

THE ROLE OF CULTURAL AND CREATIVE INDUSTRIES IN IMPROVING ADHERENCE IN DIGITAL HEALTHCARE

Ph. D. cand., Mg. art. **Līga Svempe**
Rīga Stradiņš University, Latvia

Abstract

Cultural and Creative Industries (CCIs) are an important sector in the European Union (EU) economy, recognized for their spill-over effect in promoting innovation and driving growth across various other sectors. This paper examines the impact of CCIs on digital health interventions (DHIs), addressing the critical problem of low therapy adherence. Poor adherence undermines therapy effectiveness, increases healthcare costs, and leads to premature deaths. By focusing on the role of CCIs in increasing user engagement, this study highlights their potential to improve therapy outcomes and thus public health. Through a systematic literature review, five domains were identified where CCIs directly influence DHIs: interaction experience, design, delivery formats, narrative, and gamification. The paper demonstrates how CCIs contribute to creating user-centric, accessible, and engaging DHIs by refining usability and design, tailoring content delivery, and crafting compelling narratives. These elements play a critical role in motivating users and sustaining engagement. Evidence highlights that CCIs hold great potential to influence engagement in digital health tools in both positive and negative directions. The findings underscore that by leveraging CCI expertise, DHIs can be optimized to enhance user experience, mitigate risks of disengagement, and improve therapy outcomes, ultimately contributing to better public health.

Keywords: *adherence, cultural and creative industries, digital health, engagement.*

Culture Crossroads

Volume 32, 2026, doi <https://doi.org/10.55877/cc.vol32.555>

© Latvian Academy of Culture, Līga Svempe

All Rights Reserved.

ISSN: 2500-9974



Introduction

Cultural and creative industries are among the 14 key industrial ecosystems in the EU, encompassing various subsectors, such as audiovisual (including video games and multimedia), design, music, literature, performing arts, visual arts, and others. It is recognized for having a spill-over effect of driving innovation across other industries [European Commission 2021]. While art therapy, music therapy, and drama therapy are well-established healthcare domains that harness culture's healing power [de Witte et al. 2020; Berghs et al. 2022; Xu et al. 2024], CCIs also play a significant role in digital health, particularly in developing digital health interventions – specific digital technologies that are used to achieve health objectives [World Health Organization 2019: 5]. Although their influence is less explicitly recognized, it is both substantial and far-reaching. Creative writing is essential for crafting compelling narratives to increase content engagement, while thoughtful interface design can determine whether a digital product is used or abandoned. The quality of videos used in therapy exercises relies on effective staging, proper recording angles, lighting, and suitable colour schemes. Voice talent's performance skills determine whether the audio will be listened to until the end. These are just a few clear examples of how CCIs can influence the quality and effectiveness of digital health interventions.

One of the major challenges in healthcare nowadays is the low medication and treatment adherence, directly affecting treatment outcomes and increasing healthcare costs [Stewart et al. 2022; Walsh et al. 2019]. It is estimated that 20% to 50% of patients do not take their medication as prescribed, which leads to increased morbidity and inefficacy of therapies [Pérez-Jover et al. 2019]. For chronic illnesses, medication adherence is around 50% [Baryakova et al. 2023], while in cardiovascular health, it is slightly higher at 57–60% [Chowdhury et al. 2013; Naderi et al. 2012]. Among individuals with chronic obstructive pulmonary disease, non-adherence rates vary widely, ranging from 22% to 93% [Bhattarai et al. 2020]. Non-adherence is estimated to contribute to nearly 200 000 premature deaths annually in the EU and imposes additional healthcare costs of approximately 125 billion EUR on European governments [Khan, Socha-Dietrich 2018].

Digital health technologies have demonstrated promise in addressing these challenges by enhancing patient engagement and promoting adherence when developed effectively [Pérez-Jover et al. 2019; Al-Arkee et al. 2021; Ridho et al. 2022; McBride et al. 2020]. Moreover, achieving optimal treatment outcomes often requires behaviour changes in addition to pharmacological therapies. Digital tools can play a vital role in providing daily guidance and accountability, supporting behaviours such as regular exercise and improved nutrition, and reducing unhealthy

habits. Research shows that such solutions not only improve adherence but also promote the lifestyle changes essential for managing and preventing various health conditions [Khan et al. 2017; Sheng et al. 2024; Wu et al. 2023].

The goal of this paper is to investigate how CCIs may contribute to improving engagement with digital health tools, consequently improving adherence, therapy outcomes, and overall public health. It begins by defining “engagement” as a term in the context of technologies and proceeds with a systematic literature review identifying domains where CCIs can influence targeted behaviours. Additional research, healthcare perspectives, and examples of digital health tools are incorporated throughout the review to further enrich the discussion and broaden the perspective on each domain.

Engagement

The term “engagement” has several definitions depending on the context, however, having a shared definition and understanding of the term is still a challenge due to its multidisciplinary nature. Yet it is agreed that it consists of subjective and objective dimensions [Yeager et al. 2018]. Perski et al. [2017] have proposed an integrative definition specifically for engagement with health technologies – digital behaviour change interventions (DBCIs) – which combines both objective and subjective measures: “Engagement with DBCIs is (1) the extent (e.g. amount, frequency, duration, depth) of usage and (2) a subjective experience characterized by attention, interest and affect”. The objective part of the engagement is commonly assessed using metrics like the number of daily logins, weekly or monthly active users, time spent in the app per day, the number of completed activities, and others. The subjective experience is often measured through metrics such as the Net Promoter Score (NPS), in-app reviews, various usability scales, and other tools. The choice of metrics depends on the product characteristics and the strategic goals of the company developing it.

