A UX Pedagogy on Multimodal Aspects of Emotions

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Abstract: Every day products are becoming increasingly complex, at a time when the population is progressively ageing. These trends highlight the importance of teaching future designers to create inclusive and meaningful experiences for ageing users interacting with digital technologies and smart products. This paper presents a pedagogical approach to evaluate and analyse the affective interaction with smart products. Through the development of active problem-solving scenarios, students learn to understand the multidimensional aspects of emotions and cultivate the skills and dispositions needed to empathise with users. The training requires students to capture users’ emotions through mixed methods and visually analyse the data in ways that are adapted from the initial stages of a PhD research project and grounded in the literature. Visualisations seek to enhance students’ knowledge of how these methods can provide complementary information and how to analyse and interpret the collected data. The proposed model seeks to inform design education on effective ways to design with new technologies for more meaningful and positive emotional experiences.

Keywords: user experience; smart products; digital technologies; interaction design

1 Introduction

Products embedded with positive stimuli can create pleasurable user experiences and lead to better interaction (Thoring, Bellermann, Mueller, Badke-Schaub & Desmet, 2016). Demand for user experience designers (UX) in professional practice has increased in recent years. However, academic programs that teach UX remain limited especially in areas of advanced digital technologies such as the design of robots, Internet of Things (IoT), and Artificial Intelligence (AI). This research responds to the need for pedagogical models to design advanced technological products accounting for users’ emotions. The complex nature of smart products calls for studies to investigate more extensively beyond laboratory contexts, mock homes or office environments using multi-method approaches to deeply understand users’ emotions (de Graaf, Allouch & van Dijk, 2017).
The effects of digital technologies on everyday life raise social and ethical concerns (Greenfield, 2017). These concerns accentuate for vulnerable users and technologies under development that we only partially understand today. Everyday products are becoming smarter, they incorporate advanced sensing and information processing capabilities, they communicate with local and remote devices, and they have the capacity to learn and adapt from daily user interaction. On the other hand, a global ageing population with gradually reduced physical and cognitive capacities will be increasingly exposed to these smart devices (Blackler, Popovic & Mahar, 2010). With the population growing older, future UX designers need to learn today how to identify, investigate and design while adopting an inclusive design approach to consider the affective dimensions of user experience with everyday smart products (Goddard & Nicolle, 2012). The emotional behaviour of users interacting with smart products can inform the design of future products that can trigger meaningful experiences, such as social acceptability, product desirability and ethical uses.

Whilst intelligent machines date a long way back (Oh & Park, 2014), smart products have grown rapidly over the last two decades. Smart products are everyday products embedded with computational power, information and sensing capabilities giving them information about themselves, their environment and the users (Lyardet & Aitenbichler, 2007). The ability to interpret their functions and features, the environment and users can enable these objects to interact, cooperate and adapt autonomously. In this paper, everyday products with such capabilities are referred to as smart products. Smart products require users to learn new and multifaceted skills (Barricelli & Valtolina, 2017). This complexity can cause frustrations, particularly among older people that are accustomed to manual and direct control (Yang & Coughlin, 2014).

In the user experience literature, the emotional interaction of users with products is examined (Blythe & Monk, 2018). Such studies reveal opportunities and open challenges for the education of designers to address the emotional experience of interacting with smart products (Jeon, 2017; McStay, 2018; Tonkin et al., 2018). Initial attempts to bridge aesthetic and emotional dimensions of HCI show that the literature offers limited insights into how to apply techniques and theories to the emotional design and implementation of advanced technology (Schiphorst, 2009). Teaching initiatives in HCI tend to be reported in descriptive dimensions without clear theoretical underpinnings (Martin & Roehr, 2010; Martin & Sherman, 2015). Users’ memory, previous interaction with technology, individual differences, aesthetics, and sensory elements of the designs are good examples of the factors that may shape the emotional user experience but remain largely unaddressed in the literature. While the UX field is growing rapidly, educational and academic programs with a focus on the design of advanced technologies remain limited (Vorvoreanu, Gray, Parsons & Rasche, 2017). Consequently, this research seeks to contribute to a better understanding of UX methods for smart products. Our aim here is to provide a grounded model for studio education that accounts for the affective state of vulnerable users of smart products. Building upon the literature, this research will offer a deeper understanding of teaching UX practices through the following activities:

