DiClas-Grid,

Discussing and Classifying eHealth Interventions

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***Abstract*—It is often unclear why one eHealth application is successful and the other is not, because eHealth is usually approached as a black box. Evaluation is often done in the same way for treatment like and non-treatment like application, with a focus on effects and outcomes. This leads to applications being wrongfully put away, because their expected measurements did not performed as well as expected. But in reality, it may not be fair to use these measurements for these applications. Based on discussions around the terms of user and usage, as well as differences found among eHealth application when looking at the literature, two dimensions were selected. These dimensions help discussion needed to make conscious choices during the (re)design and evaluation process of eHealth applications and to opening the black box. These two continuous dimensions are: use-structure and caregiver involvement. Combining them in a grid results into the DiClas-grid. The position on the DiClas-grid influences what a 'user' and 'usage' means in the application, but also has implications for how to best evaluate and (re)design the application. To further help facilitating discussion, six complementing dimensions to the DiClas-grid are discussed. The DiClas-grid is a discussion and classification tool that can help make conscious choices in (re)design and evaluation of applications.**

***Keywords*—eHealth; discussion; classification; evaluation; design.**

I. Introduction

In Akkersdijk et al. [1] the grid was introduced. This article elaborates on the grid, names it, and further explores the possibilities of the grid.

In eHealth, there is a diverse range of seemingly successful and unsuccessful applications and interventions. We observe that applications that represent a kind of treatment, for example eMentalHealth interventions [2], tend to be more successful than those that are more supportive of nature, for example those that try to change behavior [3]. It is often unclear why one application is successful, when the other is not. A reason why we cannot always explain the difference in success is because eHealth is often approached as a black box, without knowledge of what happens inside of this box. We search for the effects of the black box and focus on outcomes. Examining eHealth technology from a holistic perspective, in which the technology has value itself, makes it possible to also focus on the mechanisms behind the success. To find these mechanisms it is necessary to open the black box. An important reason why we observe differences in success might be that we evaluate non-treatment-like applications the same way as we evaluate treatment-like interventions, i.e., focused on outcome measures or usage numbers. This results in applications that might be wrongfully put away because their expected measurements did not perform as well as expected, while in reality it may not be 'fair' to use these measurements for these applications. In this paper, we search for a way to give more insight in the black box of the application, by helping with a (re)design and evaluation of that application.

One of the ways evaluation of applications is often done, is by measuring to which extent therapies are followed as intended. One of the ways applications are often evaluated is by measuring to which extent therapies are followed as intended. This measurement of adherence is one of the primary determinants of success in treatments [4], and overall effectiveness of health systems decreases by poor adherence [4]. Although adherence is used as one of the primary determinants of success in therapy, there are also examples in eHealth of applications with a low adherence that are successful. An example of this is QuitNet, a program for smoking cessation [5][6][7]. Adherence to this program is low (23%) [8], but the program can be successful in promoting cessation and preventing relapse [5]. These studies show that it is possible for an eHealth application to have a low adherence but still be successful for a certain group of users.

It is often assumed that a higher exposure and more usage of an application leads to a better outcome. Studies with eMentalHealth interventions often find this high dose – response relationship (also called a usage – outcome relation). An example of this is the study of Bolier et al. [9]. However, this assumption does not hold for all applications. Donkin et al. [10] further explored the usage – outcome relation. The study of Donkin investigates which usage metrics are important in predicting and explaining outcomes for an internet-delivered trail targeting depressive symptoms for those with risk factors for or diagnosis of cardiovascular disease. Their study shows that there is not always a linear dose – response relation, but could be curvilinear (e.g., reaches a saturation point where no further benefit is obtained), or even more complex.

There is a broad range of different eHealth applications and variety in how these applications should be used. These variations can be put on a continuous scale. At one end of the continuum we see applications that require the user to use the intervention in a specific way, for example a fixed order of the modules. These applications are often a (web-based) program of a method, course or intervention. At the other end of the continuum we see applications that leave the usage free, without a strict protocol for each user. Another important factor that varies among different eHealth applications is the involvement of a caregiver. Some eHealth applications are used in close collaboration between patient and caregiver, others with no involvement of a caregiver at all and all variations in between.

Knowing where your application is positioned on these two dimensions can help with (re)designing and evaluating your application. These two dimensions form the DiClas-grid, and applications can be put somewhere on this grid depending on its usage-structure and caregiver involvement. The positioning of an application on the two dimensions influences the term 'user' and 'usage' but also has implications for the way we can (re)design and evaluate the application. The aim of this paper is to present a tool to give more insight in the application, which helps with (re)design and evaluation of that application.

In Section II (The DiClas-Grid), we will take a closer look at the grid, after which we will discuss implications based on the different positions an application can take on the grid in Section III (Implications). We will end this paper with a discussion and conclusion in Section IV (Discussion and Conclusion).

II. The DiClas-Grid

In this section, we will take a closer look at the two dimensions of the DiClas-grid (see Figure 1). We will first look at the dimension of use-structure, after which we will look at the dimension of caregiver involvement. Finally, we will describe some eHealth applications and their positions on the DiClas-grid.

