Emotion-Centered-Design (ECD) New Approach for Designing Interactions that Matter

Eva de Lera(✉)

Av Marqués de La Argentera 17, Barcelona, Spain
edelera@gmail.com

Abstract. The emotional dimension of users of information and communications technologies (ICT) is a key aspect in user experience (UX), as designers' main objective is to ensure users are happy (satisfied, engaged) with their interaction designs. However, current UX design methods focus on ensuring that efficacy (success achieving a specific task) and efficiency (in the fastest, best way possible) are successfully achieved. The satisfaction of the user is evaluated at the end of the process, and evaluated in reference to the efficacy and efficiency of their experience. In this paper, the author presents a new approach (Emotion-Centered-Design, or ECD) in which the key to successful interaction design (happy users) is brought about by placing emotions at the center of the design process, versus doing so at the end. By doing so, designers can deliver more significant experiences, increase user experience satisfaction, and identify new ways to innovate in interaction design, as well as add more value to users.

Keywords:: Emotions · Usability · Design processes · Design methodologies · User experience · Human-computer interaction · User centered design · Affective computing

1 Introduction

The "happiness" (satisfaction) of a user during an ICT interaction will depend on the efficacy and efficiency of the interaction with the device, the context of use (location-specific) and, in the "moment of use" (emotional/stress level at a specific point in time). Nowadays, UX methods ensure working designs, and technology is already adapting to the users' context, but is ICT adapting to user's "moments"? UX designers are designing for people, considering a unique emotional dimension or "moment" for each person or user, when in fact, each has many "moments", and their satisfaction levels (evaluation of interactions) will differ depending on these. Then, how can ICT adapt to user's many "moments" and make users happy all the time? The objective of this paper is to introduce Emotion-Centered Design as a way to begin considering the importance of this dimension, and does so by proposing initial solutions and potential designs for the near future.

In other words, and as an initial example, depending on the user's available time, specific limitations (special needs and context included) and emotional state (level of stress and anxiety), he or she may choose a different route to go front point A to point B.

A. Marcus (Ed.): DUXU 2015, Part I, LNCS 9186, pp. 406–416, 2015.
DOI: 10.1007/978-3-319-20886-2_38

- When in a hurry, time is this person's priority and the best route is the fastest route, a time-efficient solution.
- When this person decides to begin to ride a bicycle to work, the same person, may be afraid of riding next to cars and choose a route with bike paths, away from danger, this being an effective solution, yet less time-efficient.
- And when the person is on holidays and wanting to feel good, a scenic route may be chosen, looking for a more engaging, stimulating and interesting experience, rather than a simply effective or efficient one.

There isn't a unique design path for one same individual, but a range of solutions, to adjust to each of this person's preferences, needs and overall emotional state, at a very specific time of use of the technology ("moments of use").

The Emotion-Centered-Design (ECD) approach places the level of stress and relaxation of the user at the center of the design process of any digital interaction. This means that, depending on this stress/relaxation level at the time of the interaction, the user's preferred interaction will be different. As technology has evolved, it is now possible to design for the user's emotional states at any given time, and there's no need anymore to have users adapt to the technologies, but for the technologies to adapt to users.

To help clarify this further, we bring this example to the field of human-computer interaction [21] and use the case of online travel booking as it is one of the industries that grew faster and it's quite consolidated worldwide. This example shows how ECD can bring about more satisfactory results, both to end users and the company's running online bookings, when applied.

According to Statistics Brain [27], in 2013 there were 148.3 million of travel bookings made on the Internet. Out of all of these:

- 65.4 % of hotel bookings where done on the brand website (operated and managed by the brand)
- 19.5 % of hotel bookings where done on the merchant website (e.g. Expedia/Hotels.com,)
- 11.3 % of hotel bookings took place through opaque websites where the customer does not know the brand of the supplier (e.g. Priceline)
- 3.7 % of hotel bookings are done through retail websites where hotels pay distributors a commission (e.g. HRS or Bookings).

The statistics clearly show consumers preference for using brand websites. There are several hypotheses for explaining such difference; the following are just a couple of possibilities:

- Brand websites usually project a lifestyle and a higher-level option to either (1) find out the rates or (2) make a reservation, a time-saver to user and a less frustrating experience.
- Merchant, opaque and retail websites are similar to a marketplace, quite cluttered, confusing, and therefore, perceived as overwhelming at first sight, frustrating in many occasions, and promoters on increased stress or anxiety levels.