- Interactive problem solving workshops to teach the techniques of measuring emotions proposed by Jacob-Dazarola, Nicolás and Bayona (2016).
- Visualising data that can help compare and understand the value of each technique.
- Co-design with older people to define the project priorities and represent their voices (Walker, 2018).
- Creatively expand the knowledge, attitudes, values and methodologies associated with inclusive UX designs that address the needs of ageing users.

2 User Experience Education

The emotional dimensions of everyday products can elicit a range of experiences for users (Schifferstein & Desmet, 2010). Recent studies identify multidimensional factors shaping user experience and illustrate the reactions in users including physiological and behavioural. The multifaceted nature of emotions demands a systematic and deep level of understanding of user behaviour from attitudes and expectations prior to interaction, through purchasing decision making, initial and long-term usage, and post-usage.

The acquisition and use of smart products are vital to the identities and relationships that connect individuals and determine their behaviours (Solomon, Dahl, White, Zaichkowsky & Polegato, 2017). A user starts to form an opinion about a product from the first-time interaction that is called first impression (O'Shaughnessy & O'Shaughnessy, 2003). This impression grows and changes over time with long-term interaction that will form a conspicuous and lucid story called user experience (Norman, 2013). According to Hassenzahl (2013), the user experience process stimulates various emotional responses which result in positive or negative outcomes. Hence, the emotional aspects of user experience are of especial importance in the design of smart products.
Compared to the growth of UX profession and research, little to scarce scholarship addresses the learning and teaching aspects of UX design (Martin & Sherman, 2015). Given that UX design is an emerging discipline, and the lack of disciplinary programs tailored to familiarise students with different techniques of understanding user emotions, we suggest a pedagogy based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh, Thong & Xu, 2016). UTAUT recommends users’ acceptance of technologies should be examined from initial introduction to post-adoption, throughout an extended period of time. The model suggests that studies need to focus on active adoption decision-making process. Routinized behaviours may result in retrospective reported individual reactions.

2.1 Research Design

The pedagogical approach is part of an ongoing PhD study that looks at the multidimensional aspects of emotions through conducting prolonged user research. It evaluates users’ emotions by looking through the mental reasoning, changes in physiological, gestural, behavioural and individual responses. The research targets older users’ engagement with smart products. It applies user experience theories to study the emotional responses of an older generation of users. A mixed methods approach to data collection is selected to collect both qualitative and quantitative data of the users, and to understand their emotional needs and experiences deeply (Figure 1). The study extends the traditional lab-based usability tests by going beyond conventional observation methods. There are four main methods of data collection: interviews, multimodal usability observation, solicited extended experience sampling, and co-design session. This approach will combine traditional design tools, such as interviews to identify what participants think and say, with observation of both physiological and behavioural signals. The self-report user experience method monitors users’ responses over the course of the research. Lastly, by conducting a co-design/creative session, reflection and ideation of future design of the smart products will take in place. The creative session will give the opportunity of taking the conversation beyond the lived experience and ideate what can be implemented in the future of designs.

![Figure 1. Research design data collection approach](image)

With the growth of older population worldwide, the demand for addressing the needs and expectations of older population will grow too. The capabilities to adapt to new complex technologies can decline with age. By studying user experience of the older people, we can inform the design of new technologies to create safe, inclusive, pleasurable and meaningful experiences. This demands preparing students and future designers with design practices that can understand the user experience of this growing demographic and provide design solutions for them (Razmi, 2018). The Auckland University of Technology (AUT) has established the AUT Centre for Active Ageing (ACAA) that is committed to work with older people for better living. The centre is focused on inclusivity, co-creation, and participation to engage with older people in research and projects that targets this demographic. We propose that a UX pedagogy with similar
aim and priorities of the ACA centre focused on social inclusion and active ageing can educate and facilitate students in better understanding the needs and demands of the community.