The dimension of use-structure has at one end of the continuum applications that force or require the user to use the intervention in a specific way (railroading them). This can be in a specific order, for a specific number of times or lessons, or for a specific duration. These interventions often have a specific end that is known beforehand and are often based on theories about mental health behavior like acceptance and commitment therapy (ACT) or cognitive behavioral therapy (CBT). Because they often find their origin in known theories and therapies, they are often more 'treatment' like and help deliver a kind of short-term care. As discussed in the introduction, 'Living to the full' is a good example for this end of the continuum. The intervention consists of nine lessons, which have to be completed in a specific order in a 12 weeks. Whether participants worked through a lesson in one session or in multiple sessions was up to them [11][12].

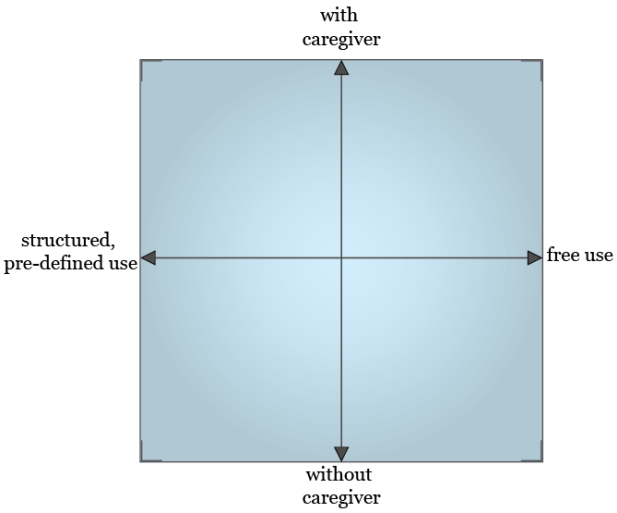

Fig. 1. The DiClas-grid

At the other end are applications that leave the usage free without a strict protocol for each user. There is no specific order or duration for which this application should be used, therefore, they have no specific end. These free-to-use applications often focus more on support and long term care. As discussed in the introduction, 'QuitNet', the application for cessation treatment, is a good example for this end of the continuum. This website offers advice to quit smoking, assistance in setting a quit date, tailored information, assessment of motivation and nicotine dependence, practical counseling (skills training and problem solving), tailored assistants in selecting pharmacotherapies and intra- and extra-treatment social support. How QuitNet is used is completely up to the user [5][6][7].

The vertical dimension represents the amount of caregiver involvement, which varies among eHealth applications. For example, treatment-driven applications often involve caregivers, while lifestyle interventions often can be used autonomously. Research indicates that caregiver involvement is important, but it is not clear what the dosage and frequency of involvement should be [13][14][15][16][17]. In applications that target people with chronic conditions, usually, there is some form of caregiver involvement. However, these applications often struggle to find their fit into daily life, and adherence is often low [18]. Users find it difficult to embed these applications in their own life, while caregivers struggle to embed them into their daily practice [19]. Nonetheless, caregiver involvement is often found to be necessary to ensure adherence and increase effects for web-based interventions for people [20][21].

To illustrate the positioning of an eHealth application on the DiClas-grid, we will now position four applications on the DiClas-grid: 'Living to the full', 'QuitNet', 'Minddistrict' and 'My Health Platform'.

As discussed in the introduction, **'Living to the full'** (LttF) consists of nine lessons, which have to be completed in a specific order in a 12-week period. While there are different versions of this intervention, we will now focus on

the version with automated feedback and without involvement of a caregiver [22].

We would place 'Living to the Full' at the bottom left corner on the DiClas-grid (see Figure 2) for the following reasons:

- horizontal dimension: Usage of 'Living to the Full' (such as how it is used, how often) is pre-defined. Exactly when (time) a lesson is completed is left to the user, and it contains some extra options that are optional for the user to complete. Therefore, we would place 'Living to the Full' almost all the way to the left on the horizontal dimension.
- vertical dimension: 'Living to the full' is a standalone program without caregiver support, usage is completely left to the user. Therefore, we would place 'Living to the Full' completely at the bottom of the vertical dimension.