Although Perski et al. use the term “digital behaviour change intervention”, which refers to “a product or service that uses computer technology to promote behaviour change” [West, Michie 2016], most DHIs are designed to encourage or support behaviour change to improve health. Since this paper focuses on behaviours related to increasing adherence, the term “digital behaviour change intervention” will be used interchangeably with “digital health intervention”.

Furthermore, Perski et al. [2017] suggest a conceptual framework of direct and indirect influences on engagement with health technologies, impacted by specific mechanisms of action. According to the scope of this article, only the factors influencing the DBCIs are explored (see Figure 1) – content and delivery. Through

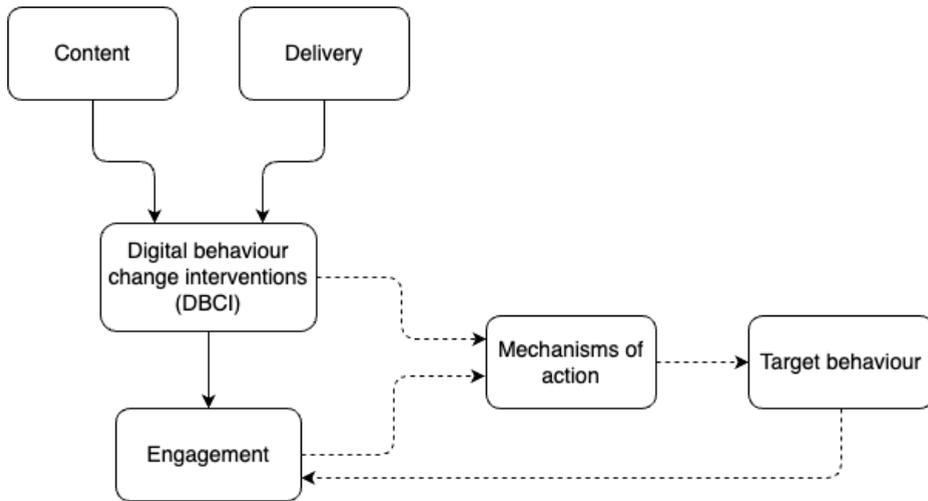


Figure 1. Conceptual framework of influences on engagement with DBCIs [Perski et al. 2017]

specific mechanisms of action, they can initiate the target behaviour. For instance, a notification displayed on the screen (content item) nudges the patient to open an app and perform a specific task (e.g., completing an exercise – the target behaviour), which means that the patient has engaged with the therapy.

Of the two influences, content is typically tailored to the specific tool, user needs, and the condition it addresses, meaning CCI likely have limited impact in this area. However, the delivery factor is deeply intertwined with CCI, offering significant opportunities for influence. As the research by Perski et al. was published in 2017, most of the proposed attributes for this factor were largely hypothetical at that time. Since then, rapid technological advancements have introduced new tools and capabilities, and numerous studies have generated evidence with actual data. This article provides a novel overview of the latest insights, highlighting how the CCI can contribute to delivery mode impacting engagement.

Methods

In January 2025, the author conducted a systematic literature review of studies examining the impact of CCI's contributions on engagement in digital health solutions. The research process and study selection results are presented following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, primarily designed for systematic reviews evaluating the effects of health interventions [PRISMA].

The Scopus database was selected for its renowned credibility and comprehensive coverage. The search strategy included two strings:

- 1) terms “digital” OR “mobile” OR “technology” AND “health” in the title, AND
- 2) terms “engagement” OR “adherence” in the title.

The author conducted a database search for literature published since 2021, limiting the document type to articles, reviews, or conference papers. Only English-language publications were considered. Results were then filtered for relevance to the topic and the scope of this paper.

To be eligible for inclusion, papers had to identify and analyse factors impacting engagement, either positively or negatively. Only factors that could be influenced by CCIs were considered, while others – such as demographics, purely technological aspects, or contextual parameters – were not considered. However, these parameters can still play a role in shaping decisions, whether related to design choices, the selection of the narrator, or other elements, therefore those are mentioned in the discussion where relevant. Papers exploring DHIs and/or their components without any analysis of their impact, or research on their clinical efficiency were excluded. The author also excluded protocols and papers that provided theoretical knowledge in the domain or studied the related processes, such as patient involvement, design processes, etc. Papers that were related to engagement in clinical trials or research settings were ineligible, as well.

Results

The search returned 298 items (see Figure 2). The first step involved screening titles based on the exclusion criteria, resulting in the removal of 67 papers (22.48%). Then abstracts were reviewed, leading to the exclusion of an additional 177 papers (59.4%). Throughout both these steps, caution was exercised to avoid premature exclusion. If there was any uncertainty regarding a paper’s eligibility, it was moved to the next stage for further screening.

A total of 54 articles (18.12%) were included in the full-text review stage. Four articles (0.01%) were excluded due to lack of open access, and the author was unable to retrieve them by contacting the authors of those papers. The full-text review was conducted on 50 papers (16.78%) to assess eligibility, resulting in the exclusion of 28 papers (9.4%), and leaving 22 papers (7.38%) deemed applicable for this study.

Most of the included studies were conducted in the United States ($n = 8$) or Europe ($n = 7$), followed by Australia ($n = 3$). Additionally, one study was conducted jointly in Canada and the United States, another in the United States and Israel, and one each in Malaysia and Thailand.

During the full-text review process, the author used content analysis to identify factors influencing engagement and to determine whether these factors were attributable to CCIs. The identified factors were then grouped into five thematical domains: interaction experience, design, delivery formats, narrative, and gamification. Each of these domains is discussed in the following sub-chapters.

