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The DECENT Toolkit to Support Design of User Engagement of Mobile Health Technologies from a Practice Theory Perspective

Tochukwu Ikwunne¹[0000-0002-6408-0172], Lucy Hederman¹[0000-0001-6073-4063], P. J. Wall¹[0000-0001-6073-4063]

¹ ADAPT Centre, Trinity College Dublin, Ireland

Abstract. User engagement is critical for the successful adoption and use of mobile health apps, but it is also influenced by a variety of factors that are not always easily accessible or quantified by designers in practice. The goal of this paper is to facilitate the application of activity theory and the communicative ecological framework to uncover various socio-cultural contexts for user engagement designs using the Design Process Engagement Enhancement System (DECENT) toolkit. The DECENT toolkit is an innovative theory-based design tool and associated method that includes socio-cultural filtration and a socio-cultural checklist that are augmented in the phases of the user-centered design model. This paper presents a set of consolidating concepts to guide future design practice which broaden designers' knowledge of mobile health app designs for user engagement. Finally, to fully explain and design for user engagement in mobile health, an integrated approach incorporating a variety of technological and socio-cultural factors is presented.

Keywords: user engagement, socio-cultural filtration, socio-cultural contexts, mobile health.

1 Introduction

Effective user engagement is a universal goal in the design of content, products, systems, services and apps, and every designer strives to engage users [1]. Inadequate engagement may be caused by an imbalance in the integration of appropriate theoretical content and features that maintain user interest [2-3]. Ikwunne et al. [4-5] conducted a systematic review of the user engagement design process and discovered a lack of consideration for socio-cultural contexts in the design of mobile health (mHealth) interventions. The systematic review recommended that such socio-cultural contexts be considered and addressed systematically by identifying a design process for engaging users in mHealth interventions [5]. In this paper, we frame user engagement as a context-dependent, individual-specific psychological state that emerges from two-way in-

teraction with an object, such as an app [6-8]. This is important as although the effectiveness of mHealth initiatives depends to a large extent on user engagement [9, 10], many such interventions frequently do not include user-engaging attributes [11].

In our globalized economy new products are frequently developed for international markets. Because user characteristics and needs differ significantly across regions [12], product development for global markets requires organizations to design products with these differences in user characteristics and needs in mind. According to Shen et al [13, p.7] "*Successful interface metaphors should be developed or adapted through cultural requirements by or regarding, representatives of the culture for which they are intended*". Culture is defined as the similar patterns of thinking, feeling, and acting of people who belong to the same group but are different in these patterns from other groups [14]. This notion of acting is largely based on unwritten rules and habits passed down from generation to generation [15].

Thus, culture, politics and society must be considered when designing and developing technology. According to Honold [16], the approach to learning how to use a new mobile phone may vary depending on national culture. According to Honold's findings, German users prefer a user manual, whereas Italians prefer learning by doing. Furthermore, while the salesperson is an important source of information for Chinese users, for Indian users, the entire family is involved in the knowledge acquisition process. Honold's research shows that culture influences patterns of user-product interaction and engagement, implying that designers should account for these differences in knowledge acquisition approaches. However, determining the nature of this impact may be difficult in the absence of theory and a deeper understanding of how users actually actually engage with technologies [17]. This emphasizes the importance of theoretical models that provide a framework for assessing users' socio-cultural contexts for user engagement designs. Also, design guidelines are needed for user engagement design practice.

This paper introduces the Design Process Engagement Enhancement System (DECENT) toolkit which is specifically designed to bridge these socio-cultural and theory-practice gaps. Our DECENT toolkit may be seen as a novel theory-based design toolkit and associated method that includes socio-cultural filtration and a socio-cultural checklist that is supplemented by the user-centered design model's phases. This toolkit and methodology addresses the research question - how can we develop a useful tool capable of supporting the design process for user engagement?

The contributions of this paper are twofold: firstly, the DECENT toolkit is presented as an innovative design tool and method to assist designers in leveraging activity theory (AT) and communicative ecological framework (CEF) for user engagement design of health apps; and secondly, the toolkit will better-assisting designers in imagining user engagement issues, as well as assessing the conceptual importance of the three components of the DECENT toolkit -personas, capture and postcards, and communication delight.

