City University London

MSc Human-Centred Systems

Project Report

2014

Creative Design of a Digital Showcase

Max Schubmann

Supervised by: Stephanie Wilson

26 September 2014

Student declaration

By submitting this work, I declare that this work is entirely my own except those parts duly identified and referenced in my submission. It complies with any specified word limits[1] and the requirements and regulations detailed in the assessment instructions and any other relevant programme and module documentation. In submitting this work, I acknowledge that I have read and understood the regulations and code regarding academic misconduct, including that relating to plagiarism, as specified in the Programme Handbook. I also acknowledge that this work will be subject to a variety of checks for academic misconduct.

Signed: Max Schubmann

[1] The word limit in this report has been marginally exceeded.

ABSTRACT

Students of Human-Centred Systems at City University London spend a lot of time and effort on projects for their modules. These projects and their outcomes are mostly viewed and rated by lecturers, and then forgotten. This is a wasted opportunity, as student work can be used communicate knowledge, promote students and their university and to help others understand what kind of work is being done in the modules.

The main objective of this project was to design an innovative prototype of a digital showcase for student work. It was decided to combine this objective with a research question on creativity techniques.

To investigate this and to follow the objective, two creativity techniques (Creativity Triggers and Circle of Opportunity) were used in design workshops with stakeholders to support idea generation. The generated ideas were rated and evaluated to compare the used techniques and to inform the design of the showcase prototype.

An interactive prototype has been designed and evaluated. It satisfies user needs and contains aspects and functionalities that are novel and creative. It is no longer just a student showcase, it evolved into a web portal for the whole study course.

KEY WORDS AND PHRASES

Creativity techniques, idea generation, requirements, digital showcase, interactive prototype

ACKNOWLEDGEMENTS

First, I would like to thank my supervisor Stephanie Wilson for her help and guidance throughout this dissertation. She has helped to shape this project, supported me with her viewpoints, and well appreciated advice.

I would also like to thank my fellow students, Dimitra, Alexandra, Ian, and all the rest of you wonderful people, for supporting me throughout the last year and for volunteering to participate in my interviews, workshops and evaluations. You made this course and the lectures more enjoyable!

Very special thanks go also to my family and to Margot Dhennin, who always supported me and who was kind enough to always listen to my complaints and problems.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

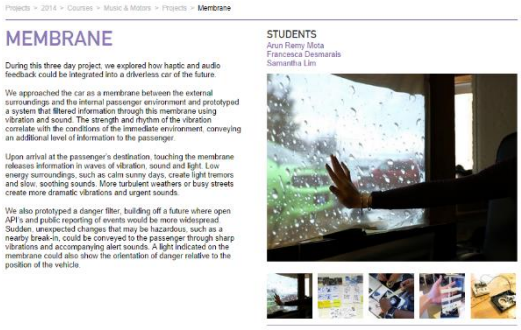
1 INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

The Centre for Human Computer Interaction Design at the City University London offers a Master's degree in Human-Centred Systems that consists of eight modules and a dissertation project. These modules teach a wide variety of expertise from human-centred design processes over to requirements engineering, the evaluation of interactive systems and creativity as part of the design process. Each module contains practical student work that is done either individually or in groups in form of courseworks and tutorial tasks. Unfortunately, in most cases, the performed work is either never seen by others (tutorial outcomes) or only seen and assessed by lecturers (courseworks).

Students spend a remarkable amount of time and effort into creating these quality works. As part of the work, people are observed and interviewed, storyboards are drawn and personas invented. These outcomes, if used correctly, could promote the study course and its students and not let the students' effort go to waste by letting them be forgotten.

Regarding the highlighted problem, we came up with the idea to create a digital showcase, as it already exists in other universities. One major example here is the Copenhagen Institute of Interaction Design. It displays all submitted student projects since 2008 has a very high-perceived standard of showcasing their content to the public audience, as seen in the Figure below.



The digital showcase will efficiently display the student work of the Human-Centred Systems study course. Easily said, not easily done.

Indeed, a digital showcase is not a straightforward interaction design problem; it is more creative as no predefined requirements exist and each showcase is unique in serving its own purpose. Thus, we had to answer a first question (that comes up when designing any showcase): What is a good showcase regarding our Human-Centred Systems study course?

