DESIGN TOOLS FOR BEGINNERS: TEACHING A DESIGN APPROACH TO PRACTITIONERS WITH MIXED BACKGROUNDS

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ABSTRACT

In this paper, an educational experience aimed to transfer design tools to practitioners with expertise in different fields such as engineering, architecture, and psychology, is discussed. During an intensive design workshop led inside a Master Level Programme in "Design For All", participants used design tools in order to develop new products/services.

The paper investigates if and how design tools can help practitioners from other fields to take on a design approach in the development of innovative products/services. The paper first outlines several design methods conceived to help and guide designers during the creative process, then the workshop's activity is described. During the workshop, the attendees were provided with specific tools to simulate the creativity phase of the design process. In particular, they were asked to: use an IDEO Card to analyze the user's interaction with a given product; use the user journey to organize the user analysis and to identify the users' needs, in order to set the design brief; perform the brainstorming to generate new ideas; use the mind mapping to visualize and group ideas. The results in terms of generated ideas were naïve because of the lack of competencies typical of designers. However, the successfulness of the experience lies in the correct use of the design methods. The attendees understood and applied properly each design method, also using a critical attitude. Limits of this approach, such as the attendees' tendency to focus more on the method's rules than on the resulting insights, will be discussed.

Keywords: Design tools, Design approach, Cross-disciplinarity.

1 INTRODUCTION

This paper describes a one-week design workshop performed by 21 students attending a Master Level Programme in Design for All. This one-year programme had the aim to train multidisciplinary professionals in the design of innovative smart services and/or products for people with physical or cognitive impairments. Attendees were not designers, but held master degrees in different disciplines, mostly in the field of engineering, but also in architecture and psychology. In particular, the class was made up of 13 engineers, 2 architects, 4 psychologists, one person with a master degree in statistics and one expert in communication sciences. The design workshop, which was performed at the beginning of the programme, aimed at helping the participants to understand and learn how to think like designers and how to be innovative using design approaches focused on users and their needs.

In brief, the goal of the teaching activity was to transfer the *human-centred design* approach to beginners in the field of design, but with backgrounds in technical fields, who were thus used to design innovative solutions focusing on *function* and *performance*, or in humanistic fields.

As Buchanan states [1], engineers are used to design for the "necessary", while designers design for the "possible". Therefore, making people trained in different fields familiarize with the design approach is not an easy task. Indeed, scientists, humanists and designers do not share the same background and epistemological approach and find it difficult to communicate on a common ground [1]. This is mainly because scholars from other fields are not used to face what have been called "wicked" problems (typical of design) i.e. problems that are ill-structured, for which there is not only one possible solution, and whose understanding changes as new solutions arise. [2]

Based on this ground, we decided to test a teaching approach focused on the use of design methods and tools and on the partition of the design process into sub-steps. Our assumption was that using

specific design methods for each step could help beginners to face the uncertainty related to design problems - and their wicked nature - in a more structured way.

These methods allowed to perform the user analysis in the context of the interaction with the vending machine or the ticket machine without interacting with real users.

1.1 Aims

The goal of this paper is to illustrate a teaching approach for beginners based on design methods and to assess its pros and cons, highlighting advantages and limits. The starting assumption for the use of methods as a teaching approach is that methods can represent a bridge between design and other disciplines, because they help to manage uncertainty, they provide a sequence of specific actions to perform in order to reach a specific goal, also helping to synthesize and visualize results. Despite some essential skills for designers (like mental flexibility and decision-making) can hardly be transferred by the use of methods and can be acquired only by experience [3], we assume that design tools can still help beginners to acquire a different approach to innovation based on users' needs.

1.2 Programme structure

The main objective of the entire programme can be summarized by three words: design, innovation, and people. In order to let students grasp the meaning of design, teachers stressed the idea that, although *design* is commonly understood to describe an object (or a result), it is in its latest and most effective form a process, an action, and a verb, not a noun. Furthermore, design *"is not a mystical ability given only to those with recondite powers but a skill, which, for many, must be learnt and practiced"*[4]. We can thus base the training in design of experts with different backgrounds on the fact that design can be seen as a set of skills that can be learnt and acquired. The aim of the design workshop, was not to teach participants to become designers, but to assume a designer's mindset in approaching the wicked and ill-defined problems and in developing solutions.