2 Related Work

Designing mHealth apps for user engagement necessitates first understanding existing theories and then applying this knowledge in design practice. This section provides a brief outline of our analytical framework, starting with a discussion on user engagement theories in general before moving on to a more specific discussion of AT and the CEF.

2.1 User Engagement Theories

The theories of user engagement have been extensively researched [1]. Ikwunne et al. [18] provide an overview of the disciplinary foundations, descriptions, and conceptualizations of engagement as they relate to each of the eight theories and models. The eight theoretical perspectives that focus on engagement were identified as Flow Theory [19], Motivation Theory [20], O'Brien and Tom's Model of Engagement [21], Sidner et al.'s Model of Engagement [22], Technology Acceptance Model [23], Unified Theory of Acceptance and Use of IT [24], Short et al.'s Model of User Engagement [25] and Luden et al.'s 'PERMA' Framework [26].

The summary indicates that theoretical conceptions of engagement can be separated into several categories, including academic, cognitive, intellectual, institutional, emotional, behavioral, social, and psychological. These distinctions are made to aid a particular type of sociocultural context-dependent analysis and design, rather than to provide objective knowledge of engagement as a universal neurophysiological or social reality. These reasons point to the ontological perspectives on engagement that have been brought to bear. As well as the choice of using activity theory and the CEF as appropriate models used in this paper for uncovering users' socio-cultural contexts for user engagement designs.

2.2 Activity Theory and the Communicative Ecological Framework

Activity theory and the CEF are widely recognised as practice theories used as organizing principles for understanding the socio-cultural complexity of users. For example, Engeström's [27] model of AT, derived from psychology, information systems design, human-computer interactions, organizational learning, and cultural studies emerged as a result of the socio-cultural perspective. It investigates the complexities of human-environment interactions by identifying activity system units, how they are related, their various voices, their history, flaws, and changes [28]. The subject, object, and community are the elements of an activity system, and the artifacts used in context-determining activities are tools, rules, and divisions of labour.

While AT can explain why an individual user interacts with mHealth artifacts in daily communication, the Altheide [29] model of CEF provides a rich description of how each individual interacts with mHealth artifacts in broader socio-cultural contexts. These theories are used to inform the development of DECENT tools. Thus, AT and CEF are used as a lens or organizing principle to uncover a user group's socio-cultural contexts for user engagement designs.

Section 3.2 describes how we use the AT model to inform the design of personas. As an example, we explained how AT provided a comprehensive set of tools for comprehending individual user complexities that inform components of the DECENT framework. Also, section 3.2 explains how the AT model is used to guide the design of the capture & postcards tools. The two examples show that while AT can explain why users engage with mHealth, it lacks the vocabulary to investigate what causes specific users to engage with mHealth apps through their daily communication in broader socio-cultural contexts. However, applying AT to mHealth app engagement does not provide insight into how users' engagement with mHealth apps is structured in social contexts. To address this limitation, CEF is used to provide a rich description of how mHealth is structured in a social context by integrating three layers of interpretation (technical, social, and discursive). Section 3.2 further describes the use of CEF to inform the design of the communication delight tool, with examples of how CEF provided a comprehensive understanding of socio-cultural contexts of user engagement with mHealth apps that inform components of DECENT framework.

3 Research Methodology

This study used a design science research methodology (DSRM) [30, 31] to provide a process model to create DECENT tools. The steps included in the model are:

1. Problem Identification and Motivation – The problem is that many mHealth apps lack engaging attributes, necessitating the development of a framework to support the design process for user engagement.
2. Solution Objectives – DECENT is developed to support the design process for user engagement with mHealth apps.
3. Design and Development – Tools such as personas, capture & postcards, and communication delight as DECENT framework components are created using activity theory and communicative ecological framework as theoretical models. The details of how these tools were designed are explained in section 3.2.
4. Demonstration – The next stage of the research will be to consult with developers and end-users of mHealth apps that use artifacts to see if the artifact can solve the identified problem.
5. Evaluation – interviews and focused group discussions will be conducted to determine the efficacy and efficiency of DECENT in solving the identified problem.
6. Communication – The description of three components of the DECENT framework including their design and purpose is described in this paper. The evaluation of the DECENT framework and other components will be described in a future paper.

