How to Give Orientation and Inspiration to Design Thinking Novices Regarding Prototyping Methods?

Testing of a developed method card deck at the School of Design Thinking Potsdam

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Abstract

This article describes the execution of a testing of a developed and designed tool: a card deck with prototyping methods to improve prototyping skills at the School of Design Thinking in Potsdam (D-School). The aim of the setting is to test the method card set (of 35 cards) and the incorporated assumptions of the researchers to further develop the results of the testing and iteration of the tool. In this experiment we used qualitative and quantitative methods and we will discuss the results of the qualitative data. The test persons are design thinking novices, all students of the D-School. The testing is documented by a video camera and after the testing a questionnaire is handed out and filled in by the tested students. The testing is the base for further development and future iteration of the cards.

Keywords: Design Thinking, Design Thinking Education. Prototyping, Prototyping Methods, Prototyping Skills, Prototyping Methods Cards, Wicked Problem Self-Efficacy and Wicked Problem Competence.

1. Introduction

The competence to solve complex and even 'wicked problems' is a characteristic of the design process see Adenauer et al. [1] Buchanan [2] and the acquisition of this core competence is an important aim in the design thinking education. Regarding Rittels' and Webbers definition of a wicked problem the importance of stakeholder centered solution is stressed.

According to Rittel and Webber, there is not only one definitive solution (as in mathematics, for example) for a wicked problem. There should be manifold solution proposals more or less qualitatively developed where one is better than the other (Rittel). The better solution is one that is able

"(...) to improve some characteristic of the world where people live." (Rittel and Webber)

Given there is no ultimate test for a solution, the only possibility is a confrontation of the user with a prototype and to test the proposed solution and to analyse the resonance and feedback towards the prototype and the idea behind it [3]. We want to support design thinking novices via the prototyping method card set therefore we developed the 35 methods cards to give orientation to the design thinking novices. We see a need of the novices to learn more about prototypes, what's a prototype, get to know the whole range of possible prototypes to use and which One to choose to improve the own prototypes to better test the own assumptions. Therefore we developed the method card set and tested it with design thinking novices at the School of Design Thinking (D-School) Potsdam.

2. Definitions

2.1 Design thinking

Initially, we want to give the following short definition of design thinking: Design Thinking is a formalized design process but flexible approach to solve complex or even wicked problems. The most important is that design thinkers are mindful of the process and not too much focused on a quick and easy outcome. The Schools of Design Thinking stresses a certain set of mindsets which are essential for a design thinker these mindsets are among others: empathy, radical collaboration, an attitude of prototyping ("be visual, show don't tell, make it tangible"), constructive feedback and iteration.

2.2 Design thinking Education at the School of Design Thinking

Behind the background that innovations for complex and even wicked problems are needed, the question appears which educational program fits best when teaching students to generate the innovations that are needed to focus on social, human and sustainable aspects, which are supplementary to viability and technical feasibility. To overcome this gap, the Schools of Design Thinking in Stanford (USA) and Potsdam (Germany) are trying to educate future innovators. At the School of Design Thinking in Potsdam (D-School) for example students with multiple disciplinary backgrounds learn the design thinking process in a project often next to their regular studies, twice a week. Within the curriculum, the students learn methods with regards to process, knowledge, and gaining team competencies to face challenges. The D-School is experienced in conducting projects, which are provided by partners from the economy, administration, non-governmental organizations (NGOs) or research departments. The project partners ask student teams to generate innovative ideas for partners' needs. At the Schools of Design Thinking learning is project-based and students are not taught in a classical sense. A D-School teacher acts more like a coach and supplies the students a toolkit for problem solving. The goal of d D-School is to form an innovative person that is able to find his or her own pathway to a solution, which also addresses social and sustainable aspects [3]. Among others one of the central skills at D-School is prototyping.

2.3 Prototypes

For us prototypes have two characteristic roles in the design process, on the one hand prototypes enable interactions and feedback with the user, manager, client or teammate and make the generation of new information and insights possible. Via a prototype a user can give feedback on the general idea, on a detail or a function and also on whether the solution -based on Rittel and Webber- is a "better or worse" one. On the other hand prototyping is a generative tool for designers that will accompany the draft and design process [2]. At the same time a designer makes progress in the process, the prototypes reflect the progress of the knowledge and assumptions.