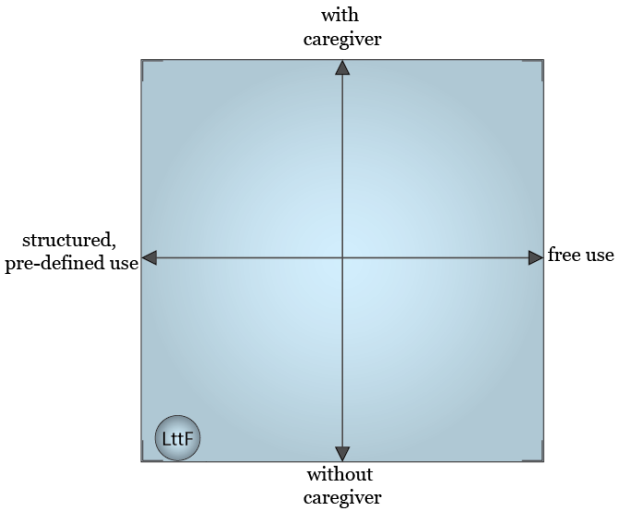

Fig. 2. Positioning of 'Living to the full' on the grid

'QuitNet' (QN) is a website for cessation treatment. There are two versions of QuitNet: a basic version, and an enhanced version, which provides direct access to online cessation counselors and social support systems. Usage frequency of the program is left to the user [5][6][7]. For this example we will discuss both versions. Firstly, we will look at the basic version, **'QuitNet basic'** (QN basic), after which we will look at the enhanced version, **'QuitNet enhanced'** (QN enhanced).

We would place the basic version of QuitNet (QN basic) at the bottom right of the DiClas-grid (see Figure 3 (QN basic)) for the following reasons:

- horizontal dimension: Usage of the basic version of QuitNet (such as how it is used, how often and when it is used) is completely left to the user. Therefore, we would place QuitNet completely at the right side.
- vertical dimension: There is no involvement of a caregiver in the basic version of QuitNet. Therefore, we would place QuitNet completely at the bottom of the vertical dimension.

We would place the enhanced version of QuitNet (QN enhanced) at the right side of the DiClas-grid, at the lower half of the vertical dimension (see Figure 3 (QN enhanced)) for the following reasons:

- horizontal dimension: Usage of the enhanced version of QuitNet is the same as for the basic version (completely left to the user). Therefore, we would place QuitNet completely at the right side.
- vertical dimension: Usage of QuitNet in the enhanced version does provide direct access to online cessation counselors, though usage of this feature is up to the user. Because we have no knowledge about how often this feature is used, we assume that half of the users used this feature and probably not that often. Therefore, we would position QuitNet on the lower half of the caretaker involvement dimension.

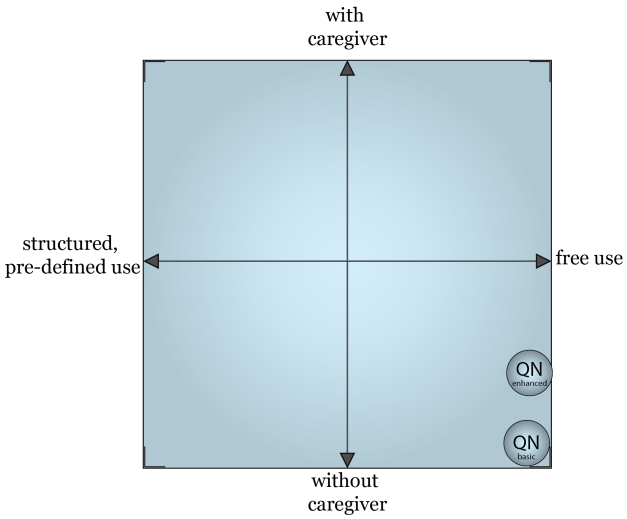

Fig. 3. Positioning of the basic and enhanced version of'QuitNet' on the DiClas-grid

'Minddistrict' [23] provides an online doctor's office for caregivers. It is designed to help deliver personal care tailored to the client, enhance independence in clients, help to go beyond routines, and is always accessible. The platform assists caregivers from triage through blended treatment and relapse prevention. The online platform provides caregivers with an overview of their clients and their progress. The online platform gives the caregiver various tools to do part of the treatment and communication online. Communication between the caregiver and client is enabled through a secure messaging system or by video calling. A triage instrument of questionnaires, either pre-defined or custom-made, can be assigned to clients. Caregivers can give additional psychoeducation through online "modules", consisting of text, video, animation and/or exercises. These modules can be tailored to the client by removing parts of the modules or adding parts from another module. Clients can complete modules on their own or in cooperation with their caregiver. There are many modules to choose from, with subjects ranging from self-help, addiction, chronic pain, eating disorders, depression and anxiety, rehabilitation, ADHD, and everything in between. Finally, there are self-monitoring diaries that can be added to

the treatment.

Placement of Minddistrict on the DiClas-grid can be done by looking at the context of both users of the application individually. Placement on the DiClas-grid would be different in a different context.

In the context of the way a client/patient works with it, we would place Minddistrict at the left-hand side, in the upper-side of the vertical dimension on the DiClas-grid (see Figure 4 (MD tech)) for the following reasons:

- horizontal dimension: How many modules a user should complete and the order in which they should be completed is fixed for a patient. How often a client should do a session is agreed with the caregiver. When exactly a session is completed is up to the client. Therefore, we would place Minddistrict (looking at it from the context of the client/patient) just a small bit to the right out on the horizontal dimension.
- vertical dimension: Usage of Minddistrict is prescribed by the caregiver and modules are selected and adjusted by the caregiver. The client can do modules by themselves or in cooperation with their caregiver. Therefore, we would place Minddistrict at the top half of the DiClas-grid. We would not place Minddistrict completely at the top because clients still can do the sessions on their own and not all sessions only in cooperation with their caregiver.