The following section depicts all of DECENT's components as well as how socio-cultural filtration and a socio-cultural checklist of the DECENT framework are augmented in the phases of the user-centered design model.

3.1 The DECENT Framework

The DECENT framework is a process-oriented user-centered design process that takes a socio-cultural approach. It emphasizes aesthetic, socio-cultural, and contextual values and has a critical understanding of the importance of design in socio-cultural contexts. The DECENT framework has six phases, and it is adapted from a user-centered framework, as shown in Figure 1. Phase1: Socio-cultural filtration – This phase involves a collection of sets of tools to understand users' socio-cultural contexts. Phase 1 consists of six tools: (1) contextual inquiry, (2) personas, (3) capture cards and postcards, (4) self-built guide, (5) communication delight, and (6) ethics. Other phases of DECENT include analysis of needs assessment of users, design solution, socio-cultural checklist, evaluation, and implementation.

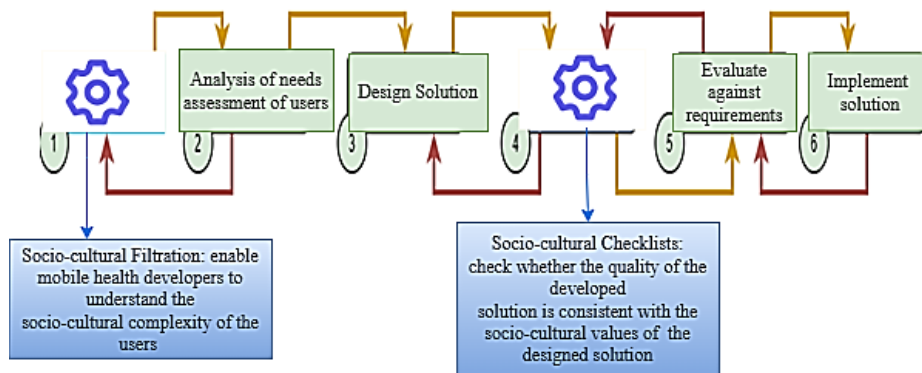


Fig. 1. The DECENT framework as adapted from the User-Centered Design framework as extended by our method.

The presented socio-cultural filtration and socio-cultural checklist in Figure 1 fit nicely into the first and second phases of already existing user-centered design framework. The socio-cultural filtration phase focuses on enabling mHealth designers to understand the user's socio-cultural contexts; this is the input to the first phase of user-centered design, the "analysis of user needs assessment," which focuses on understanding the user's needs and values.

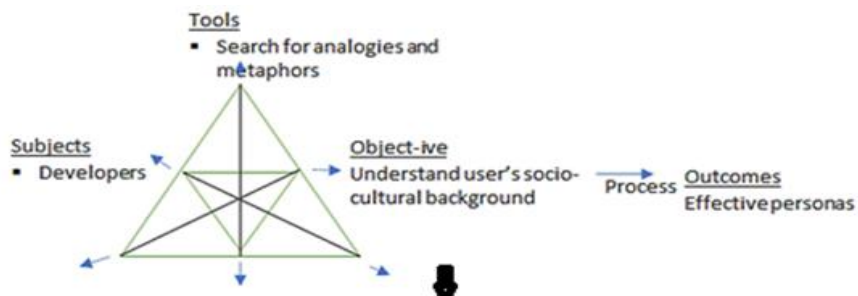
The second addition to the user-centred design framework is a checklist following the "design" phase. This checklist checks that the socio-cultural aspects identified as a result of the first, socio-cultural filtration, phase have been addressed by the solution. .