As I understand, this question has no single right answer. Every person may have different ideas and concepts what an effective showcase may look like and what content it may present. Thus, the necessity of generating, collecting and combining creative ideas suitable in the design of the showcase was vital. It led us to more questions to answer: How can creative ideas suitable in the design of the showcase be generated, collected and combined? Are some techniques to do so more appropriate than others? To answer these questions, I decided to combine the designing of the showcase with a research study investigating creativity techniques.

This project will pursue to answer these questions by analysing existing showcases and collecting data through performing stakeholder interviews and creativity workshops. This study will use a rarely used and non-evaluated creativity technique called "Circle of Opportunity" in a creativity workshop and compare it with a technique called "Creativity Triggers" to contribute novel insights to the overall knowledge of the use of creativity techniques. It will furthermore provide a working prototype of a digital showcase for the study course Human-Centred Systems.

1.2 OBJECTIVES

The overall aim of this study is to design an innovative prototype of a digital showcase for student work. To achieve this, the following objectives were established.

- To investigate creativity techniques in a design workshop
    - To gain a better understanding of creative design processes
    - To identify suitable creativity techniques
    - To compare produced results of used creativity techniques
- To develop an interactive prototype of a student showcase for the study course Human-Centred Systems
    - To generate ideas for the showcase with stakeholders
    - To synthesise generated ideas into requirements
    - To create an appropriate design solution

The decomposition of high-level objectives into sub-objectives was not included in the initial project proposal, as it developed over the course of the project. Despite this, the overall project did not change; the objectives were simply refined into more detailed sub-objectives.

Tests for objectives[2]

- **To investigate creativity techniques in a design workshop**

This high-level objective was decomposed into three more detailed sub-objectives. If all three sub-objectives are met, the high-level objective of investigating creativity techniques for the use in design workshops is considered as met as well.

- To gain a better understanding of creative design processes

This sub-objective is met if a literature review about creativity and creative design processed is provided.

- To identify suitable creativity techniques

This sub-objective is met if existing creativity techniques are presented in an overview and if two techniques are chosen for the use in creativity workshops.

- To compare produced results of used creativity techniques

This sub-objective is met if the results are:

- Quantitatively analysed and summarized in a table
- Qualitatively analysed and summarized as a comparison

- **To develop an interactive prototype of a student showcase for the study course Human-Centred Systems**

This high-level objective is met, if a working prototype of the student is developed.

- To generate ideas for the showcase with stakeholders

[2] Are tested for in Chapter 5.2

This sub-objective is met, if stakeholders generate a total amount of 50 ideas for the digital showcase.

- To synthesise generated ideas into requirements

This sub-objective is met, if a requirements specification document is created consisting of at least 50% ideas generated by stakeholders.

- To create an appropriate design solution

This sub-objective is met, if a design solution for the showcase is created and if a user evaluation produces positive results.

1.3 RESEARCH QUESTIONS

RQ1: Does the integration of creativity workshops into the design process produce any creative ideas that no other existing showcase has?

RQ2: Which creativity technique produces higher rated ideas?

1.4 BENEFICIARIES

Various stakeholders can benefit from this project:

Students: Student can show their skills and outcomes to a broad audience without building and distributing a specific portfolio. Time and effort spend on the outcome are not wasted, which may raise the motivation to work on it.

University: City University London or the human-computer interaction department can show the public audience what kind of work is being done in the offered modules, which can raise the status and reputation in case of high quality outcomes.

Employers: Can access public showcases, look for promising or high quality projects in order to employ students.

Academics: Are presented with an overview and comparison of creativity techniques, which can support their decision in choosing a suitable idea generation method.

Third parties: Other universities and courses can benefit from the created prototype by using it as a model for their own digital showcase.

Potential students: Get a clearer understanding of the offered study course and its content. A good showcase can potentially increase number of students who apply.

1.5 Scope

The scope of the project includes the development of an interactive prototype, but not the development of a fully functional system. A functional system requires a working background system with databases, hosting platforms and administration tools. This project duration does not allow such a complex development.

