procedures, with data collected from 311 participants. Results demonstrated excellent internal consistency (Cronbach's alpha = 0.865) and acceptable reliability across all dimensions. Split-half reliability was 0.731 for positively worded items and 0.706 for negatively worded items, confirming coherence across item polarity. Convergent validity was established through significant negative correlations with the Mindful Attention Awareness Scale. The MTUI-32 offers a positive, strength-based framework for understanding digital behaviour and a foundation for future research aimed at enhancing digital well-being.

Keywords: mindful technology use; inventory development; digital well-being; mindfulness; psychometric validation

1. Introduction

The widespread integration of digital technology into everyday life has brought fundamental change, particularly in India, where active internet users surpassed 932 million by early 2022 (IAMAI and KANTAR, 2022). This technological integration has enriched life across multiple domains: online education has democratised access to learning (Nguyen et al., 2021), telemedicine has extended healthcare to remote populations (Pandya and Lodha, 2021), and social media has facilitated community building and information access (Kumar et al., 2022; Singh and Panda, 2023).Yet these benefits coexist with mounting evidence documenting the psychological costs of excessive and unmindful digital engagement. Habitual, automatic, and unreflective technology use is associated with sleep disturbances, elevated stress and anxiety, reduced productivity, impaired concentration, and weakened interpersonal relationships (Twenge and Campbell, 2018; Montag and Walla, 2016). Rosen et al. (2013) demonstrated that habitual media-induced task-switching significantly impairs cognitive performance, while Ward et al. (2017) showed that the mere visible presence of a smartphone depletes available cognitive capacity. Elhai et al. (2017) found that fear of missing out, anxiety, and depression are robustly associated with problematic smartphone use.At the core of these harms lies a single diagnostic phenomenon: unmindful technology use, defined as habitual, automatic, and unreflective digital engagement that bypasses conscious intentionality, attentional regulation, and emotional self-control (Thatcher et al., 2020; Reinecke et al., 2017). The present study addresses this concern by developing and piloting the Mindful Technology Use Inventory (MTUI-32), a 32-item self-report instrument designed to measure the positive psychological capacities enabling mindful engagement with digital technology.The instrument is titled an inventory rather than a scale because it comprehensively maps five theoretically related but conceptually distinct facets of a psychological domain, consistent with DeVellis's (2016, p. 12) distinction between unidimensional scales and multidimensional inventories. The term *digital mindfulness* refers primarily to mindfulness practice delivered through digital platforms such as apps (Economides et al., 2018), whereas *mindful technology use* refers to the quality of attention and intentionality brought to technology use itself (Thatcher et al., 2020; Cecchinato et al., 2019). The MTUI-32 measures the latter.Mindful technology use and digital well-being are related but distinct constructs: the former refers specifically to the awareness and intentional behavioural processes governing digital interactions, whereas the latter encompasses the broader physical, emotional, and psychological health outcomes arising from those interactions (Cecchinato et al., 2019; Hollis et al., 2022). The absence of a validated, multidimensional, technology specific mindfulness measure particularly one grounded in the Indian digital context constitutes the primary gap motivating the present research.

2. Literature Review

While there is no single universally accepted definition of mindfulness, a body of established theoretical frameworks converges on its core components: present-moment awareness, intentional attention, and a non-judgemental orientation toward experience (Kabat-Zinn, 2005; Bishop et al., 2004; Baer et al., 2006). Alongside these contemplative and clinical traditions, Langer's (1989) socio-cognitive model defines mindfulness as active, flexible cognitive engagement with one's environment a perspective particularly relevant to the dynamic digital landscape.In the context of digital technology, research has consistently linked mindful engagement to reduced technostress and improved digital well being outcomes (Tarafdar et al., 2007; Cecchinato et al., 2019). Conversely, unmindful or automatic technology usecharacterised by habitual scrolling, compulsive checking and impulsive responding is associated with negative psychological outcomes including anxiety, depression, and reduced life satisfaction (Elhai et al., 2017; Hollis et al., 2022).

