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Review Article

Designing for Digital Wellbeing: From Theory to Practice a Scoping Review

Reem S. Al-Mansoori, Dena Al-Thani, and Raian Ali

College of Science and Engineering, Hamad Bin Khalifa University, Qatar

Correspondence should be addressed to Reem S. Al-Mansoori; reem.almansoori.qtr@gmail.com

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In a world that is highly dependent on digital connectivity, technology use is becoming unavoidable, intense, and possibly harmful. The pervasiveness of technology which has been in tandem with the increasing number of reported cases of harmful usage styles, with some exhibiting symptoms of behavioural addiction, raised concerns around users' psychological health and well-being. Digital Wellbeing is a new facet of human well-being that has recently emerged. While the term is yet to have a commonly agreed definition, it typically denotes a technology that promotes positivity, personal growth, and a usage that is balanced and healthy. In this paper, we aim to examine the extent, range, and nature of Digital Wellbeing research activity in human-computer interaction- (HCI-) related literature. We conducted a scoping review analysing 87 articles that researched Digital Wellbeing and its interrelation with technology design. Our analysis identified different meanings and constructs of the Digital Wellbeing concept, research trends, and a gap related to incorporating it in the design process. Accordingly, we recommend that an agreed-on definition for Digital Wellbeing and validated tools and frameworks are needed to ensure its integration in the digital design process. We also recommend that a wider research direction for HCI researchers and practitioners interested in Digital Wellbeing is needed to include the role of designers and societal institutions in the digital design process to ensure a design that is inclusive and well-being sensitive.

1. Introduction

Despite the fact that technology has provided people with work flexibility [1] and contributed towards enhancing health [2], social connectedness [3], and enjoyment, the harmful impact of unhealthy relationships with and through technology is a concern [4]. It has been argued that digital designs can influence users' decisions, systematically, causing them to lose self-control [5]. Smartphones, as an exemplary, have been found to be sources of distractions [6], and their excessive use may contribute towards causing mental health problems [7] or addiction [8]. Online gaming, which was described as time-consuming and addictive, is able to hook users for long hours through satisfying their desires for achieving game goals and socialization [9–11]. For these reasons, topics such as "nonuse" [12–14] and "digital detox" [15] emerged in research to promote technology abstinence as a solution [4]. Moreover, companies such as Google, Facebook, and Apple introduced the Digital Wellbeing features, such as time screen manager, in their platforms and devices to help users be conscious about their digital usage and manage it [4].

The initial term, wellbeing, without the digital association, has no one universal definition [16]. Scholars claim that what has been published about well-being does not represent a definition, rather, discusses the dimensions of well-being [16, 17]. In the public policy arena, measuring well-being has been described as central to the domain where it is used for three main purposes: progress monitoring, policy designing, and policy appraising supportive tool [18]. Scales and frameworks for well-being varied in their focus and constructs. Subjective well-being (SWB), which is a self-reported well-being, uses the life satisfaction scale, discussed in [19, 20], as it is the most prevalent [21] and comprehensive measure which are the reasons why it is mostly appealing for policymakers and economists [22]. For the societal

progress and development, Organization for Economic and Cooperation and Development (OECD) adopted a well-being framework with eleven key dimensions to support the measurements of the social progress of nations. In this framework, well-being is measured in the current status (an example for the current status indicator is inequalities between the top and bottom performers), and in the future status (an example for the future status indicator is resilience) [23]. In the health sector, the World Health Organization (WHO) identified a well-being index since 1998, and it was translated for more than 30 languages [24].

The term Digital Wellbeing (hereafter, DWB) is used in the human-computer interaction (HCI) field, to describe "the impact of technologies and digital services on people's mental, physical, social, and emotional health" [25]. It also represents the contribution of technology on "what it means to live a life that is good for a human being in an information society" [26, 27]. The representations of DWB in literature took many forms and labels and differed according to the studied context. There is no single definition nor operational definition for DWB that is widely accepted. In the educational context, for instance, a study was conducted in Australia to determine the impact of Internet usage on children's wellbeing, where they referred to DWB as the associations among Internet usages, risks, and regulations [28]. The research in [28] was an effort to bridge the differences between health and inclusion frameworks where risk protection measures and ethical and critical online participation knowledge are combined. In HCI, the representation of well-being came in two main forms, the technology designed to enhance wellbeing, or the design considerations to minimize harmful impact on users [29]. The latter has been labelled by some scholars as positive computing [30]. Positive computing stems from positive psychology that inspects factors contributing towards human flourishing [31] and aims to promote users' well-being through digital design interfaces for an optimal user experience [30].

Tools specifically designed to measure DWB are yet to be developed [16]. Well-being measurement tools have been applied to DWB, despite their debatable suitability to the online context. In this regard, there have been a number of challenges and risks associated with this application. One challenge retains in the questionable effectiveness of these tools when applied within the online context, especially that both terms (well-being and DWB) lack universal meanings [16]. In the area of positive computing, the measurement process of DWB and the ethical considerations represent big challenges [32]. Whether the positive design targets the well-being in general or is tailored to be user-specific to achieve tech-life balance is a question to be addressed. To narrow the scope and be specific about it, Desmet and Pohlmeyer [33] identified three goals for design which are the following: design for pleasure, design for virtue, and design for personal satisfaction.

The consideration of wellbeing-supportive design might seem challenging, especially with the fragmented literature of DWB that makes it hard for novice designers to capture a holistic idea of the DWB concept. The current findings from the HCI domain show that, while modern DWB applications can be used to reduce some addictive behaviors, such as using social networks [34], the road to effectively assisting users in changing their smartphone behaviors and promoting more conscious and healthy technology use is still long [35]. To address the limitations of traditional self-monitoring methods, researchers in the field of HCI are currently investigating digital wellness solutions with a stronger theoretical foundation in habit formation and social support [36]. This may encamp the role of the designers of these technologies as they need to consider wellbeing-supportive design knowledge and practices into their work.

For these reasons, and for the fact that DWB as a concept is relatively new, in this paper, we aim to review the state of research on DWB meanings and operational representations in HCI literature. We focus on the interplay between the design and users' wellbeing, i.e., how the design can harm or enhance the well-being of humans concerning their relationship and interaction with technology. We exclude research focusing primarily on enhancing health and well-being through technology, e.g., solutions that aid the self-monitoring and enhancement of actual life activities such as adherence to plans concerning eating, fitness, smoking cessation, and medication. Our main research question is the following: what is the meaning, extent, and representation of DWB in HCI literature, and how it has been operationalized in the digital design processes?

Our review will help examine the current state of research on the newly emerging concept of DWB, clarify the ambiguity around it, and understand its meaning within the HCI literature. This understanding will aid its operationalization specially for researchers, educators, designers, and practitioners in the HCI arena.

The rest of the paper is divided into four main sections. In Section 2, we identify the methodology we followed to achieve the objectives of the study. In Section 3, we describe the main results in the forms of tables and diagrams representing the study characteristics. In Section 4, we analyse and discuss the results in relation to the research question. We then conclude with practical and research applications, limitations, and a conclusion.

2. Methodology

A scoping review was undertaken following the methodological framework of [37] to examine the extent, range, and nature of research activities on the topic of DWB and to identify research gaps in the existing literature. The framework of [37] consists of five stages, in which the first stage is to identify the research question. The other stages include identifying relevant studies, selecting studies, classifying the studies, and summarizing the results which are discussed in the following sections.

2.1. Identifying the Research Question. Our main research question is: what is the meaning and representation of DWB in HCI literature and how it has been operationalized in the digital design process? We divided this broad question into subquestions to guide our research in the steps to follow. The subquestions are shown in Table 1.

Table 1: Research questions for guiding the scoping review.

Question		Implications
Main RQ	What is the meaning and representation of DWB in HCI literature, and how it has been operationalized in the digital design processes?	General
Sub-RQ 1	What does DWB denote in HCI literature?	Definitions and conceptualization
Sub-RQ 2	How is DWB being measured?	Practical applications (scales, statistical analysis)
Sub-RQ 3	Is DWB part of the digital design process and how?	Existing framework
Sub-RQ 4	Are there any existing applications (interventions, artifacts) related to DWB?	Evidences for operating the concept of DWB

2.2. Identifying the Studies. For this review, the following bibliographic databases were used: The Association for Computing Machinery Digital Library (ACM DL), Scopus, the Institute of Electrical and Electronics Engineers (IEEE), and PubMed. The selection of the databases was based on the interdisciplinary nature of our topic representing a nexus between humans' health and well-being and the digital design. The search did not have a time limit as the topic of DWB is relatively new. The search for articles took place between November 2021 and December 2022. The main search term for this review was "digital wellbeing." Another two alternatives were used to account for different punctuations and pronunciations, which were "digital well-being" and "digital wellness." The review covered English-language peer-reviewed articles and conference proceedings. We excluded abstracts and extended abstracts, workshop proposals, reports, dissertations, posters, and grey literature, i.e., literature that is not peer-reviewed and produced by entities where publishing is not their primary activity.