Interviews will be performed with some stakeholders, but not with all of them, as some stakeholders (lecturers, potential employees) are not easily accessible.

Additionally, only two workshops with one creativity technique each will be performed. More than two workshops or multiple use of creativity technique would be preferred in an ideal world without time and resource limits, as any observed results could be an artefact of the personality of the people who were involved in the workshops

1.6 Reader's guide

Overview of what the rest of the project is about, overview of what I have done (methods) with forward references in which chapters to find it.

This dissertation consists of six chapters, which are organized in the following way:

This chapter (**Chapter 1 - Introduction**) gives an overview of the background and motivation of this project along with main objectives and research questions.

Chapter 2 – Literature Review forms the basic knowledge around creativity for this project and informs the choice of creativity techniques for the design workshops. It gives an overview of current research on creativity and the integration of creativity into the design process. It presents various creativity techniques, a case study of how they were used as creativity support in design workshops and ways of how creativity can be measured.

Chapter 3 - Methods describes in detail how this project was carried out. It describes three data gathering methods that were performed to inform the design of an innovative student showcase. The three methods were the following: 1) a review of existing showcases to get an overview of how universities present their student's work, 2) stakeholder interviews to get general input on student showcases and feedback about existing showcases, and 3) two creativity workshops that were performed each with four participants. Additionally, the chapter describes how the two used creativity techniques are compared with each other and how the gathered data is analysed and converted into a working prototype of the digital showcase.

Chapter 4 - Results presents the results of the three data gathering methods and compares the outcomes of the two used creativity techniques. This chapter also presents the designed prototype and summarizes the results of the usability evaluation.

Chapter 5 - Discussion discusses the results of the work during this project and puts it into a broader context. It compares the results with what other people have reported and identifies similarities and contradictions between them. The chapter also revisits the set out objectives and research questions and provides a discussion of whether the objectives and research questions were met and answered or not.

Chapter 6 – Reflections and Conclusions looks back and evaluates the done project work as a whole. It reflects on the difficulties experienced during the project and presents lessons-learned

during the process. It also identifies limitations of the project and suggests future work that could be done to overcome these.

2 LITERATURE REVIEW

2.1 INTRODUCTION AND DEFINING CREATIVITY

What is creativity?

The concept of creativity gained importance in recent years and creativity is one of the most important qualities that companies look for in employees (VILLALBA, 2008). To be able to compete with a product against competitors, the product has to be innovative and of high quality. Innovation can only be achieved through creativity thus, creativity is a key aspect of success (Nguyen and Shanks, 2009). As stated in the objectives, a goal of this thesis is to design an innovative prototype of a digital showcase for student work. To achieve this goal, and especially the part of it being "innovative", it is important to get a better understanding of creative design processes and of techniques to support creative idea generation.

However, what is creativity? How can a design process be utilized to ensure that creativity plays a major part in it? Finally yet importantly, how can creativity be measured? The following literature review will provide answers and insights to these questions. The review will ultimately inform the design of a workshop to let participants collaboratively come up with design ideas for a digital showcase of student work. To support the idea generation, different supporting techniques have to be researched. Two of the researched techniques will be used in workshops to support participants in generating ideas. One of the goals of this dissertation is to collect data about the usage of those techniques in order to be able to compare and analyse the techniques with each other in regard of effectiveness. Through the literature review, it will become clear which techniques have not been measured and compared before, which data was collected in similar researches and if a measurement of effectivity for creativity techniques exists.

In the literature, creativity has multiple different definitions by various authors. One of the most known and accepted definitions is that creativity is "the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive to task constraints)" (Sternberg and Lubart (1999)).

When somebody is talking about creativity, innovation is a word that often comes with it. (Biskjaer et al., 2010) describe creativity as the generation of novel approaches or ideas, while innovation is used in the context of applying ideas in the development of a specific product or service. As such, creativity is a pre-requisite for innovation, although it is not in itself a sufficient condition for it.