Furthermore there is an important psychological dimension of prototyping: Research of Gerber and Caroll has also described the designers' enhancement of self-efficacy by experiencing (low fidelity) prototyping .

"Dealing with prototypes and being surrounded by own prototypes which shows an advancing progress. The practice of low-fidelity prototyping not only influences work outcomes, but also the way people feel about the work. This practice led to reframing failure as an opportunity for learning, fostering a sense of a sense of forward progress, and strengthening beliefs about creative ability." (Gerber and Caroll)

At the Schools of Design Thinking prototyping is a core technique. Given that prototyping in the design thinking education is introduced at a very early stage, often hours after handing out a new project (for example in the fast forward exercise). First ideas will be made tangible and can be modified iteratively. For the early phase of the process techniques, such as paper models or those made in rough shapes are quickly realized and offer an easy way to make an idea tangible and testable.

The idea to develop method cards is based on previous research in the Schools of design thinking about the teaching aims of the design thinking education thinking stanford and potsdam. One finding was that creative confidence is a main aim of the design thinking education [4]. We work with the self-efficacy construct of Bandura [5] to conceptualize our insights and to put it within a scientific context [6], we work now with the term of self-efficacy in the context of wicked problems and call it wicked problem self-efficacy [7].

Our further research shows evidence that prototyping is a crucial element to cope with wicked problems. Building on that insight we proposed a model regarding the interaction between three factors considered as important to enhance wicked problem solving competence. We discussed how factors as wicked problem self-efficacy, wicked problem solving competence and prototyping skills interact with each other. We suggested approaches for testing it as means to enhance wicked problem solving competence by improving prototyping skills. We developed prototyping method cards as mean to improve the novices' prototyping skills. Therefore we selected the most relevant methods for the design thinking context and left out part of the method which are very disciplin specific (as for example geo maps).

To learn more about if the method cards are comprehensible and useful to inform and inspire as planned we tested the method cards set with novices at D-School Potsdam.

2.4 Prototyping methods and skills

The skill to build a prototype in the design thinking education context aims to inform students and how to create the novices awareness of a prototypes impact. When an idea will be prototyped an assumption is always included and can be tested. First there is a need to inform novices about the manifold types of prototypes as for example a storyboard, a paper prototype or a role play. To make use of a prototype benefits novices try out different prototyping methods with the aim to better understand and learn how to use them as a helpful tool to interact with teammates, user or clients. Aim is to gain experiences in building prototypes and to use them to incorporate an idea in a tangible way. For this aim we developed method cards: briefly method cards are analog and tangible cards in a smaller format (mostly DinA6 and smaller) with methods shortly explained on it. Quite well known are the ideo method cards to illustrate a range of 51 design methods which are differentiated into different phases of the design process. The authors aim are "51 ways to inspire design" [8].

3. Description of the test

3.1 Description of the method card set

The card set was developed to address the need of design thinking novices to enlarge their prototyping comprehension and knowledge about the varity of prototyping as well as enable them to make a selection of their idea and assumption-fitting prototype. For this aim to give a quick orientation we designed specifically the back of the cards. The set of cards consists of 35 cards in DinA6 with prototyping methods, which are applicable in the design thinking education context but also in design education or innovation context. Supplementary information is indicated on the front page: a photo, which illustrates the process to build the prototype. The shown prototype refers to the subject of the development of the cards. The didactical idea behind the concept of the photos is to use the prototypes which where prototyped within the process to make the method cards. The photos show prototypes during the making of the method card set (pre-production prototype) or in use of the cards (for eg an advertising of the method card set or a person who makes a video of a team making use of the set). A text of seven lines which describes the prototyping method in general, and the information of the average time needed to build the prototype and the aim of the prototype in one sentence. Supplementary you find the information which group (user, manager, team) the prototype will address. When all cards are jig sawed (5 by 7 grid) the back of the cards shows a square. Similar to a jigsaw you can see a graphic on the back of the cards. This graphic shows on the one hand four colors starting in the center and ending on the margins and on the other hand four categories on the extreme margins: quick-costly and concept-detail. The aim is that by using the set the novices will easier choose and quicker find the right prototype for their project than without the set.