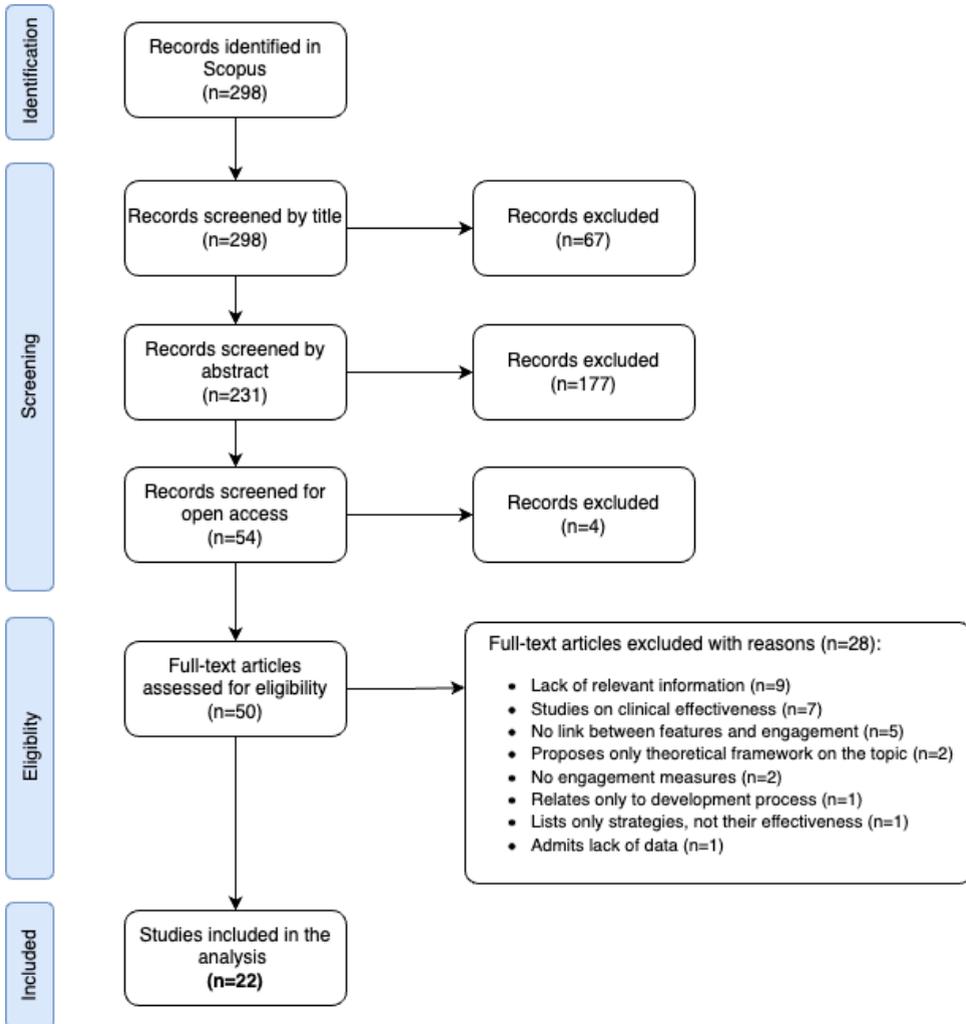


Figure 2. Flowchart illustrating the inclusion and exclusion of studies

Interaction experience

Ease of use was one of the most frequently cited factors influencing engagement, appearing in 11 of the 22 included papers. In general, it is considered that ease of use has a positive effect on engagement, while difficulty in usability deteriorates it. Research proves that better usability leads to greater improvement in treatment [Graham et al. 2021]. Studies suggest that feature convenience has a positive correlation with engagement [Zainal et al. 2024], and that clear, simple, intuitive content delivery with visual components is preferred, whereas unclear, textual content delivery decreases engagement [Schwarz et al. 2023]. Flexibility and ease of navigation are also considered positive factors [Gan et al. 2023; Saleem et al. 2021]. Even reducing the number of manual operations can increase engagement [Sheng et al. 2024]. However, if the interface is too complicated, not user-friendly, and the information is difficult to access and understand, it can negatively affect engagement [Chadwick et al. 2024]. Usability issues [Borghouts et al. 2021] and navigation difficulties [Van Kessel et al. 2024] are also viewed as negative factors. Ease of use is additionally defined as being simple enough to be usable by non-tech-savvy individuals [Xiang et al. 2024; Hasnan et al. 2022]. A good example of how usability impacts engagement is Headspace app, which improved its onboarding process by reducing the number of steps, incorporating more suitable delivery formats, and streamlining the overall flow. These changes led to a measurable increase in user engagement [Bilham 2021].

However, this attribute is vague enough and lacks specificity, often encompassing several interconnected elements that collectively shape the overall ease of use. Moreover, the identified factors do not translate into specific actionable activities. Generally, to improve ease of use, developers should focus on enhancing design, narrative, and delivery modes, where CCIs can greatly contribute. More specific factors are discussed in the following sections.

Design

Design is undoubtedly one of the primary areas where CCIs can make a significant contribution, and it plays a crucial role in driving engagement. User-friendly interfaces and visually appealing aesthetics are key factors that increase engagement [Elkefi et al. 2024; Gan et al. 2023]. Positive impacts can also result from specific interface attributes, such as large buttons and clear visual components [Xiang et al. 2024]. Even a platform's high level of realism has been found to positively influence the user experience [Ferreira-Brito et al. 2024]. The specifics of content delivery are explored in the next section.