As we cannot here go deeper into the business decision variables that may affect consumer choices, the ECD approach tries to over-ride these potential hypotheses and be proactive, by allowing consumers to choose the user experience they need at that particular moment and context in time.

The ECD approach applied to any of the above online booking websites helps understand the user's needs further, and deliver the best solutions for them. For example:

- An entrepreneur with family responsibilities and working long-hours needs to book a flight for a business trip and any time used in searching for this flight is time that he or she does not apply to the actual work or family. In this case, the person needs the fastest (and cheapest) option. In ECD terms, the person's level of stress or anxiety is higher than usual and needs an interaction that saves him or her time.
- The same entrepreneur planning the Summer holidays with a romantic partner may choose to do so after dinner, while comfortably sitting down in the sofa, lights dimmed, fireplace on. In ECD terms, the person's level of stress or anxiety is low, time is not an issue, but the contrary, the person is relaxed and needs the type of interaction that would allows them both to savor what the next holiday would be like: discover options, explore ideas, compare rooms, amenities, find friends, forums, etc. These two people (as web interactions are not only done individually) may prefer to take the "scenic" online route (path) for planning a holiday, and they may be on the travel website for hours that night, enjoying the experience of having multiple choices.

In the above scenarios we see one same person using online booking with two different experiential needs. Current human-computer interaction and user-centered design processes do not contemplate the importance of the emotional dimension in the design process, and it is key to reach a fuller and more impactful user satisfaction and engagement, while also contributing to the online travel business, as more satisfied consumers usually mean gaining new clients and maintaining loyalty.

2 Identifying Stress and Relaxation Levels

There are several ways for knowing the stress or relaxation level of a user. In the Emotion-Centered-Design approach we focus on the following two methods:

- Self-reporting assessments: the person tells us how he or she feels at the end of the interaction, or task requested by the evaluator. These measures are subjective and therefore non-correlational or fully unreliable. The efficacy of self-reported assessments has been questioned throughout the year and these may usually need to be supported and accompanied by other measures (both qualitative and quantitative) [18, 29].
- Automatic measures: through affective wearables [25], the person wears a sensor that captures the neurological or physiological response of the user during the interaction with the specific interface; or a facial recognition software can help co-relate facials to emotions (most of these systems still based on Paul Ekman's FACS) [11]. Even though these are objective measures, these still offer many limitations, such as their

intrusive aspect, its inability to discriminate between negative stress and positive stress (e.g. happy) or to specifically correlate measures to exact emotions. Once again, these measures serve as a guide to help designers in their design processes and still will need to be accompanied and supported by other qualitative and quantitative measures (usability, questionnaires, etc.).

Both of this stress and relaxation reporting levels are still fully unreliable, but do serve as "red" or "green" flags to designers, to aid in their design process.

Red flags are used to identify what should be a specific time or place in the interaction design, indicating further evaluation and study is needed in that particular part of the design process. Green flags indicate that a particular part of the interaction design is both, not an obstacle and also adds value to the user.

3 Limitations of User-Centered Design

The User-centered design (UCD) process has mostly been focusing on integrating the human characteristics and capabilities of users, and their needs at a specific point in time [26]. Moreover, new approaches, such as Designing for Situation Awareness, have proposed improvements for the UCD, such as the Emotion-centered design process is doing: "The operational concept, environmental constraints, user characteristics and operational requirements" as the basic input of the design process [5]. In this paper, the Emotion-Centered Design process proposes a more dramatic change in the design process as it's not a mere new set of data that requires to be gathered (which it also does), but it creates a need to place emotion at the center of the design process, to direct the process, calling for multiple designs of a one desired person's interaction, working simultaneously.

The large success and impact of UCD, applied to the newer design of new technologies, interfaces and multiple devices, has made it possible for technology products with interfaces to be used by a much wider audience, and also by those who did not necessarily know much about technology, or even feared it.

One of the key processes of UCD was the creation of Personas, the creation of fictitious user profiles based on real yet grouped characteristics, attributes and needs of a variety of users [3]. These Personas have been extremely useful as a way to design processes and have served guide the design of interfaces, as they identified the most common needs or preferences of users, ensuring that all profiles incorporated the basic characteristics of all target users. Personas help define needs, tasks and also evaluate the interaction throughout an iterative process. Its success has been fully documented in the literature [2, 17, 20]. Personas however are limiting in that it tries to identify the most commonly used profile (set of needs and preferences).

