Chapter 2
Design for e-Mental Health: Toward a New Health Intervention Research Approach

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1 e-Mental Health: A Quick Overview

e-Mental health is an area of research and intervention that relies on digital technologies to provide mental health care, support, or information to complement traditional care. According to the Mental Health Commission of Canada, *"e-mental health delivers timely, effective mental health services by using the internet and other related technologies"* (Mental Health Comission of Canada 2021). E-mental health emerged in the early 2000s and has been often related to telepsychotherapy and telehealth. However, it is much wider and includes access to medical information, coordination of care pathways, prevention and follow-up, treatments, self-care, or peer-to-peer support.

For instance, the *Sleepio* app (https://www.sleepio.com, United Kingdom) helps to overcome insomnia through a digital sleep improvement program; the web-based tool *Aller mieux à ma façon* (https://allermieux.criusmm.net, Canada) aims to support mood disorders self-management; the *Ginger* app (https://www.ginger.com, United States) offers emotional support and guided self-care to employees of select employers; or the *Temstem* app (https://www.reframingstudio.com/projects/temstem, The Netherlands) helps people who suffer from psychosis to distract from the voices they hear and strengthen themselves.

In many countries such as Canada, e-mental health is seen as a means to deeply transform the mental health system (Mental Health Comission of Canada 2014) and make it easier to use, more efficient, and more equal. Research in e-mental health conducted around the world is increasing (Drissi et al. 2020). Since the beginning of the COVID-19 pandemic, digital health at large has experienced unprecedented

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growth (Golinelli et al. 2020). In particular, the potential of digital health to improve access to quality mental health care has never been greater (Torous et al. 2020).

However, the market of e-mental health services is confused and the many challenges identified in recent years in the literature have not disappeared, such as the lack of scientific validation (Anthes 2016; Torous and Roberts 2017; Donker et al. 2013; Olff 2015; Larsen et al. 2019), the privacy and data security concerns (Torous and Roberts 2017; Torous 2016; Lipschitz et al. 2019; O'Loughlin et al. 2019), the lack of availability and advertising (Lipschitz et al. 2019; Mehrotra and Tripathi 2018), or the financial interests of developers (Lal 2019).

This is why the reality of digital uses in mental health is far from the initial ambitions imagined nearly 20 years ago. Large-scale implementation faces the harsh reality of long-term adoption (beyond simply downloading a mobile app). A study based on 93 mental health apps found that overall user retention is very low, with a median 15-day retention rate of 3.9% and a 30-day retention rate of 3.3% (Baumel et al. 2019). This is what Eysenbach in 2005 called *"the law of attrition"*: in any digital health trial, a significant proportion of users drop out before completion or stop using the application (Eysenbach 2005). The limited data available about the health app market confirms this: most mobile health apps are downloaded less than 5,000 times and 46% of these apps have fewer than 1 monthly active user.

Yet, investments in digital health are massive: the average cost of developing a mobile health app is US$425,000 (Research 2 Guidance 2018). The growing market of mental health startups is impressive, approaching 1000 startups worldwide in 2020 (Hays 2020). The benefit–cost ratio of these technologies is very high and unsustainable if nothing is changed in the way they are developed. More importantly, these apps will not be associated with a decrease in mental disorders if they are not used for a sufficient period (Torous et al. 2018).

2 Why Design Methods Matter in e-Health

Several studies show that most users are willing to accept and use new technologies for their mental health (Proudfoot et al. 2010; Huang and Bashir 2017; Dragovic et al. 2018). How can we explain the low rates of use? Supported by the literature, our hypothesis is that the lack of adoption of digital health technologies is due to a lack of attention to user needs when designing these technologies (Birnbaum et al. 2015). In fact, existing solutions consider the needs of users too late or too little (Hostetter et al. 2014). There are very few examples of the involvement of people with mental disorders in the conception and design of a mobile application for them (Torous et al. 2018). The most common design methods are based on the bilateral partnership between clinicians and engineers (National Institute of Mental Health 2019) and they are not adapted to the challenges of the contemporary digital culture that systematically places the users at the center by empowering them (Cardon 2019).