Moreover, AT and CEF provide a holistic context for informing DECENT tools in phase 1 of the DECENT framework. The next section describes how the AT model informed the development of personas, capture, and postcards. The use of CEF to inform the design of the communication delight tool is described in Section 3.2. The AT inspired tools explore individualized contexts, while the CEF ones explore socio-cultural contexts in Phase 1 of DECENT. Phases 1 and 4 are built on top of the existing phases of UCD.

3.2 Designing the DECENT Tools for Capturing Users' Socio-cultural Contexts

The first phase of the DECENT framework consists of a collection of tools for capturing users' socio-cultural contexts. The following sections provide three examples of how AT and CEF are used as organizing principles to inform the design of DECENT tools such as personas, capture & postcards, and communication delight.

The AT Model to Inform the Design of Personas - AT serves as an analytical lens for understanding and describing the process of achieving the goal of creating effective personas. Figure 2 shows a persona tool which is a realisation of the application of AT to aid developers to achieve their goals of creating an effective persona. Personas are used as a tool to represent a specific group of people based on their interests and behavior (Figure 2).



Project name _____ Date _____

Personas

Fictional characters to represent a particular group of people.

User Information Identify a type of users who may be present in a given context.

+ Add photo

Name _____

Age _____

Profession _____

Academic education _____

1

Interest/Hobbies Tell us about an interesting hobby of a particular individual.

💡 Add an idea

2

Frustrations Give an example of what frustrates a particular individual.

💡 Add an idea

3

Goals What are the goals of a specific individual?

💡 Add an idea

4

Personal story-- a day in the life What is a personal story - a day in the life of a particular group of individuals?

💡 Add an idea

5

Generate user's card

Fig. 2. Examples of creating personas tools from the lens of AT.

Collecting insights about the users' socio-cultural backgrounds, frustrations, and goals will aid in developing a broad understanding of the users. Personas are created by combining trend observations [32]. Improved communication about the target users within the design team and with other stakeholders is one of the widely described benefits of personas in the literature [33-35]. Personas, according to Chapman and Milham [36], still lack a solid empirical foundation. A name and a picture are chosen to represent the fictional representative in a persona, and the persona is described in narrative form, according to Miaskiewicz and Kozar [37]. The activity theory model provides a holistic context with which to design personas. The tool can be used to collect information, interest and frustrations, occupation, goals, and personal stories in a day of the life of the individual.

AT Model to Inform the Design of Capture and Postcards Tools - Figure 3 depicts how AT can be used as a lens to inform the design of capture and postcards tools which aids in understanding how users engage or disengage with mHealth products.