Sternberg (2006) defined five shared features of creativity research around the world, which give an insight about the properties of creativity:

1. Creativity "involves thinking that aims at producing ideas or products that are relatively novel and that are, in some respect, compelling".
2. Creativity "has some domain-specific and domain-general elements. That is to say, it needs some specific knowledge, but there are certain elements of creativity that cut across different domains".
3. Creativity "is measureable, at least to some extent".
4. Creativity "can be developed and promoted".
5. Creativity "is not highly rewarded in practice, as it is supposed to be in theory".

One general measurement of creativity is the number of generated ideas. The larger the number of ideas produced in total, the higher the probability that one of these ideas is a very good and creative one. (Warr and O'Neill, 2005) argue that creativity during the design process results in a higher probability in coming up with better applications and systems. (Carroll et al., 2009) on the other hand say that a quantity of work produced is not a reasonable measure, as "creative individuals are likely more concerned with quality than quantity".

Current methodologies focus not on measuring the creativity of a person or the creativity of the produced idea, but on the support that methods, techniques and technologies provide to persons. Creativity Support Tools (CSTs) have the goal to enhance one's creativity, since "creativity research shows that an individual's creativity can be improved" (Carroll et al., 2009).

In order to enhance creativity, one has to establish what characteristics creative work and creative people have and depends on to be utilized effectively. One of the main characteristics of creativity is the so-called "flow" which describes the state of mind of a person who is passionate about, and fully absorbed by, the work. The concept of flow was introduced by Mihaly Csikszentmihalyi, who came up with 9 elements that are required for flow to be active (Carroll et al., 2009).

1. There are clear goals every step of the way.
2. There is immediate feedback to one's actions.
3. There is a balance between challenges and skills.
4. Action and awareness are merged.
5. Distractions are excluded from consciousness.
6. There is no worry of failure.
7. Self-consciousness disappears.
8. The sense of time becomes distorted.
9. The activity becomes autotelic.

However, (Carroll et al., 2009) argue that the flow itself is not sufficient for creativity and bring in the concept of play, as creative work hardly resembles real work and is more similar to playing activities, where discovering and playing around with things and ideas is important. The concepts of flow and play have major similarities in the aspects of engagement and durability. It is important for an individual to be fully engaged in an activity to get creative and the activity has to be challenging, enjoyable and rewarding in order to invoke the desire to repeat the task several times.

To measure these attributes, (Carroll et al., 2009) came up with the Creativity Support Index (CSI). The CSI is a survey metric that tries to measure six factors (*exploration, expressiveness, enjoyment, immersion, collaboration, results worth effort*) related to creativity support that software applications provide to their users. It consists of a 12 rating scale questions and 15 comparison questions. The answers are combined in an index between 0 and 100 that indicates the creativity support provided by the system, software, or interface. This index gained popularity and acknowledgment in the academic world as a metric that can complement other evaluation methods. Unfortunately, it is not designed to be used with creativity support techniques that are performed during workshops or are not software based.

Nevertheless, creativity is not only a word. It is also the qualification of a person, process and product. Over the last decades, there have been three main concepts how creativity should be defined: the concept of the creative person ((Gough, 1979), see Chapter 2.9), the creative

process (Boden, 1996) and the creative product (Warr and O'Neill, 2005). The following chapter will discuss the concept of the creative process according to (Boden, 1996).

2.2 Creative Process

How does creativity work?

The creative process is described as the inner process of an individual that results in the generation of ideas. There are multiple categories of creative processes and different views on each category by various authors.

(Boden, 1996) identifies three different categories of creativity.

1. **Exploratory creativity**: The creative process is an exploration of conceptual spaces, where the human mind and its memory is a space that can be searched
2. **Transformational creativity:** The creative process is a transformation of conceptual spaces, where the human mind is extended to create additional searching space.
3. **Combinational creativity:** The creative process is a combination of single instances inside conceptual spaces to create new relations and spawn novel ideas.

Koestler, an author with different views than Boden, sees the creative process as the combination of matrices, where a matrix symbolises a thought or idea in a person's mind. By combining matrices, concepts are merged and transformed into new unexplored ideas (Warr and O'Neill, 2005).

Koestler's model resembles the combinational creativity model of Boden, as the combination of matrices has the same principle behind it as the combination of instances inside conceptual spaces.