According to John Heskett, *"design, stripped to its essence, can be defined as the human nature to shape and make our environment in ways without precedent in nature, to serve our needs and give meaning to our lives"*[5]. Therefore, design enables *innovation* that is the exploitation of new ideas, or the process that leads to generate new products/services. The specific aim of the workshop experience described here was to develop new products/services for users with impairments in dexterity and fine motor skills or users with visual impairments. We specifically asked to redesign two products: a vending machine and a train ticket machine. Both the user categories to which the students had to refer have specific needs and require ad-hoc design solutions. Consequently, authors decided to put the emphasis on the *human-centred design* approach. Human-centred design is a process that starts with the analysis of *people* to which the solution is addressed and results into new solutions that are tailor made to suit their needs. [6] The entire teaching experience was based on theoretical lectures aimed to explain the design process and to present a set of design tools. Parallel to theoretical lectures, students were asked to perform four design exercises (one for each step of the design process), during which they had to use the methods.

2   DESIGN PROCESS AND METHODS

The design activity was presented to participants as a process composed of a number of different steps, which can be grouped into three main phases: Research, Concept Generation and Concept Development. The first two phases are the creative ones, while in the last phase the final concept is developed and finalized (Fig.1).

In the Research and Concept Generation phases, the designer is asked to repeatedly broadening perspectives (using an open, creative and lateral thinking) and synthesizing learning (using an analytical and rational thinking). This approach partially follows the British Design Council's double diamond process. [7]

During the Design Workshop, we performed only the creativity phases of the design process, leaving the Concept Development phase apart. In this section, we outline some sets of design methods able to help and guide designers during the steps of the creative process: (i) Data collection: methods for user analysis; (ii) Data organization: methods for organizing data and identifying the project's aims (design brief); (iii) Ideas generation: creativity methods; (iv) Ideas visualization: methods for organizing and summarizing ideas
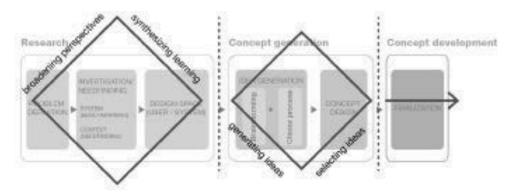
Figure 1. Design Process

2.1 Methods for user analysis

During the theoretical lectures, an overview of the design methods for user analysis was presented to attendees. It comprised tools coming from existing sets of user analysis methods, like Design Council's Methodbank, Bootcamp Bootleg [8] and the IDEO methods cards. [9]

Such methods were divided into three categories: i) direct methods, investigating what people *say* about the product analyzed or a design problem (e.g. interviews, questionnaires, diaries or focus groups); ii) indirect methods, analyzing what people *do* when they use a product (e.g. observation, shadowing or camera studies); iii) methods for analyzing users without users, exploring users' needs, behaviour, activities, problems before or without interacting with real users (e.g. Activity analysis, Role playing, Error analysis, Try it yourself or Empathy tools). During the first design exercise, the participants were asked to choose one of the following methods, taken from the IDEO methods cards: Empathy tools, Error analysis, Try it yourself. Empathy tools is a method conceived to empathize with users having different abilities (e.g. physical or mental impairments). It asks designers to use devices that simulate the user's impairments while performing a specific activity in the context under study (e.g. interacting with a vending machine while wearing thick glasses, to simulate low vision). Error analysis aims to list all the errors that can occur in the interaction with a product, and their possible causes. Try it yourself asks the designer to use the product he/she is redesigning, to have a first-hand experience of the interaction with that product.

The reason why we asked the students to choose among these three methods is mainly due to the time we had. These methods allowed to perform the user analysis in the context of the interaction (with the vending machine or the ticket machine) without interacting with real users. Indeed, considered the short time (one week workshop) the students had no chance to use other methods such as interviews or shadowing.