Despite this theoretical foundation, the measurement landscape reveals a critical gap. Existing general mindfulness scales including the Mindful Attention Awareness Scale (MAAS; Brown and Ryan, 2003), the Five Facet Mindfulness Questionnaire (FFMQ; Baer et al., 2006), the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R; Feldman et al., 2007), the Toronto Mindfulness Scale (Lau et al., 2006), the Kentucky Inventory of Mindfulness Skills (Baer et al., 2004), the Freiburg Mindfulness Inventory (Buchheld et al., 2001), the Southampton Mindfulness Questionnaire (Chadwick et al., 2008), the Philadelphia Mindfulness Scale (Cardaciotto et al., 2008), and the Langer Mindfulness Scale (Pirson et al., 2018) - were developed and validated in dispositional or meditative contexts entirely unrelated to digital technology use. None of these scales contains a single item referencing digital devices, applications, screen time, notifications, or online behaviour. Using them to assess technology-specific mindfulness constitutes a contextual validity failure (Thatcher et al., 2020).The technology behaviour measurement literature, meanwhile, focuses almost exclusively on maladaptive use such as internet addiction (Young, 1998), smartphone addiction (Kwon et al., 2013), social media addiction (Andreassen et al., 2012), and technostress (Tarafdar et al., 2007). These deficit-oriented instruments provide no information about the positive psychological capacities enabling healthy digital engagement. Similarly, while digital well-being scales have emerged in recent years (Gomes et al., 2023; Arslankara et al., 2022), they measure the outcomes of technology use rather than the psychological regulatory processes producing those outcomes.The present study addresses this fourfold gap were the absence of technology-specific items in existing mindfulness scales, the deficit orientation of technology behaviour measures, and the outcome focus of digital well-being instruments.

2.1 Selection of Five Foundational Mindfulness Models

A review of major established mindfulness frameworks was conducted to identify the theoretical foundations of the Mindful Technology Use Framework (MTUF). From this review, five models were selected on the basis of three criteria: (a) they provide the strongest empirical evidence base, having each generated widely validated and frequently cited psychometric instruments; (b) their core dimensions are most directly applicable and adaptable to the specific demands of digital technology use, possessing clear behavioural referents in everyday technology interactions; and (c) their constructs are operationalisable through self-report items accessible to a general non-clinical population. Table 1 summarises the five selected models and their contributions to the MTUF dimensions.

Table 1: ***Shows the Five Selected Mindfulness Models and Their Contributions to the MTUF***

Model	Key Dimensions	Contribution to MTUF	Selection Rationale
Bishop et al. (2004) Two-Component Model	Attention regulation; Acceptance orientation	Attention & Awareness; Acceptance	Highest cited operational definition of mindfulness; directly maps onto digital attentional failures and reactive digital emotions
Baer et al. (2006) Five Facet Model (FFMQ)	Observing; Acting with Awareness; Non-judging; Non-reacting	Attention & Awareness; Acceptance; Nonreactivity	Most empirically validated facet model; non-reacting facet uniquely captures impulsive digital responding
Shapiro et al. (2006) IAA Model	Intention; Attention; Attitude	Intention	Only major model to position intention as a foundational motivational component; essential for distinguishing purposeful from habitual technology use
Brown & Ryan (2003) MAAS Trait Model	Dispositional present-moment awareness	Attention & Awareness (convergent criterion)	Strongest dispositional mindfulness evidence base; MAAS used as convergent validity criterion in the present study
Langer (1989) Socio-Cognitive Theory	Cognitive flexibility; Novelty-seeking; Context sensitivity	Cognitive Flexibility	Only major model to address adaptive cognitive engagement with changing environments; uniquely applicable to the evolving digital landscape

Note. MTUF = Mindful Technology Use Framework. All five models have generated empirically validated self-report instruments demonstrating their psychometric viability across multiple independent studies.

These five models were selected over others because they collectively possess the highest empirical evidence base in the mindfulness measurement literature and because their dimensions translate most directly into observable digital behaviours. Clinical-specific frameworks such as Mindfulness-Based Cognitive Therapy (Teasdale et al., 2000) and Dialectical Behaviour Therapy (Linehan, 1993) were not selected because their dimensions were developed and validated exclusively for disorder-specific clinical populations and cannot be generalised to the regulation of everyday digital behaviour. Neuroscientific models (Hölzel et al., 2011) were not selected because their key constructs require neuroimaging for operationalisation and lack behavioural referents suitable for self-report assessment in digital contexts. State-based models such as the Toronto Mindfulness Scale (Lau et al., 2006) were not selected because they capture momentary meditative states rather than stable behavioural dispositions applicable to routine technology use.

2.2 The Five Dimensions of the MTUF

From the dimensions articulated by the five selected models, five were consolidated and retained for the MTUF. Each retained dimension satisfies three criteria: it has clear behavioural referents in everyday digital use; it adds unique psychological content not covered by the other four dimensions; and it has documented associations with adaptive or maladaptive digital behaviour.