3.2 Sample group

Overview of the sample: 12 student participants of the school of design thinking with an average age of 27,7 years (range between 23 to 41 years). There are 7 female and 5 male participants (who filled in the questionnaire). The sample consists of three teams, who worked as a team on a three weeks long project which was handed in by a company or a social organization. During this project the students worked two days a week.

3.3 Description of the methods

Analysis of the recorded videos

The interaction between the moderator and the novices with the test materials was recorded on video. So it is possible when watching the video to repeat sequences of interactions as often as desired to analyse it. The video recording allows an all including and systemic approach to observe behavior and opens the possibility to decipher interactions by watching small details again and again.

The questionnaire

A questionnaire is developed with questions on a 1 to 7 scale. The aim is to get deeper and more detailed information from the sample group.

4. Testsetting

The moderator welcomes the test participants and presents his team (a photographer, a person with the video camera and an assistant). The test persons are invited to sit down and to tell their names. The moderator mentions the background of the research project and the reasons or aim for the testing, which is to improve prototyping skills and to give orientation and inspiration to design thinking novices. The feedback of the test will be used to improve the tool: method cards. With the aim in mind to initiate a reflection about prototypes and the last built prototypes, which was completed during the previous three weeks project the moderator asked which prototypes the team built. The team sums up in three sentences which prototype they presented. The team names the prototype and in the case that they don't know the name, the moderator helps the team to find the name of the prototype. The team is asked to write down the name of the prototype on a blank card (in the same size as the set of cards). The moderator asks for the satisfaction of the team with the prototype built on a scale from 1 to 7 (1 is very satisfied, 7 is not satisfied at all). The moderator asks for the reasons of their answers. The aim is to receive more information about how conscientious the team is about the topic prototypes in general and specifically, how reflective or critical they are and what do they know about their own assumption what they put into the prototype. The moderator's next question was if the prototype was able to transport well, to ask the "right" question to the user to really test the included assumption and the idea of the prototype. Was the prototype built to generate feedback and to advance the project? When the team answered with a "no" the aim was to find out the reasons for it via further questions. The team is asked what they would change if they had the possibility to do so. The team is asked which questions after the presentation they still have and would like to test and generate feedback for and what other prototype they would have chosen. When a team answered with a yes they were asked for the reasons. Why was the chosen prototype successful? The aim of these questions was to gain more details about the reasoning about prototypes and their use or application. The moderator presents and explain three of the developed prototyping method cards which are: First: Video, secondly: Letter to Grandma, and third prototyping technique: Paper click Dummy. The team completes the three cards with their card (with their own prototype's name). The novices' task is now to position these four cards on the matrix, exploring whether they are close together or far away because of their character?

The team receives an A1 format sized sheet with a drawn 2by 2 matrix without categories. They are asked to develop categories (within 10min time, a time-timer clocks the time). The aim of the test situation is to find out which categories for the novices are relevant and make sense for novices. Which categories do they choose and which categories do they prefer? The team discusses how to describe and label the two axis and writes it down on the sheet. The result is photographed. The moderator gives the team a bucket with the 35 cards and asks them if they could jig saw it as quickly as possible. The aim is to take the time and to see if the jigsaw is easy to complete and if it is fun to do or not, etc. After completing the jig saw the moderator asks the team to position the cards within the developed 2by2 matrix, which is the jig sawed set. The team is asked to position their cards with the written down name of their prototype) and the three other prototyping cards within the matrix with the categories: "concept"-"detail" and "quick" and "costly". Photos are taken of the arrangement. The team is asked to give their feedback to the suggested categories: are the categories clear? Are the categories more plausible or relevant to the group than the one's they have developed? The team has to decide on one matrix their own self-developed one or

the following already developed. The team gives arguments and reasons for their choice. The aim of the task was to get feedback on the developed 2by2 matrix and to see if the categories are comprehensible and relevant for the novices. Is the arrangement of the cards into a 2by2 helpful and does it deliver orientation? To get more answers from the sample group questionnaires were handed out. So we received information about details, such as if the student saw the QR-Code on the cards or if not. If they are interested in getting more information via the QR-Code and if so which information would be interesting for them. Due to the limited space in this paper we will not publish the whole analyses of the questionnaire.