It is also essential to consider the target audience for the DHI, as demographic factors heavily influence design preferences and an appealing design can drive

individual engagement. For example, younger audiences tend to favour clear, concise messages with a positive and personal tone, as well as interface designs that differ significantly from those preferred by older generations [Schwarz et al. 2023]. While younger users may appreciate sophisticated and visually appealing interface features, older users tend to prefer minimalist designs [Hasnan et al. 2022].

Research further highlights that poor design and unappealing aesthetics negatively affect engagement, often resulting in lower user interaction and engagement [Van Kessel et al. 2024; Gan et al. 2023].

Delivery formats

Delivery formats refer to the methods used to present content to the user. Although closely linked to overall design, this area requires its own detailed exploration. While design encompasses the broader user experience and aesthetic appeal of a DHI, delivery formats represent the specific components through which content is conveyed. Even with an appealing overall design, the choice of content delivery format can significantly influence engagement, underscoring its critical role in the process. This domain was the second most frequently discussed, appearing in 9 of the 22 papers included in this review.

Research shows that users tend to prefer a multimodal approach [Xiang et al. 2024], incorporating multimedia elements such as emojis, GIFs, and videos [Langdon et al. 2021]. Combining text with audio or video formats is also highlighted as creating a more engaging experience [Andrade et al. 2023; Borghouts et al. 2021]. Preferences include bright graphics, large colourful icons, and easily understandable content [Saleem et al. 2021], as well as data visualization [Lipschitz et al. 2023] instead of plain numerical data. Even the inclusion of images or references to famous artists and actors can drive engagement [Andrade et al. 2023].

It is also crucial to consider the demographics of the target audience and tailor the design to their specific preferences, as each generation has distinct priorities. For instance, younger users prefer interfaces with more images, symbols, videos, and enhanced or realistic visuals, avoiding excessive text or large blocks of text [Schwarz et al. 2023]. At the same time, older users highlight other parameters to focus on as they may struggle with complex menu bars, small fonts, tightly spaced buttons, blurred illustrations, similar colour shades, and low contrast [Hasnan et al. 2022].

The health condition of the target audience also plays a significant role in shaping the design of a digital health tool. Different health conditions require specific, tailored design choices and solutions. While simple adjustments, such as font size (larger fonts for older users), are common, the possibilities for customization are extensive. For example, colour blindness can be congenital or result from diseases or injuries, such as stroke, Alzheimer's, multiple sclerosis, or eye degenerative diseases.

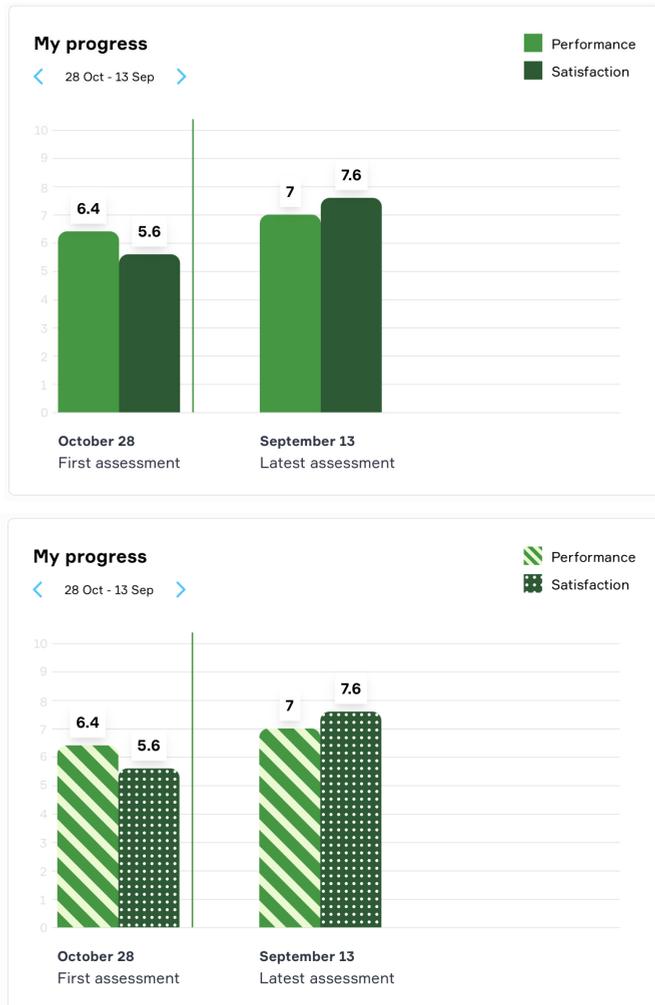


Figure 3. Vigo app screenshots. On the left: standard design of a chart. On the right: design tailored for users who have selected having colour blindness

Adjusting design elements to accommodate colour blindness is an essential step in making the tool accessible and easier to use for these individuals. Vigo app for stroke patients [Vigo Health] is a great example showing how the design of a graph can be tailored by using patterns instead of shades (see Figure 3).

Another example is ADHD, where symptoms can include having difficulties in reading comprehension [Miller et al. 2013]. Delivering content in a text-heavy format would not be an effective choice for these users. Instead, more engaging formats, such as video or a combination of audio and transcripts, should be prioritized to better capture and maintain their attention.

These examples illustrate that the choice of delivery format is not merely a matter of preference but often a necessity tailored to the specific needs of the target audience. There are accessibility standards, such as the “Web Content Accessibility Guidelines” (WCAG) [World Wide Web Consortium], but the final design for the optimal benefit may need to exceed these minimum standards.