Moreover, the successful promotion by UCD of the need for continuous participation of the users in the design process, through multiple iterations in the design and development phases brought about a major change in the Usability and HCI field. Such iterative participation (also seen in agile development) has allowed the users to become active participants and continuous evaluators of the product or website being designed, ensuring a reduction of errors and frustration once the produce was launched. Its success

is clearly documented in multiple case studies and scientific publications [28, 32]. However, participating participants are non-representative of a diverse society and people's self-diversity.

The current user-centered design approach and its many variants do not incorporate the users' global needs and preferences, as temporary and permanent, in terms of access (include disabilities, as short as a minute as long a years), context, and emotional as well, as their emotional state at the time of the interaction (stressed or relaxed, in terms of time or other variables influencing the emotional state) can be a major influencer in the satisfaction or frustration level of the user, and their sense of happiness or frustration with the given experience.

Some of the hypothesized reasons why the emotional dimension was not incorporated in the UCD approach and design process point to:

- Overall focus on removing frustration of navigation as opposed to focusing on generating increased satisfaction or engagement ("satisfaction" used as a measure of ensuring the quality of the end-design as opposed to a measure to help guide the design, before the tasks are even set up, or the concept created).
- Lack of tools and methods to assess the "satisfaction" of users, as these are unreliable and do not provide accurate objective measures (surveys, questionnaires and interviews). Such subjective measures being unreliable based on a conflict of certain variables: the context of evaluation, the actual profile of people willing to participate in an evaluation and the recurrent lack of well-wished dishonesty, possibly to please the researchers [9].
- Lack of non-intrusive wearables capturing objective measures and producing reliable results.

It is also understandable that the changes in the technology allow for different methodologies to be set in place, as these depend on the technological solutions available, and affordable. With the current technological landscape, the growth of the online population and the removal of the initial fear brought about by non-tech users, we are now at a new cornerstone in which the user-centered methodologies can now integrate the emotional dimension into the design process, and go even further, have these emotions direct the design process.

As before human computer interaction, usability, user-experience, user-centered design and related others focused on the efficacy and efficiency of use, followed by a satisfaction-of-use assessment measuring "the feedback of user's attitude, perceptions, and feelings about the service" [4], the current landscape allows for a major change in the design process to incorporate this "satisfaction" measure at the center and beyond the satisfaction of that interaction scenario, to help guide designers in the design process, and creating different interactions based on the different satisfaction or emotional dimension levels.

4 The Emotion-Centered Design (ECD) Approach

The Emotion-Centered-Design approach is inspired on the "satisfaction" measure objective used-to-date in HCI, UCD and other user experience methods, and aims at going

beyond these past practices to deliver more impactful interaction experiences and designs. ECD proposes to do so by placing emotions in a central phase of the design process in which these serve to guide the design process, as opposed to evaluate it, guaranteeing more significant and valuable results.

Emotions are not new to user experience; it is an area of expertise that several UX professionals have been flirting with for the past years. The emotional dimension of users has long been a focus of interaction designers [12, 22, 23] and research clearly shows that such variable is a key to a successful interaction design. The challenge being that there are no clear methodologies or sets of methodologies that help incorporate such dimension in an objective, easy and efficient way. The ECD approach aims to ensure that the concerns, intuitions and knowledge in regards to the importance of this dimension in the interface design field finds a way to reach professionals around the world that are craving for solutions to help, not only improve their products, but the satisfaction level of their users in a way beyond removal of frustration, and in a more engaging and added-value way. And to do so, emotion has to be looked at from a bigger distance, from a global point of view for the experience, and not as only a part of a concrete designed interaction.

5 Opening-up to the Emotional Dimension

Just as designers must understand their users' needs, characteristics and behavior, is also necessary to understand designers themselves. Human beings tend to do what had previously worked for them, insist in their practices and ways of doing things and many times find themselves resistant to change [24]. As the need to understand and integrate the emotion dimension has well documented and alive for decades, the user experience community has only entered superficial or peripheral stages, and not seriously enough to make the leap that user experience needs to make, to innovate in user experience by looking at the design process from an emotion-centered perspective, instead of a task-centered perspective which incorporates the user at the center.

Integrating the emotional dimension requires for all of those involved in the design process to be open to new ways of doing things, challenge current methods and incorporate new ideas (often meaning people with different talents and experiences).

5.1 The Case of Mobile Phones

A great example of the above-described situation is what has taken place in the mobile industry during these past years, since these were able to access the Internet and the many services offered through them (e.g. email).