2.2 Methods for organizing data

After collecting data about users' habits and needs, it is necessary to organize the gathered information, in order to identify design spaces. Among the design tools to organize data, participants were asked to familiarize with the Empathy Map, Personas, and User journey. Such tools allow the designer to summarize and visualize the information in a synthetic way. In particular, the practitioners were asked to use the user journey to visualize the user experience with the chosen service. This tool requires the designer to identify a number of touchpoints of a specific user's activity/experience and to highlight the interaction with the products during the activity on a timeline. For each touchpoint, the designer should visually represent the event occurring, and add comments and information, such as: the personas or stakeholders involved, the channels (where the event takes place and the context of use), the emotions the user feels and the user's level of involvement. A visual template was given to participants to fill in, in order to create a user journey map.

2.3 Creativity Methods

Designing involves the devising of solutions, which, in addition to solving a problem, should be *creative*, that is original and purposeful (Torrance 1964). Creativity is the ability to produce an idea that is in some way novel with efficiency, effectiveness and high quality. (Amabile, 1998; Kauffman & Sternberg, 2007; Deiser, 2011) During the theoretical lecture, participants were explained that creativity is not an inborn skill, but it can be stimulated through specific methods, taking on a lateral

thinking approach. Lateral thinking, also called right brain thinking, is the process that helps people solving problems with an indirect approach or the observation of the problem from different angles. It is opposed to convergent thinking (left-brain thinking), which seeks a direct solution to the problems and is the typical approach of engineers. [10] Several creativity methods were listed and described (brainstorming, body storming, analogical reasoning, six thinking hats, triz etc.). In the practical exercise, attendees were asked to define a design space (design brief) starting from the problems session. This method was selected because it generally involves figures with different backgrounds and is able to bring out the creative abilities and experiences of all members of the group.

2.4 Methods for organizing and summarizing ideas

Once several ideas are generated, they have to be described and visualized. Several tools are used for this purpose such as charts, diagrams and visual tools. Among them, the mind maps are considered very powerful tools to use after a brainstorming session. [11]

A mind map is a diagram used to represent words, ideas, tasks or other items linked to and arranged around a central key word or idea. It is a graphical representation of the concepts around a central theme, and the relations among them. Mind map helps in systematically unpacking abstract thoughts and notions, and in bringing structure and overview to a problem. It is especially useful for identifying all the issues and sub-issues related to a problem. We provided the participants with a mind map composed by empty areas representing categories, sub categories and concept's main features, in order to help them to organize the ideas generate by the brainstorming in a fast, instant way.

3   THE DESIGN WORKSHOP

The workshop objective was to generate new ideas for two different products/services: a vending machine and a train ticket machine. According to the program's aim, the new systems should address either users with impairments in dexterity and fine motor skills or users with visual impairments. During the workshop, we provided the attendees with some tools to simulate the creativity phase of the design process (from data collection to idea visualization). For the generation of the new concepts, the attendees were asked to work in groups, each made up of 3 students with mixed backgrounds, in order to have different perspectives. Each group had to choose a specific user category and one of the two suggested products to redesign. In the simulation of the creativity process, the groups were specifically asked to: (i) use an IDEO Card to analyze the user's interaction with the product (among Error analysis, Try it yourself, Empathy tools); (ii) use the user journey to organize the user analysis and to underline user needs, in order to set the design brief with requirements connected to the arisen needs/problems; (iii) perform the brainstorming to generate new ideas; (iv) use the mind mapping to visualize and group the ideas by categories and purposes.

We supervised the use of the methods by participants and collected a number of first-hand impressions and comments about the methods application, which are reported below. During each phase of the creative process, we encouraged the attendees to focus more on the interpretation of the insights and results stemming from the use of methods, than on the methods' rules. Indeed, the risk was to use design tools as scientific formula to apply to a specific problem. On the contrary, two distinctive features of design methods are *flexibility* and *interpretation* [12].