Selecting the appropriate voice for audio formats is equally important, as research shows it can significantly influence engagement. Younger users prefer sounds that are associated with their movements or game activities, and they dislike robotic or monotonic voices and click-like noises [Schwarz et al. 2023]. Older users, however, exhibit mixed preferences regarding voice monotonicity [Hasnan et al. 2022]. Another study on meditation voice qualities found that human-like voices enhanced users’ enjoyment and the relaxing effect of the exercise, compared to synthetic voices [Menhart, Cummings 2022]. This insight is particularly relevant given the rapid evolution of AI services, which offer tempting solutions for quickly generating audio. However, despite advancements, AI still has limitations, and the resulting quality can fall short of a studio recording performed by a professional voice actor. Research further supports the notion that a lack of images and audiovisual tools negatively impacts engagement [Van Kessel et al. 2024].

To summarize, selecting the appropriate delivery formats is a critical step in developing a DHI. The right choices can significantly boost engagement, but predicting the most effective approach for each situation can be challenging. Therefore, developers should begin with thorough user discovery, followed by surveys, user testing with prototypes, and A/B tests to determine the best solutions. Depending on the specifics of the DHI and its target audience, personalization options are highly valued, such as the ability to adjust the colour scheme, select font size, and customize other settings to enhance the user experience.

Narrative

The narrative is seemingly closely tied to the content which is inherently health-related and not influenced by CCIs. However, it is important to distinguish that the manner in which the content is presented significantly affects engagement. For instance, boring content has a negative impact on user engagement [Gan et al. 2023], or if the content is hard to translate into real life [O’Brien et al. 2024]. This is where CCIs can play a crucial role, as creative professionals have the power to transform a dull, monotonous text into an engaging and captivating narrative that encourages users to return.

Firstly, users tend to favour a supportive and non-judgmental tone [Borghouts et al. 2021]. Heavy and complicated language is generally disliked, particularly among younger users [Schwarz et al. 2023]. Interestingly, even the gender of the narrator

can influence outcomes. Research indicates that female conversational agents have more adherent users compared to their male counterparts, with a relatively higher proportion of long-term adherence among users engaging with female agents [Jakob et al. 2024].

A recent innovation enabled by technological advancements is the availability and use of avatars, which have been shown to positively impact engagement. Research indicates that users respond well to the content presented through animated, character-driven approaches [Xiang et al. 2024]. Younger audiences, in particular, enjoy interacting with avatars, and offering a range of character options further enhances content delivery [Schwarz et al. 2023]. However, the use of avatars requires caution. If the avatar is not convincing or appears unrealistic, users may not respond positively, and such avatars might receive mixed reactions [O'Brien et al. 2024].

Personalization is a key aspect to consider, as content should be tailored to the individual [Xiang et al. 2024; Saleem et al. 2021]. For example, a storyline featuring a young Caucasian woman may not resonate with an Afro-American senior man, which could reduce engagement. However, the wide range of technological possibilities for personalization can also be leveraged in this context. Users could have the option to select their narrator, avatar, and other parameters for their DHI. For example, allowing users to choose their age during the onboarding process can help tailor the available content to the individual. Some DHIs incorporate peer stories into their therapy programs, so these stories could be prioritized based on the user's age or a specific condition.

Gamification

Gamification is widely recognized as one of the top strategies to enhance engagement in digital tools, including health-related applications [Saleem et al. 2021]. While some researchers view it as a promising tool for engagement in the future [Amagai et al. 2022], there are mixed results, yet some studies indicate that gamification does increase engagement [Lipschitz et al. 2023]. It has been shown to improve or at least maintain optimal adherence [Tran et al. 2022]. Additionally, when implemented correctly, gamification has been proven to increase physical activity [Intawong, Puritat 2021]. However, the effectiveness of this domain also depends on the user's age: while younger generations tend to prefer gamification, this may not be the case for older generations [Hasnan et al. 2022].

The effectiveness of gamification certainly depends on its structure and narrative. Users generally enjoy earning both tangible and intangible rewards, but it is crucial to offer a variety of challenges, along with the regular addition of new ones and special events. Repetitive challenges or a lack of progression and goals

can diminish motivation and decrease engagement [Schwarz et al. 2023], and also the preferences for gamification types can differ between generations [Gan et al. 2023]. However, it is important to keep in mind the user and their condition. For instance, research in the mental health domain shows that users tend to dislike streaks [Burns, Volda 2023]. This aligns with the theory that losing a streak can induce unpleasant emotions [Kamei et al. 2018], which may enhance the negative feelings users already experience due to their mental state and therefore should be implemented with caution. As a result, gamification, in this case, could have a detrimental effect on engagement and users' mental health in general.

Limitations

The review has several limitations that should be considered when interpreting the findings. First, there was heterogeneity among the studies, some being systematic reviews and others focusing on specific DHIs. The latter may raise questions about the generalizability of findings to broader digital health contexts. Another limitation is the sample size of some studies, which may not accurately represent target populations.

The search was conducted using only one database, Scopus, which is a credible source that covers high-quality research. Nevertheless, relying on a single database may have led to the exclusion of relevant studies available elsewhere. Furthermore, the review was limited to English-language publications, meaning that relevant research in other languages may have potentially been overlooked.

It is also important to acknowledge that a significant portion of digital health research, including usability tests and engagement experiments, is conducted by developers and not published in academic literature. As a result, valuable insights remain inaccessible. Moreover, specific scientific studies on the role of CCIs in DHIs are scarce. The data gathered in this paper primarily comes from broader engagement studies rather than research explicitly focused on this intersection.