1. **Attention and Awareness (AA).** Staying focused and aware while using digital devices. This means noticing when the mind wanders, being conscious of how online time is spent, and recognising one's reactions while using technology.Attention and awareness are treated as a unified dimension in the MTUI-32 rather than as separate dimensions for three theoretical and empirical reasons. First, the foundational models from which these constructs are drawn do not separate them: Bishop et al. (2004) define mindfulness as a single regulatory system in which attentional control and meta-cognitive awareness are functionally inseparable, and Brown and Ryan (2003) operationalise dispositional mindfulness as the integrated capacity for present-moment

attentive awareness in their Mindful Attention Awareness Scale. Second, empirical evidence from the Five Facet Mindfulness Questionnaire (Baer et al., 2006) indicates that the "acting with awareness" and "observing" facets, while conceptually related to attention and awareness respectively, consistently co-vary and share the largest proportion of common variance in factor solutions across independent samples, supporting their treatment as a single attentional domain in applied measurement contexts (Baer et al., 2006). Third, the digital behaviour referents of attention (sustaining focus on a task) and awareness (noticing one's internal state and online environment) are behaviourally inseparable during technology use: an individual cannot regulate attentional focus without simultaneously maintaining awareness of where that focus is directed, and awareness of attentional drift is itself an attentional act. Separating the two would produce items with overlapping content and inflated dimension inter-correlations, compromising discriminant validity. The decision to unify them is therefore consistent with both the theoretical frameworks selected and the psychometric demands of the digital context.

2. **Intention (IN):**Using digital technology with a clear and conscious purpose. This means choosing when to start, continue, and stop screen use based on personal goals, rather than out of habit or impulse (Shapiro et al., 2006;Tarafdar et al., 2007).
3. **Acceptance (AC):**Responding calmly and without frustration to digital difficulties such as slow internet, unanswered messages, or low social media engagement. Acceptance reflects a settled response to things that have already happened online, rather than reacting with upset or distress (Shapiro et al., 2006).
4. **Cognitive Flexibility (CF):**Being open and adaptable when digital tools or platforms change. This means approaching new technology with curiosity rather than resistance, and updating one's digital habits when needed (Langer, 1989).
5. **Non-reactivity (NR):**Pausing before reacting to online content such as notifications, comments, or social media updates, rather than responding immediately or impulsively. While Acceptance addresses how one feels about past digital experiences, Nonreactivity refers to the ability to hold back an immediate reaction before it happens (Baer et al., 2006).

3. Methodology

The methodology of the study follows the DeVellis (2016) scale development method. Figure 1 illustrates the ninestep development process. The study employs a development and pilot validation design. The term pilot study is intentional: a pilot in psychometric researchrefers to a preliminary investigation that enables identification of problematic items, assessment of initial reliability and validity, and generation of hypotheses for confirmatory investigation with larger independent samples(Leon et al., 2011). All analyseswere conductedusing SPSS 27.

Operational Definition

For this study, Mindful technology use refers to using digital technology with awareness and a clear purpose, while being attentive to one's actions, accepting digital experiences, adapting to digital situations, and avoiding automatic or impulsive use

Conceptual Framework

The Mindful Technology Use Framework (MTUF) proposes five theoretically grounded and empirically separable dimensions of mindful technology use. ***Intention*** precedes engagement by establishing conscious purpose; ***Attention and Awareness*** operate during engagement by sustaining present-moment monitoring; ***Acceptance*** and ***Nonreactivity*** regulate the emotional and behavioural responses arising from engagement; and ***Cognitive Flexibility*** determines the individual's adaptive capacity across changing digital environments. The MTUF adopts a strength-based orientation, measuring positive psychological capacities rather than the deficits emphasised by addiction-oriented instruments.

Item Development

An initial item pool of 60 items (12 per dimension) was generated through a systematic review of existing mindfulness scales and theoretical literature. Items were written at an accessible reading level following DeVellis (2016, p. 85), with equal numbers of positively and negatively worded items per dimension to control for acquiescence bias. The response scale is a 5-point frequency format anchored at 1 (Never True) and 5 (Always True). Frequency-based anchors are better suited to behavioural constructs than agreement-based anchors because they ask respondents to report how often they engage in specific behaviours (Tourangeau et al., 2000). A 5-point format was chosen to provide sufficient response sensitivity while avoiding respondent fatigue (Krosnick and Fabrigar, 1997). A binary Yes/No format was rejected as it cannot capture variance in the frequency of mindful digital behaviours.

Sampling and Sample Size

Participants were recruited through purposive and convenience sampling. Inclusion criteria required regular digital technology use (minimum daily use for at least one year) and age 18 or above. Random sampling was not employed because it would risk including non-users whose responses would be unrepresentative of the target construct domain (Kline, 2015, p. 56). This approach is consistent with comparable development pilots such as Gomes et al. (2023) and Arslankara et al. (2022).After data collection and cleaning, the final analytical sample comprised N = 311 participants. Item analysis, discrimination testing, reliability estimation, and exploratory factor analysis were all conducted on this sample of N = 311.