However, there are design methods that allow end-users to influence the design of technologies significantly and positively. They are known under different names

such as user experience design (UX), user-centered design, human-centered design, service design, design thinking, codesign, etc. Originating from academic research, these design approaches have been developed and adopted by creative agencies, design agencies, and major companies in the tech industry, who have appropriated them for developing their digital products/services and solutions. These methods are historically derived from the disciplines of industrial design and graphic design (Moggridge 2007). They should not be confused with the disciplines of engineering design, to which they combine advantageously. The differences between engineers and designers in the way they approach the design of a technology are documented. In the initial prototyping phases, engineers seek to define specific goals to be achieved and focus on technical functioning following a linear thought pattern, whereas designers use the prototype to creatively explore the design space for new possibilities (Yu et al. 2018). Design thinking is globally recognized for fostering the emergence of innovative solutions (Brown 2008), including in healthcare (Ku 2020).

Although they are not specifically related to mental health, two of these approaches, in particular, are worthy of use in mental health: user-centered design and codesign.

User-centered design, also called human-centered design, was defined in the late 1980s by D. Norman in his book *The design of everyday things* (17,370 citations in Google Scholar) (Norman 2013). It aims to design products that are easily usable and immediately understandable, thanks to a certain number of design principles, for example, the importance of affordances (the user understands what to do just by looking). Enriched by the works of J. Nielsen on web usability (Nielsen 1999) and J. J. Garrett on user experience (Garrett 2002), user-centered design has become the standard for best practices in web design. Garrett defines it as *"the practice of creating engaging, efficient user experiences"*, which means: *"Take the user into account every step of the way as you develop your product"* (Garrett 2002, p. 17). User experience is defined as *"the experience the product creates for the people who use it in the real world",* that is, not its internal operation but *"how it works on the outside, where a person comes into contact with it"* (Garrett 2002). In the case of an app, it is the cognitive (ease of use) and emotional (affective dimension of the use) experience that the user has when facing the screen. Recognized for fostering user engagement, user-centered design tends to be called user experience design (UX design). It has become an industry standard and has been widely used in the design of social media, video games, or fitness apps. However, the principles on which user experience design is based have little or no use in mental health (Torous et al. 2018; Bakker et al. 2016).

Codesign emerged in the late 2000s. According to Sanders and Stappers' definition (4380 citations in Google Scholar), codesign refers to *"the creativity of designers and people not trained in design working together in the design development process"*. It is *"collective creativity as it is applied across the whole span of a design process"* (Sanders and Stappers 2008). It is a highly participatory process in which the user is not only a subject of study (as in user-centered design) but a full design partner who intervenes alongside the designers from the beginning to the end of the design process. Codesign is practiced in focus groups, using materials such

as post-it notes, paper models, mockups, predefined card sets, boundary objects, etc. This type of approach is not well developed in digital health (Birnbaum et al. 2015) and is very rare in mental health (Torous et al. 2018).

Both user-centered design and codesign could have a great impact on more patient-centered research in mental health.

3 Design for e-Mental Health

Design for e-mental health refers to the broad range of human-centered design creative strategies that define the structure, function, and form of a digital mental health service from a high ethical and experiential quality perspective. At first glance, it is the application of codesign and user experience design methods to the field of digital mental health intervention research. But it is much more than that. Design for e-mental health is an approach to health innovation that is rooted in transdisciplinary research and inspired by responsible innovation in health. It is an end-to-end codesign-driven methodology which involves at all stages stakeholders such as patients, families, peer support workers, mental health professionals, and more. It is a slow innovation process facing complexity, which integrates theoretical and methodological foundations that are usually separated.

3.1 Theoretical Foundations

Design for e-mental health is rooted in three theoretical foundations: technological mediation, design for social innovation, and responsible innovation in health (Fig. 1).