5. Analyse of the test data

5.1 Method: Video-based observation method

The interactions between the moderator and the novices with the test materials were recorded on video. This is done so it is possible to repeat sequences of interactions as often as desired when watching the video and to analyse it. The video recording allows a comprehensive and systemic approach to observe behavior and opens the possibility to decipher interactions by watching small details again and again.

5.2 Short Description of the Method: Cluster

The goal of clustering is to reduce the amount of data by categorizing similar data items together. Clustering proceeds successively by either merging smaller clusters into larger ones, or by splitting larger clusters. During the process of clustering every cluster is in the end categorized.

5.3 Analyse of the video:

Step 1: To make notes of intriguing details

The research team and some guests (from the design thinking education context) watch the video of the three tests. Simultaneously, every person on the team takes notes on sticky notes sorted by colors designating if the note refers to team 1, 2 or 3. The questions to answer were: What do I see, what does it mean to me? Why were the cards helpful? Why are the cards still imperfect? What surprised me? What went well during the experiment? What did not?

Step 2: Synthesis

Clustering the noted details the team formulated their insights on the three testing and wrote them down on sticky notes. The notes were arranged and categorized to make sense out of the huge amount of notes (on a six meter long wall). The sticky notes were grouped into buckets and titles and categories were formulated. The aim was to find formulation to synthesize an insight of the testing. In sum, seven insights could be formulated, as follow:

1) Our Beginners enjoy sorting cards the first time

2) Our Beginners can all position prototypes in a matrix

- 3) Color spectrum is hard to do a jigsaw
- 4) Our Beginners get to know new prototypes by cards and they like it
- 5) Our Beginners mix a limited number of prototypes
- 6) Our Beginners don't read texts under time pressure therefore pictures and titles are powerful
- 7) Dealing with our cards provokes discussions about what prototypes actually are



Step 3: Apply (transfer or implement) the gained insights on the method cards

Based on insights of the testing some elements of the cards were confirmed, others must be iterated and for some aspects new solutions must be found and developed. In the following we will transfer the insights to concrete iterations and further steps.

1) Our Beginners enjoy sorting cards the first time

We assume that the tangibility of the cards matches the topic. The students were enthusiastic about the cards. They like that they were easy to put close to other cards, which made it simple to compare them. Due to the A6 format the cards are tangible and easy to handle and to interact with them. In comparison to a digital application the cards come without technical barriers, for example discussing three methods at once on only one screen is difficult to share with teammates, etc.

2) Our Beginners can all position prototypes in a matrix

The back of the cards gives orientation via 2x2 categories. Some of the students had difficulties in understanding the meaning of the categories used, for example: concept (left) and detail (right) on the matrix. For some of them the use of these words didn't makes sense. We will change the categories into "idea" and "solution". The same for the vertical category: "quick" and "costly" will be changed into "quick" and "sophisticated" because the term "costly" was considered as negative. Nobody wanted to choose a costly prototype technique, because of time constraints and the unattractive aim: a costly prototype. So we changed it into a sophisticated one. We hope in this way to enhance the attractiveness of some prototypes, even if they cost more time (and sometimes: money). So we have to scientifically verify if the position of the techniques within the matrix is the right one. Therefore we have to test it separately with three interdisciplinary experts and determine how they would locate the techniques within the matrix.

3) Color spectrum is hard to do a jigsaw

We stopped the time that the teams need to complete the puzzle made up of the back of the cards. We arranged the 35 cards with an obvious center; the general shape is a rectangle. The graphic on the reverse aims to make the "do a jigsaw" easy to fit together.

4) Our Beginners get to know new prototypes by cards and they like it

The beginners in the test know only a limited range of prototypes. They are interested and curious to get to know new prototypes. For us it is confirmed that the idea to offer a set of cards as a tool works well. Our idea is to give access to supplementary information and more detailed input of methods by further media. See the QR-Code as a possibility to learn more about prototypes. For example, Power Point Presentations and "making of" films, which illustrates more in, detail the techniques. Before doing so, we need to compare the advantages of the media types with the needed goals. What does the novices really need?

5) Our Beginners mix a limited number of prototypes

The tested students don't have a clear idea about what prototyping is. Among the few prototypes techniques that they know, some of them had only used only three different techniques before.