2.2 Evaluating Emotions Workshops
The pedagogical model proposed here addresses the multidimensional aspects of emotions and focuses on learning how to evaluate users’ emotions by analysing physiological, gestural, behavioural and verbal responses. Studying all these dimensions of emotions will provide rich data to produce insights for an in-depth understanding of interactive experiences of older users with smart products. Emotions can be analysed based on the understanding of each of these dimensions, suggesting essential techniques for UX students to be familiar with. Jacob-Dazarola et al. (2016) categorise five groups of emotional processes shown in Table 1.

<table>
<thead>
<tr>
<th>Dimensions of Emotions</th>
<th>Description</th>
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<tbody>
<tr>
<td>Subjective</td>
<td>Individual differences, perspectives, values, and responses.</td>
</tr>
<tr>
<td>Physiological</td>
<td>Physiological responses that can be measured into quantitative data.</td>
</tr>
<tr>
<td>Thought-action</td>
<td>Gestures and expressions that can be categorised into emotional expressions.</td>
</tr>
<tr>
<td>Behavioural</td>
<td>Prolonged activities for learning functions in naturalistic environments.</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Individual’s evaluation, classification and ratings of products.</td>
</tr>
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This studio pedagogy integrates five sessions to learn a set of methods for data collection and five sessions to interpret and apply these data in experience prototyping exercises. Starting from understanding subjective user values and how similar or varied different users’ perception and needs might be. Based on these findings, learners conduct ideation activities and early prototyping. The second method involves physiological measuring techniques and how to visualise and use the data collected from techniques such as electrocardiograms (ECG). The second round of ideation and concept development starts with the focus on physiological data. The third process includes thought-action tendencies that takes the students to learn gestural and other non-verbal assessments. The last two stages address behavioural and cognitive processes. These techniques are appropriate for late stages of the design and prototyping process. They allow learners to study and capture users’ emotional feedback and interaction in more depth and iterate their designs. Based on a critical review of the literature, each of these dimensions is discussed in detail in the following subsections to teach students the process of evaluating emotions.

2.2.1 Subjective Emotional Experience
The first dimension for students to practice and understand is the individual differences and characteristics that influence various judgements from the potential users. It is essential to understand that individuals will differ with respect to their emotional responses. While one person may be attracted to a product, another person may dislike it. Similarly, the same person may experience different emotions to a given product at different points in time. For designers to create deep connections between the users and their designed products, they need to understand the emotions of their users and their journeys. Advancements in new technologies are changing the ways people work, play and interact. Technologies designed with a lack of empathy for their users can lead to a failure in delivering pleasurable experiences and result in a sense of isolation for the user (Shin, Im, Oh & Kim, 2017). Students can practice interviewing techniques to grasp several users’ experiences and their expectations to capture any individual differences such as capturing diversity in lifestyles, hobbies and values. This dimension can be practiced at early stage of the course and before the first stage of design and ideation, so the students can identify users’ various emotional needs and expectations.

2.2.2 Physiological Process
Smart products are rapidly integrating into most everyday activities (Coughlin, D’Ambrosio, Reimer & Pratt, 2007). Examples including booking appointments, calling taxis, measuring our physiological responses such as monitoring heart rate, calculating ECG, and learning behaviour patterns such as sleeping time and favourite routes to work, are now part of our everyday products. They are considered to require minimal instruction and training (O’Brien & Rogers, 2013). However, this shift towards integrating technologies into everyday activities has caused great difficulties and frustration for older users to interact with contemporary smart products smoothly (Pattison & Stedmon, 2006). After first stage prototyping, we will introduce the physiological measurements to the students for measuring their first initial design. Physiological changes in users can be triggered by positive or negative experiences. These physiological changes can be measured through bio-signals. Studies in HCl and user experience use the data captured from bio-signals to deduce the emotional state of users (Subramanian et al., 2016). The physiological process can monitor hormonal levels, heart rate, circulatory and nervous systems. Famous techniques to measure user experience responses include galvanic skin
response (Nakasone, Prendinger & Ishizuka, 2005), pupillary response (Chen, Epps, Ruiz & Chen, 2011), electroencephalogram known as EEG measurement (Das, Chattjee & Sinha, 2013), and electrocardiography (ECG) data (Haag, Goronzy, Schaich & Williams, 2004). By visualising the data captured from physiological responses, students can study the similarity and differences of for example ECG data that are captured from different emotions such as excitement, happiness, fear and boredom. Using physiological processing will allow them to start learning how to compare and contrast the opportunities and limitations of the captured quantitative data with the qualitative, explanatory or observation techniques.