Warr and O'Neill take Koestler's model and extend it so that the combination of matrices is not limited to a single person's mind. Matrices from different individuals are combined with each other, which allows a greater range of possibilities in generating ideas. The human mind's extension to a further space, which consists of multiple individuals, is based on a previous psychological model by Edwin Hutchins called Distributed Cognition (Hollan et al., 2000).

By including other individuals into the process, we can see that creativity becomes a more social process.

In order to get an overview on how other people see creativity, (Shneiderman, 2000) summarizes perspectives on creativity from "large literature" in three groups:

1. **Inspirationalist perspective**: Interplay between consciousness and unconsciousness. Preparation of the mind and incubation lead to a moment of illumination. The creative outcomes from the illumination have to be verified and transformed into a practical solution.
2. **Structuralist perspective**: Rational and systematic approach to exploring and solving problems. Important to study previous work and explore possibilities exhaustively. When a promising solution is found, it has to be evaluated, compared and refined to a point where it can be used.
3. **Situationalist perspective**: Social context is a main part of the creative process. Individuals are influenced by others; new knowledge is built on previous knowledge.

Creativity is embedded into a community of practise; solutions require approval from peers.

Each of the three perspectives has its own model of how creative processes work. As a similarity between all of them, the initial step is always an analytical, data-collection phase where individuals have to prepare themselves by finding and reading relevant information. The individual has to have a profound knowledge of the problem area in order to be able to come up with ideas and solutions that are appropriate.

After the initial preparation or data collection phase, the process of idea generation can occur. Depending on the model that is viewed, this idea generation occurs either consciously or subconsciously while incubating.

After an idea was generated, it has to be validated for appropriateness to ensure that the novel idea is reasonable and fitting to the existing problem.

The described models of creative processes were widely analysed and implemented into practical design and development frameworks. These frameworks try to incorporate each step of the chosen creativity model into its design process to include and support creativity in the design process.

(Shneiderman, 2000) suggests a framework called genex (generator of excellence) that integrates social creative activities in its process. It is built on the cores of the situationalist's perspective and consists of four stages. Each stage is accompanied by primary activities, which can be used at any stage if needed.

1. Collect
    a. Search and browse digital libraries in order to gather knowledge, categorize it and write it down. Browsing functionalities provide the possibility to explore knowledge that one could not think of before by using search functionalities with keywords.
    b. Visualize data and processes gathered from digital libraries to understand and find relations between knowledge by using visualization techniques or tools.
2. Relate:
    a. Consult with peers and mentors to discuss new ideas. Consultations might go on and continue through tools such as phone calls, email, video conferencing etc.
3. Create:
    a. Liberate the mind by making free associations to related concepts by using supportive online services or well-established techniques such a mind-maps.
    b. Explore solutions by using tools to create variations of scenarios and run simulations
    c. Compose artefacts and performances in the form of written documents, presentations, and other forms of visual high-density content presentations.
    d. Review and reflect on the work, possibly with the support of tools such as web browser history and saved search queries.
4. Donate
    a. Disseminate results by sending out emails, contacting digital libraries, scientific journals etc.

The genex framework provides a research agenda and a clear way of conducting creative work from a more social and tool-driven perspective. But it may in same cases lead to a decrease in performance or creativity, as it is dependent and limited by single individuals and used technologies during the relate- and create phases.

(Jones et al., 2008) describe a framework called RESCUE[3], which models genex process from the situationalist perspective into its idea and requirements generation process. RESCUE uses workshops that utilizes creativity techniques to support creative idea generation by participants. Creativity workshops are an important part of RESCUE as they support "the discovery and invention of requirements and ideas needed to specify use cases". If workshops are able to incorporate entire creative process models, will now be examined.

2.3 Creativity Workshops

How can creativity processes be performed in reality?

An effective way of encouraging creative thinking is to include creativity methods and exercises into workshops as shown by (Maiden et al., 2007).

The workshop activities are designed to take advantage of three established models of creativity by Boden, as reported previously. Some of the activities, also called creativity techniques, are the following:

1. **Exploratory creativity** – e.g. brainstorming.
2. **Combinational creativity** – e.g. analogical reasoning, solution presentation.
3. **Transformational creativity** – e.g. creativity triggers, constraint removal.