Another limitation is the potential for author bias, as this review was conducted by a single researcher. However, to mitigate this, studies with exclusion concerns were moved to the next review stage to avoid premature dismissal. The included papers were carefully examined, and in cases of uncertainty, reviewed twice to ensure accuracy and consistency.

Finally, many aspects of engagement remain underexplored. There is a limited number of studies that investigate engagement by considering the specific needs and preferences of different user groups, such as variations by age, gender, or medical condition. Addressing these gaps in future research could provide a more nuanced understanding of how CCIs influence DHIs and contribute to more effective interventions.

Conclusion

This paper expands current knowledge and provides evidence on how CCIIs can contribute to increasing engagement with DHIs, thereby improving adherence and therapy outcomes. It presents the findings from 22 studies, complemented by other research, healthcare perspectives, and digital health tool examples.

The results demonstrate that a range of design features, both general and specific, can positively impact adherence. Key elements that enhance engagement include ease of use, visually appealing design, appropriate design elements, engaging delivery formats and narratives, and gamification. Conversely, poor design, complex navigation, usability challenges, inappropriate design elements, and boring content are negatively associated with engagement and should be carefully considered during DHI development.

The context is also crucial and must be carefully considered, as different health conditions may require specific design adaptations to ensure usability. For instance, standard design systems and principles may not work for visually impaired users, who would need alternative formats such as screen readers, high-contrast visuals, or simply larger fonts and buttons. Similarly, individuals with Attention-deficit/hyperactivity disorder (ADHD) may engage more in video and audio formats rather than in text-based content. Tailoring the design to meet the specific needs of users based on their health conditions is essential for increasing engagement and ensuring the tools' effectiveness.

An important feature to consider is personalization, which involves tailoring the DHI to the specific preferences of the user. While much of personalization depends on technical capabilities, CCIIs play a key role in developing appropriate and engaging designs and narratives for different audiences. The review findings underscore the significant differences in preferences across age groups, and even genders, and races, highlighting the impact of creating engaging content tailored to each demographic. Compelling stories, engaging videos, personalized avatars, and captivating gamification challenges are just a few examples where CCIIs make a crucial contribution to enhancing user engagement and adherence.

To summarize the results, CCIIs have the potential to significantly influence engagement in both positive and negative directions. By leveraging CCIIs' expertise, DHIs can be optimized to drive engagement, and consequently improve therapy outcomes and public health in general. However, the author suggests further research on the specific domains, as currently the scope and depth of the research is limited.

Bibliography

- Al-Arkee, S., Mason, J., Lane, D. A., Fabritz, L., et al. (2021). Mobile Apps to Improve Medication Adherence in Cardiovascular Disease: Systematic Review and Meta-analysis. *Journal of Medical Internet Research*, 23(5), e24190. <https://doi.org/10.2196/24190>
- Amagai, S., Pila, S., Kaat, A. J., Nowinski, C. J., et al. (2022). Challenges in Participant Engagement and Retention Using Mobile Health Apps: Literature Review. *Journal of Medical Internet Research*, 24(4), e35120. <https://doi.org/10.2196/35120>
- Andrade, E. L., Abroms, L. C., González, A. I., Favetto, C., et al. (2023). Assessing Brigada Digital de Salud Audience Reach and Engagement: A Digital Community Health Worker Model to Address COVID-19 Misinformation in Spanish on Social Media. *Vaccines*, 11, 1346. <https://doi.org/10.3390/vaccines11081346>
- Baryakova, T. H., Pogostin, B. H., Langer, R., and McHugh, K. J. (2023). Overcoming barriers to patient adherence: the case for developing innovative drug delivery systems. *Nature Reviews Drug Discovery*, 22(5), 387–409. <https://doi.org/10.1038/s41573-023-00670-0>
- Baryakova, T. H., Pogostin, B. H., Langer, R., McHugh, K. J. et al. (2020). Barriers and Strategies for Improving Medication Adherence Among People Living With COPD: A Systematic Review. *Respiratory Care*, 65(11), 1738–1750. <https://doi.org/10.4187/respcare.07355>
- Berghs, M., Prick, A. E. J. C., Vissers, C., Van Hooren, S. (2022). Drama Therapy for Children and Adolescents with Psychosocial Problems: A Systemic Review on Effects, Means, Therapeutic Attitude, and Supposed Mechanisms of Change. *Children (Basel)*, 9(9), 1358. <https://doi.org/10.3390/children9091358>
- Bilham, J. (2021). *Case Study: How Headspace Designs for Mindfulness*. Raw Studio. Available: <https://raw.studio/blog/how-headspace-designs-for-mindfulness/>
- Borghouts, J., Eikey, E., Mark, G., De Leon, C., et al. (2021). Barriers to and Facilitators of User Engagement With Digital Mental Health Interventions: Systematic Review. *Journal of Medical Internet Research*, 23(3), e24387. <https://doi.org/10.2196/24387>
- Burns, Q., and Volda, S. (2023). Investigating Mobile Mental Health App Designs to Foster Engagement Among Adolescents. In: Tentori, M., Weibel, N. (eds.), *Adjunct Proceedings of the 2023 ACM International Joint Conference on Pervasive and Ubiquitous Computing & the 2023 ACM International Symposium on Wearable Computing*. New York: Association for Computing Machinery, 118–122. <https://doi.org/10.1145/3594739.361070>
- Chadwick, H., Laverty, L., Finnigan, R., Elias, R., et al. (2024). Engagement With Digital Health Technologies Among Older People Living in Socially Deprived Areas: Qualitative Study of Influencing Factors. *JMIR Formative Research*, 8, e60483. <https://doi.org/10.2196/60483>