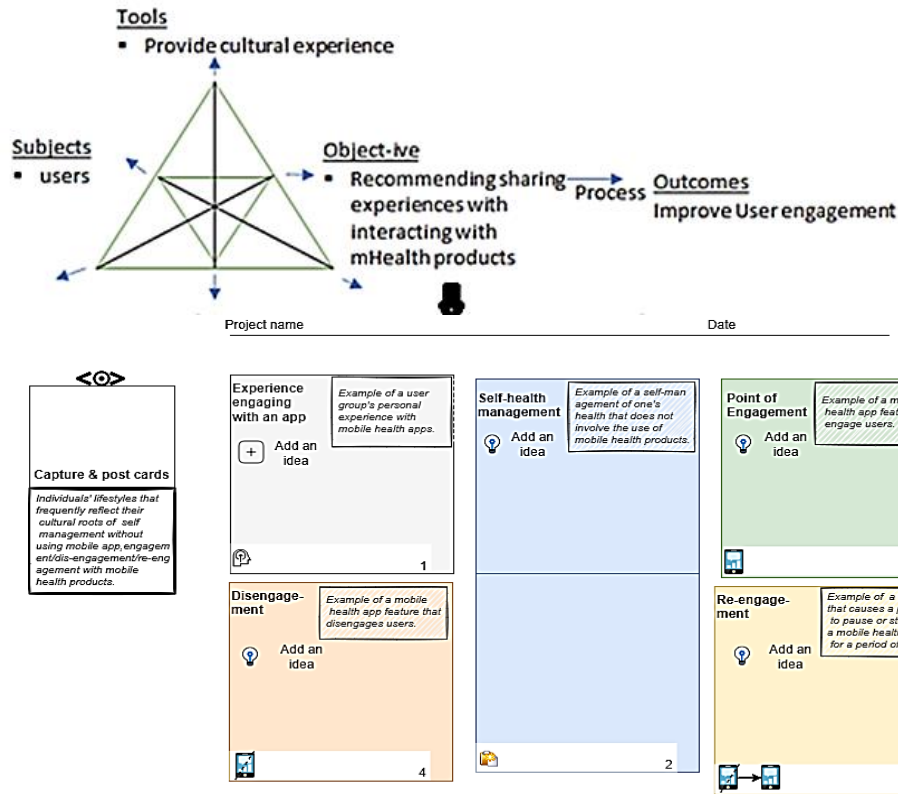


Fig. 3. Examples of creating capture and postcard tools from the lens of AT.

The capture and postcards tool are designed based on the use of AT that serves as an organizing principle to understand the socio-cultural complexity of users interacting with mHealth products (Figure 3). Users are described as "innovators" based on the AT model because they are actively involved in co-creating their user engagement designs with the designers. They share more information with developers about different points of engagement/disengagement with mHealth products that they have previously used to improve user engagement. The AT model provides a context with which to design the capture and postcards tool.

The capture and postcards tool are intended to motivate users to provide various points of engagement when interacting with mobile apps. Capture and postcard capture special moments of users engaging with mHealth products, as well as different stages of points of engagement/disengagement, to uncover insights about users' lifestyles, which are often reflected in their inherent cultural roots while engaging with mHealth products for user engagement designs.

The two examples in sections 3.2 show that while AT can explain why users engage with mHealth, it lacks the vocabulary to investigate what causes specific users to engage with mHealth apps through or their daily communication in broader socio-cultural contexts. As a result, applying AT to mHealth app engagement does not provide insight into how users' engagement with mHealth apps is structured in social contexts. To address this limitation, CEF is used to provide a rich description of how mHealth is structured in a social context by integrating three layers of interpretation (technical, social, and discursive). Example is shown in the next section of how CEF provided a holistic content of socio-cultural contexts of user complexities that inform components of DECENT framework.

CEF Model to Inform the Design of Communication Delight Tool - Figure 4 shows how CEF can be used to understand and describe how users should share their ideas in form of images communicate between two or more cultures. The idea of communicative ecology emerged as a reaction to issues those studies attempting to identify a causal relationship between discrete technologies and social impacts overlook variables critical to the successful implementation and adoption of technologies in situ [38]. The three layers of CEF, according to Foth and Hearn [39], are as follows: The technology and media layer describes the methods used to communicate between different people and groups, and it includes all communication devices, distribution systems (digital or analog), and the technical systems that enable them (e.g software). The discursive layer is ideational and focuses on the actual communication content, such as stories, understandings, beliefs, and symbols that define – in this case – design culture and user engagement design practices. The people layer describes the various people and groups involved, as well as their social relationships and the social institutions and structures that connect them. The CEF serves as a framework to inform the design of the communication delight tool. Communication delight, inspired by previous work done to share ideas and facilitate communication in the form of images between two or more cultures [40], allows designers and users to share ideas and communicate via images and visual diagrams.