They reflect the iterative nature of the design process, during which the designer adapts and changes perspective according to the results and the understanding of the problems pursued using the method. Despite that, the participants experienced the difficulty of handling the flexibility and the degree of interpretation proper of the design methods. For instance, they found difficult to interpret the findings coming from the user analysis and to translate them in requirements for the design brief. Translating the user needs in project requirements meant to them to "take risks" and "make decisions" without objective and quantitative data, but based on their interpretations of the analysis results. On the other hand, user analysis methods such as the IDEO Cards (Error analysis, Try it yourself, Empathy tools) and the mind map resulted to be easy to understand, use and manage. The reason for this result may depend on the fact that, in these two steps, the tasks and rules that the attendees had to follow were thoroughly presented; while in the other steps they had more degrees of freedom. For the user analysis, authors provided both the goals to achieve and the specific actions to perform in order to analyse the user experience with the product. In the case of the vending machine, the user's goal was eating a snack, and the tasks were: locate the vending machines; go to the ticket machine; choose the snack; buy the snack; take the snack; eat/drink it; dispose wastes. For the use of the mind map, authors

gave the participants a precise scheme organized by categories, sub categories and idea's features, where they just had to insert their ideas by text and sketches without any further effort in interpreting data. It seems that the more detailed and specific the instructions the easier it was for students to use the method confidently. However, surprisingly, this did not hold for the brainstorming. Attendees were given the seven basic rules of brainstorming, but they were not concerned about not having detailed instructions to follow. Instead, they generated ideas freely and spontaneously, taking on a lateral thinking approach as required. In this case the participants did not perceive the use of brainstorming like a commitment. The reason for such an attitude, which is different from the ones taken on with the other methods, may stem from the fact that no ideas development was required. The attendees were aware that no convergent thinking (ideas selection) and concept development would have followed. This would easily explain why they enjoyed the session as a fun moment, without paying attention to the rules.

4 WORKSHOP RESULTS AND PARTICIPANTS' FEEDBACK

The workshop results in terms of generated ideas cannot be considered truly innovative, in some cases they were weak and naïve, mainly because attendees lacked typical design skills such as the ability to compare new solutions with existing products, to consider feasibility, to spot market opportunities, and to critically assess and select the resulting ideas. Despite the quality of the ideated concepts was not satisfying at a general level, the effectiveness of the teaching experience was assessed on the correct application of the design methods by students and on the increased awareness about design approach's nature and specificity they gained at the end of the workshop. Attendees understood and were able to apply each design method in a proper way using also a critical approach to them. The use of methods facilitated communication among group members coming from different disciplines, because it gave a common ground to discuss and cooperate. The successfulness of the experience is proven also by the positive feedback given by the students at the end of the workshop, collected through a questionnaire composed of closed and open questions. One questionnaire was delivered to each group, thus we collected seven questionnaires in the end of the activity. The questionnaire was framed into three sections: (i) personal information of the group components: age and background; (ii) personal knowledge about design tools before the workshop experience; (iii) the use of the design tools: comprehension, use, and efficacy. Questionnaire results are described below.

All the participants declared that they already knew most of the design tools used during the workshop (especially the ones related to the user analysis). However, only five of them (three psychologists, one engineer and the statistician) had already used them, but never in a design process. In the first exercise - the user analysis - 5 out of 7 groups used the Empathy tools. They were highly satisfied by its use and they declared that it was useful to reach a deep understanding of the difficulties experienced by users with specific impairments. Moreover, they declared that the tool allows a complete immersion in the user experience. About data organization, all the groups evaluated the user journey as easy to understand, but more than half of them experienced some difficulties in the selection of the relevant user actions to analyse and in their organization. 4 out of 7 groups assessed the elaboration of the design brief as hard to perform, because the collected data needed to be interpreted in order to identify the project requirements. Moreover, they stated that this step had not specific rules to follow, and this lack of details made the activity very difficult to perform. The brainstorming session was considered easy to understand and to perform. 6 out of 7 groups evaluated the brainstorming positively, students stated that listening to the others' ideas and matching them could get new and unexpected insights and solutions for a specific problem. All the groups but one agreed on the evaluation of the mind map as easy to understand and use. The questionnaires' results shows that the most effective and easy-to-use tools were the IDEO Cards and the Brainstorming. This confirms the impressions we got while supervising the attendees' activity. Some participants stated that they appreciated the fact that the use of these tools did not require any specific previous competences. However, it should be stressed that, although these tools were useful to approach the problems in different ways and to identify gaps otherwise overlooked, the resulting knowledge and solutions were affected by the student's limited experience and skills. During the design activities, authors realized that, more than helping participants to face ill-problems in a more structured way, the design methods forced them to give order to their instinctive creativity. Attendees were tempted to generate solutions from the very beginning of the process, without really analysing the user's needs and problems. Also while presenting the user analysis, some of them tried to propose solutions instead of explaining the