Most mobile manufacturing companies (often lead by engineers) have designed and competed with similar products (Nokia, BlackBerry, Samsung, Erikson, Etc.). During the annual Mobile World Congress, a gathering of the top mobile industry players became a showcase of similar products trying to compete amongst themselves. During the mobile fair, visitors are able to confirm that mobile devices have been designed for

similar Personas and for the tasks these had been planned to execute. The phones displayed and showcased during the 2002 Mobile World Congress:

– Were mostly black
– Had small buttons with multiple functions each
– Used the same number keyboard to type text
– Lacked interface color and aesthetics
– Used technical language
– Hard to set up (settings)
– Displayed cluttered menus
– Displayed as luxurious items (following a display design similar to those found in New York Fifth Avenue jewelry stores)
– Supported by visual materials representing the young and mature executive world (suits, success, beauty, perfection, etc.)
– Geared to executive professionals
– Geared to men.

When the first Apple's iPhone was launched in 2007 [1], it was mentioned by Time Magazine as the "Invention of the Year" [13]. This new mobile phone had broken with what had been done to-date and for the past 9 years has been rated the highest in user satisfaction: "For the ninth consecutive study, Apple ranks highest among manufacturers of smartphones in customer satisfaction. Apple achieves a score of 855 and performs particularly well in physical design and ease of operation". [15]. What had apple done differently? Apple challenged the status quo of the mobile industry and made its initial breakthrough by making the following changes:

- Geared to a much wider population through ease-of-use characteristics.
- Integrated aesthetics into the physical design of the device and the interfaces.
- Used a simple terminology, easy to understand by a wide variety of users, mostly non-technologically savvy.
- Understood the basic needs of this wider audience and provided easy-to-use functions (e.g. photo/video camera, applications and games).
- Amongst other improvements related to performance, features, operations and customization.

Up until that time the mobile industry had been implementing UCD methodologies in their design processes in such a way that it actually limited their capability to really satisfy and engage the user, and expand their market reach. The narrow focus in target, effectiveness and efficiency became an obstacle to growth and innovation. Evaluating "satisfaction" of the interaction was not a guarantee of "satisfaction of the user". In part, most mobile brands had focused on the executive work force and the technology savvy, party because it was unthought-of that other type of users would pay a large sum for such a device. For years, their assumptions, possible fear to risk and lack of multi—disciplinary teams, impeded mobile brands from identifying a major gap in the mobile industry, the people:

- The grandparents wishing to receive current photos from their loved ones.
- The teenagers wishing to exchange photos with their peers.

- The lovers wishing to send love texts and visuals to each other.
- The impatient wishing to entertain themselves while waiting in line, on the bus or at the doctor's office.
- And every person who wished something more personable was available to them (a daily horoscope app, a driving-test app, an cloud-expense recording tool, etc.).

iPhone not only delivered a new brand of mobile phone, but a personalized experience that would add value to their wide range of users, would bring perceived happiness. The App Store allowed for the existence of multiple solutions, providing a vast variety of choices ensuring that each person would find some solution, service or product that would adapt to his or her personal needs.

When the emotional dimension is placed at the center of the design process, and before (such as Apple did with the iPhone), the experience becomes richer and more engaging, not only removing user experience obstacles but also actually adding new values to the user experience. Variables such as graphic design, use of specific colors, layouts and other visual aspects (aside from actual physical aspects of the product) are key in user experience and not just a layer that is used to paint over a lo-fidelity prototype, but also the layer directing the design of prototypes. By also taking into account the user's emotional dimension (including lifestyle preferences, psychographics and stress/relaxation state levels), the ECD approach brings about a need to re-think the design process and methodologies used to date, and generate new experiences, enhanced experiences, interactions and products.

5.2 The Case of Online Learning

Some early approaches to integrating the emotional dimension of users into the design process are found in the field of online learning, and virtual environments, as such is the case at the Universitat Oberta de Catalunya [30] and their research toward the Joy of Learning [7, 8, 10]. At UOC, the researchers developed different approaches for measuring the affective dimension of learners in an objective manner, to account for this dimension and incorporate it in the design of the online learning environment, including a study that incorporates a method of triangulation of pupil-size data, emotion heuristics and self-assessment methods [31]. The Ten Emotion Heuristics, the Enjoy Guidelines and the Joy of Learning have been early efforts for integrating these emotional variables into the design process of online learning experiences. Emotion-Centered-Design represents an evolved approach based on the previous work done in online learning [9, 10], one in which incorporates the previous emotion research, findings and experiences, and proposes a new methodology for ensuring that emotions take the leading role it needs to ensure that designs go beyond satisfying users and into enriching them.

