Development and Initial Validation of a Scale to Measure Engagement with eHealth Technologies

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ABSTRACT

In eHealth, engagement is viewed as an important factor in explaining why interventions are beneficial to some and not to others. However, a shared understanding of what engagement is and how to measure it, is missing. This paper presents the set-up of the development and initial validation of a new scale to measure engagement with eHealth interventions, based on scientific literature and interviews with users and experts. Furthermore, it presents the preliminary results of a systematic review, 11 interviews with engaged users and the first version of the new engagement scale. It is expected that the final scale, which will be based on theoretical and empirical research and focus on the different components of engagement, will enable researchers to investigate what features and

eHealth: the use of technology to support health and wellbeing

Engagement: the extent of usage and a subjective experience characterized by attention, interest and affect.

Overview of proposed methods

- A systematic literature review on the concept of engagement in different fields to provide the theoretical basis
- Interviews with engaged users of eHealth technologies and experts in the field to investigate which attributes are part of engagement and how these become apparent
- Pilot testing and initial validation of a first version of the new self-report measure of engagement with eHealth technologies

forms of technology influence individuals' engagement and thereby pave the way to create more engaging technologies.

INTRODUCTION

In eHealth, engagement is viewed as an important factor in explaining why interventions are beneficial to some and not to others [3, 5, 8, 10]. However, within the context of eHealth, a shared understanding of what engagement is, is missing. A recent review on engagement in digital health interventions has described engagement as the extent of usage and a subjective experience characterized by attention, interest and affect [8], but provides little information on what this subjective experience is, suggesting a need for more (qualitative) research [5, 10]. The definition describes engagement to be more than only usage of a system. However, the majority of eHealth studies only view and measure engagement in behavioral terms, i.e. as usage [8, 9]. This seems problematic as system usage data merely captures just how often a system is used and therefore seems to provide a narrow image of engagement without taking into account the subjective experience [10].

Various ways to assess (a form of) engagement have been identified, e.g. via qualitative methods, self-report scales, ecological momentary assessments and system usage data [9]. Of these methods, self-report scales might be the most accessible way to gain a more nuanced view of engagement, especially relating to the subjective experience. However, most existing scales are created for measuring user-engagement with e.g. e-commerce websites or video games [9]. In these contexts, the goals of users are different than with health interventions. Moreover, engagement with health technologies seems to be needed at two levels: engagement with the technology itself, and engagement with the health behavior the technology aims to improve [10], in contrast to e.g. user-engagement with a shopping website, which involves only engagement with the technology and not with another, 'offline' behavior. This makes these existing scales less applicable to eHealth technologies. Another issue with many existing user-engagement scales is that they often include attributes that predict engagement, but are not in itself part of engagement (e.g. aesthetic appeal), which raises validity concerns [9].

Of the two scales specifically targeted at eHealth which were identified in a recent overview paper on measuring engagement [9], one has only been published in a study protocol and has not been used or validated yet. The other scale has been the subject of a validation study, but is an example of a scale that includes attributes that might predict engagement, but are not part of the engagement itself. The scale e.g. includes an assessment of the credibility of the technology, which may well be a predictor of engagement, but is not something that is seen as being a part of engagement itself [6].

It is clear that more work needs to be done in the field of engagement to eHealth interventions and it seems valuable to create and validate a self-report measure that captures the entire, complex concept. Based on the previous discussion, it seems important that a new scale has a sound theoretical base, is focused on how people experience engagement to both the technology and the health behavior,

focuses only on attributes that are seen as part of engagement and not on predictors, and must be usable for a wide range of eHealth interventions.

Previous studies have not yet yielded a way of measuring engagement that fulfills these criteria and this might be one of the reasons why engagement has been used in so many different ways in this field, hampering scientific progress on this important topic. Therefore, the goal of this study is to develop and provide an initial validation for a scale that fulfills these criteria. In this paper we will describe the different methods that will be used in the study, provide preliminary results on the development and present a first draft of the new scale.