An overview of existing creativity techniques can be found in the next chapter.

Creativity workshops allow participants to discover and invent ideas by performing creativity exercises such as brainstorming, creativity triggers and constraint removal. As workshops consist of multiple participants that collaborate, the creative process during a workshop fits best in the situationalist perspective described above, as it describes creativity as a social process where multiple individuals are involved.

However, how do creativity workshops fit into the concept of a creativity process, as participants of the workshop have to come up with ideas while cooperating with each other and use chosen techniques?

Workshops vary highly in the amount of time that is available to conduct them. In optimal cases with many participants and a high budget, workshops can go on for up to two days while reoccurring and consist of multiple groups of different stakeholders. In smaller projects, workshops can be very short (one to two hours) and only occur once. This limits the creative process that participants can go through immensely; there is hardly any time do all the necessary stages properly.

At the beginning of a workshop, it is the facilitator's task to introduce the participants into the subject, the concept of the workshop and the techniques that are going to be used. One can say that the facilitator does the collect phase or preparation phase for the participants and transfers the acquired knowledge to them in the introduction. This limits participants to the knowledge that they acquire in both range and depth. An aspect to work against this limitation is the range

[3] Requirements Engineering with Scenarios in User-Centred Environments

of different participants that should attend a workshop. Preferably, various stakeholders from different areas participate in a workshop so that each individual brings novel knowledge from his expertise area that they can utilize and therefore communicate to other participants (Maiden et al., 2007).

As the workshop proceeds, participants get the opportunity to perform the relate phase by consulting with participants, exchanging ideas, discuss experiences and possible solutions. This phase is an ongoing process during the entire workshop and is only disrupted when the used technique is specifically designed to let participants work individually or when the facilitator is giving the introduction.

After the introduction to the workshop, subject and technique that is going to be utilized, the participants start to tackle the identified problem with the instructed creativity technique. This step represents the create phase thus, the create phase's execution and success is highly dependent on the choice of the technique. Various techniques are available and under consideration.

To be able to use a creativity technique in a workshop for initial idea generation, techniques will have to be identified and analysed if they are suited to be used in a workshop with specific properties such a limited amount of participants and time available for the workshop (see objectives). The following chapter will inform creativity activities and techniques by giving an overview of creativity techniques described in literature.

2.4 Creativity Techniques

Which creativity techniques exist?

(Biskjaer et al., 2010) present nine creativity methods that can be used specifically in interaction design in order to foster innovation and creativity in early stages of a project.

1. **Future Workshops**: Future Workshops consist of three stages. Initially, the critique phase has the objective to shed light on a common problematic situation. The fantasy phase aims to let participants generate visions about an ideal future ignoring resource limitations and technical constraints. Lastly, the implementation phase adapts these visions to the circumstances of reality. This also includes the implementation of an action plan for setup.
2. **Interaction Relabeling and Extreme Characters**: Interaction Relabeling is the idea to imagine that the product being designed is like some other product, typically a mechanical device, in order to map functionalities from one to another.
   Extreme Characters has the purpose to consider sociocultural roles during the design phase by taking fictional users with exaggerated emotional attitudes (e.g. pope, super-hero, a criminal mastermind) as the user base. (Djajadiningrat et al., 2000)
3. **Metaphorical Design**: Metaphorical Design uses metaphors in the design process to understand the domain that is being designed for. A different domain has to be carefully chosen and is looked at. It is metaphorically seen as identical to the target domain in order to transfer working concepts from one to another. (Madsen, 1994)
4. **Inspiration Card Workshop**: The Inspiration Card Workshop is a collaborative design event involving professional designers and participants with knowledge of the design domain, in which domain and technology insights are used to create design concepts. The goal of the workshop is to develop design concepts by combining beforehand created Technology Cards and Domain Cards, which represent examples from current

technology solutions and specific concepts from the target domain. Experts from each domain present and explain the content of the cards to each other, which broadens everyone's horizons and allows solutions that are more creative. (Halskov and Dalsgård, 2006)