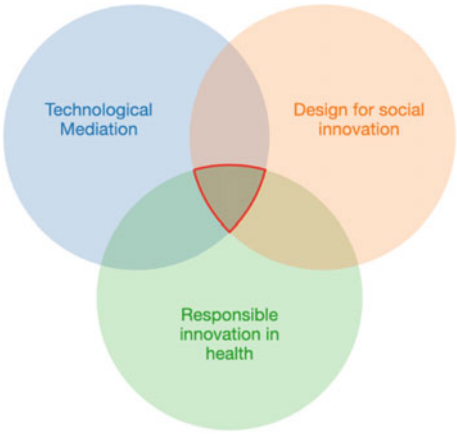

Fig. 1 The three main theoretical foundations of design for e-mental health

Technological mediation. Coming from the field of philosophy of technology, mediation theory is an approach to relations between humans and technologies based on the idea that technologies play a mediating role in the broad relation between humans and their world (Verbeek 2015). According to this approach, designers do not design things, they design human–world relations in which practices and experiences take shape. The role of design is to shape human–technology relations and, in that sense, it is a highly responsible activity. *"Designers materialize morality"*, says Verbeek (2015). They incorporate in technologies values and choices about how we want to experience the world. Design is philosophically responsible for experience (Vial 2019). In this view, the type of mental health technologies we develop determines the type of relationship we want to have with our mental health, that is, the type of practices and experiences we want to have with it. Understood in a broad sense, this includes a various range of technologies such as architectures, medical devices, or mobile apps. Design for e-mental health is a proactive approach to building digital technologies that contribute to shaping desirable relations between humans and their mental health. It proposes to rethink the experience of care, treatment, or the health system, thanks to new types of relations between humans and mental health mediated by the digital (mobile apps, internet-based services, etc.).

Design for social innovation. Coming from the field of design and based on a worldwide network of university labs, design for social innovation is a design approach focused on codesign and social change (Manzini 2015). Groups of people who cannot solve their problems alone join together in cooperative projects in order to develop sustainable social innovation at the local level and to focus on the design of less polluting services centered on collective well-being (shopping groups, materiel sharing, shared gardens, etc.). These collaborative projects are led by expert designers and rely on collective creativity, thanks to codesign. Codesign appears when *"diffuse design"* (the natural designing capacity of anybody, i.e. non-experts) meets *"expert design"* (the ability to operate as a trained designer, i.e., design professionals). Design for social innovation is *"the expert design contribution to a co-design process aiming at social change"*, says Manzini (2015). Design for e-mental health builds on design for social innovation in the specific area of e-mental health. It aims to improve population mental health and mental health services, in a more responsible and human-centered manner. It is a codesign process led by researchers and designers that involves patients, families, and mental health professionals.

Responsible innovation in health. Coming from public health, research innovation in health is an integrative framework that builds on the field of responsible research and innovation. It is a collaborative approach *"wherein stakeholders are committed to clarify and meet a set of ethical, economic, social and environmental principles, values and requirements when they design, finance, produce, distribute, use and discard sociotechnical solutions to address the needs and challenges of health systems in a sustainable way"* (Silva et al. 2018). It is comprised of nine dimensions organized within five value domains, namely population health, health system, economic, organizational, and environmental. This framework supports the development of innovations that address important challenges for the health system,

such as health equity, alternative business models that benefit more society, or eco-responsibility. Design for e-mental health is an attempt to develop responsible innovation in e-mental health by focusing on the specific ethical issues of the digital domain. For instance, it gives central importance to data privacy and cybersecurity, thanks to privacy by design methods (Cavoukian 2010), or it seeks to develop eco-responsible technologies, thanks to digital sobriety strategies (Chevance et al. 2020).

3.2 End-to-End Codesign

In design for e-mental health, codesign is used as a qualitative method of participatory action-research, within a general process of design for social innovation seen as an innovative and responsible approach to intervention research in mental health. As seen above, codesign is a process of collective creativity applied to the entire design process, involving both professional designers (expert design) and people not trained in design (diffuse design). By people not trained in design, we mean various mental health stakeholders such as patients, families, peer support workers, psychologists, psychiatrists, health professionals, health managers, and more. These stakeholders bring in the process their natural creativity (which is a personal gift universally shared) while expert designers bring *"original ideas and visions"*, *"practical design tools from different design disciplines",* and a structured design process (Manzini 2015). Imagined by the design team, the initial idea of the project becomes a shared object of collective design that keeps evolving in the form of a *"social conversation"* between the different participants (Manzini 2015) and that takes shape in an iterative way through a commented and continuously improved prototype (Fig. 2). In order to express their needs and expectations, typical activities offered to participants are ideas generation based on visual tools, discussions, and consensus-building processes (Fig. 3).

Stakeholders involvement is not ad hoc or isolated, for example only at the beginning of the project to gather insights or at the end to test the app. Participants are selected following a public call for volunteers based on various relevant inclusion criteria. They are involved from start to finish and have a say in all major decisions, from design to implementation, through several participatory mechanisms (co-creation workshops, validation meetings, priority beta testing…). Of course, this may take more time than traditional innovation processes, but it's worth it since the outcome will be the shared construction of a solution that is appropriate to the common needs and meets the shared expectations of all stakeholders.