6) Our Beginners don't read texts under time pressure therefore pictures and titles are powerful

Our idea is to enhance the legibility. This means we will change the gray background into a white one for a higher contrast and the color of the type from white into dark grey. We will check if there is a better way to do the typography to make reading the texts easier. We are convinced that the texts are reduced to the minimum regarding the number of letters, which are currently: seven lines. The second idea is to stress the importance of the

photos and we will therefore develop concepts for own pictures of the techniques are important. We will make good photos. The aim of future photos will be to communicate in a clear visual language the process of the method or the result of it.

7) Dealing with our cards provokes discussions about what prototypes actually are

We consider it essential that the team members discuss different cards to find arguments for the best fitting technique. Using the cards enhances the reflection about the range of prototyping techniques and contributes to finding and reaching the team's goals.

5.4 Limitations

For the next testing we would change some details of our testing to receive more valuable results to build on: There were three questions in the questionnaire not enough precise formulated so the answers are difficult to take into count. The test was filmed but a supplementary voice recorder would have been good because of some noisy situations, which made it difficult to analyse some situations. We missed one time to introduce to the test team that we want to film and to make sure that the data will be treated anonymous. This fact maybe influenced the behavior of some test persons.

6. Conclusions

The aim of the experiment is to transfer the gained insights for further iterations of the method cards and to give further suggestions for dealing with the cards to select the best fitting prototype. We tested the prototype of a deck of prototyping method cards with design thinking novices at the school of design thinking in Potsdam. The experiment was recorded by video to identify non-verbal responses and a questionnaire was handed out to the participants at the end to explore their experience and potential benefit from using of the card set.

The analysis of the generated results of the experiment supplied insights for further development and iteration of the card set. On the one hand we learned more about our participants - they don't have a common understanding of what prototypes are. And on the other hand some of our basic assumptions were confirmed (for example: the sample group finds the cards helpful in getting orientation concerning the adequate prototype; the participants like the analogue format and also appreciate the materiality of the cards.

In parallel to the confirmations of some our assumptions; we received further inspiration for iteration and changes of the concept as for example: the legibility of the texts, no relevance for the novices if the prototype is for team, manager or user, for some students some of the categories were difficult to understand. Via the test we received a deeper understanding of what our stakeholders need when dealing with choosing a fitting prototype and what their (communicable) needs are.

We assume that the method card set is a promising approach, among other learning materials and inputs via presentation or short videos to transfer knowledge and provide support for novices in the design (and innovation) process. We will continue to elaborate, test and iterate the cards set as a learning tool. Therefore we plan a testing during a whole basic track term at D-School Potsdam, which lasts about three months. We will evaluate over a

longer period, if the prototyping cards will affect the prototyping skills, wicked problem self-efficacy and the wicked problem solving competence or not.

7. References

- [1] Julian Adenauer, Jörg Petruschat, "Was wir denken," in *Prototyping! Physical, virtual, hybrid, smart,* Berlin: Form+Zweck Verlag, 2012, pp. 13–37.
- [2] Buchanan, Richard, "Wicked Problems in Design Thinking," *Design Issues*, vol. 8, no. 2, pp. 5–21, Spring 1992.
- [3] Elizabeth Gerber, Maureen Carroll, "The Psychological Experience of Prototyping," *Design Studies*, vol. Volume 33,, no. Issue 1, pp. 64–84, Jan. 2012.
- [4] I. Rauth, E. Köppen, B. Jobst, and C. Meinel, "Design Thinking: An Educational Model towards Creative Confidence," in *Proceedings of the 1st International Conference on Design Creativity ICDC* 2010, 2010.
- [5] A. Bandura, Self-efficacy: The exercise of control. New York: W.H. Freeman, 1997.
- [6] Jobst, Birgit, Köppen, Eva, Lindberg, Tilmann, Rhinow, Holger, Moritz, Josephine, and Meinel, Christoph, "The Faith Factor," in *Design Thinking Research Measuring Performance in Context*, Heidelberg: Springer, 2012, pp. 302, 127 illus.
- [7] Jobst, Birgit and Meinel, Christoph, "How Prototyping Helps to Solve Wicked Problems," in *Design Thinking Research*, Heidelberg: Springer, 2013.
- [8] IDEO, "Method Card Deck," http://www.ideo.com/work/method-cards, 2013-07-08