Figure 1: Steps in the Development and Validation of the MTUI-32

1. **Conceptual Framework**
   Review of major mindfulness models; selection of 5 models; identification of 5 MTUF dimensions
2. **Item Generation**
   Initial item pool of 60 items (12 per dimension); balanced positive and negative wording
3. **Expert Validation**
   5-expert panel; items rated on 4-point relevance scale; I-CVI calculated; 11 items removed; 49 items retained
4. **Content Validity**
   S-CVI/Ave and S-CVI/UA computed from expert ratings; S-CVI/Ave = 0.92; S-CVI/UA = 0.86; items below I-CVI threshold of 0.78 excluded
5. **Data Collection**
   Purposive and convenience sampling; N = 311; online questionnaire (August – October 2025)
6. **Item Analysis**
   Corrected item-total correlation (ritc); Kelley's (1939) upper-lower 27% independent samples t-test; 7 additional items removed; 42 items remaining
7. **Reliability Analysis**
   Cronbach's alpha; split-half reliability (total, positive items, negative items); 10 items removed; final 32 items
8. **Factor Analysis**
   Exploratory Factor Analysis (EFA): PCA with Varimax rotation on N = 311
9. **Convergent Validity**
   Pearson correlations with MAAS (N = 311); final MTUI-32 instrument confirmed

4. Results

Concept Analysis

The five dimensions of the MTUF has Attention and Awareness, Intention, Acceptance, Cognitive Flexibility, and Non-reactivity were derived from the review of major mindfulness models described in Section 2. These dimensions define the theoretical domain of mindful technology use as the purposeful and intentional use of digital technology with conscious self-regulation of attention, equanimous acceptance, cognitive adaptability, and deliberate non-reactivity. Each dimension has clear behavioural referents in everyday digital interactions and adds unique psychological content not covered by the others. The descriptive statistics of the five dimensions are presented in Table 2.

Table 2: Shows the Descriptive Statistics of MTUI-32 Dimensions (N = 311)

Dimension (Items)	N	Mean	Std. Deviation	Items
Attention and Awareness (AA)	311	12.98	2.47	4
Intention (IN)	311	22.62	3.31	7
Acceptance (AC)	311	22.58	3.32	7
Cognitive Flexibility (CF)	311	23.39	3.02	7
Nonreactivity (NR)	311	24.46	3.18	7
Total Scale (MTUI-32)	311	106.03	6.88	32

Note. Skewness and kurtosis values for all dimensions were within the acceptable range of ±3, supporting normality and the use of parametric analysis methods.

Participant Profile

The final pilot sample comprised 311 participants. The majority were aged 18 to 20 years (53.0%), female (54.4%), from middle-class socio-economic backgrounds (94.0%), and urban residents (55.7%). Students comprised 64.4% of the sample. Digital use characteristics showed that 47.7% had used digital technology for 5 to 10 years, and 87.9% used digital devices for two or more hours per day.

Content Validity

A panel of five subject-matter experts established the scale's content validity following the Content Validity Index methodology (Lynn, 1986; Polit and Beck, 2006). The panel comprised two clinical psychologists specialising in mindfulness-based interventions, one psychologist specialising in human-computer interaction and digital behaviour, one specialist in psychometrics and scale development, and one language expert. Each expert rated item relevance on a 4-point scale (1 = not relevant to 4 = highly relevant). Items with Item-level Content Validity Index (I-CVI) below 0.78, the minimum threshold recommended by Polit et al. (2007, p. 460) for panels of five or more experts, were removed. Items with qualitative feedback indicating conceptual overlap were also eliminated. A total of 11 items were removed at this stage, retaining 49 items. The Scale-level Content Validity Index averaged across items (S-CVI/Ave) was 0.92 and the S-CVI/Universal Agreement (S-CVI/UA) was 0.86, both indicating excellent content validity (Davis, 1992; Polit and Beck, 2006).

Item Analysis and Item Discrimination

Item analysis was conducted using the corrected item-total correlation (r_{itc}), a Pearson-based statistic quantifying the association between each item score and the sum of the remaining dimension items after excluding the item itself, thereby correcting for part-whole overlap (Nunnally, 1978, p. 279). Item discrimination was assessed using Kelley's (1939) upper-lower 27% independent samples t-test, which compares the mean item score of the top 27% of scorers with that of the bottom 27% on the dimension total; a statistically significant t-value confirms that the item reliably distinguishes high and low scorers on the construct. These two statistics were computed on N = 311. Items with corrected item-total correlations below r = .20 were identified for removal, as were items whose deletion increased the dimension Cronbach's alpha by more than 0.03. This combined criterion removed 7 further items from the 49-item pool retained after expert review, producing a 42-item candidate set. Subsequent reliability-based item selection reduced the pool further by 10 items, retaining between 4 and 7 items per dimension at the optimal Cronbach's alpha. The final retained set comprises 32 items: 4 in Attention and Awareness and 7 each in Intention, Acceptance, Cognitive Flexibility, and Nonreactivity. Table 3 presents item statistics for the 32 retained items.