5. **Fictional Inquiry**: Fictional Inquiry is a collaborative Participatory Design technique that allows designers to create a narrative frame for a workshop in order to foster creativity and transgress the participants' understandings of the current situation. The key aspect of the workshop is to use narrative means to overcome fixations on the present and establish a space in which workshop participants are less constrained in imagining possible futures. The technique creates a fictional scenario through a shared narrative, which urges participants to imagine desirable futures. Its focus is on supporting the participants in creating the not-yet-existent. It enables inquiries into the participants' own ideas and opinions. (Dindler and Iversen, 2007)
6. **The Five Obstructions:** The Five Obstructions is a method extracted from a film by Lars von Trier with the same name. The creative challenge is to create a product by setting up aesthetic constraints to restrict and thus frame the space of action during the design phase.
7. **Provocative Operation:** Provocative Operation aims at stimulating cognitive, forward movement by formulating radical provocations in the form of statements, which eventually might lead to an innovative idea.
8. **Brainstorming:** Brainstorming is a group creativity technique that aims to gather a list of spontaneous ideas contributed by the group members. Every participant records everything that comes to his mind without any restraints. The taught can be recorded in written text, bullet points, sketches or any other format that effectively communicates the taught to another person.
9. **Oblique Strategies:** A deck of cards created by Brian Eno and Peter Schmidt expressing various imperatives and cryptic comments to offer a way out of blind alleys during creative processes.

Additionally to these techniques, there are four techniques that were previously used as part of the RESCUE framework, which includes creativity workshops as part of the whole process. (Schlosser et al., 2008)

1. **Round Robin:** Each stakeholder of the project is asked to come up with and present one or two major ideas that each stakeholder has for the targeted system. Round robin is not a creativity technique per se, as it merely releases the ideas that participants already have. It is a collect process, as other participants are influenced in their thinking by hearing about ideas from other stakeholders.

2. **Analogical Reasoning:** Analogical reasoning is a cognitive process of transferring information from one domain to another domain and encourages thus combinational creativity. As a technique, it can be described as the comparison between two different fields, where similarities in solving problems or performing actions can be found and applied from one to another. This method can be used in order to come up with solutions for one field by looking at how another field is solving a similar problem from its own domain. The complete problem-solving process consists of five stages:
    - Recognition of a source domain
    - Development of analogical mappings between source and target domain
    - Evaluation of the developed analogy

- Transfer of knowledge using analogical mappings
- Consideration of newly generated knowledge

Analogical reasoning needs to be carefully planned and executed as the results heavily depend on the source domain. Analogies are not fully recognizable from the beginning and it requires some incubation and illumination time to get the full grasp on it. Researchers have shown participants can exploit analogies if helped to understand them (Maiden et al., 2004).

3. **Creativity Triggers:** Practical rules for exploring spaces by James Robertson, tailored to software problems. These rules use questions in order to support divergent thinking by utilizing exploratory creativity. The standard set consists of seven different triggers that should be adapted to the scenario.

    - **Connections**: How to keep users connected?
    - **Service**: What extra service can you provide your users?
    - **Convenience**: Remove one-step. Do something instead of making your user do it
    - **Participation**: How do your users participate in your business?
    - **Green**: What solutions can offer more green solutions? Or perceptions of being greener?
    - **Trust**: Invent a better way to let your users know they can trust you, or your system
    - **Information**: What do your customers want to know? What information would they find useful?

    Each trigger provides one or more rules, as questions, with which to search and explore creative space. (Schlosser et al., 2008) states that the effectiveness of creativity triggers depends on the project context and the interests and experience of the participants. Depending on the type of project, some triggers may produce more results than others may or may not be applicable at all. Triggers have to be selected for each usage and adapted to the existing scenario. The main logic behind the questions and triggers stays the same, but questions are adapted to fit into the presented context.

4. **Constraint Removal:** Constraint removal focuses on identifying barriers or constraints that one is restricted by. It is categorized as transformational creativity as the solution space is changed in a way that makes things possible, which were considered impossible before. After the identification process, which is usually done as a brainstorming activity, single constraints are removed (imagined to be non-existent) in order to allow novel ideas to emerge that would not have been possible if the constraints would still exist. This is a divergent process, which generates a large number of ideas, which have to be reviewed by reinstating constraints. Bringing back one constraint after another allows the participants to rethink their ideas and come up with modifications of how to realize them despite existing constraints. This convergent process minimizes the amount of ideas that are non-relevant or not realizable at all and thus increases the overall quality of the outcomes.