The essential challenge is to design technologies that are in line and in close connection with the needs and realities of the end-users (represented by codesign participants, i.e., stakeholders). It is this challenge that most mental health startups fail to address, because of their obsession with going fast, too fast: they are missing a deep understanding of stakeholders needs (that they study in a superficial way through quick user research) by avoiding the difficulty of diving into the infinite complexity

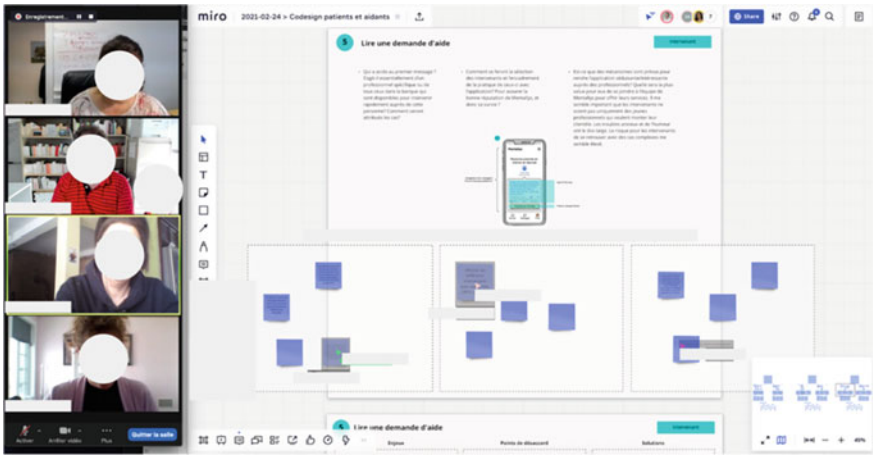

Fig. 2 A commented prototype during a remote codesign workshop with patients and caregivers: participants share their views and add virtual "post-its" on a mobile app mockup

Fig. 3 A face-to-face codesign workshop with psychologists and psychanalysts: participants describe their daily lives with patients and discuss the best options

and detail of mental health issues and practices. As well said by Paul Yock, *"the 'move fast and break things' approach that works in tech doesn't translate well to healthcare"* (Yock 2018). This is why design for e-mental health is a slow innovation process, whose motto would rather be: "move slow and break nothing". Design for e-mental health needs to welcome vulnerability with delicacy, and in that sense, it is close to the Ethics of Care (Tronto 1993). And to address the challenge of complexity in a truly relevant way, it requires transdisciplinary research.

3.3 Transdisciplinary Research

Multidisciplinarity (also called pluridisciplinarity) occurs when several disciplines offer their points of view on the same object without exchanging concepts or methods.

Table 1 Examples of transdisciplinary relations

Type of relation	Concept or method A	Concept or method B
Equivalence	Innovation through uses in sociology	User-centered approach in design
Equivalence	Technology acceptance in communication and marketing	User engagement in health research and e-health
Combination	Agile development in IT/computer science	Iterative process in design
Complementation	User eXperience (UX) in management (evaluation)	User eXperience (UX) in design (production)

Interdisciplinarity occurs when several disciplines develop a shared perspective on the same object by sharing or combining some of their concepts and methods. Transdisciplinarity occurs when multiple disciplines contribute to the development of a point of view that transcends those disciplines and becomes independent of them, possibly crossing all major scientific sectors (Darbellay 2015).

Design for e-mental health is a transdisciplinary intervention research approach.

First, it brings together several disciplines from the three main scientific sectors: (1) health research and sciences (psychiatry, clinical psychology, health technologies, public health); (2) social sciences and humanities (design, ergonomics, ethnography, communication, sociology, marketing, linguistics); (3) natural sciences and engineering (computer science, software engineering).

Second, it offers a unified point of view based on various relations between concepts and methods from the different disciplines involved. As we could observe in the initial steps of our research project Mentallys (see Sect. 4.2), these relations can be (at least) of three types: equivalence, combination, and complementation (Table 1).

The relation of *equivalence* concerns ideas or methods coming from different disciplines, but which are similar, and therefore equivalent to each other, even though they are formulated differently by each discipline.

The relation of *combination* concerns ideas or methods coming from different disciplines that benefit from being put together to form a more effective or powerful idea or method that could not otherwise exist.

The relation of *complementation* concerns ideas or methods coming from different disciplines that complement each other, i.e., that fill in their mutual gaps to constitute an exhaustive whole.