2.2.3 Thought-Action Tendencies
While teaching the shadowing technique to the students on how to observe users’ emotions can be very beneficial, it needs a lot of practice and time for them to be mastered in. Some emotions are more easily detected in people’s expressions and gestures. They act as a communication channel about individual intentions and actions (Desmet, 2018). Facial Action Coding System (Ekman & Friesen, 2003), Genetic Programming (Loizides, Slater & Langdon, 2002), Maximally Discriminative Facial Moving Coding System (Izard, 1979), and the AMUSE tool (Chateau & Mersiol, 2005) are some of the well-established quantitative approaches of data collection in usability testing studies. These studies quantify emotions using scale techniques proposed by Ekman (2007) on recognised key expressions such as happiness, sadness, anger, neutral, fear, surprise and disgust. Introducing the techniques for measuring users’ expressions and gestures while interacting with the prototypes will provide the opportunity for the students to compare how some basic expressions can be easily grasped and identified while some other gestures and expressions might look similar. These processes can assist the students as supportive evaluating systems in the observational and usability tests of smart products.

2.2.4 Behavioural Tendency
One of the essential elements of user-product interaction is the temporality of the experience. Karapanos, Zimmerman, Forlizzi and Martens (2010) recommend a conceptual model for extended user experience studies. They suggest four weeks’ timeframe can present the transition of users’ experience in the adaptation phase of the product. They propose that users’ familiarity, functional dependency and emotional attachment increase over time. An extended user experience test can measure the level of excitement and overall evaluative judgement of users across time. These techniques are significant when measuring users’ emotional responses toward smart products that handle several tasks and require longer period of time for adaptation. Their aim is to study the users’ activities shared with the subconscious level of everyday actions such as the continuous learning of functions and interfaces of a newly designed mobile phone. Standard techniques used for measuring users’ behavioural responses range from self-report and journaling in naturalistic approaches through studying users in real environments (Wu, Thomas, Drobina, Mitzner & Beer, 2017). Other techniques include monitoring behavioural responses, task performance and usability in controlled laboratory settings (Hertzum, Borlund & Kristoffersen, 2015). We recommend that instructing the students with the journaling, observation and usability tests at the final design and prototyping stage when several improvements toward their design has been made, can provide deep understanding of the interaction steps and the challenges or benefits of their design elements. These techniques can support the students only after they have gained some good level of understanding about their users’ expectations and needs.

2.2.5 Cognitive Process
Emotions help users to evaluate whether a product is generating positive or negative feelings. Emotions can provoke memories, perception, attention, identification, classification and reasoning (Chowdhury, Reddy, Chakrabarti & Karmakar, 2015). A product’s character is considered a cognitive structure. Cognition is closely related to emotion. Certain cognitive structure of a product can generate different basic emotions. For example, a simple user interface of a product may represent the product as easy to use, even if the user has no actual hands-on experience with the product (Hassenzahl, 2018). There are many well-established studies in the field of product design that explain the underlying cognitive processing of emotions (Chen et al., 2016). Students will capture users’ experience of interacting with the prototype using scale-rating interviews. It will allow them to capture users’ evaluations and responses toward their design while understanding the reasons for it in a quantifiable method.