2.3. Selecting the Studies. The study had two main screening processes. The first one was the inclusion of the main search terms in the titles, abstracts, and keywords, which resulted in $n = 322$ papers in total from the four databases, and after removing duplications, i.e., papers appearing in more than one database, it resulted in $n = 281$ papers. This step was conducted by the first author and checked independently by the other two authors for confirmation. The second screening was conducted to check the papers' relevance to our research questions. Hence, the full texts were checked for the inclusion of a discussion on DWB and its measurements or the designing process to enhance it and promote the DWB concept. We also considered papers which focused on aspects of DWB such as life satisfaction, happiness, and the absence of digital addiction or FOMO. For this reason, the keywords set (design/designers/supportive-design tool(s), framework/guideline, definition/concept, dimensions, theory, measure, scale, feature, model/conceptual model) helped facilitate the review in the second screening. Twenty-eight papers were removed due to the lack of full-text, and 166 were excluded for not meeting the selection criteria. As a result, 87 were selected for the full analysis discussed in Section 3.

The second screening also entitled establishing a database with basic categories representing the paper's main characteristics, such as paper ID, year, authors, country, population, paper type, the main target of the paper (conceptual or user study), the main variables to be studied, measured, or reviewed, in addition to examples or resulted artifacts. This database was used by the two reviewers as a validation tool for including and excluding papers due to relevance or lack of relevance.

2.4. Classifying the Studies and Synthesising Extracted Data. Data extraction and classification were conducted in a systematic approach using an agreed-on data extraction sheet, which was guided by the research questions. This approach has been followed by other scholars such as [38]. The following information were extracted from all included studies. Their descriptions are listed in Table 2.

(i) *Problematic Issue.* This represents the problem to be solved within the included papers

(ii) *Aim and Sought Outcome.* These represent the goal of the included papers, whether it is to evaluate an existing tool, provide a theoretical analysis or framework, or create a technical solution

(iii) *Underlying Theory Categories.* These represent the psychological or design theories and concepts that the arguments of the included papers were built on, such as behavioural change and ethical computing

(iv) *Main Variables.* These represent the main variables to measure, discuss, or review, such as screen time, digital competence, and digital addiction

(v) *Scales.* These represent the scale used to measure the main parameter if it exists, the tools (e.g., survey and focus groups), and whether it is quantitative or qualitative and subjective or objective

(vi) *Framework.* This represents whether the main parameters to be measured are part of a specific framework or guideline or not

(vii) *Intervention.* In the context of this study, it represents an artifact or a tool suggested or tested by the corresponding researchers as a solution to fulfil the purpose of the study with regard to DWB, such as changing users' behaviour in using technology or enhancing their awareness on topics related to DWB

Table 2: A descriptive representation of the data extraction and classification sheet.

(1) Problematic issue	(2) Aim and sought outcome	(3) Foundation theory
Problem to be solved within the paper – can give an indication of whether wellbeing is addressed directly or indirectly	The purpose of the study is important to identify its context	To support information on the aim sought in this paper and whether it is supported by a theoretical foundation in psychology-some papers clearly state this, others you can infer from the discussion/intro
These information are useful for setting the contextual element		
(4) Main parameter to measure/discuss/review	(5) Scale	(6) Framework/guidelines
To identify the representation of WB, if addressed directly, or the proxy used to represent it when addressed indirectly	The scale used to measure the main parameter(s)	To identify if this measuring is part of an existing framework or specific guidelines for a design process
Direct: intended to measure WB (or a representation for it, i.e, autonomy, connectedness, and happiness) Indirect: intended to measure problematic use of technology	Quan = quantitative/qualt = qualitative Sub = subjective/obj = objective	"Name of framework" or none (to identify if part of a well-established design process or not)
(7) Intervention	(8) Type of intervention	(9) Intervention orientation
A suggested artifact or tool proposed by the authors to test its accuracy and efficiency in solving a problem	The description of the intervention will help in understanding its orientation	To identify whether it is directed towards the users (i.e., educational booklets), or towards the design (adjusting/adding a design feature to a mobile application)
Name/and * Indication if created by the research team	Technical solution (application: mobile/web-based) Workshop Educational booklet	User/designer/both

(viii) *Type of Intervention.* This represents the category of intervention, e.g., a mobile application, a workshop discussion, an educating booklet, or a nudge

(ix) *Intervention Orientation.* This represents whether the intervention was directed towards the users (e.g., educational booklets) or towards the design (mobile application, browser extension).

For user-studies, sample size and demographics were collected. In addition, the authors collected information related to the year of publication, the type of publication (journal, conference proceedings), the countries of the authors' affiliations, and the type of affiliation (academia or industry), as descriptive data for all the included studies. The first author conducted the review of 20 papers independently. Each of the other authors randomly selected five of these papers and analysed them using the same criteria. The authors' team compared the results and discussed discrepancies. This practice helped reach a consensus amongst the authors. The first author carried on with the remaining papers and consulted with the other authors for unclear cases. After completing data extraction for all papers, the data were indexed and coded.

2.5. Summarizing the Results. All 87 papers were analysed by the first author to identify key issues, their context, and possible themes related to DWB. The preliminary list of themes resulted from the identified key issues, and data extraction was done in an inductive approach. The theme list was reviewed by the other authors and discussed during group meetings to clarify disagreements. A final meeting was held to reach a consensus on the final mapping for themes related to DWB.

Within the data extraction sheet, which was developed based on the research questions, the nine parameters were grouped into subgroups for further analysis as shown in Table 2. Parameters 1-3 represented the problematic issue, the aim of the study and sought outcome, and the main variables to measure. These parameters helped set the contextual element of the retrieved papers, where seven domains resulted from these parameters as representations of contexts in which DWB appeared in the literature. The domains and their definitions are described in the discussion section. These parameters helped in understanding the extent and range of DWB as a concept represented in the HCI literature which reflect RQ1.

Parameters 4-6 represented the main parameter to measure, the scale, and the framework. They addressed the second research question (Sub_RQ2) of whether DWB has a framework to guide the design process and the third question (Sub_RQ3) of whether DWB has tools for measurements. These parameters were classified as being subjective or objective and quantitative or qualitative types of measurement.

Parameters 7-9 represented interventions, their types, and orientation which addressed the fourth research question (Sub_RQ4) of whether applications for DWB are available. These parameters helped in identifying evidence for operationalizing the concept of DWB.

3. Results

3.1. Search Results. The search of the term DWB, digital well-being, and digital wellness in the electronic databases of ACM DL, PubMed, IEEE, and Scopus resulted a total of 322 papers with one of the three terms in the title and/or abstract and/or keywords. After removing duplications, a total number of 281 papers were eligible for the second screening. Out of the 281 papers, 28 papers were excluded as their full text was not found. In the full-text screening, papers covering well-being through digital tools for physical monitoring and awareness were excluded. The focus of our research was to study DWB through the lens of design. In other words, we focused on well-being connected to the interaction with technology. Papers that had Digital Wellbeing in the title, abstract, or keywords only but not in the body of the paper were included as their reference to DWB was indirect, such as in [39, 40] discussing FoMO. We also included papers that had alternative terms to represent DWB such as "digital detox" in [41] or digital overload in [42]. All studies were searched for any provisions of definitions, descriptions, or dimensions related to DWB and any inclusion of tools and frameworks for measuring DWB. The availability of any of these, not necessarily all, was considered as inclusion criteria as they helped in answering the research questions. As a result, a total of 87 papers were included in the data synthesis. The paper selection process is summarized in Figure 1.