METHODS

Systematic Review

First, a systematic review was conducted on what attributes are understood to be part of engagement in a variety of fields. Therefore, five scientific databases (i.e. PsycInfo, Scopus, ScienceDirect, Web of Science and ACM Digital Library) were searched for published articles with a combination of the words "engagement" and "concept, theory or definition" in the title. To be included in the review, articles had to address a definition, conceptualization or theory of engagement in any field. Articles that were about attributes that predict engagement, but are not itself part of engagement (e.g. usability) were excluded. Included articles were clustered on type of engagement (i.e. the field) and attributes that were considered to be part of engagement were extracted. Articles were screened in three steps (title, abstract, full paper) by two researchers, to assess whether they could be included in the review.

Interviews

Second, 20 self-proclaimed engaged users of an eHealth intervention (i.e. a Health related app) and 10 eHealth experts (i.e. researchers and developers of eHealth interventions) will be interviewed to gain insight in the attributes that constitute engagement from their point of view. Ethical approval for the study was obtained from the BMS ethics committee of the University of Twente. Informed consent was obtained from participants before the start of the interview. Interviews will be held in a quiet space, audio recorded and are expected to take between 20 and 30 minutes. For the interviews, a semi-structured interview schema was developed (see Tables 1 and 2). All interviews will be transcribed verbatim. A combination of deductive (based on the results of the systematic review) and inductive analysis was used to create a code scheme for both the interviews with users and with experts.

For the current paper, 11 interviews with engaged participants have been transcribed and coded. Convenience sampling was used and only participants that use an app for their health and feel

Table 1: Interview scheme engaged users.

Topic	Example question
App and goals	Why did you start using this app?
Usage in daily life	Can you explain or show what you usually do with the app?
Meaning of the app	You have indicated that you feel that the app is important to you. Can you elaborate on that?

Table 2: Interview scheme experts.

Topic	Example question
eHealth engagement	What do you consider to be engagement in the context of eHealth interventions?
Results literature	What would you consider to be affective engagement?
Results interviews	What do you think of this first draft of the engagement scale?

Table 3: Set up of pilot study.

Time	Measured concepts
T0	Background, personality
T1, after one day	Engagement, involvement enjoyment, app usage, steps
T2, after one week	Engagement, involvement enjoyment, app usage, steps
T3, after two weeks	Engagement, involvement enjoyment, app usage, steps

Box 1. Student engagement An influential review paper within the student engagement literature describes different ways in which behavioral, cognitive and affective engagement are conceptualized in this context [1]. The behavioral part of student engagement is often seen as participation in classes and in school and for example positive conduct. Cognitive engagement is seen in e.g. self-regulation and in seeing value in learning. Affective, or emotional, student engagement, is seen as identification with school or a positive attitude about learning.

Box 2. Codes and example quotes
Behavioral engagement
Routine: *'Yes, it is part of my daily life. I scan the bar-codes of the products before cooking'*
No effort: *'But a short look at it is enough to have everything in your mind.'*
Adjusting to goals: *'Since four months [I use the app] even more intense, because my motivation changed.*
Cognitive engagement
Ability: *'I wanted to get a more accurate idea of how many calories I burn while exercising to have more control over my body.'*
Motivation: *'It really has an impact on my behavior, it helps me to be more active and you get more conscious about your own behavior and this motivates me.'*
Mental effort: *'I track calories carefully'*
Affective engagement
Enjoy app: *'It's fun and I like to use it'*
Enjoy progress: *'I like the special effects when achieving my goal. I enjoy them'.*
Connection: *'I would miss something if it was not there anymore'*

engaged with it in some way (e.g. feel that it is important to them) have been included. Their mean age was 27 years (from 20 to 52 years) and seven were female.

Ten participants used an app focused on physical health (of which four on physical activity and diet, four on physical activity only, one on physical activity and sleep, and one on diet only). One participant used an app for mental health (Mindfulness).

Pilot study

Based on the results of the previous methods, a first version of a self-report scale to measure engagement with eHealth technologies was created by the two authors. A study was set up in which participants were asked to use any step-counter app on their smartphone for two weeks. Participants were eligible for the study when they were willing to use a step counter app on their smartphone. They were asked to fill out a survey with multiple measures on four time-points. Table 3 gives an overview of the measures assessed at the different time points. For measuring engagement, both the new scale was used as the previously identified scale from literature that has not been validated yet [9]. Data analysis will focus on the factor structure of the new scale and correlations between the different time-points and other measures, to assess reliability, construct and convergent validity. Currently, the pilot study is in the preparatory stage, therefore no results can be presented yet.