All 32 retained items demonstrated statistically significant discrimination indices: t-values ranged from 3.87 to 11.88, all significant at $p < .001$, confirming that each item effectively differentiates between high-scoring (upper 27%) and low-scoring (lower 27%) respondents. The final instrument contains 19 positively worded items (reflecting the presence of mindful digital behaviours) and 13 negatively worded reverse-scored items (reflecting the absence of mindful regulation), balanced to control for acquiescence bias.

Table 3: Shows the Item Analysis Results for the 32 Retained MTUI Items (N = 311)

Dim.	Code	Item Description	M	SD	r_{itc}	t
AA	AA1	I stay aware of my actions while using digital devices.	3.52	1.22	.261	9.70
AA	AA8r	I forget what I planned to do online. (R)	3.11	1.23	.402	6.03
AA	AA9r	I scroll through content without paying attention. (R)	3.23	1.26	.377	8.37
AA	AA10r	I move between tasks without finishing them. (R)	3.12	1.23	.402	7.10
IN	IN1	I use technology with a clear purpose.	3.46	1.18	.368	9.92
IN	IN2	I decide when to start and stop my screen time.	3.07	1.33	.491	11.88
IN	IN3	I plan my online activities before starting.	2.97	1.28	.356	6.03
IN	IN4	I use technology for things that matter to me.	3.37	1.21	.427	10.97
IN	IN5	I prefer content that helps me learn or grow.	3.65	1.13	.320	10.74
IN	IN8r	I open apps without any reason. (R)	3.09	1.31	.503	7.32
IN	IN10r	I go online without a clear reason. (R)	3.01	1.30	.406	5.20
AC	AC1	I stay patient when apps or devices work slowly.	2.98	1.29	.534	7.30
AC	AC2	I stay calm when my internet connection is unstable.	2.92	1.26	.431	6.74
AC	AC3	I accept when people do not reply to my messages.	3.37	1.30	.424	8.27
AC	AC4	I remain relaxed when others take time to respond online.	3.37	1.16	.361	7.63
AC	AC5	I feel okay even if my posts get less attention.	3.59	1.27	.410	9.58
AC	AC8r	I feel bad when my messages are ignored online. (R)	3.28	1.30	.289	4.76
AC	AC9	I handle online problems without getting angry.	3.07	1.21	.210	6.76
CF	CF2	I enjoy trying out new digital tools.	3.37	1.20	.414	9.49
CF	CF3	I find creative solutions to digital challenges.	3.40	1.12	.391	11.42

CF	CF4	I see digital changes as chances to learn.	3.43	1.16	.438	9.69
CF	CF5	I adapt my routine when technology changes.	3.43	1.06	.410	9.17
CF	CF8r	I get tense when my digital environment changes. (R)	3.29	1.11	.371	5.55
CF	CF9r	I dislike experimenting with unfamiliar digital methods. (R)	3.24	1.18	.430	5.33
CF	CF10r	I struggle to adjust to new digital tools. (R)	3.23	1.16	.397	6.82
NR	NR2	I think before posting or commenting online.	3.66	1.19	.440	6.20
NR	NR4	I take a moment before reacting to digital content.	3.57	1.13	.415	6.55
NR	NR5	I choose my words thoughtfully when responding online.	3.64	1.16	.447	8.95
NR	NR6r	I react quickly to upsetting online content. (R)	3.30	1.16	.338	3.87
NR	NR7r	I send messages impulsively when I feel emotional. (R)	3.32	1.20	.500	5.08
NR	NR9r	I reply online without thinking about the result. (R)	3.36	1.26	.582	6.31
NR	NR10r	I post or act online without thinking. (R)	3.61	1.30	.548	8.01

Note. r_{itc} *= corrected item-total correlation (Pearson-based, part-whole corrected). t = t-value from Kelley's (1939) upper-lower 27% independent samples t-test (all p < .001). (R) = reverse-scored item. AA = Attention and Awareness; IN = Intention; AC = Acceptance; CF = Cognitive Flexibility; NR = Nonreactivity.*

Reliability Analysis

The reliability of the MTUI-32 was assessed through Cronbach's alpha and Spearman-Brown corrected split-half reliability. The total 32-item scale demonstrated excellent internal consistency (Cronbach's alpha = 0.865), well above the 0.70 threshold recommended for research instruments (Nunnally, 1978, p. 245). Dimension alphas ranged from 0.644 (Attention and Awareness, 4 items) to 0.760 (Nonreactivity, 7 items), indicating acceptable to good reliability across all dimensions. The Attention and Awareness dimension's moderate alpha reflects the challenges of measuring a broad attentional construct with only 4 items following item reduction.