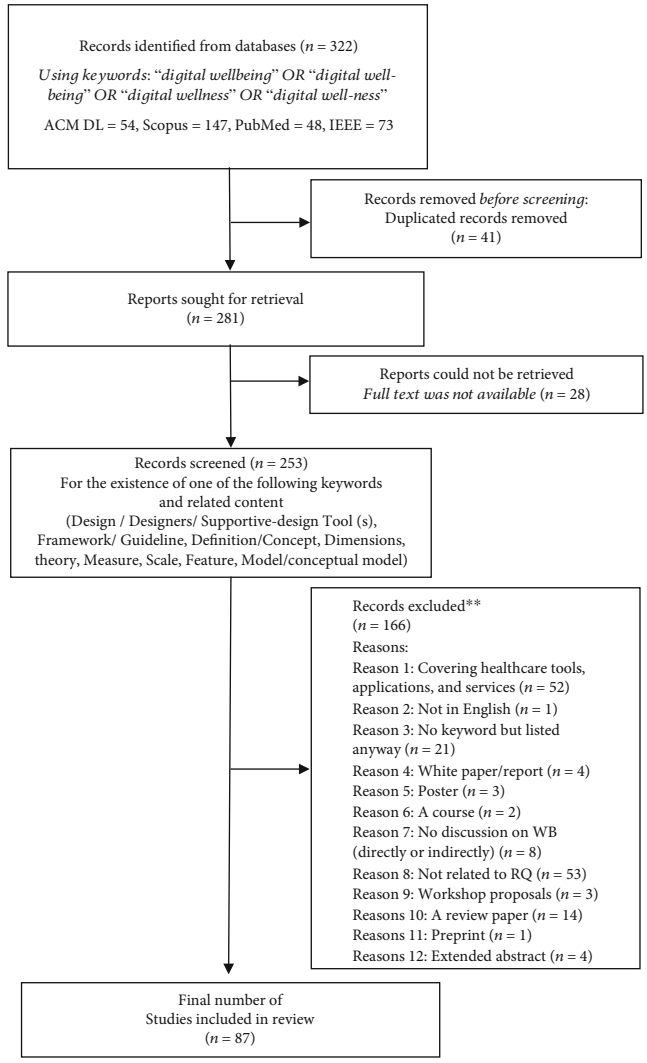

Figure 1: Flowchart of the paper selection process.

3.2. Description of Included Studies. The 87 studies included in the final review indicated that the research on DWB is emerging, with the oldest publication year being 2014 [26] (Figure 2). The number of publications increased gradually throughout the following years to reach more than 20 publications in 2021 and 2022. Publication in year 2022, alone, represented 45% of the total retrieved publications. A noticeable increase in the number of papers started after 2018, which could be due to the official announcement of the term Digital Wellbeing in August 2018 by Google through their DWB tools [43]. The types of included publications were divided nearly equally between journal articles and conference proceedings, with 45 papers for the former and 42 for the latter.

The United Kingdom shows the highest number of publications ($n = 25$), followed by the USA ($n = 16$), then Germany ($n = 9$), Italy and Switzerland ($n = 7$ for each), Qatar ($n = 6$), South Africa, Australia and UAE with ($n = 5$ each), and the remaining countries have less than five publications as shown in Figure 3. Papers from the UK focused on digital designs and design features to minimize the negative impact of technology and the problematic attachment to it, while publications from other parts of Europe focused on DWB through providing digital services to users such as creating an intelligent interface for senior users in Finland and technology-related user habit and behaviour control in Italy, Germany, and Hungary. Publications from East Asian countries (China and Korea) focused on social media and its impact on users' feelings and life satisfaction.

Studies that included a form of definition or description for DWB represented 39.1% of the studies included in the review ($n = 34$), while the remaining 69.9% either referred to the term through Google's DWB tools or the theories of well-being in psychology where no peculiarities or special considerations were made concerning the digital aspects. In terms of measurements, ten studies reported nine scales and two frameworks for quantitative measurement for well-being, where eight (out of nine scales) were validated.

Fifty-six of the total included studies were user studies, i.e., studies involving human participation, while the remaining 31 studies were based on theoretical discussions. Different data collection tools were reported in the user studies. Survey was the most commonly used tool (n =37) in studies, followed by interviews ($n = 21$), then focus groups ($n = 11$), then diaries ($n = 12$), then workshops ($n = 6$), and lastly reviewing posted reviews of users ($n = 2$). A number of studies combined multiple data collection tools, such as [44], which combined focus groups, diary writing, and interviews, and [45], which combined surveys and focus groups.

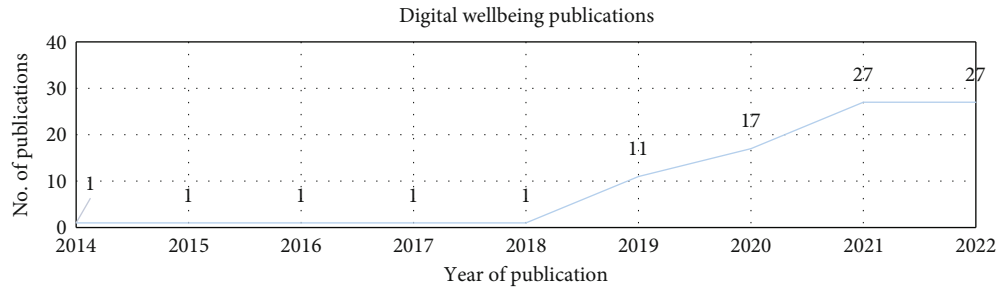

Figure 2: DWB publications according to the publication year.

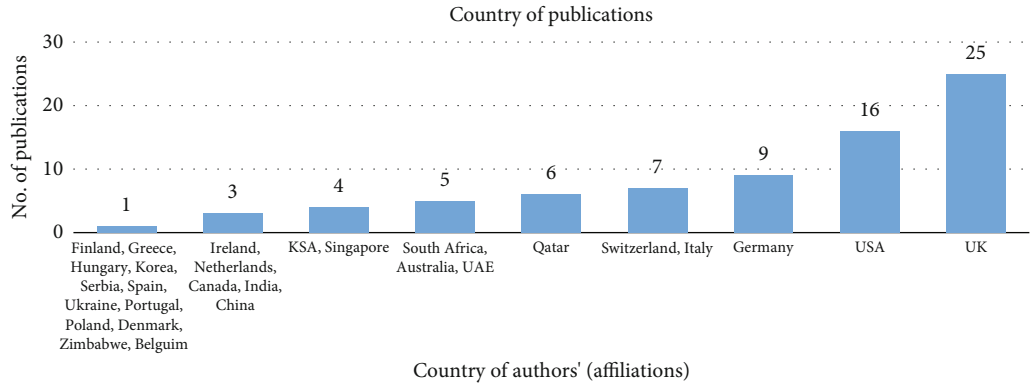

Figure 3: DWB publications according to the authors' country of affiliation.

In terms of the source and type of data, the majority of the studies relied on subjective data, as mostly collected by surveying the users who had to self-report their thoughts, feelings, and behaviour. Only six studies utilised objective data for the analysis, where five studies collected users' logs and screen time [43, 46–49], and one study compared between the subjective and objective records [50].

The sample size in the papers which conducted user studies ranged between $n = 6$ and 415769. The highest number of participants was in a study exploring the impact of virtual reality application on emotional well-being during the COVID-19 pandemic lockdown period with more than 400,000 users distributed in six continents) [47]. The lowest participants' number was in a mobile app evaluation study, where six experts had to evaluate the suitability of a serious-game created by the researchers in [51] for preschool-level children.

In terms of the demographics and characteristics of participants, 69.6% of the user studies (39 out of 56) reported the gender of participants, while the remaining 17 studies did not report participants' genders. The mean percentage of female accumulated from all studies reporting gender was 45%. General audience was the highest participating sample with more than 35% representation within the studies that reported this variable. Students came next with 26.8% representation. Users with problematic attachment to mobile phones regardless of their profession were represented in 12.5% of the studies. Participants with chronic diseases and intellectual disabilities (including patience, experts, and caregivers) were represented in 8.9%, and researchers, practitioners, and professionals were represented in 8.9% as well. Participants from early users of social media (young adolescents 10-14 years) were represented in 3.6%, while young adults (18-30 years) and old adults (>65 years) were represented in 1.8% (one study for each category).

In terms of the participants' age, 19 studies reported the mean ages of their participants while 18 studies reported age ranges (with lower and higher values being 10 and 65, respectively). One study reported both mean and age ranges for different parts of the study, and one study reported that participants were above 18, while the remaining 14 studies reported neither mean nor age range. Study [47] reported age using categories such as teenagers, young adults, seniors, and elders. We calculated the mean of ages in all studies, and it was 29.32 years.

Regarding the measured variables of DWB, users' characteristics, feelings, and moods were the most reported ($n = 15$), followed by digital competence and media literacy and usability and effectiveness of a tool or course with ($n = 10$) for each. Awareness of WB theories and components, in addition to ethical risks such as loss of autonomy or lack of transparency come next as the third most reported variables with ($n = 9$) for each. Digital addiction came next with ($n = 8$) studies reporting this variable, and the remaining variables are shown in Table 3. We divided these variables into two categories, related to users and related to

Table 3: Summary table for the characteristics of the included studies.