RESULTS
Systematic review

The search identified 1065 unique titles of which 139 full text articles were screened and 61 included. Engagement is a construct that has received attention within many different fields, e.g. health, education, work, digital technologies and the society. The main difference between the different types of engagement is what people are engaged *with*: e.g. patient engagement is about how people are engaged with their health and management of their disease; user engagement is about how people are engaged with technology, and student engagement is about how students are engaged with their learning and/or school. Although the basic idea behind engagement seems to be similar, the concept is operationalized differently, based on the context. In many fields, a general consensus seems to be that engagement is a multicomponent construct, with the components behavior, cognition and affect most prominently mentioned [1, 2, 4]. Differences, not only between fields, but also within one field, seem to lie mostly in what these different components entail and what their perceived importance is. Box 1 gives an example of how engagement is seen in one of these fields; education.

Box 3. First version of the Twente Engagement with eHealth Technologies Scale (TWEETS).
Thinking about using [the technology] the last week, I feel that:

- [this technology] is part of my daily routine
- [this technology] is easy to use
- I'm able to use [this technology] as often as needed (to achieve my goals)
- [this technology] makes it easier for me to work on [my goal]
- [this technology] motivates me to [reach my goal]
- [this technology] helps me to get more insight into [my behavior relating to the goal]
- I enjoy using [this technology]
- I enjoy seeing the progress I make in [this technology]
- [This technology] fits me as a person

Interviews with engaged users

200 fragments were identified covering what participants feel it is to be engaged with a health app. First, these fragments were deductively categorized in behavioral, cognitive, and affective engagement (based on results of the systematic review). Second, all fragments within each component were coded inductively: i.e. codes were based on the content of the fragments. Overall, the number of quotes coded in each of the categories behavior, cognition and affect were similar, with quotes about behavioral engagement (n = 75) and cognitive engagement (n = 72) somewhat more frequent than quotes relating to affective engagement (n = 53). Box 2 shows the categories and subcategories with an illustrative quote.

Draft self-report engagement scale

Box 3 presents the draft of the new engagement scale. The scale consists of three components, based on the literature review. Each component contains three items, based on the results of the interviews with engaged users. This draft will be refined based on the last interviews with engaged users and the interviews with eHealth experts. A new version will be created and used in the pilot study.

DISCUSSION

Results from the systematic review revealed that behavior, cognition and affect are important aspects of engagement that need to be specified for each field. The first 11 interviews with engaged users showed that all participants were in some way engaged behaviorally, cognitively and affectively, and gave insights in what these components are in the context of eHealth interventions. We found that for being behaviorally engaged, routine is important as well as having to spend little to no effort in using the technology. Moreover, the frequency of using a technology varies within an engaged user, relating to the goals users wish to achieve with the technology. Being cognitively engaged consists of users knowing that the technology can motivate them to achieve their goals and can increase their ability to do that. Moreover, when cognitively engaged, users are willing to spend mental effort to work with the technology. Affective engagement consists of users experiencing positive emotions in working with the technology itself, but also in the progress that they achieve with the technology. Moreover, affectively engaged users feel connected to the technology in some way.

Together, behavior, cognition and affect seem to be the building blocks that shape individual engagement. In the interviews, we have seen that these building blocks can have different sizes in different individuals. It seems that these differently sized blocks can shape an individual's engagement: the blocks can be larger or smaller and they can be arranged in different ways so that the blocks support each other. E.g. it might be that for one individual the behavioral engagement is largest: she has created a routine with it, which costs her little effort, but there are periods in which she slips from

her routine. If this person also has some cognitive or affective engagement, this might be enough to re-engage her in a non-active period. She might realize that she knows the app enhances her ability to achieve her goals, or she might miss the enjoyment of seeing that she reached her goal within the app. This resonates with theory on stages of engagement, where different attributes of engagement are of different importance at certain stages of engagement [7].

Concluding, it seems important for eHealth technology to allow and design for different forms of engagement to make sure users will not be dependent on one form or shape of engagement that does not fit their own engagement style. Having a validated, theory and empirically based assessment scale that focuses on the different components of engagement, like the one that will be developed based on this study, might enable researchers in this endeavor.

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