3 Expected Outcomes
The suggested pedagogy seeks to equip students with the skills to instantiate comprehensive information that can augment the reliability of their designed products. We suggest this model can provide the possibility to assist UX students in differentiating their design practices through understanding older users’ emotions concerning smart
products. It will explain a feasible opportunity for them to learn how to refine new technologies into humanised instruments that can create meaningful and engaging experiences for the users.

The implementation of the UX evaluating techniques in the design workshops can demonstrate more user focused approaches that are being used by the businesses and scholars. Such practices can teach students how to prioritise users’ emotions in all stages of their design and keep up-to-date with measuring techniques available through learning basic knowledge about data collection, analysis and data visualisation processes. These practices can extend the students’ skills in how to differentiate themselves as UX practitioners compared to other design curriculums. By comparing and analysing users’ emotions, students will gain more in-depth understanding of the significance of conducting UX research in design practices. They will learn how to design solutions based on enhancing users’ emotional needs at every stage of design practice, from ideation to final prototyping.

4 Discussion

The UX pedagogy presented in this paper focuses on the evaluation of older people’s emotions when interacting with smart products. The main goal is to prepare future designers to tie their design practices with data collection processes that are necessary to understand advanced digital technologies including smart products. We propose that by positioning older users’ emotions and empathy stage at the core of UX workshops, students will gain deeper knowledge about UX practices and inclusive design.

We recommend that adequate information can be gathered to test the proposed pedagogy throughout the project by collecting users’ evaluation of the students’ designs at each step based on each captured dimension. It can work as a justification tool for the decisions that were made and whether or not the final designs had better desired outcomes for the selected demographic. Another relevant approach could be students working on either two mini projects, one without the proposed dimensions, and one with learning the tools and applying the changes based on the captured emotions. This can help them to compare the results and evaluate their own learning process as well as getting the final feedback from users on what they think of the final designs. Same approach can be tested among two different classes to compare and document the learning process of each group.

This paper aimed to address the importance of user-centred programs designed for students seeking to become UX practitioners by teaching the different dimensions of evaluating emotions. It is important that concepts of individual differences, such as different generation of users, concepts of familiarity being discussed in this pedagogy in more detail to address these influential factors that can deepen students’ knowledge. Research related to the design of technology for older users distinguishes age-related changes as essential factors in the application of information and communication technologies (Braun, 2013). The goal of a majority of the research on older users is to increase adoption and effective use of technology. Brophy, Blackler and Popovic (2015) argue that smart products should not only be useful and usable by the next generation of older users but appropriate, engaging and meaningful. It is essential to understand the relationship that older users have with technology.

Studies suggest that a combination of cognitive, physical, sensory and attitudinal changes that occur as a result of age also impact older users’ interaction with technology (Rogers, O’Brien & Fisk, 2013). They interact with current smart products less intuitively and more slowly. Familiarity and knowledge gained from past experiences is a fundamental component of an intuitive interaction (Lawry, Popovic, Blackler & Thompson, 2019). Older users interact with products less instinctively than younger generations due to less familiarity. One approach of improving the experience of complex contemporary products is to integrate intuitive interaction into design practices with an aim of shifting towards a more inclusive society.

The design community needs to have a broader perspective for the envisioned future of technologies designed for older users. According to Blackler et al. (2010), it is tempting to believe that, as the population matures, users that are experienced with technologies will likewise mature, and the age-related issues will resolve themselves. However, it is likely that the dynamic nature of technology will create a disparity between the experience of older users and the new products of the day (Fisk, Rogers, Charness & Sharit, 2009). We recommend that the design of future products has to extend beyond the narrow focus of age-related decline. Designing for this space is not exclusive to supporting functional independency, but also about living experiences that have been digitalised, such as activities like reading, listening, making and creating, playing, communicating, and sharing. The design community needs to prepare UX practitioners with broader perspectives for the envisioned future of technologies designed for older users.
References


Hassenzahl, M. (2018). The thing and I: understanding the relationship between user and product. In M. Blythe & A. Monk (Eds.), Funology 2: From Usability to Enjoyment (pp. 301-313). Springer.


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