Characteristic	Number of studies	
Type of publication	Journal article: $n = 45$; conference proceedings: $n = 42$	
Year of publication	2014: 1; 2015: 1; 2016: 1; 2017: 1; 2018: 1; 2019: 11; 2020: 17; 2021: 27; 2022: 27	
Country	UK: 27; USA: 11; Qatar:7; Switzerland: 6; German/Italy: 5; KSA/South Africa/UAE: 4; Australia/China: 3; Ireland: 2; Canada/Finland/Greece/Hungary/India/Korea/Serbia/Singapore/Spain/Ukraine: 1	
Papers with definitions/descriptions for DWB	DWB: $n = 33$; WB (general): $n = 23$; referral to DWB de facto tools and initiatives (i.e., Google DWB or others): $n = 7$; Google's commitment statement of DWB: $n = 4$	
Papers with scales for DWB	$n = 10$	
Papers with framework for DWB	$n = 2$	
Sample size	6-415769	
Mean age	29.32	
Age range	(10-65)	
Gender	45% female	
DWB outcome* (parameters and concepts to measure or study)	Related to users: Users' characteristics, feelings, and moods: $n = 15$ Digital literacy and competency: $n = 10$ Awareness of WB theories and components: $n = 9$ Digital addiction (& problematic usage): $n = 8$ Mental wellbeing: $n = 5$ Life satisfaction: $n = 4$ Procrastination: $n = 3$ Screen time: $n = 4$ Sense of agency: $n = 4$ FoMO reduction and classification: $n = 2$ Needs satisfaction: $n = 2$ Work-life-balance: $n = 1$ Burnout: $n = 1$ Mindful scrolling: $n = 1$ No of keystroke and scrolls: $n = 1$ Sense of coherence (self-control, meaningfulness, mindfulness): $n = 1$	Related to design: Usability, effectiveness, and acceptance (of a tool or training): $n = 10$ Ethical risks (i.e. loss of autonomy or lack of transparency): $n = 9$ Regretful usage (caused by design features): $n = 1$ Others DWB as a parameter impacted by social, cultural, and political complexity: $n = 2$
Underlying theory categories	BC: $n = 28$; SWB: $n = 28$; ED: $n = 21$; DL: $n = 10$	

Key: UK = United Kingdom; USA = United States of America; KSA = Kingdom of Saudi Arabia; UAE = United Arab Emirates; BC = behavioural change; WB = wellbeing; SWB = subjective wellbeing; ED = ethical design; DL = digital literacy. *n value does not add up to 87 as some studies include more than one outcome.

design. Variables related to users represent users' behaviour and characteristics such as feelings, while variables related to design represent design aspect such as usability.

We analysed the papers regarding the underlying theory that underpins their view and approach towards DWB, i.e., the psychological or design theories and concepts that the arguments of the reviewed papers were built on. The theories varied depending on the scope and aim of each paper. Our review showed that behavioural change (BC) and subjective well-being (SWB) categories were the most used categories ($n = 28$ for each), followed by ethical design and computing (ED) ($n = 21$), and lastly digital literacy (DL) ($n = 10$), as listed in Table 3.

4. Discussion

4.1. Digital Wellbeing: Definitions and Representations. Within the full screening process, we discarded papers that handled physical well-being and its tools, services, and supportive applications. We observed that these papers tended to use the keyword wellness more than well-being or well-being, e.g., [52, 53]. Fifty percent of these papers were conducted by researchers from Finland where authors had a special focus on a vulnerable group of users which is the young-elderly, e.g., [54–58].

Digital Wellbeing had multiple definitions, descriptions, and dimensions. Our review identified three major groups of definitions. The first group focused on the user-technology relationship. The second group focused on users' needs and characteristics, hence, borrowed most of its concepts from the well-known definitions and psychological theories of well-being, such as self-determination theory (SDT). The third group referred to Google's well-being tools or commitment statement when discussing DWB.

Within the definitions in the first group, i.e., the user-technology relationship group, the most cited definition

was Floridi's definition, which refers to DWB as the impact of digital technologies on "what it means to live a life that is good for humans" [26] and was cited in eight papers. Floridi's definition is one of the early definitions for DWB and can be described as general and reliant on measures which are subjective in nature. Other scholars, such as [59], went a step further and referred to the impact of technology on users' emotions in particular by stating that DWB is "the emotional status that can derive from or be affected by the use of technology." The author in [60] emphasised the wider impact of technology on users' health that is not limited to emotions, by stating that DWB represents "the impact of technologies and digital services on people's mental, physical, social and emotional health," which is similar to the definition stated in [61, 62] where DWB was defined as the benefits and harms that digital practices may have on individual's emotions, psychological and social states. Health and safety were also introduced as part of DWB in [51] where the two factors were emphasised as part of digital wellness, where having a mental and physical balance was stressed for people to be "happy, comfortable, healthy, and safe in a digital realm." Similarly, in [63], health and safety were combined with relationships to foster responsible actions in the digital environment, and all three were listed as characteristics of the education that young digital users are required to have to protect their DWB.

In the first group of definitions, there was a strong presence of the concepts of "balanced" and "safe" interactions with technology, where the scholars focused on personal skills and values as the main drivers for the positive status of the relationship between humans and technology. For instance, in [51, 62, 63], a focus on the user's values and responsible actions was required for DWB, while in [64], a balance between the benefits and drawbacks from mobile connectivity was required to maintain DWB on the personal level. Recognising the subjective nature of well-being explains the use of the notion of quality of life (QoL) and happiness as representations of wellbeing, such as in [65], or even the use of the two concepts interchangeably with wellbeing, such as in [62] who use happiness to represent wellbeing.

While some scholars articulated unique definitions for DWB, others looked at DWB through the lens of well-known psychological theories such as self-determination theory (SDT). The second group of definitions uses the basic psychological needs to define DWB. SDT is a theory of human behaviour and personality development which is focused on the multiple types of motivation and the impact of the social-contextual factors that support or thwart individuals' satisfaction of basic needs of relatedness, competence, and autonomy [66]. Works such as [60, 67] and [68] were amongst those who took this approach and adopted this theory within the digital context as humans' psychological needs of relatedness, competence, and autonomy can be impacted by technology.

A third group of scholars, such as [43, 69–72], referred to Google's DWB tools or Google's statement of commitment "giving everyone the tools they need to develop their own sense of digital wellbeing." Google's commitment statement emphasised providing enabling tools for users to enhance their lives by stressing that first, technology represents tools in life, not the life itself as it is a virtual medium, and that second, users have complete autonomy to design the tools to protect their well-being (user centred).

DWB definitions and descriptions varied from being general, such as achieving a balance between technology's benefits and drawbacks, to being specific, such as technology's impact on users' physical, mental, social, or emotional health, each or all together. The latter description suggests that being inclusive to the diverse user's needs is a requirement for safeguarding their wellbeing, which is a concept supported by [73] inclusivity pyramid. In [73], the researchers advocated the need for being inclusive to users' physical, cognitive, and socioemotional needs and status while designing a digital product and that such inclusivity shall minimize feelings of exclusion, fear, anxiety, and isolation, hence safeguard users' DWB. Projecting the retrieved definitions of DWB on the inclusivity pyramid with well-being as a target [73] shows that focusing on the physical and cognitive aspects of well-being is limited in nature. Moving towards the top of the pyramid to include the socio-emotional status represents a more holistic representation of DWB which can be mapped to the definition in [60]. This holistic representation of DWB shall present a reference model for HCI researchers, practitioners, and technology designers during the design process that can lead to a balanced, not harmful, relationship with technology as in [64] definition.

4.2. Digital Wellbeing Domains. When classifying the papers according to the context in which DWB appeared in literature, seven domains resulted from this classification. The seven identified domains are personal and social development, design improvements, digital education, health support, ethical considerations, inclusivity, and policy recommendation. The domains are discussed in the following paragraphs.

Personal and social developments: papers under this domain tackled issues related to tools that aided self-control over technology usage and interventions for better digital usage management. The DWB issues being addressed through these interventions and tools included problematic internet and phone usage, problematic attachments to social media, procrastination and social network sites, and others. Examples of papers under this category are [40, 70, 74].