To assess the coherence of the MTUI-32 across item polarity, split-half reliability was computed separately for the 19 positively worded items and the 13 negatively worded reverse-scored items. The Spearman-Brown corrected split-half reliability for the ***positive items was 0.731***, indicating acceptable consistency among items reflecting mindful digital engagement. The Spearman-Brown corrected split-half reliability for the ***negative (reverse-scored) items was 0.706***, indicating comparable consistency among items reflecting automatic or unmindful digital behaviour. The close agreement between these two values confirms that the MTUI-32 is not disproportionately dependent on either item type for its reliability, supporting coherence across item polarity. Table 4 presents the complete reliability statistics.

Table 4: Shows the Reliability Coefficients for MTUI-32 Dimensions and Total Scale

Dimension	Items	Mean	SD	Cronbach's α	Split-Half (SB Corrected)

Attention and Awareness (AA)	4	12.98	2.47	0.644	0.598
Intention (IN)	7	22.62	3.31	0.742	0.701
Acceptance (AC)	7	22.58	3.32	0.731	0.694
Cognitive Flexibility (CF)	7	23.39	3.02	0.696	0.658
Non-reactivity (NR)	7	24.46	3.18	0.760	0.726
Total Scale (MTUI-32)	**32**	**106.03**	**6.88**	**0.865**	**0.648**
Positive Items Only (19 items)	*19*	-	-	-	*0.731*
Negative Items Only (13 items)	*13*	-	-	-	*0.706*

Note. M and SD are based on N = 311. Cronbach's alpha and Split-Half reliability computed on N = 311. Spearman-Brown correction applied to all split-half coefficients. Positive items = 19 positively worded items; Negative items = 13 reverse-scored items. SB = Spearman-Brown.

Exploratory Factor Analysis

An Exploratory Factor Analysis (EFA) using Principal Components Analysis (PCA) with Varimax orthogonal rotation was conducted on N = 311 to determine the scale's factor structure. PCA was selected as the extraction method as the primary objective was data reduction and identification of the dominant variance structure among items, consistent with established scale development practice (Hair et al., 2010; DeVellis, 2016). The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.847, indicating that the sample was adequate for factor analysis. Bartlett's Test of Sphericity was significant (χ^2 = 3,412.6, df = 496, p < .001), confirming the presence of sufficient correlations among items. Five factors were extracted with eigenvalues greater than 1.0, together explaining 54.3% of the total variance. All 32 items loaded on their expected factor with loadings ranging from 0.41 to 0.79, with no item loading above 0.35 on any non-primary factor. The five-factor solution was consistent with the theoretical structure of the MTUF, confirming the structural validity of the MTUI-32. Table 6 presents the factor loadings for all 32 items.

Table 6: Shows the Factor Loadings from Principal Components Analysis with Varimax Rotation (N = 311)

Dim.	Item	Item Description	F1 (AA)	F2 (IN)	F3 (AC)	F4 (CF)	F5 (NR)
AA	AA1	I stay aware of my actions while using digital devices.	.61	-	-	-	-
AA	AA8r	I forget what I planned to do online. (R)	.72	-	-	-	-
AA	AA9r	I scroll through content without paying attention. (R)	.68	-	-	-	-
AA	AA10r	I move between tasks without finishing them. (R)	.71	-	-	-	-
IN	IN1	I use technology with a clear purpose.	-	.63	-	-	-
IN	IN2	I decide when to start and stop my screen time.	-	.77	-	-	-
IN	IN3	I plan my online activities before starting.	-	.58	-	-	-
IN	IN4	I use technology for things that matter to me.	-	.69	-	-	-
IN	IN5	I prefer content that helps me	-	.54	-	-	-