- Chowdhury, R., Khan, H., Heydon, E., Shroufi, A., et al. (2013). Adherence to cardiovascular therapy: A meta-analysis of prevalence and clinical consequences. *European Heart Journal*, 34(38), 2940–2948. <https://doi.org/10.1093/eurheartj/ehs295>
- De Witte, M. da Silva Pinho, A., Stams, G.J., Moonen, X., et al. (2020). Music therapy for stress reduction: A systematic review and meta-analysis. *Health Psychology Review*, 16(1), 134–159. <https://doi.org/10.1080/17437199.2020.1846580>
- Elkefi, S., Blecker, S., and Bitan, Y. (2024). Health Information Technology Supporting Adherence Memory Disorder Patients: A Systematic Literature Review. *Applied Clinical Informatics*, 15(01), 85–100. <https://doi.org/10.1055/s-0043-1776792>
- European Commission (2021). *Annual Single Market Report 2021*. Available: <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52021SC0351>
- Ferreira-Brito, F., Alves, S., Guerreiro, T., Santos, O., et al. (2024). Digital health and patient adherence: A qualitative study in older adults. *DIGITAL HEALTH*, 10. <https://doi.org/10.1177/20552076231223805>
- Gan, D. Z. Q., McGillivray, L., Larsen, M. E., and Torok, M. (2023). Promoting engagement with self-guided digital therapeutics for mental health: Insights from a cross-sectional survey of end-users. *Journal of Clinical Psychology*, 79(5), 1386–1397. <https://doi.org/10.1002/jclp.23486>
- Graham, A. K., Kwasny, M. J., Lattie, E. G., Greene, C. J., et al. (2021). Targeting subjective engagement in experimental therapeutics for digital mental health interventions. *Internet Interventions*, 25, 100403. <https://doi.org/10.1016/j.invent.2021.100403>
- Hasnan, S., Aggarwal, S., Mohammadi, L., and Koczwara, B. (2022). Barriers and enablers of uptake and adherence to digital health interventions in older patients with cancer: A systematic review. *Journal of Geriatric Oncology*, 13, 1084–1091. <https://doi.org/10.1016/j.jgo.2022.06.004>
- Intawong, K., Puritat, K. (2021). A Framework of Developing Mobile Gamification to Improve User Engagement of Physical Activity: A Case Study of Location-Based Augmented Reality Mobile Game for Promoting Physical Health. *International Journal of Online and Biomedical Engineering (iJOE)*, 17(07), 100–122. <https://doi.org/10.3991/ijoe.v17i07.22349>
- Jakob, R., Narauskas, J., Fleisch, E., König, L. M., et al. (2024). Factors associated with adherence to a public mobile nutritional health intervention: Retrospective cohort study. *Computers in Human Behavior Reports*, 15, 100445. <https://doi.org/10.1016/j.chbr.2024.100445>
- Kamei, M., Matsumoto, S., and Sakuma, H. (2018). The Effect of a Pseudo Winning or Losing Streak on Mental Attitudes and the Evaluation of Results. *Psychological Reports*, 121(3), 488–510. <https://doi.org/10.1177/0033294117732344>
- Khan, N., Marvel, F. A., Wang, J., and Martin, S. S. (2017). Digital Health Technologies to Promote Lifestyle Change and Adherence. *Current treatment options in cardiovascular medicine*, 19(8), 60. <https://doi.org/10.1007/s11936-017-0560-4>

- Khan, R., Socha-Dietrich, K. (2018). *Investing in medication adherence improves health outcomes and health system efficiency*. Organisation for Economic Co-operation and Development (OECD). <https://doi.org/10.1787/8178962c-en>
- Langdon, K. J., Scherzer, C., Ramsey, S., Carey, K., et al. (2021). Feasibility and acceptability of a digital health intervention to promote engagement in and adherence to medication for opioid use disorder. *Journal of Substance Abuse Treatment*, 131(14), 108538. <https://doi.org/10.1016/j.jsat.2021.108538>
- Lipschitz, J. M., Pike, C. K., Hogan, T. P., Murphy, S. A., et al. (2023). The Engagement Problem: a Review of Engagement with Digital Mental Health Interventions and Recommendations for a Path Forward. *Current Treatment Options in Psychiatry*, 10(3), 119–135. <https://doi.org/10.1007/s40501-023-00297-3>
- McBride, C. M., Morrissey, E. C., and Molloy, G. J. (2020). Patients' Experiences of Using Smartphone Apps to Support Self-Management and Improve Medication Adherence in Hypertension: Qualitative Study. *JMIR mHealth and uHealth*, 8(10), e17470. <https://doi.org/10.2196/17470>
- Menhart, S., and Cummings, J. J. (2022). The Effects of Voice Qualities in Mindfulness Meditation Apps on Enjoyment, Relaxation State, and Perceived Usefulness. *Technology, Mind, and Behavior*, 3(4), 494–503. <https://doi.org/10.1037/tmb0000089>
- Miller, A. C., Keenan, J. M., Betjemann, R. S., Willcutt, E. G., et al. (2013). Reading comprehension in children with ADHD: cognitive underpinnings of the centrality deficit. *Journal of Abnormal Child Psychology*, 41(3), 473–483. <https://doi.org/10.1007/s10802-012-9686-8>
- Naderi, S. H., Bestwick, J. P., and Wald, D. S. (2012). Adherence to Drugs That Prevent Cardiovascular Disease: Meta-analysis on 376,162 Patients. *The American Journal of Medicine*, 125(9), 882–887.e1. <https://doi.org/10.1016/j.amjmed.2011.12.013>
- O'Brien, H. L., Chen, A. T., Kaneshiro, J., Zaslavsky, O. (2024). User Engagement in an Online Digital Health Intervention to Promote Problem Solving. *Interacting with Computers*, 36(5), 355–369. <https://doi.org/10.1093/iwc/iwae030>
- Pérez-Jover, V., Sala-González, M., Guilabert, M., and Mira, J. J. (2019). Mobile Apps for Increasing Treatment Adherence: Systematic Review. *Journal of Medical Internet Research*, 21(6), e12505. <https://doi.org/10.2196/12505>
- Perski, O., Blandford, A., West, R., and Michie, S. (2017). Conceptualising engagement with digital behaviour change interventions: a systematic review using principles from critical interpretive synthesis. *Translational Behavioral Medicine*, 7(2), 254–267. <https://doi.org/10.1007/s13142-016-0453-1>
- PRISMA (n.d.). *PRISMA Statement*. Available: <https://www.prisma-statement.org/>
- Ridho, A., Alfian, S. D., Van Boven, J. F. M., Levita, J., et al. (2022). Digital Health Technologies to Improve Medication Adherence and Treatment Outcomes in Patients With Tuberculosis: Systematic Review of Randomized Controlled Trials. *Journal of Medical Internet Research*, 24(2), e33062. <https://doi.org/10.2196/33062>