Design improvements: papers in this domain covered the discussion and evaluation of existing technology and suggested technology designs with the purpose of enhancing user experience and their wellbeing, hence, they appear to be directed towards designers and the digital design industry. Examples of papers under this category are [44, 75, 76].

Digital education: papers in this domain included topics related to digital education and literacy and their impact on enhancing the well-being of educators through digital support. In addition, papers under this domain call for awareness about balanced and effective technology use and user privacy protection as ways to protect their wellbeing. As the content is education focused, the group of papers

Table 4: Scales to measure DWB used in the reviewed papers.

Appeared in:	Scale	Type	Description	Validity
[87] Craven et al. (2019) [88] Gui et al. (2017)	WHO-5 well-being index [89]	Survey	Describing feelings within a specific period of time (i.e., 2 weeks). Measured on a Likert scale of 0 to 5 Sample statement: (1) I have felt cheerful and in good spirits; (2) I have felt calm and relaxed	Validated
[87] Craven et al. (2019) [59] Rich et al., 2020	Warwick–Edinburgh mental well-being scale (WEMWBS) [90]	Survey	Evaluating affective-emotional aspects, cognitive evaluative dimensions, and psychological functioning (including satisfaction, autonomy, competence, and relatedness)-in 14 statements on a 5-Likert scale 1-5 Sample statements: (1) I've been feeling optimistic about the future; (2) I've been feeling useful; (3) I've been dealing with problems well.	Validated
[65] Harrington et al. (2015) [91] Docherty and Biega (2022)	Satisfaction with life scale (SWLS) [92]	Survey	Cognitive evaluation of satisfaction of life on 7 points Likert scale Sample statements: (1) in most ways my life is close to my ideal. (2) the conditions of my life are excellent. (3) if I could live my life over, I would change almost nothing	Validated
[62] Joubert et al. (2020)	Human well-being index [93]	Indicators	Built on five categories of wellbeing: Health and population, wealth, knowledge and culture, community, and equity. Indicators may include how long people are expected to life with good health, how well needs are met for different incomes, enrolment in different levels of education, political rights and press freedom, household and gender equity in income shares and decision making	Validated
[45] Martzoukou et al. (2021)	Digital Wellbeing 6 items	Survey	DWB represents one of the digital competences and is measured on a 5-point Likert scale (1-novice, 5-expert). Consists of 6 survey items. Sample items: (1) "feeling comfortable, in control, and safe when using digital technologies"; (2) "recognising that digital information and media can cause distraction, overload and stress, and disconnecting when necessary"; (3) "considering the rights and wrongs and the possible consequences of your online behaviour"	—
[65] Harrington et al. (2015)	Zarit et al.'s burden (for dementia carers WB) [94]	Interview questions	Interview to assess the well-being of the carer of people with dementia and how well they are coping in their role. An example of the questions asked: "do you wish you could leave the care of this person to someone else?" with a slide scale of never, sometimes, and nearly always.	Validated

Table 4: Continued.

Appeared in:	Scale	Type	Description	Validity
[65] Harrington et al. (2015)	Quality of life in late-stage dementia' QUALID- [95]	Questionnaire	Caregiver acts as a proxy rater and answers questions relating to care recipient's behaviour and mood Through activity and affect approach, the proxy rates the frequency of certain behaviors and moods exhibited by their care recipient	Validated
[65] Harrington et al. (2015)	Bath assessment of subjective quality of life in dementia' BASQID [96]	Questionnaire	Direct assessment for the quality of life as per the evaluation of the person's with dementia (themselves) on a 5-likert scale of: Not at all satisfied, a little satisfied, satisfied, very satisfied, and extremely satisfied Sample question: "how satisfied are you with your level of energy?"	Validated
[65] Harrington et al. (2015)	Dementia care mapping (DCM) assesses well-being and quality of life [97]	Observational analysis	A structured observational analysis. An assessor uses a six-point ordinal response format which ranges over twenty-four activity categories	Validated

under this domain appeared to be directed towards users, educators, and education institutions, but not the designers or regulators. Examples of papers under this category are [45, 60, 77].

Health support: papers in this domain included articles about providing digital services for mental and psychological health and for people with chronic conditions. These digital services are considered as part of supporting individuals' well-being that includes emotional and digital wellbeing. Examples of papers under this category are [47, 59, 78, 79].

Ethical considerations: papers in this domain focused on ethical and professional issues as part of preserving users' DWB such as maintaining their privacy. Papers in this category called for design transparency and amendments to support users' DWB and minimize the use of "attention hooking" strategies that can cause problematic attachments to technology. Most of the papers in this category revolved around social media and their addictive features. For these reasons, it can be inferred that these papers are directed to the HCI community and UX designers for better considerations of users' DWB when designing digital applications and services. Examples of papers under this category are [80–83].

Inclusivity: this group of papers discussed inclusivity in digital designs as a way to achieve DWB. The design is considered noninclusive if DWB is not achieved or negatively affected by the feeling of exclusion that a user might experience. Moreover, inequality, power, and socioeconomic issues were addressed as factors impacting the inclusivity in digital connectivity, hence DWB, such as in [84]. Our review resulted in only two papers under this category [85] which indicate that the view, which is also advocated in [73], is yet uncommon.

Policy recommendations: the two papers in this category [62, 86] had the goal of establishing guidelines and policies at the country level for using big data to enhance citizens' well-being and having a framework for enhanced technology use to serve the tourism industry.

More than 36% of the reviewed papers lay primarily under personal and social development domain ($n = 32$), 21.8% under design improvements ($n = 19$), 12.6% under ethical considerations ($n = 11$), 10.3% under health support ($n = 9$), and 13.8% under digital education ($n = 12$), while the remaining 4.6% is divided between inclusivity ($n = 2$) and policy recommendation ($n = 2$). This result shows the need for directing the research agenda towards inclusivity related topics especially that inclusivity is tightly connected to DWB, as discussed earlier in Section 4.1. The results also show the need for directional policies and guidelines for embedding DWB considerations within the design process and professional practice of the designers.

4.3. Digital Wellbeing Scales. Nine different scales were reported in the collected studies for measuring wellbeing, where four scales were designed specifically for users with dementia and their caregivers (two questionnaires, one observational analysis, and one interview question). Table 4 represents a summary of the collected scales, with a brief description for each.

All the scales that appeared in the studies are related to the general notion of wellbeing, except for one scale which is the DWB dimension in [45]. DWB represents one construct of the digital competencies survey developed by [45] and has six items focusing on how to behave online safely and responsibly. The scale values range from 1 to 5, where one represents novice and 5 represents expert and closer to attaining DWB. This survey was developed based on two main frameworks, which are the European Digital Competence Framework for Citizens [98] and the Digital Capabilities framework, developed by JISC [99].

Table 5: Frameworks to measure DWB used in the reviewed papers.

Appeared in:	Framework	Description
[67] Peters and Ahmadpour (2020) [100] Chaudhary et al. (2022)	"Motivation, engagement and thriving in user experience" METUX model [101]	Applying SDT within six spheres of technology experience (adoption, interface, task, behaviour, life, and society) that technology has impact on
[102] Hakami and Leo (2021)	IEEE P7010 well-being impact assessment [103]	Context-based well-being metrics aimed to proactively safeguard and increase human well-being throughout the lifecycle of autonomous and intelligent systems (A/IS)

Other scales measured well-being through the human well-being index (HWI). HWI takes into consideration the different experiences for the individuals in different ecosystems to ensure balance with ecosystem conditions [93], which is why it is normally measured with ecosystem well-being index (EWI). Another scale is the World Health Organization well-being index (WHO-5) [89] which measures the well-being of individuals on a specific period, on a scale of 0 to 5, where the higher is the closer to attaining well-being. A number of well-being scales were dedicated to individuals with dementia. These scales evaluate the quality of life through direct assessment by the individuals with dementia themselves, or by proxy measures, being reported by their care givers. Satisfaction with life scale (SWLS), and the Warwick–Edinburgh mental well-being scale (WEMWBS) were other scales for measuring well-being through surveys [65]. Even though these scales are validated, they lack any representation for the human's interaction with technology and do not represent the meaning of DWB, which shows a need for a bespoke tool to evaluate DWB assuming it differs from the general notion of wellbeing.

4.4. Digital Wellbeing Frameworks. Two frameworks were reported in the collected studies for studying well-being in the digital design. Table 5 represents a summary of the collected frameworks with a brief description.