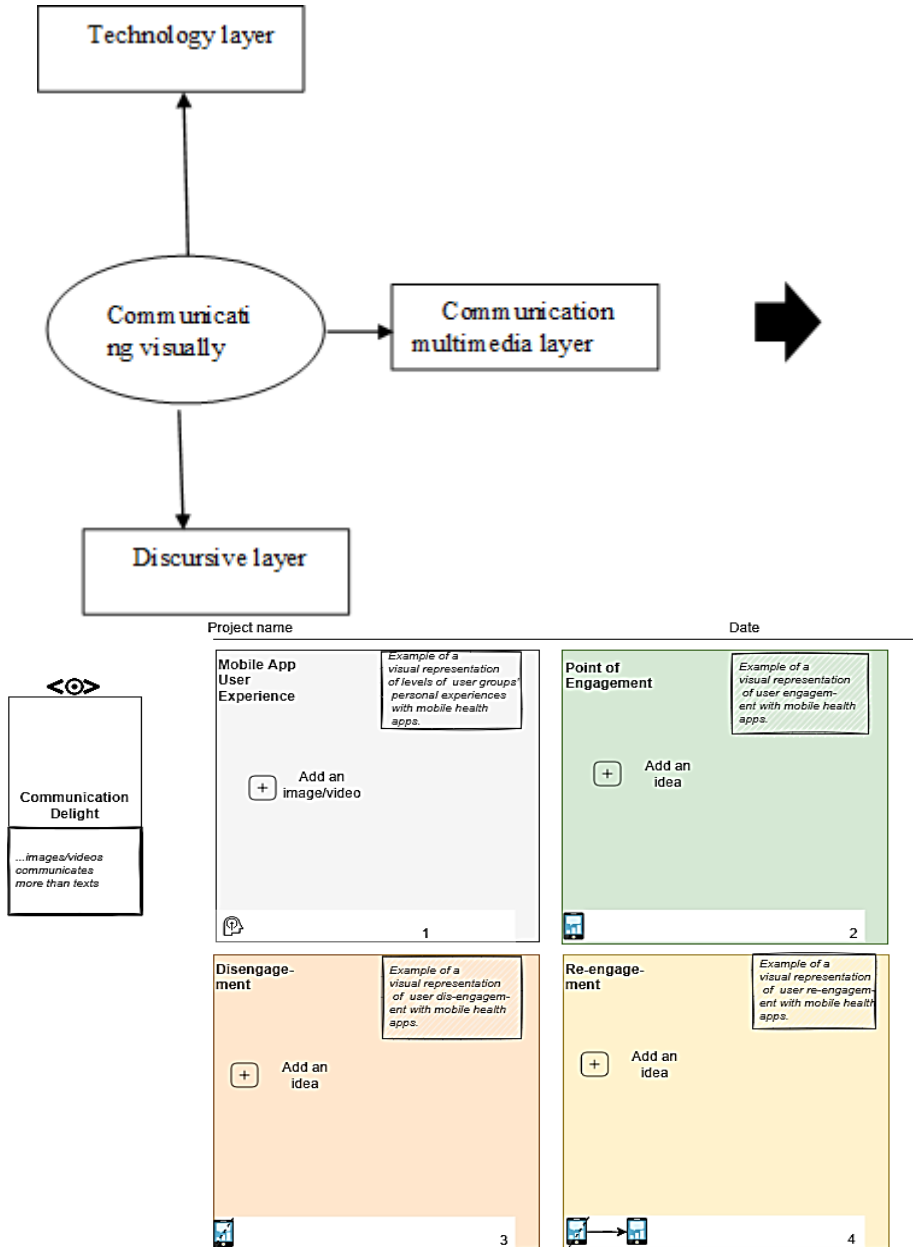


Fig. 4. Example of creating communication delight tool from the lens of communicative ecology framework.

Our interactions with software developers on ways to uncover the socio-cultural background of users sparked the idea of using visual images to communicate between two

or more cultures. Thus, communication delight is used as a DECENT tool to enable mobile health users to communicate with designers or other users by interacting with them using images rather than words to share their experiences with mobile health products. Language barriers may no longer irritate the user as a result.

4 Conclusion

This paper presents the outcome of early phases of a Design Science approach to the design of the DECENT toolkit, a bespoke and innovative theory-based design tool and associated method to support the design of mobile health apps. We described the Phase 1 components of the DECENT framework and focused on the theories that informed them, their design, and their purpose. Future iterations of this work will further describe the components, develop, refine, and test our DECENT framework in a specific application of mHealth interventions in Sierra Leone. This will be framed by our use of AT and CEF to evaluate whether the outcome resulting from the DECENT toolkit has impacted user engagement in this case either positively or negatively.

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