In the context of implementation and the way a caregiver works with it, we would place 'Minddistrict' at the right-hand side, in the top of the vertical dimension on the DiClas-grid (see Figure 4 (MD impl)) for the following reasons:

- horizontal dimension: Which modules and sessions are selected is completely left to the caregiver. Therefore, we would place Minddistrict at the right side of the grid.
- vertical dimension: The client can do modules by themselves or in cooperation with their caregiver. We would not place Minddistrict completely at the top because clients still can do the sessions on their own and not all sessions only in cooperation with their caregiver. This is not changed compared to looking at Minddistrict from the context of the client/patient.

In case of Minddistrict, the caregiver tailors the content of the technology closely to the patient, and caregiver involvement is high. Seen from the perspective of the client/patient as user of the technology Minddistrict is very structured. However, seen from the perspective of the caregiver as user of the technology, and the way Minddistrict is implemented, Minddistrict is free in use.

Placing Minddistrict on the DiClas-grid when taking a different context into account shows that the context of an application is an important factor when placing an application on the DiClas-grid. Changing the context in which you look at the application can change the placement of an application.

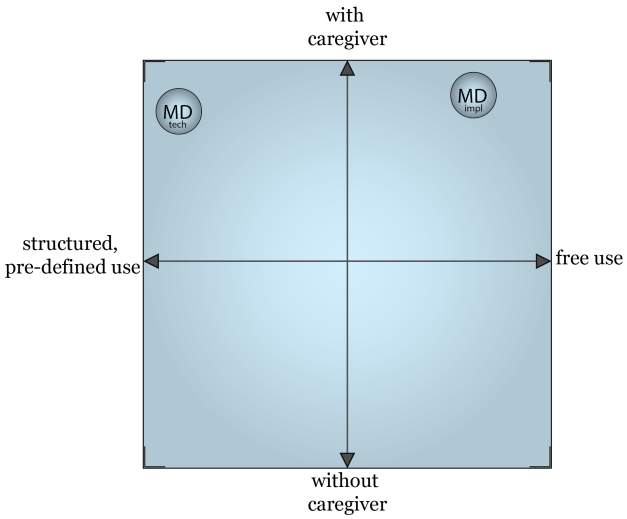

Fig. 4. Positioning of Minddistrict on the DiClas-grid for both contexts(technology and implementation)

'My HealthPlatform' (MHP) is an online platform to support self-care and self-management for people with a chronic illness (e.g., increased cardiovascular risk, COPD, Diabetes mellitus type 2). It is designed to help users keep an overview of and be a director of their own health and lifestyle, alone or in cooperation with a caregiver or expert. In MHP they can monitor their health, find information about their conditions, but also use one of the lifestyle coaches (quit-smoking, nutritional, and exercise coach). While the usage of most of the platform is unstructured, the lifestyle coaches follow a 12 week schedule.

We would place My HealthPlatform at the right-hand side, in the middle of the vertical dimension on the DiClas-grid (see Figure 5) for the following reasons:

- horizontal dimension: Usage of MHP (such as how it is used, how often, and whether or not a coach is used) is left to the user. We would not place MHP completely at the right side, because the coaches do require the user to use them in a specific way and for a predetermined number of weeks.
- vertical dimension: Usage of MHP is mostly left to the user. When MHP is used in cooperation with a caregiver, the caregiver is able to see at home measurements of the user, which provides more insight in the health status of their patient. Because MHP is used with and without caregiver involvement, we would place MHP in the middle of the vertical dimension.

You can position MHP on a different position on the DiClas-grid based on other arguments. In this case, especially the vertical dimension of the DiClas-grid leaves room for discussion. We would like to emphasize that when we would ask multiple people to position the same application on the DiClas-grid we are very likely to end up with as many different positions as we asked people. We would like to argue that this is perfectly fine, because the main purpose of the DiClas-grid is to help you think about certain characteristics of you

application and about the implications of the positioning on the DiClas-grid.

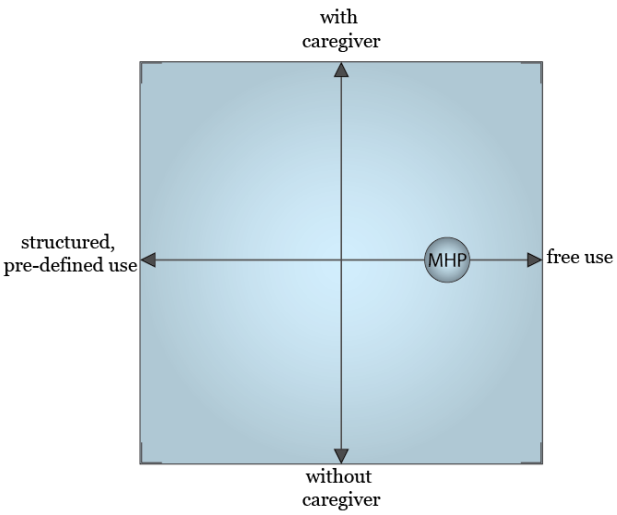

Fig. 5. Positioning of My HealthPlatform on the DiClas-grid

This section consists of examples of how placing an application on the DiClas-grid can work. The examples show that based on another argumentation you can place an application on a different position (as shown in the example of My HealthPlatform), and that the context of an application can play an important role in positioning on the DiClas-grid (as shown in the example of Minddistrict). In the next section, we will talk about some of these implications of the different positions on the DiClas-grid.