- Saleem, M., Kühne, L., De Santis, K. K., Christianson, L., et al. (2021). Understanding Engagement Strategies in Digital Interventions for Mental Health Promotion: Scoping Review. *JMIR Mental Health*, 8, e30000. <https://doi.org/10.2196/30000>
- Tran, S., Smith, L., El-Den, S., and Carter, S. (2022). The Use of Gamification and Incentives in Mobile Health Apps to Improve Medication Adherence: Scoping Review. *JMIR mHealth and uHealth*, 10(2), e30671. <https://doi.org/10.2196/30671>
- Ridho, A., Alfian, S. D., Van Boven, J. F. M., Levita, J., et al. (2023). Design Features Associated With Engagement in Mobile Health Physical Activity Interventions Among Youth: Systematic Review of Qualitative and Quantitative Studies. *JMIR mHealth and uHealth*, 11, e40898. <https://doi.org/10.2196/40898>
- Sheng, Y., Bond, R., Jaiswal, R., Dinsmore, J., et al. (2024). Augmenting K-Means Clustering With Qualitative Data to Discover the Engagement Patterns of Older Adults With Multimorbidity When Using Digital Health Technologies: Proof-of-Concept Trial. *Journal of Medical Internet Research*, 26, e46287. <https://doi.org/10.2196/46287>
- Stewart, S.-J. F., Moon, Z., and Horne, R. (2022). Medication nonadherence: health impact, prevalence, correlates and interventions. *Psychology & Health*, 38(6), 726–765. <https://doi.org/10.1080/08870446.2022.2144923>
- Van Kessel, R., Ranganathan, S., Anderson, M., McMillan, B., et al. (2024). Exploring potential drivers of patient engagement with their health data through digital platforms: A scoping review. *International Journal of Medical Informatics*, 189, 105513. <https://doi.org/10.1016/j.ijmedinf.2024.105513>
- Vigo Health (n.d). *The only clinic stroke patients will ever have to visit*. Available: <https://vigo.health/usa/>
- Walsh, C. A., Cahir, C., Tecklenborg, S., Byrne, C., et al. (2019). The association between medication non-adherence and adverse health outcomes in ageing populations: A systematic review and meta-analysis. *British Journal of Clinical Pharmacology*, 85(11), 2464–2478. <https://doi.org/10.1111/bcp.14075>
- West, R., Michie, S. (2016). *A Guide to Development and Evaluation of Digital Behaviour Change Interventions in Healthcare*. United Kingdom: Silverback Publishing.
- World Health Organization (2019). *WHO guideline: recommendations on digital interventions for health system strengthening*. Geneva: World Health Organization.
- World Wide Web Consortium (n.d.). *Web Content Accessibility Guidelines (WCAG) Overview*. Available: <https://www.w3.org/WAI/standards-guidelines/wcag/>
- Wu, T., Xiao, X., Yan, S., Fang, Y., et al. (2023). Digital health interventions to improve adherence to oral antipsychotics among patients with schizophrenia: a scoping review. *BMJ Open*, 13(11), e071984. <https://doi.org/10.1136/bmjopen-2023-071984>
- Xiang, X., Turner, S., Ruiz-Sierra, S., Zheng, C., et al. (2024). Older Adults Experience with a Layperson-Supported Digital Mental Health Intervention for Depression: Qualitative Insights on Engagement. *Clinical Gerontologist*, 1–12. <https://doi.org/10.1080/07317115.2024.2395890>

- Xu, J., Wang, B., Zhu, W., Ao, H. (2024). Creative art therapy for postpartum depression: A systematic review and meta-analysis. *Complementary Therapies in Clinical Practice*, 57, 101886. <https://doi.org/10.1016/j.ctcp.2024.101886>
- Yeager, C. M., and Benight, C. C. (2018). If we build it, will they come? Issues of engagement with digital health interventions for trauma recovery. *mHealth*, 4, 37. <https://doi.org/10.21037/mhealth.2018.08.04>
- Zainal, M., Zainal-Abadin, A. I., and Sulaiman, S. (2024). A study of quality criteria of mobile health application for medication adherence: User viewpoints. *Journal of Theoretical and Applied Information Technology*, 102(17), 6317–6329.