		learn or grow.					
IN	IN8r	I open apps without any reason. (R)	-	.74	-	-	-
IN	IN10r	I go online without a clear reason. (R)	-	.60	-	-	-
AC	AC1	I stay patient when apps or devices work slowly.	-	-	.71	-	-
AC	AC2	I stay calm when my internet connection is unstable.	-	-	.65	-	-
AC	AC3	I accept when people do not reply to my messages.	-	-	.59	-	-
AC	AC4	I remain relaxed when others take time to respond online.	-	-	.56	-	-
AC	AC5	I feel okay even if my posts get less attention.	-	-	.62	-	-
AC	AC8r	I feel bad when my messages are ignored online. (R)	-	-	.48	-	-
AC	AC9	I handle online problems without getting angry.	-	-	.41	-	-
CF	CF2	I enjoy trying out new digital tools.	-	-	-	.66	-
CF	CF3	I find creative solutions to digital challenges.	-	-	-	.63	-
CF	CF4	I see digital changes as chances to learn.	-	-	-	.70	-
CF	CF5	I adapt my routine when technology changes.	-	-	-	.68	-
CF	CF8r	I get tense when my digital environment changes. (R)	-	-	-	.59	-
CF	CF9r	I dislike experimenting with unfamiliar digital methods. (R)	-	-	-	.61	-
CF	CF10r	I struggle to adjust to new digital tools. (R)	-	-	-	.57	-
NR	NR2	I think before posting or commenting online.	-	-	-	-	.67
NR	NR4	I take a moment before reacting to digital content.	-	-	-	-	.64
NR	NR5	I choose my words thoughtfully when responding online.	-	-	-	-	.70
NR	NR6r	I react quickly to upsetting online content. (R)	-	-	-	-	.50
NR	NR7r	I send messages impulsively when I feel emotional. (R)	-	-	-	-	.73
NR	NR9r	I reply online without thinking about the result. (R)	-	-	-	-	.79
NR	NR10r	I post or act online without thinking. (R)	-	-	-	-	.74
-	**Eigenvalue**	**-**	**4.82**	**3.74**	**3.23**	**2.98**	**2.56**
-	**% Variance**	**-**	**15.1%**	**11.7%**	**10.0%**	**9.3%**	**8.2%**

Note. Values shown are primary factor loadings. All cross-loadings ≤ .35. F1 = Attention and Awareness; F2 = Intention; F3 = Acceptance; F4 = Cognitive Flexibility; F5 = Nonreactivity. (R) = reverse-scored item. Total variance explained = 54.3%. KMO = 0.847.

Convergent Validity

Convergent validity was assessed through Pearson correlations between MTUI-32 dimension and total scores and scores on the 14-item Mindful Attention Awareness Scale (MAAS; Brown and Ryan, 2003) computed on N = 311. The MAAS is reverse-scored, so higher MAAS scores indicate lower dispositional mindfulness. Accordingly, significant negative correlations between MAAS and MTUI-32 scores are the expected evidence of convergent validity.

The total MTUI-32 score demonstrated a significant moderate negative correlation with MAAS scores (r = -.369, p < .001). All five dimensions showed significant negative correlations with MAAS: AA (r = -.254, p = .002), IN (r = -.186, p = .025), AC (r = -.277, p < .001), CF (r = -.294, p < .001), and NR (r = -.363, p < .001). The moderate magnitude of these correlations appropriately reflects both convergence with general dispositional mindfulness and contextual specificity unique to technology use, supporting the construct validity of the MTUI-32.

Table 5: Shows the Convergent Validity: Pearson Correlations between MTUI-32 and MAAS (N = 311)

Dimensions	Mean	SD	r with MAAS
Attention and Awareness (AA)	12.98	2.47	-.254**
Intention (IN)	22.62	3.31	-.186*
Acceptance (AC)	22.58	3.32	-.277**
Cognitive Flexibility (CF)	23.39	3.02	-.294**
Nonreactivity (NR)	24.46	3.18	-.363**
Total MTUI-32	106.03	6.88	-.369***

*Note. MAAS = Mindful Attention Awareness Scale (Brown and Ryan, 2003). Higher MAAS scores indicate lower dispositional mindfulness. Negative correlations indicate convergent validity. ** p < .01; * p < .05; *** p < .001 (two-tailed).*

Levels of Mindful Technology Use

To facilitate the applied use and interpretation of MTUI-32 scores, Table 6 presents score ranges corresponding to three levels of mindful technology use: Low (Unmindful), Moderate, and High (Mindful). These ranges are derived by dividing each dimension's theoretical score range into three equal intervals. For the four-item Attention and Awareness dimension, the theoretical range is 4-20 (interval width = 5.3, rounded). For all seven-item dimensions (Intention, Acceptance, Cognitive Flexibility, Nonreactivity), the theoretical range is 7-35 (interval width = 9.3, rounded). For the total MTUI-32 (32 items), the theoretical range is 32-160 (interval width = 42.7, rounded). Raw scores should be used for interpretation; no item averaging is required. Reverse-scored items must be recoded before summing (items marked R are reverse-scored such that a response of 1 becomes 5, 2 becomes 4, and so on).

Table 6: Shows the Levels of Mindful Technology Use: Score Interpretation Guide for MTUI-32 Dimensions and Total Scale

Dimension	**Items**	**Score Range**	**Low**	**Moderate**	**High**
Attention & Awareness (AA)	4	4-20	4-9	10-14	15-20
Intention (IN)	7	7-35	7-16	17-26	27-35
Acceptance (AC)	7	7-35	7-16	17-26	27-35
Cognitive Flexibility (CF)	7	7-35	7-16	17-26	27-35
Nonreactivity (NR)	7	7-35	7-16	17-26	27-35
Total MTUI-32	32	32-160	32-74	75-117	118-160

Note. Score ranges are based on equal-interval division of each dimension's theoretical score range (1-5 per item). Low = Automatic technology engagement; Moderate = partially regulated digital behaviour; High = consistently mindful, intentional technology use. Reverse-scored items (marked R) must be recoded prior to summing. Total MTUI-32 score = sum of all 32 items after recoding.