III. Implications

Positioning on the DiClas-grid has several implications for the terms 'usage' and 'user' and for the (re)design and evaluation of eHealth applications. In this section, we will discuss some of these implications. We will start with the implications on the terms 'user' and 'usage', after which we will discuss implication for (re)design and evaluation.

A. User

Defining when someone is a user is quite clear when you are dealing with applications that are on the left-hand side of the DiClas-grid. A person that uses the application is a user, and one who does not is not a user. With applications that leave the usage up to the user the way people use the application can vary widely, which leads to a discussion about the term 'user' in this context. We will discuss some questions around the term user, after which we will give our view on the answers.

An important question is: when does a person become a user of the application? This is important because we, for example, use the number of users as an outcome measurement, or we want to know the reach of an application. There are several possible answers to this. We could argue that a person who uses the application is a user, but is there a minimum amount of usage before that person becomes a user, or is 10 seconds enough? And what about someone who does not use the application for a long period of time? Is that person not a user during this period? And could we define certain activities in the application that a person must have done before that person is marked as a user?

For applications that focus on monitoring health or increasing health awareness (mostly positioned on the right-hand side of the DiClas-grid), we can argue that by only becoming aware of such an application a person could potentially be triggered to become more involved in his own health. This means that, in order to have an effect on a person, it does not automatically require that person to use that application. Is this person then a user? We might argue that this person is not a user of the application because he/she did not interact with it. However, the application could still have an effect. In this case the person is not a user in the most common sense of the word, but due to the effect that the application had it balances on the edge of the definition of 'user'.

When we consulted the people who used MHP (Figure 5), it became clear that they had their own view on being a user. There were quite a lot of people who had used the application only a couple of times and therefore, declined to join several studies (interviews, questionnaires, and usability testing) because they did not see themselves as 'users'. In their minds, their definition of a user involves a certain number of reoccurring visits to the application, entering some monitoring data into the system, or participating in the program of a coach. Because they did not meet their own standards of the term user, they thought they could not participate in the study. This example shows that using the system does not equal being a user, at least not for the people who used it. People might have expectations about the intended usage of an application, and it is relevant to communicate the intended use to avoid misunderstanding about the usage.

For evaluation purposes, the definition of what we would call a user can focus on several aspects:

1) The percentage of registered users who see themselves as user, could be a measurement for evaluation of an application. The number of registered users who see themselves as user tells you about their involvement with an application and this in turn can show which role the application holds in their lives and whether the application helps them.
2) You do not always know beforehand who will be a 'user'. When evaluating an application, it is important to define which group of people can be defined as a user, and this group does not always include the people you expected beforehand. For a certain type of evaluation, questionnaire, or interview, a specific group of users might be suitable.
3) An important user that is often forgotten is the caregiver. The caregiver can have his own section in the application where he can see caregiver-specific functionality. He can have his own version of the application, or he can have the same functionality as a patient user. It is important

to realize that the caregiver is a user as well, a user with different needs than a 'patient'. Additionally, both users (the caregiver and the 'patient') affect each other and how they use the application, which means that both types of users should be included in the (re)design and all evaluations.

Finally, a point that we need to take into consideration is that the user, in the sense of usage characteristics, can change over time. That means that when someone starts using an application, their usage can change over time. This change can be caused by a different expectation of the content (they were expecting to find A in the application and were using it that way, but it actually contained B and now they have adapted their usage to B). But is can also be the evolution of the user over time. Knowing that the user can change is important to keep in mind during the design and evaluation process.

B. Usage

The term 'usage' (in the context of an application) can mean a lot of things, such as: How often people return to a website, paths that users follow on a website, how often certain elements on a site are used, etc. This can all be measured by logging user actions with timestamps on a website. Depending on the position on the horizontal use-structure dimension of the DiClas-grid measurements can be used differently and they tell different things about the system/application. Measuring the use of a system or application is useful and insightful for both ends of the spectrum, but evaluating this use differs and the implications/interpretations are different.

For 'railroaded' applications, like 'Living to the full' (see Figure 2), usage measurements can tell you much about the applications. 'Railroaded' applications, positioned at the left-hand side of the DiClas-grid, often are similar or represent a therapy. The user has to follow the structure within the application, do certain actions in a certain order, and use it for a certain amount of time for it to be successful. Therefore, we can define 'normal', or 'ideal' use. We can compare the measured use with the way the application should be used (this can be whether someone completed the application, or the use within an application). Knowing where the occurred usage deviates from the normal or ideal use can help identify problems with the application, or give an explanation why an application does not have the expected results.