The two frameworks used for bridging the gap between theoretical understandings of DWB to practical application by designers identified in this review were motivation, engagement, and thriving in user experience (METUX) and IEEE P1070 well-being impact assessment [67, 101–103]. METUX model is based on SDT theory where it is applied within six spheres of technology experience. According to METUX, the six spheres influenced by technology are adoption, interface, task, behaviour, life, and society. In [67], METUX was used as a framework for learning activities within the two evaluated workshops conducted for HCI and technology professionals to enhance their awareness in well-being psychology by offering research-based knowledge in an adaptable way for design application. IEEE P1070 well-being impact assessment, on the other hand, is another framework that represents an iterative process to ensure safeguarding and improving human well-being through a produced set of well-being indicators to be considered in the design and development processes of A/IS [103]. In [102], it was used as an evaluation tool for educational technologies to measure their impacts on human wellbeing. This framework shows that the application and evaluation of DWB are context based, goal and stakeholder dependent, and can be situational.

4.5. Digital Wellbeing Interventions. Out of the 87 studies, 33 included interventions. The majority of studies with interventions came from the UK which was expected as their papers were mostly focused on the design perspectives as discussed in Section 3.2. The interventions came in multiple forms, such as educational and training digital booklets ($n = 4$), well-being mobile applications ($n = 12$), browser extensions ($n = 3$), adaptive mobile systems ($n = 2$), mobile built-in system ($n = 1$), workshops ($n = 5$), codesign sessions ($n = 2$), haptic feedback ($n = 1$), focus groups and diary writing ($n = 1$), focus group, and interview ($n = 1$), in addition to one theoretical paper on suggested interventions that designers and mobile providers should consider to ensure moderate internet use and minimize ethical threats due to exposed users' information. Twenty-one of these interventions were created by the corresponding research teams and are shown in Table 6.

The interventions appeared in the studies can be divided into two groups, interventions created by the corresponding research teams and will be referred to as intervention with software support and interventions with existing tools, which will be referred to as other interventions.

4.5.1. Interventions with Software Support. It is evident that usage time has been the focus of a number of interventions. A number of scholars suggested regulating tools for users to better manage the time spent online. Interventions were mobile applications such as Socialize, Actuflow, Finesse, and Mindphone, or browser extensions such as NUDGE and Facebook investment. Another group of interventions focused on providing enhanced online experiences for users through break reminders. The suggested break reminders took the form of built-in interventions in mobile games (such as Jump and jump) or haptic intervention (such as the pause board) which helped in preserving users' flow status by gradually increasing the resistance in the keyboard. Other interventions focused on enhancing production and protecting privacy (Annotif), enhancing SWB for individual with chronic condition through life satisfaction and positive emotions (Happify), and fulfilling the sense of agency (Chirp Twitter client). Satisfying the needs of autonomy, environmental mastery, personal growth, positive relations with others, purpose of life, and self- acceptance through adaptive systems for people with different cognitive styles were the

Table 6: A list of software-assisted interventions developed by the corresponding teams of the reviewed papers.

Study	Intervention/type	Purpose	Collected measures for evaluation	Duration	Prepost assessment
[35] Roffarello and Russis (2019)	Socialize/application	Promoting conscious use to enhance users' DWB, through tracking features, and phones and apps interventions such as rewards and notification blocker	(i) Problematic use (using smartphone addiction scale (SAS-SV) (ii) Self-regulation scale (iii) Usage time (logs)	1 week before 2 weeks after	Yes
[104] Roffarello and Russis (2021)		To evaluate changes in habits after using socialize	Conduct habits characterization for 1 week (collecting users logs by socializing) Conduct an in-the-wild study after activating "just-in-time" reminders using socialize for 21-113 days to measure (i) Time spent on meaningless habits (TSMH) (ii) Time spent on context (TSC)	1 week before 3-16 weeks after	Yes
[50] Cho et al. (2021)	Finesse/adaptive mobile system	To identify social media features that cause regretful usage for users	Using the experience sampling method (ESM) with Feature-level tracking system where users are prompted with messages to: (i) Evaluate social media features after using them	1 week	No
			Users were interviewed later to explain reasons for regretful usage	1 hr	
[41] Purohit et al. (2020)	NUDGE/browser extension	a nudge for decreasing social media usage	Uses techniques such as hiding notifications, switching off social-media website, making slider hard to drag when a website is used frequently to minimize social media usage, followed by survey evaluating liked and disliked features of nudge	2 days	No
[80] Purohit and Holzer (2021)		Soft nudge for mindful scrolling in social media	Recording timestamps for log in and out recorded in CSV files	1 week	Yes
			Collect CSV files when turned on the feedback nudge intervention with temporary visual feedback combined with a potent nudge moment (during scrolling) and repeat every 1 min	1 week	
[43] Neznaradko and Demkiv (2021)	Actuflow/application	Smartphone usage control (by adding goals with every unlock of the smartphone to minimize screen time and distraction)	Success of application was measured by the number of downloads and positive feedback provided	Not reported	No

Table 6: Continued.

Study	Intervention/type	Purpose	Collected measures for evaluation	Duration	Prepost assessment
[105] Alhalafawy et al. (2021)	AMSS/mobile application with adaptive system AMSS: adaptive mobile scaffolding system	Provide a mobile application with an adaptive system to different cognitive styles of users (students)	Evaluated the impact of a unified system versus and adaptive system on the users' well-being through a developed DWB scale, with the following components: (i) Autonomy (ii) Environmental mastery (iii) Personal growth (iv) Positive relations with other (v) Purpose life (vi) Self- acceptance	Not reported	No
[106] Weber et al. (2019)	Annotif/adaptive mobile system (server and web-based)	Minimize interruptions by providing a privacy-aware notification system where users classify their own received notification based on urgency and importance	Interruption and productivity	1 week	No
[78] Parks et al. (2020)	Happify/mobile application	To improve subjective well-being for individuals with chronic conditions through games and activities based on positive psychology	Life satisfaction (6 items) Positive emotions (3 items)	6 weeks	Yes
[79] Vereenooghe and Westermann (2019)	"Pudelwohl"/haptic feedback	Improve SWB for people with intellectual disabilities	Well-being index—intellectual disability (PWI-ID)	4 weeks	Yes
[39] Alutaybi et al. (2020)	FoMO_R/booklet	Education booklet for FoMO reduction strategies	Survey for users to evaluate FoMO_R: (i) Usefulness (ii) Coverage (iii) Coherence (iv) Clarity E-therapy attitudes and process questionnaire (e-TAP) (16 items) to measure the intention to use the FoMO-R	10 days	Yes
[70] Alblwi et al. (2020)	D-Crastinate/booklet	Learning booklet with procrastination types, rewards, tools, and countermeasures	(i) The e-therapy attitudes and process questionnaire (e-TAP), to measure acceptance and willingness to continue the process of behaviour change	1 week	No

Table 6: Continued.

Study	Intervention/type	Purpose	Collected measures for evaluation	Duration	Prepost assessment
[107] Blake et al. (2021)	Powers study/digital support package	Provide advice on WB and DWB such as self-care techniques, physical activity, eating habits, sleep strategies, self-compassion and mindfulness, and meditation. In addition to microboundary (email management), notifications and awareness cues (disable online status)	Assessment for e-package on: (i) User experience (ii) Content relevance (iii) Utility and accessibility	Not reported	No
[75] Bell et al. (2020)	Pause board/haptic feedback	Keyboard that increases resistance gradually with time to encourage taking breaks	Assessment for the usability of the device by the two groups who used it in different configurations Group 1: stepped increase = gradual Group 2: binary = min to max	Not reported	No
[51] Allers et al. (2021)	Serious game/mobile application	Mobile application with animals as the main characters with the aim of teaching preschool children topics related to cybersecurity, by using components of poem (educate), quiz (for parents to follow-up), and game (educate on taking action)	Topics of focus in the application: Cyberbullying, screen time, online disinhibition, online security, and privacy Experts evaluated the application on clarity & simplicity (goals), feedback and rewards, interface appropriateness, material appropriateness, method of representing material Followed by interview for explanation	Not reported	No
[46] Rofarrello and Russis (2022)	Facebook-investment/ browser extension	A compatible extension with contemporary browsers (i.e. Google Chrome, Firefox/ Microsoft Edge) that gradually removes the presence of social investment (i.e., likes, comments, followers) from social media platforms such as YouTube and Facebook until it is completely removed.	Measures the impact of removed social investments from Facebook on users' timestamp, duration, number of scrolls, and number of keystrokes performed by the users Passive and active Facebook use measure (PAUM) [108] Multidimensional Facebook intensity scale (MFIS) [109]	3 weeks	Yes
[110] Zhu et al. (2022)	Jump and jump/Mobile casual game with three built-in intervention	Built-in interventions in a casual mobile game to remind users to take a break, in three versions: In-game direct intervention, postgame direct intervention, in-game embedded intervention	Qualitative data: a 30-minute semi-structured interview with all participants with open-ended questions on game experience and playing behaviour Quantitative data: general game experience using the core module [Ijsselsteijn et al., 2008] and postgame module [Ijsselsteijn et al., 2013], on a 5-point Likert scale, time spent, participants' decision of whether or not to	4 days	No

Table 6: Continued.