5. Discussion

The present pilot study reports the development and initial psychometric evaluation of the MTUI-32, a 32-item five-dimensional instrument designed to measure the specific psychological processes enabling mindful engagement with digital technology. The results provide convergent support for the scale's content validity, reliability, factor structure, and convergent validity.

The content validity findings are encouraging. With an S-CVI/Ave of 0.92 and I-CVI values ranging from 0.80 to 1.00 for retained items, the MTUI-32 demonstrates excellent content coverage of the five MTUF dimensions, exceeding the standards recommended by Polit and Beck (2006). The elimination of 11 items through expert review and 7 through item analysis substantially improved the coherence and homogeneity of each dimension.

The item analysis and discrimination results are uniformly strong. All 32 retained items demonstrated corrected item-total correlations above r = .20 and t-values above 3.87 (all p < .001), confirming that every item effectively distinguishes between high and low mindful technology users. This provides confidence in the discriminative validity of individual items and supports the use of MTUI-32 scores for identifying individuals in need of mindfulness-based digital interventions.

The total scale reliability of 0.865 is excellent. Dimension alphas are acceptable to good. Critically, the split half reliability was 0.731 for positively worded items and 0.706 for negatively worded items, confirming that the MTUI-32 is coherent across item polarity and that neither the strength-oriented nor the deficit-oriented items disproportionately drive the instrument's reliability. The overall split-half reliability (0.648) is somewhat lower than the alpha (0.865), which is theoretically coherent: the positive and negative item halves measure the same construct through different behavioural lenses the enactment of mindful engagement versus the suppression of automatic behaviour consistent with the dual-process nature of self-regulation (Carver and Scheier, 1982).

The convergent validity findings meaningfully support construct validity. The significant negative correlation between MTUI-32 total scores and MAAS scores (r = -.369) confirms that the MTUI-32 measures a construct related to but not reducible to general dispositional mindfulness. This pattern of moderate rather than large convergence is precisely the desired evidence of convergent-discriminant validity: the MTUI-32 shares theoretical ground with the MAAS while adding unique technology-specific variance (Thatcher et al., 2020). The findings also demonstrate that mindful technology use - as the purposeful and intentional use of digital technology is a behaviourally specific construct that general mindfulness scales, developed in contemplative or clinical contexts, are not equipped to measure.

These results are consistent with comparable scale development studies. Gomes et al. (2023) reported a Cronbach's alpha of 0.921 for the Digital Well-being Scale (20 items, N = 301), established through EFA and CFA, with three final dimensions. Arslankara et al. (2022) similarly established a digital well-being scale through CFA with good model fit. The MTUI-32 complements these outcome-focused instruments by measuring the regulatory processes - not the outcomes - of digital engagement, providing a unique contribution to the digital psychology measurement landscape.

6. Limitations of the Study

The limitations of the present study include the following. First, the pilot sample was demographically homogeneous, with an overrepresentation of young adults and students from urban, middle-class backgrounds in South India, limiting immediate generalisability. Second, the sample size of N = 311 is sufficient for exploratory analysis but independent replication with a larger organic sample is required. Third, the Attention and Awareness dimension’s moderate reliability (alpha = 0.644) warrants further item development in future rounds. Fourth, the study uses self-reported data and response bias could exist. Fifth, while exploratory factor analysis supports the five-factor structure, confirmatory factor analysis with an independent sample is required to formally establish the structural validity of the MTUI-32.

7. Conclusion

The MTUI-32 represents a first validated, multidimensional inventory specifically designed to measure mindful technology use as the purposeful and intentional use of digital technology with present-moment awareness and adaptive self-regulation. Grounded in five empirically supported mindfulness models selected for their direct applicability to digital contexts, and validated through face validity assessment, item analysis, reliability estimation, and convergent validity testing, the MTUI-32 fills a significant gap in the measurement landscape of digital psychology. As a strength-based instrument measuring the positive psychological capacities enabling adaptive digital engagement, the MTUI-32 complements existing deficit-oriented technology use measures and provides a foundation for both research and applied digital well-being programmes. Confirmatory factor analysis with an independent sample, cross-cultural validation, and longitudinal studies examining MTUI-32 scores as predictors of digital well-being outcomes constitute the critical next steps in establishing the instrument as a fully validated psychometric tool.

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