6 One Person, Multiple Paths

The Emotion-Centered-Design approach presents a new design process that changes the diagram of a design methodology process in which the "pieces" or elements stop looking

like a circle or spiral indicating the need of iteration, and the graphic begins to look like a tree that sprouts several branches, a tree being a metaphor for a given person. ECD proposes that design methods do not use unique paths but multiple paths for moments of use, as opposed to profiles. A need to design different experiences for different moments, and people will convene and coincide in their choice of experience depending on their "moment".

According to ISO 9241-201:2010's definition (formerly known as ISO 13407) [14, 16], user experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use. The ISO also list three factors that influence user experience: system, user and the context of use. However, this definition does not contemplate the variability of emotions over time (and this may be within an hour), being this key to Emotion-Centered-Design. This "emotional" variability must be taken into account before initiating a design process, defining and prioritizing goals, tasks and needs. Assuming that people's emotional dimension stays at one same level throughout the person's day, or life, is unrealistic and will lead to limiting the designer's knowledge and therefore, negatively influence the design, and the user experience. Understanding the inconsistency and variability of users will help provide the measures that allow them to either choose their preferred experience for that moment/time/context or to be automatically offered (prompted) the right design, or interaction path, matching their emotional scale at the time of use.

The Emotion-Centered-Design approach invites UX designers to continue applying their design methods, yet to moments, levels of stress and other emotional related potential interactions, as opposed as to the people or users (Fig. 1).

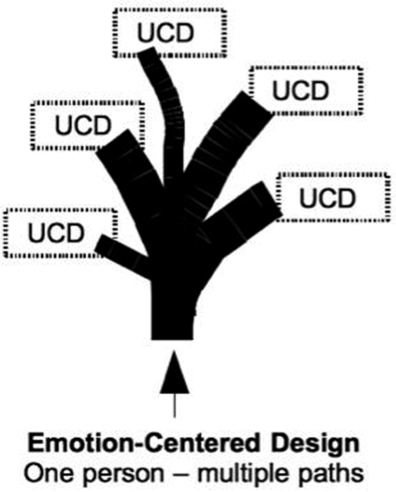

Fig. 1. Visual representation of the Emotion-Centered-Design approach, multiple paths for one same user at any given time.

7 Conclusion

The Emotion-Centered-Design approach here introduced presents a new method for designing highly satisfactory user experiences, by taking into account people's range of "moments" throughout their days and lives, as opposed to designing interactions for a person's profile. By doing so, this approach invites user experience professionals to undertake a major revision in their methods, to introduce the necessary design needs, technologies and solutions to ensure that people's variability and diversity is taken into account.

Implementing ECD can be done today by offering users the option to choose the way they feel, so their choice provides them with the right interaction. In the future, this could be done through sensors, and other existing – of future – technologies. The way to implement such call-for-action from the user can be as creative and innovative as designers design, from a pop-up window, to a top-left button, or through an app that pushes that information onto all devices and effects behavior, or via a new key added to all keyboard, or. What's important is that the users' moments are taken into account and that they enjoy, and are really satisfied, with their online experiences.

Acknowledgments. We thank the all research, professionals and colleagues, who throughout the year supported and provided helpful comments on previous revisions of this document.

References

1. Apple, http://www.apple.com/
2. Aoyama, M.: Persona-scenario-goal methodology for user-centered requirements engineering. In: 15th IEEE International Requirements Engineering Conference, RE 2007. IEEE, (2007)
3. Billestrup, J., et al.: Persona usage in software development: advantages and obstacles. In: The Seventh International Conference on Advances in Computer-Human Interactions, ACHI 2014 (2014)
4. Bratati, C., Roy, S., Pattnaik, P.K.: User satisfaction metrics for cloud computing environment. Eur. J. Acad. Essays **1**(3), 63–69 (2014)
5. Silva da Silva, T., et al.: User-Centered design and agile methods: a systematic review. In: Agile Conference AGILE 2011. Salt Lake City, UT (2011)
6. De Lera, E., Almirall, M.: ENJOY: guidelines for designing engaging eLearning environments. In: proceedings of iLearning Forum (2008)
7. De Lera, E., Fernàndez, C., Almirall, M.: Emotions: the forgotten key success in online learning. In: 13th UNESCO-APEID International Conference and World Bank-KERIS High Level Seminar on ICT in Education, Hangzhou, China (2009)
8. De Lera, E., Fernandez, C., Valverde, L.: The emotional gap in virtual online environments. In: Abas, Z., et al. (Eds.), Proceedings of Global Learn 2010, AACE. pp. 67–70 (2010)
9. De Lera, E., Muriel, G.: Ten emotion heuristics: guidelines for assessing the user's affective dimension easily and cost-effectively. In: Proceedings of the 21st British HCI Group Annual Conference on People and Computers: HCI… but not as we know it-Vol. 2. British Computer Society, (2007)