Study	Intervention/type	Purpose	Collected measures for evaluation	Duration	Prepost assessment
			take a break when encountering an intervention. To measure the effectiveness of the intervention		
[111] Zhang et al. (2022)	Chirp twitter client/ Mobile application	A mobile application with two external features (time limit dialog, usage stats page) and four internal features (reading progress indicator, feed filter, recommended tweet blocker, custom list) to support user's sense of agency	(i) Usage data via automated logs (ii) Experience data via in situ user feedback collected by experience sampling method (ESM) pop-up questionnaire on a 5-point Likert scale (sample question: how much did you feel in or out of control? 1(less in control), 5 (more in control)) (iii) Contextual and self-reflection data via weekly surveys and exit interview	4 weeks	No
[112] Terzimehić et al. (2022)	Mindphone/Mobile application	a mindfulness-based intervention to tackle absentminded and excessive smartphone use	This application asks the user two questions at unlock to increase mindfulness usage: (1) What the user intends to do with the smartphone? (2) What the user intends to do in the real world after using their smartphone? (i) The impact of this intervention was collected via poststudy survey to evaluate (ii) Screen time and number of unlock (iii) Absentminded smartphone use SUQ-A [113] which contains 10 items to be evaluated on a 7-point Likert scale. Sample question "how often do you check your phone without realizing why you did it?" (iv) User experience via poststudy survey with open-ended questions	2 weeks	Yes
[47] Franzoni and Marco (2022)	TRIPP/platform	VR-based application for wellness which is based on scientific research (e.g. AI and mindfulness) with indicators and positive modifiers for users' mental and emotional states specially during global crisis	(i) Session data: number of accesses, duration, timestamp, completed or aborted (ii) Feedback on focus and calm experiences: Initial and final well-being on a 10-point Likert scale 1 negative, 10 positive, initial and final moods (first choice being the most prominent) (iii) Global experience rating: on a 5-star Likert scale for the overall experience	4 months	Yes

Table 6: Continued.

Study	Intervention/type	Purpose	Collected measures for evaluation	Duration	Prepost assessment
[114] Ba et al. (2022)	Smart planning course/ educational course	Workshops that included surveys, lectures, and activities on Digital Wellbeing to enhance adolescences skills in managing daily digital device usage	Data were collected using: (i) Prepost surveys for access to digital devices at home, health consciousness, time management skills [115], mental stress, internet addiction, sleeping time, recent feelings, engagement at school (ii) Wearable devices (e.g., Fitbet versa wristband): to collect activities, calories burnt, steps, and distance travelled (iii) Day reconstruction method (RDM): to capture context-related events and emotions Data were analysed via multimodal learning analytics (MMLA)	3 weeks	Yes
[116] Alibasa et al. (2020)	MindGaug and rescue time/mobile application (applications are freely available online)	A mobile application to collect and analyse moods and behaviors in relation to task-switching and productivity (productivity was measured using RescueTime)	Rescue time: Collects the time spent on each application or website, the productivity value, and task-switching MindGauge: Collects users' moods and lifestyles in the diary-like questionnaire Sample questions: "How are you feeling now?" on a 5-point Likert scale [117], "how physically active were you today?" [118]	16 months	No
[119] Boucher et al. (2022)	Happify/mobile application (same application applied in [78] Parks et al., 2020)	To improve subjective well-being for individuals with chronic conditions through games and activities based on positive psychology	Life satisfaction (6 items) Positive emotions (3 items)	6-26 weeks	Yes
[120] Patel et al. (2022)	Unified Mobile application	A mobile application combined with a sensor to collect user data and provide customized interventions	A unified mobile application that collects phone usage and sensor data with minute-by-minute levels of granularity that records physical activities and infers human behaviour to provide timely intervention	1 week	No

Table 7: Interventions with software support classified by their objectives.

Minimize and manage usage time	Enhance online experience (maximize benefits for fulfilling experience)	Educational and sociotechnical support
NUDGE [41, 80]	AMSS [105]	Power study [107]
Actuflow [43]	Happify [78, 119]	D-Crastinate [70]
Socialize (app) [35, 104]	Pasue-board [75]	FoMO_R [39]
Facebook-investment [46]	Pudelwohl [79]	Serious game [51]
Mindphone [112]	Annotif [106]	Smart planning course [114]
	Finesse (system) [49]	
	Jump and jump [110]	
	Chirp Twitter client [111]	
	TRIPP [47]	
	Unified mobile application [120]	

aims of AMSS intervention. VR technology was represented in platforms such as TRIPP, where AI and mindfulness were used to support users' mental and emotional status. A third group of software-supported interventions focused on providing packages as aids to enhance awareness, provide self-assessment tools, reward mechanisms, and countermeasures to understand and change online behaviour towards DWB. Examples for interventions with such focus include power study, D_Crastinate, FoMO_R, and serious game where all were digital booklets except the latter, serious game, which came in the form of mobile application. Smart planning course intervention combined theory and application to enhance young adolescence knowledge on Digital Wellbeing through the use of lectures, workshops, and technology (i.e., fitbit). All the interventions mentioned in this section targeted groups of adult users (and their care givers such as "Pudelwohl" by Vereenooghe and Westermann [79]), except the smart planning course which targeted young adolescence (10-14 years), and the serious game by Allers et al. [51] which targeted preschool audience and their parents through regulating their presence in the online spaces.

It was observed that most studies with interventions in the forms of booklets and macroservice systems (applications) were applied for longer periods of time than studies applying interventions at the microservice system levels such as browser extensions and adaptive systems. These elongated studies (more than one week) had pre and postmeasures for intervention effectiveness such as [78], unlike shorter studies, which were mostly exploratory, such as [41]. The software-supported interventions classified by their objectives are shown in Table 7.

4.5.2. Other Interventions. Studies with interventions such as diary writing, focus groups, interviews, and questionnaire were mainly theoretical and had the goal of understanding relationships between multiple variables within HCI and different technologies. For example, the authors in [121] studied the mobile usage and its impact on users' emotions, similarly, [116] explored the relationships between users' moods and life-style with task switching online and productivity using Mindgauge and RescueTime which are free mobile applications available online. The authors in [70] studied social networking site (SNS) features and their impact on procrastination habits, and the team in [72] studied the relationship between personal and cultural traits on the acceptance and rejection of joining online peer support groups for combating digital addiction. The relationship between online behaviour, evoked emotions, and problematic attachment to social media was studied by [44]. Studies contained codesign sessions were focused on giving suggestions for enhancing existing tools, such as changes in YouTube mobile app for a higher sense of agency [122], or better visual representations for well-being that are appealing for adults with mental health issues [87], and also better features for digital self-control tools that are suitable for multidevice ecosystem [74]. One study provided suggestions for designers and mobile service providers to adjust the settings for throttling data trafficking, minimizing user data collection, and ensuring transparency in providing information to users [123].

More than 80% (28 out of 33) of the studies with interventions were interventions directed towards users. Few studies were directed towards designers where one of them aimed to increase awareness of designers and practitioners in the HCI communities on DWB, and another was about giving suggestions for modified designs to protect users' privacy and minimize internet usage through data throttling. This observation indicates that most of the researchers studying DWB believe that more responsibility relies on users rather than designers or design features when it comes to preserving users' DWB.

4.6. Practical and Research Implications and Future Research Suggestions. This review is aimed at providing an overview of the extent, range, and nature of DWB research activities in HCI literature, and how it has been operationalized in the design processes of digital products. The current review identified that a great deal of the published literature is focused on creating technical interventions for users' behavioural change but not on problematic design features. For this reason, we recommend that HCI researchers should redirect the focus towards design requirement for safe

technology that does not facilitate problematic attachment, but rather preserves users' DWB. A common limitation observed in a number of studies was the lack of preassessment for the user's behaviour before applying the intervention. In future studies, we recommend that researchers should consider a more accurate method for evaluating the efficiency of the tested interventions to consider pre and postevaluation and randomised control trials as it is one of the most effective study designs [124]. Moreover, as some studies relied on subjective measures for measuring behaviors such as surveying users on their usage time which could be erratic and suffering from recall bias, researchers should consider usage logs for more reliable data collection [125].