problems. This resulted in confused (often poor) ideas, addressed to small sub-problems. Forcing the students to postpone the ideas generation and to make a hierarchy of the identified problems resulted in a more complete overview of the design requirements. This fact was confirmed by the questionnaire results. Indeed, a group stated that the user journey and the design brief forced them to focus on design requirements and goals, although they instinctively had tried to find immediate solutions to the problems identified. Another participant declared: "the methods stimulated reflection and assessment, and above all helped us to consider details initially overlooked and to change our point of view". The participants were also asked to comment on their ability to understand and follow the design process and on their familiarity with the design approach for developing new products/services at the end of the workshop. They found the use of the design methods purposeful to organize the work's flow during the design process. Besides, they evaluated the methods as helpful for looking at new and unfamiliar problems from different perspectives (e.g. in the user analysis) and consequently to generate ideas with new insights that otherwise they would not take into account.

5   CONCLUSIONS

The questionnaires' results show that the main objective of the teaching experience was achieved. Indeed, the entire workshop experience aimed at helping the participants to take on a design approach in order to let them understand how to think like designers in the generation of innovative solutions, with a human-centred approach. Most of the attendees came from engineering and were used to develop solutions based on *function* and *performance*. Thanks to the workshop experience they started to acquire a design mind-set, a new approach to innovation based on users' needs and on the devising of ideas suited to face "wicked problems". Finally, decomposing the design process into sub-steps was really appreciated, because it helped the attendees to face one challenge at a time. However, one of the limits of a teaching approach based on design methods lies in the difficulty experienced by the participants in handling the flexibility and the degree of interpretation of specific tools, like the user journey and the design brief. Moreover, one of the most relevant challenges for students was to separate the divergent and convergent thinking into different steps of the activity. Although during the workshop these two ways of thinking were often overlapped by most of participants, at least at the end of the experience they were much more aware of the importance of keeping these two activities separated, in order to first explore the real problems with a rational thinking, and to gradually elaborate new solutions by a divergent thinking. Results show that the use of design methods can be an effective educational approach to teach practitioners with mixed background to take on a design approach in the development of innovative solutions, even if further research should be accomplished to find solutions to the identified limits.

REFERENCES

[1] Buchanan, R. (1992). Wicked problems in design thinking. *Design issues*, *8* (2), 5-21.
[2] Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy sciences*, *4*(2), 155-169.
[3] Daalhuizen, J., & Badke-Schaub, P. (2011). The use of methods by advanced beginner and expert industrial designers in non-routine situations: a quasi-experiment. *International Journal of Product Development*, *15*(1-3), 54-70.
[4] Lawson, Bryan (1980). *How Designers Think*. The Architectural Press Ltd, London, U.K.
[5] Heskett , J (2002), Toothpicks & Logos: Design in Everyday Life, Oxford University Press, p.7
[6] Masaaki Kurosu (Ed.) *Human Centered Design*, First International Conference, HCD 2009 Held as Part of HCI International 2009 San Diego, CA, USA, July 19-24, 2009 Proceedings
[7] Design Council (2007). Eleven lessons: managing design in eleven global companies Desk research report. *Design Council.*
[8] Bootcamp Bootleg D. School (2010). Available at http://dschool.typepad.com/files/bootcampbootleg2010v2slim-1.pdf. Hassno Platner & Institute of Design at Standford University.
[9] IDEO Method Cards: 51 Ways to Inspire Design. IDEO, Palo Alto (2003)
[10] E. De Bono, Lateral Thinking, Creativity Step by Step. Penguin UK, 1991
[11] B. Martin and B. Hanington. Universal Methods of Design. Rockport, 2012.
[12] J.W Creswell, A framework for Design in *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches,* Sage Publication, 2014.