Although these relations are not specific to mental health intervention research and could apply to various other fields, we have defined them from the observation of our research process in e-mental health. They illustrate the complex nature of a transdisciplinary approach applied to mental health. Such a transdisciplinary approach is absolutely necessary for working on complex problems such as those in the field of mental health, where many different types of actors (patients, families, peer support workers, clinicians, etc.) are involved in many different processes

(clinical, institutional, financial, etc.) in many different contexts (public, private, and community).

However, the implementation of this approach is also complex. The transdisciplinary relations between ideas generate many more misunderstandings than in a classical monodisciplinary approach. The same term is understood very differently from one discipline to another (e.g., a simple word like "object" can refer to very different realities depending on whether it refers to psychiatry, design, or software development). To maintain an effective collaboration and a shared understanding of problems during co-creation workshops with clinicians or co-investigators, it is necessary to invest a lot of time in a *term mediation* work allowing each member of the team to appropriate correctly the key terms of each discipline. Such work requires a great deal of familiarity with the way of thinking and the vocabulary of each discipline. A good understanding of the relevant concepts and methods in each discipline involved makes it possible to assign to each discipline the part of the work for which it is most relevant. Therefore, one of the keys to successful design for e-mental health lies in transdisciplinary leadership, which can only be achieved through many years of experience in contact with several disciplines. The ability of design to facilitate multidisciplinary innovation projects also plays an important role (Minder and Heidemann Lassen 2018).

4 Two Case Studies: Temstem and Mentallys

In this section, we present two emblematic cases studies of design for e-mental health. First, the Temstem app (The Netherlands), which is already developed and released on app stores. Second, the Mentallys app (Canada), which is in early stage and under development. Both are using a codesign process and a design-driven transdisciplinary approach.

4.1 Helping People to Cope with Hearing Voices: Temstem

Developed in the Netherlands, Temstem is an app based on language games that aim to help people to distract themselves from the voices they hear, and to actively exercise and strengthen themselves in relation to these voices (Temstem: An app to help people cope with 'hearing voices'. Reframing studio, Amsterdam). It was codesigned by a group of designers, psychotherapists, and people who suffer from psychosis, involving a design university (TU Delft), a design firm (Reframing Studio), and a private non-profit mental health institution (Parnassia Groep).

Temstem offers to play two language games: in one of them, the user must tap the number of syllabi in a set of words during a predefined time; in the other, the user must form correct combinations of two words by linking them (Fig. 4). By playing these word games, the user activates the language production areas in the brain,

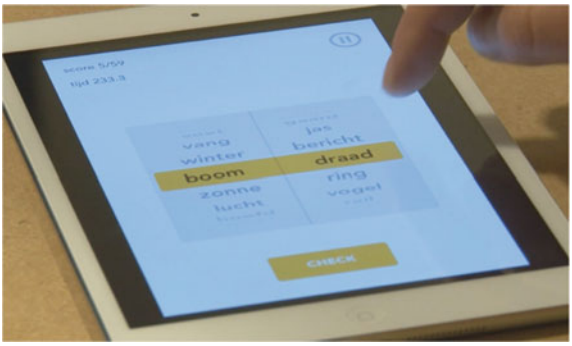

Fig. 4 Woordlink offers two sets of words that must be correctly combined

the same that becomes active when hearing voices. Playing these games cancels or reduces hearing voices, offering a way to distract from them (Fig. 5). In Dutch, the word "temstem" means "tame voices".

In order to build this app, industrial design students spent a day in the life of people with psychosis and were asked to design a product that would promote the recovery of psychosis and social inclusion. This led to the Temstem app, designed by the Reframing studio design firm. Main methods used to make this app were codesign, user experience design, game design, and ethnographic approach. The transdisciplinary approach consisted mainly in putting in dialogue the creative disciplines of design, mental health sciences, and computer engineering disciplines.