Achieving the goal of the application is not completely dependent on the use (the amount and which parts). While a high-dose response relation is often found in eMentalHealth interventions [9], we know that this relation can be far more complex [10]. With applications that leave the user free (right-hand side of the DiClas-grid) the duration of usage is often longer and different situations can be seen than with the use of a 'railroaded' application. For applications positioned at the right-hand side of the DiClas-grid there is no easy definition of 'normal' use, in quantity or in order. This is in contrast with applications positioned at the left-hand side of the DiClas-grid, where the 'correct' following of the structure is essential.

Because there is no prescribed use for applications at the right-hand side of the DiClas-grid, we cannot measure to which extend the measured usage deviates from the optimal use. For example, the measured use of an application positioned at the right-hand side of the DiClas-grid (like 'MHP' in Figure 5) could show users that were dormant for maybe months or years, after which they suddenly used it again. This is unlikely to happen in an application that is 'railroaded'. Because we cannot easily define 'normal use' and it is more likely to vary for different users, adherence, in which we compare the occurring usage with the optimum usage, cannot easily be measured for applications on the right-hand side of the DiClas-grid.

The occurring usage and the use-structure of an application go together. When your application is 'railroaded' and positioned at the left-hand side of the DiClas-grid, all users have a similar usage pattern, while with an application that leaves the use up to the user the occurring usage patterns can vary greatly. It might be good to take this into consideration with evaluation, but also during the design process.

Even though measurements like adherence might not really be suitable for applications that are positioned at the right-hand side of the DiClas-grid, usage measurements can still be very valuable. These measurements can tell you much about the interaction with the application, which parts are used most often, which parts are often used subsequent of each other, after which part users often stop, etc. Knowing more about the interaction with the application is valuable for improving applications, but can also be valuable for finding mechanisms behind application success. Combining usage measurements with use context (what triggered the session) can be used to find a better fit of the content to the context, or improve interaction with the application. By improving the system, and better tuning it to the needs of the users (based on context en measured usage) we can probably increase the effect of applications.

Finally, when we are looking at the usage of an application we should not forget to observe the usage of the application by the caregiver. Caregivers play an important role in the usage of an application by their 'patients' because their usage can be driven by input of said caregiver. When a caregiver does not work with the application as intended or adequately, this will influence the usage of the 'patient' user as well. When the application is meant to be used with a form of caregiver involvement and the caregiver is less involved than the 'patient' expects, the 'patient' user will experience less added value of the application.

C. Implications on (re)Design

With an existing application, the DiClas-grid can be used during the redesign process. Determining the current position of the application on the DiClas-grid based on the characteristics of the application can help you to reflect on your

current application by facilitating the thought process about your applications and its characteristic. A first step in the redesign process is to reflect whether it is feasible to reach the objectives of the application from its current position; is it possible to accomplish the goal of the application from this position or is the position of the application on the DiClas-grid not suitable for the goal of the application. The second step is to determine if the current position is the best, or if there are better alternative positions. When the current position and the desired position are known, the next step is to identify their differences. Knowing these differences, it is then possible to determine if the application should be changed and can give a indication about how the application should be changed.

Designing an application is not supposed to be an individual process. It should involve all stakeholders [24], one of the most important being the end users. They have to use it, and can indicate what is most important for them [25]. The DiClas-grid is meant as a discussion and classification tool to help in the design and evaluation process. It can help facilitate the thought process of design choices and their effects to make better conscious decisions.

D. Implications on Evaluation

All implications based on how an application is used (the position of an application on the use-structured on the DiClas-grid) have consequences for the evaluation procedures. 'Railroaded' applications can be evaluated by measuring the usage and comparing it to the optimum usage, in contrast to applications on the right-hand side of the DiClas-grid where usage can vary widely. Because usage can vary so widely, it is also harder to link measured effects to a specific element of the application. Applications on the right-hand side of the DiClas-grid are less feasible to evaluate with an Randomized Controlled Trial (RCT), because they are used for a much longer time, which makes it difficult to keep the circumstances constant. Secondly, because large groups and free use often occur together, it might be harder to find changes in measurements like quality of life for applications on the right-hand side of the DiClas-grid. This does not imply that these changes are unimportant. It would be more suitable to evaluate applications that are positioned on the right-hand side of the DiClas-grid on processes rather than on effects. On the other hand, applications that are positioned on the left-hand side of the DiClas-grid are easier to evaluate on effects, because they have a fixed setting and use-time.

When discussing the implications on the term of user, we discussed that a user (in the sense of usage characteristics) can change over time. This can be true for both sides (left and right) of the DiClas-grid. It is more likely to occur on the right side of the DiClas-grid, because usage there has more freedom. This asks for a process evaluation rather then a effect evaluation. Evaluations more focused on process can include methods like, analysis of logdata [26], machine learning (supervised or un-supervised) [27], Markov modeling [28], [29], Market-basket analysis [30], or time-series analysis [31].