10. De Lera, E., Mor, E.: The joy of e-learning: redesigning the e-learning experience. In: Proceeding of HCI 2007 workshop: Design, Use and Experience of e-Learning Systems (2007)
11. Ekman, P., Rosenberg, E.L., (eds.).: What the face reveals: basic and applied studies of spontaneous expression using the facial action coding system (FACS). Oxford University Press, Oxford (1997)
12. Fogg, B.J.: Persuasive technology: using computers to change what we think and do. Ubiquity 2002. December 2002. doi:10.1145/764008.763957
13. Grossman, L.: Invention of the year: The iPhone. Time Magazine. 1 November 2007
14. ISO. http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=52075
15. JDPower. http://www.jdpower.com/press-releases/2013-us-wireless-smartphone-satisfaction-study-volume-1-and-2013-us-wireless
16. Jokela, T., et al.: The standard of user-centered design and the standard definition of usability: analyzing ISO 13407 against ISO 9241–11. In: Proceedings of the Latin American Conference on Human-computer Interaction. ACM, (2003)
17. Khalayli, N., et al.: Persona based rapid usability kick-off. In: CHI 2007 Extended Abstracts on Human Factors in Computing Systems. ACM, (2007)
18. Levenstein, S., et al.: Development of the perceived stress questionnaire: a new tool for psychosomatic research. J. psychosom. res. **37**(1), 19–32 (1993)
19. McDonagh, D., et al. (eds.): Design and Emotion. CRC Press, Boca Raton (2004)
20. Nielsen, L., Nielsen, K., Stage, J., Billestrup, J.: Going global with personas. In: Kotzé, P., Marsden, G., Lindgaard, G., Wesson, J., Winckler, M. (eds.) INTERACT 2013, Part IV. LNCS, vol. 8120, pp. 350–357. Springer, Heidelberg (2013)
21. Norman, D.A., Draper, S.W.: User centered system design: new perspectives on human-computer interaction. L. Erlbaum Associates Inc., Hillsdale (1986)
22. Norman, D.: Emotion and design: attractive things work better. interactions **9**(4), 36–42 (2002)
23. Norman, D.A.: Emotional Design: Why We Love (or Hate) Everyday Things. Basic books, New York (2007)
24. Park, R.E.: Human nature and collective behavior. Am. J. Sociol. **32**, 733–741 (1927)
25. Picard, R.W., Healey, J.: Affective wearables. Personal Technologies **1**(4), 231–240 (1997)
26. Ritter, F.E., Baxter, G.D., Churchill, E.F.: Introducing user-centered systems design. In: Ritter, F.E., Baxter, G.D., Churchill, E.F (eds.) Foundations for Designing User-Centered Systems. pp. 3–31. Springer, London (2014)
27. Statistics Brain. http://www.statisticbrain.com/internet-travel-hotel-booking-statistics/. http://www.adobe.com/products/acrobat/
28. Sy, D., Lynn, M.: Optimizing agile user-centred design. In: CHI 2008 Extended Abstracts on Human Factors in Computing Systems. ACM, (2008)
29. Oscar, T., Marc, P., Joaquim, L.: Analyzing the role of constructivist psychology methods into user subjective experience gathering techniques for product design. In: Proceedings of the 16th International Conference on Engineering Design ICED07, (2007)
30. Universitat Oberta de Catalunya (UOC). http://www.uoc.edu/portal/en/index.html
31. Valverde, L., Eva de, L., Fernàndez, C.: Inferencing emotions through the triangulation of pupil size data, facial heuristics and self-assessment techniques. In: Second International Conference on Mobile, Hybrid, and On-Line Learning, 2010. ELML 2010. IEEE, (2010)
32. Williams, H., Ferguson, A.: The UCD perspective: Before and after agile. In: Agile Conference (AGILE), 2007. IEEE, (2007)