Our review showed that out of the nine well-being scales used in the included studies, only one study reported a scale specifically created to measure DWB, while the other studies used borrowed scales from general wellbeing. This lack of specialised scales should encourage researchers to create a validated scale for DWB measurement and an agreed-on definition as the conceptual ambiguity makes the measuring process difficult and hard to compare across studies or generalize the results [126]. Lack of clear conceptualisation of DWB and its constructs might be a contributing factor for the scale's shortage.

This review showed that the current representation of DWB operationalization is biased as 80% of the identified interventions for DWB were focused on users and their behaviors and overlooked the designers' role. However, the theoretical part of the review showed that DWB is not an individual responsibility nor a state to be realized by personal skills and behaviour; rather, it is a process of cocreation between technology providers and technology consumers [28, 88, 127]. As this was not reflected in the interventions found in this review, nor in the only scale found to specifically measure DWB (in [47]), we propose a set of recommendations to help HCI professionals and researchers to identify areas for future research which can help to have a wholistic and balanced understanding for DWB related issues. In these recommendations, we try to stress the fact that the responsibility of achieving DWB is divided between users and designers where both should be supported by societal institutions such as educational and judicial institutions. We also stress that research should focus on the representation of DWB not only as a concept but also as a practical application through sets of actions to be operationalized by users, designers, and societal institutions.

Future research should focus on three directions:

(i) Frameworks for designing for DWB shall be more than just a cosmetic addition but rather a radical change in digital designing and testing processes. The impact of technology on the physical, mental, and socioemotional state of individuals and groups should be covered in this framework. Creating frameworks with the purpose of preserving users DWB should be part of any digital design process, just as accessibility and usability guidelines. Having such frameworks with specific operational steps shall provide a preventive step to protect users' DWB against negative emotions triggers

(ii) Objective measurements of DWB and a scale that can be used to measure a software against its contribution to DWB. The importance of having a validated scale to measure how DWB-sensitive any existing digital design is can provide continuous improvement and sustainability to any design process. This process can be a top-down or bottom-up where societal institutions can support this call by shaping the digital knowledge, behaviors, and values of designers and users through the type of education both designers and users receive and the laws (or lack of them) to regulate the production of digital products. The education received by designers needs to elicit more empathy towards users as the separation between individual's professional discipline and their emotions, values, and aspirations is problematic and discourages empathy towards others [128, 129]. Societal institutions taking a responsibility in integrating digital literacy into school curricula can raise awareness and empower young users. Created laws to preserve the well-being of users can regulate the digital production process, as it is a grey area that some tech companies can take advantage of [130, 131].

(iii) Innovative tools to enhance the inclusivity among users are tightly connected to relatedness, which is a basic psychological need for humans' well-being [132]. This review showed only two papers were categorized under the inclusivity domain, which shows the need for more attention on this important determinant of DWB. One suggestion is the explainable software design for the impact caused by using specific digital products on the user's mental, physical, and socioemotional wellbeing. This explanation shall be considered as an ethical and professional requirement just as food labels provided to identify nutrition values. Providing such software shall aid a better use of digital products through understanding their impact on user's wellbeing

4.7. Limitations. The review was limited to peer-reviewed publications. Also, we did not conduct forward and backward references list check and excluded grey literature which may cause retrieval bias. Grey literature could be a good source of advancement and new knowledge in a topic that is considered relatively new. The review covered publications in four bibliographic databases that are relevant to the focus we aimed for, for this topic, which are ACM digital library, Scopus, IEEE, and PubMed. Digital wellbeing, being multidisciplinary in nature, might benefit from expanding the search to include other databases to clarify the understanding of the term itself and to eliminate possible source of publication retrieval bias by excluding studies published in other databases.

Table 8: Summary table.

Research question	Answer/outcome	Recommendation
(1) What does DWB denote in HCI literature?	Our review identified three major groups of definitions. (1) This group focuses on the user-technology relationship and can be represented in Floridi's definition of the impact of digital technologies on "what it means to live a life that is good for humans" [26] and other definitions that include the impact of technologies on humans' emotional [59], mental, physical, and social well-being [60, 61, 133]. (2) This group focuses on users' needs and characteristics and is represented by the SDT [67, 68]. (3) This group uses Google's well-being tools as a representation of DWB.	We support the holistic view of DWB where mental physical emotional and social well-being are addressed, such as in [25]. Moreover, we recommend stressing the important role of individuals (users), designers, HCI researchers, and society institutions in achieving and preserving the DWB of all. In this suggestion, we aspire that the DWB definition should go beyond minimizing the negative impact of technology on humans' well-being, to represent the ability of technology to contribute towards the motivation, productivity, and flourishing of individuals and societies.
(2) Is DWB part of the digital design process and how?	Two frameworks were identified in the reviewed papers: (1) "Motivation, engagement and thriving in user experience" METUX model [101] (2) IEEE P7010 well-being impact assessment [103]	As the two available frameworks depend on the assessment of the digital products, we recommend that designing for DWB should be an integral part in the designing phase, and before disseminating the product to be used by the users. Hence, having a DWB check within the guidelines, just as the guidelines for accessibility and usability should be a requirement (e.g., W3C and WCAG)
(3) How is DWB being measured?	Nine scales were identified in the reviewed papers, however, only one scale was identified as unique for DWB and the remaining scales were borrowed from well-being to measure different aspects of well-being such as satisfaction of life and health (see Table 4).	Measuring well-being should be done by designers and users. Designers by assessing whether DWB considerations have been accounted for during the design phase, and by users, through assessing the impact of using any digital product on their productivity, satisfaction, and flourish in general. Moreover, as explained in recommendation no.1, when DWB is a build-up process where its responsibility lies on the society as a whole, educational and legal institutions need to have indicators for applying DWB in the educational and judiciary systems.
(4) Are there any existing applications (interventions, artifacts) related to DWB?	This review identified 33 studies with interventions, where 80% were users focused which shows a biased perspective towards DWB responsibility.	We suggest a list of research directions that are user and designer focused with the support of societal institutions to balance the course of actions. This list can be a roadmap for HCI researchers to adjust the focus from being heavily placed on users' behaviors to include users' education and awareness and designers' innovation and protection strategies as proactive steps to prevent the possible negative impact of the digital product during the design phase.

5. Conclusion

In this review, we identified definitions and descriptions used for DWB with its multiple components and foci. In addition, we presented the different available frameworks and scales that are used to measure DWB or the representative parameters of DWB as no specific scale for DWB has been identified due to differences in its meaning (exception appeared in [47] where DWB represents a component with 6 items as part of digital competencies survey). Moreover, we identified the extent and range of the term through identifying different contexts within which DWB appear in the literature. It was clear that the definition of DWB evolved with time from being general to specific, and from being technology focused to being user focused, which resulted lack of agreement on its definition and scale of measurement. Most of the studies used well-being measurements as proxies and not direct representation of DWB as DWB lacks any tools specifically designed for it. Examples of well-being proxies used in literature were level of happiness, life satisfaction, low screen time, absence of digital addiction, and others.

We encourage HCI researchers and practitioners interested in DWB to stress the fact that users and designers have a shared responsibility towards DWB, and society institutions (i.e., educational and judicial) should provide the needed support. We call for designers to take action to innovate to protect users' physical and psychological health by being inclusive for different physical, mental, and socioemotional needs in their designs and to protect users from ethical threats that might result from the lack of autonomy and transparency in digital designs. We also call for users to build their digital skills and knowledge specially in topics related to persuasive techniques and cyber security to be able to enhance their self-regulated behaviour and safely navigate online spaces. We call for societal institutions to contribute to building the digital knowledge, behaviors, and protective laws with the purpose of enhancing and regulating the production of digital products. We aspire that having informed HCI researchers and practitioners in DWB challenges, limitation, and opportunities within design teams shall provide a starting point towards DWB-friendly design considerations and closing the gap between theoretical and practical application for designing for DWB. Table 8 represents a summary table of the review's findings and authors' recommendations where both are aligned against the initial research questions proposed in Table 1.

Data Availability

Data extraction sheet for paper classification purposes is available upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Reem S. Al-Mansoori was responsible for the conception and design development, data acquisition, data analysis and interpretation, and manuscript drafting, writing, and revising. Dena Al-Thani was responsible for the conception and design development, data screening, and manuscript revision. Raian Ali was responsible for the conception and design development, analysis cross-checking, and manuscript revision.

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