IV. Discussion and Conclusion

There are different ways to classify eHealth that provide an overview of eHealth, such as device driven, based on the medium the technology uses (web-based, mobile apps, etc.), context-of-care driven (eCare, eTherapy, eAppointment, ePrevention, etc.), or actor driven (based on the interaction between the actors of such a system). The DiClas-grid we propose is not meant to replace these classifications, because they provide an overview that our DiClas-grid does not provide. However, our DiClas-grid serves as an extension of these. The different classifications mentioned above serve a different need, while they did not serve our need for a simple way to have some guiding when (re)designing and evaluating eHealth applications. We were looking for a better way to help make a conscious choice in order to find a better fit (in (re)design and evaluation). Positioning of an eHealth application on the DiClas-grid helps to become more aware of implications this has (as discussed in Section III).

Blended care always is a combination of face-to-face and online therapy, and both modalities contribute substantively and procedurally to the treatment process [32]. Therefore, blended care itself always has a high caregiver involvement. When only looking at the technology this is not automatically true, because there can be forms of blended care in which the caregiver plays a small role in the technology.

Based on the position of an application on the DiClas-grid we discussed that the term 'user' can include a different group of people. Those who 'use' an application do not always perceive themselves as a 'user', because they have expectations about the intended usage of an intervention. It is relevant to communicate the intended use to avoid misunderstanding about the usage. The percentage of users who see themselves as a user might be an additional measurement for evaluating an application, because it includes values about involvement with the application. An important group of 'users' that is often forgotten are the caretakers. They often also use the application, and their use or their communication about the application influences the use of the application by their patients.

Adherence is an important measurement for applications positioned on the left-hand side of the DiClas-grid. For these applications, we can define 'normal' or intended use. Because 'normal' or intended use is often a lot harder to define for applications positioned on the right-hand side of the DiClas-grid (there often is no prescribed use) and usage patterns can vary widely, the measurement of adherence might not be suitable. However, usage measurements can be valuable for process evaluations and improvement of the application.

The DiClas-grid can help with the (re)design process by gaining more insight facilitated by the thought process needed for placement of the application on the DiClas-grid. It is

important to think about whether the intended (or current) position of the application is suitable for the goal of the application, or whether another position might be better.

Positioning of an application on the DiClas-grid (left versus right, and with or without caregiver involvement) influences which sorts of evaluations are suitable. Evaluations can be focused on process or effects and positioning on the left-hand of the DiClas-grid are more suitable for effects evaluations than positions at the right-hand side of the DiClas-grid.

When using a time series in a process evaluation, the DiClas-grid can also help determining the frequency and number of point measurements. Because, positioning on the DiClas-grid gives an indication about the usage.

We selected the two dimensions of the DiClas-grid based on our needs in the discussions we had around the terms of user and usage, as well as differences we found among eHealth application when looking at the literature. The DiClas-grid is a good way to have a simple tool to compare applications and to facilitate discussions around the (re)design and evaluation process. To complement the DiClas-grid other dimensions can help to facilitate discussions around design choices and evaluation. It is interesting to think about what these dimensions can be. In the following section we will discuss, in random order, some ideas about other dimensions as well as what different positions on these dimensions can implicate.

The first dimension is also a dimension of use, but in a different context: a social context. Whether a user uses an application solitary or the application provides a form of contact or social support can make a difference in the dynamic of the application and how it is used. The social aspect can for example come from others with the same condition/goals, others using the same application, or maybe from their own social network. The occurring dimension can be found in Figure 6 (A). Hardiker and Grant [33] found that social aspects of use was one of the four factors which influences public engagement with eHealth. Placing an eHealth application on this dimension can help in the discussion if, and how to incorporate the social context in the application. It also can help to determine how to evaluate this part of an application. When social context is an important factor in your design, it is important to evaluate this accordingly.

Use context consists of two elements. The first element (see Figure 6 (B)) is whether the application has to be used in private only, or in a more public setting in which sharing of (personal) information plays a role (such as a work environment). Both settings ask for a different approach and different decisions in the design process. At one end of the dimension is an application that is only used in a private setting, while at the other side of the dimension there will be applications used in a public setting, a less comfortable setting and a setting in which sharing (personal) information with others plays an important role. This will influences privacy matters. But also, the willingness to share information [34].

The second element, and third dimension, is how well the application fits in the patient's regular life and schedule (see Figure 6 (C)). If you keep getting reminders to exercise more while you are at work and in a meeting, chances are that you stop using the application. Also data exchange between you and your caregiver sounds great, and if your caregiver gets them without problems even better. But what if your caregiver then has no time to do something with the data you send during a consultation because working with the data does not have a place in the protocols, and he keeps running out of time to actually look at your data? Therefore, an interesting dimension (mostly from an evaluation point of view) might be implementation/fit into daily life, with at one end of the spectrum applications that fit smoothly into daily life and at the other end applications that have an awful fit. It can be argued that all applications should be unobtrusive, because the application is more likely to be used when it is unobtrusive and does not require lots of effort. However, it can also be possible for an application to have a less than perfect fit into daily live especially because this is annoying, motivating the user to change his behavior to the intended goal of the application (where the intended behavior is less obtrusive in daily life). As long as the application supports the changes required to make this change it is unobtrusive, as is also discussed in Laurie and Blandford [35]. Discussing which factor contribute to a perfect fit [36], how to achieve a better fit, and which elements lead to this fit can also be interesting.