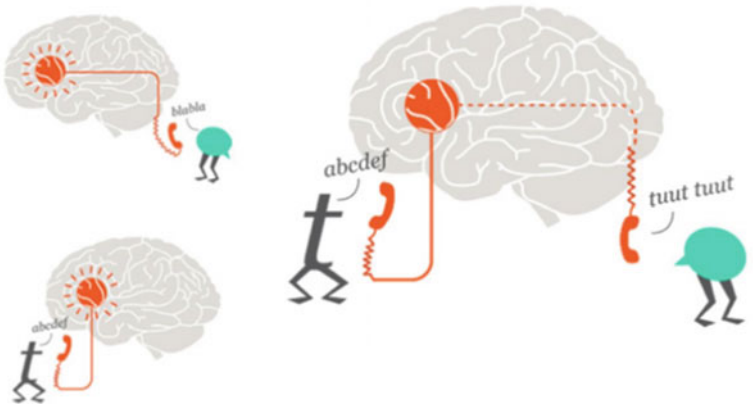

Fig. 5 Illustration of how the Temstem app helps to reduce voices by activating language areas

4.2 Improving the Experience of Accessing Mental Health Care: Mentallys

Under development in Québec, Canada, Mentallys is an app-based service that aims to improve the experience of accessing mental health care. The experience of accessing care refers to the fact that an individual initiates and follows a care path through the various mental health systems (public, private, and community), from the first steps to long-term follow-up. Mentallys seeks to open a mental health care access point in people's pockets, where their cell phones are, to drastically facilitate and simplify the experience of accessing care and services and to support the recovery process.

The project codesign process is multi-level, involving several levels of codesign with different types of participants, namely end-users (patients, families, psychologists, psychiatrists, peer support workers), transdisciplinary co-investigators (researchers from various disciplines), and expert designers (professional designers) and software developers (dev team). With each of these groups, specific codesign activities are implemented in order to maximize the benefits of the collective intelligence that inspires the project. In addition, specific codesign workshops within the lead design team are also organized (Fig. 2).

End-users are involved from start to finish in all stages of the app's design, placing their needs and perspectives at heart. They are composed of two main groups: end-users who are involved in the design at a very early stage, and end-users who test the app prototype in real-world health care environments, thanks to partnerships with public psychiatric services, a professional association, and a community organization (Fig. 6).

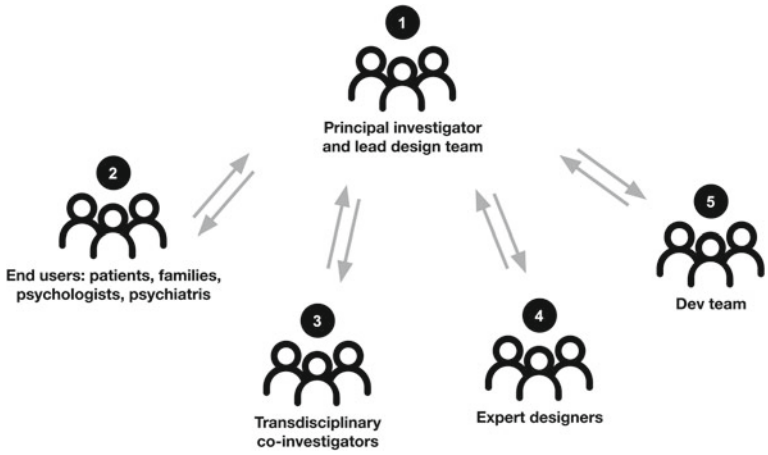

Fig. 6 Mentallys multi-level codesign process

The Mentallys app is currently under development and the project is still in early stage. However, the first series of six codesign workshops conducted between January and June 2021 with 14 end-users has allowed defining the first core of functionalities. The project involves 4 universities, 24 researchers, and more than 10 disciplines including design, ergonomics, psychology, ethnography, nursing, public health, computer science, software engineering, linguistics, marketing, and communication.

5 Conclusion

E-mental health is a growing field of research and intervention that can deeply transform our mental health experience. However, the user retention rate of digital mental health technologies is very low. The lack of design methods such as codesign and user experience design is largely responsible for this. Design methods have the power to facilitate technology acceptance and generate user adoption. This is critical when it comes to mental health.

Existing research tends to focus mainly on science, that is evaluation of the effectiveness of these technologies. This is essential, but this is not enough. A technology that is highly validated by science is *useless* if it is not *used*. Design methods help to integrate the users' needs into the design early on and stay true to them from start to finish. In that sense, design for e-mental health is a contribution to the development of high-quality standards in digital technologies for mental health.

Design for e-mental health refers to the broad range of human-centered design creative strategies that define the structure, function, and form of a digital mental health service from a high ethical and experiential quality perspective. It is an attempt to bring codesign and user experience design methods to the field of digital mental health intervention research. But it is also a new approach to health innovation that relies on end-to-end codesign and builds on highly transdisciplinary research.

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