A fourth dimension could be a dimension of user target (see Figure 6 (D)): Does the application target a large diverse group, or does it target a small uniform group? Think about an application that targets users with only diabetes versus an application that targets users with a chronic disease. Firstly, when you find that you target a diverse group, it also might be that it is not clear what makes the group you target unique. Therefore, try to think of characteristics of the target group that make this group unique. Secondly, when only targeting a small specific group you can tailor the application more specifically to their needs. Serving a large diverse group, you have to make sure you cover their needs enough to not lose them, or find clever ways to still tailor to their specific needs. When evaluating an application that targets a large diverse group it is possible that the application works fine for a specific group within the larger group. This should be looked at while evaluating.

A fifth dimension is related to the goal of the application: Is the goal of the application disease management, prevention or treatment of an illness? This dimension could be a scale with prevention at one end, and treatment at the other, while disease management is exactly in the middle (see Figure 6 (E)). What kind of consequences does positioning on this dimension have? The content of the application would be different for all of the applications depending on the positioning. Intrinsic levels of motivation of your users probably also would vary, for the simple reason that users of an application that is focused on treatment probably experience problems, and therefore, are more likely to be intrinsically motivated. On the other hand, users of an application focused on prevention probably do

not yet experience problems, therefore, there is less (obvious) need to used the application. This influences decisions about content of the application as well as functioning of the system itself, and the service. Positioning of an application further to the right of this scale also influences the evaluation. When measuring effects of an application that is focused on treatment, you look for positive change in specific variables. When dealing with disease management these variables are more far fetched (there probably is not one outcome measurement, but a larger combination). Effects of an application focused on prevention can take a long time to become clear and measurable. Secondly, the duration over which the application should be used differs depending on the position on this dimension [2]. Prevention and lifestyle applications in general have a longer duration, while treatment often is shorter.

A sixth dimension could be: How proactive or reactive is the application? A proactive application is an application that for example gives alerts, send reminders, or emails. A reactive application is an application that only reacts to what the users does with the application (if it even is reactive). The dimension can be seen in Figure 6 (F). Some parts of this dimension are already implemented in applications. However, most eHealth applications are still mostly reactive. Proactive, fine-tuned apps are still work for the future, but have a lot of potential.

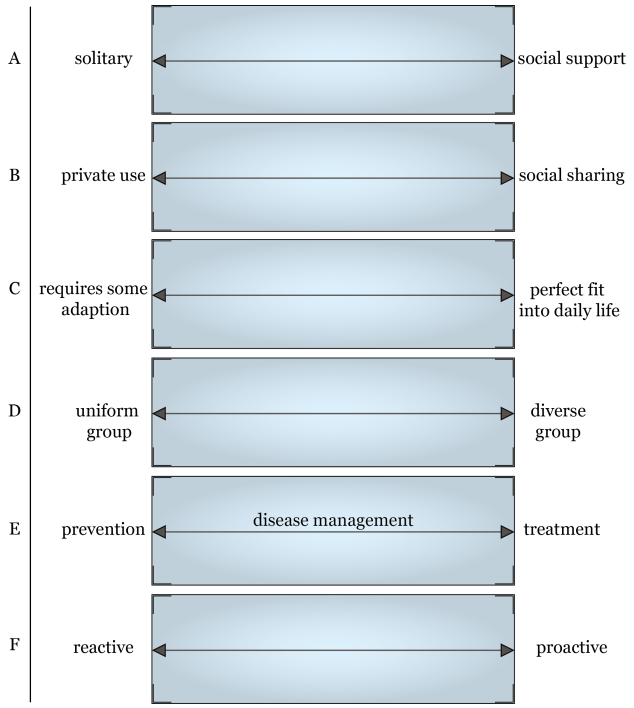

Fig. 6. All dimensions: from top to bottom: A) social context, B) use context, C) fit into life, D) target users, E) goal dimension, F) reactive/proactive

We have discussed six complementing dimensions for the DiClas-grid. These dimensions can help facilitate discussion about other subjects for design and evaluation purposes. They do not replace the DiClas-grid, or a specific dimension of the DiClas-grid, but serve as an addition.

While the six dimensions complement the DiClas-grid, they do not focus on keeping users and their experience. Other important subjects to have a discussion about include e.g., persuasiveness, tailoring of the application, engagement of the user and involvement of the user.

The DiClas-grid is a tool to classify eHealth, to gain insight, facilitate thought processes, and start discussions, and is not meant to be a formal and rigid model. The DiClas-grid combined with the dimensions as discussed can help facilitate discussion and help make conscious choices around many different subjects concerning evaluation and design of eHealth applications.

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