The main difference between Future Workshops and Constraint Removal is that the constraints and limitations have to be identified and removed one at a time. Future Workshop tries to

remove all possible constraints at once without identifying them by instructing the participants to fantasize about an ideal future with an integrated solution. This approach may result in solutions that are too far away from reality and which would be impossible adjust for real life usage. Identifying and removing constraints one by one allows precise and reversible adjustments without limiting the creative thoughts of the individuals.

Additional creativity techniques are shortlisted and classified by (Sutherland, 2010). In his dissertation, Sutherland uses the mycoted database[4] of 176 creativity techniques and classifies them in sections that are relevant for requirements engineering. Seven out of 176 are classified as purely used for "Ideas Finding" or idea generation.

After analysing the techniques, only one of those seven fulfils the requirements of being easy to learn, applicable in a small group and possible to execute in a short time period: Circle of Opportunity. The Circle of Opportunity supports idea generation by linking together attributes of a stated problem and challenges participants to "free-associate" or brainstorm around the attributes and their combination (Michalko, 2006).

The technique consists of three stages and starts with the formulation of a problem. In the next step, a big circle is drawn on a large piece of paper, whiteboard or any other medium. This circle is numbered like a clock from one to twelve and in the middle of the circle is filled with the identified problem. The second part of the technique is to select twelve attributes or aspects that are either common or relevant to the problem. Afterwards, the attributes are written next to the numbers on the circle, which completes the initiation process for the technique.

The participants throw a dice to determine the first attribute, and two dice afterwards to determine the second attribute. These two attributes have to be free-associated both individually and combined to search for a link between the associations and the challenge. Any found links should be considered as analogies Circle of Opportunity is a combinational and exploratory creativity technique as it both combines and expands search spaces to generate new ideas. It has play-related elements (throwing a dice) and works best in small groups.

To inform the choice of a suitable technique, we should now see, using a specific example, how a creativity workshop has been conducted in the past as part of the RESCUE framework.

2.5 Creativity Workshops in Practise: The APOSDLE Project

Which creativity techniques were performed in the past and what results did they produce?

One example of where RESCUE and creativity workshops were used is a European Union funded project called APOSDLE, which run for four years, involved 12 organisations and aimed to develop a "work-integrated learning environment for knowledge workers" (Jones et al., 2008).

The creativity workshops in APOSDLE were performed in small sessions, each session using a different creativity technique to enhance and facilitate creativity. In total, four different half-day activities were performed throughout two consecutive days.

The first creativity technique was "Round-Robin", where each stakeholder had to come up with a big idea by himself for half an hour. This session lasted for half an hour and was meant as a

[4] www.mycoted.com

warm-up session. Afterwards, Creativity Triggers were used in groups of four people over approximately two hours in order to generate new ideas.

On the second day, constraints on the project were brainstormed by all participants and removed afterwards in groups of four over a period of 3 hours to open their minds to new ideas as described above (technique “Constraint Removal”). The fourth and last technique was a presentation of existing solutions by technology experts in order to allow participants to combine their ideas from previous techniques with existing real life concepts. All on all, all three models of creativity by Boden (see Chapter 2.2) were utilized, with a focus on transformational creativity, as both constraint removal and creativity triggers are categorized under transformational creativity.

The results of the workshop were analysed and evaluated in order to answer whether workshops provide an effective way of generating ideas for system development. The main data sources for the evaluation were documentation created by the facilitators and questionnaires that were filled out by participants after the workshops.

Each questionnaire contained 40 ideas that were the outcome of the four used creativity techniques during the workshop. Each technique was represented by ten randomly chosen ideas (four techniques x 10 ideas from each technique = 40 ideas). The ideas were chosen randomly out of 195 in order to avoid bias towards one technique by the selector. This causes obvious problems in the evaluation of the techniques, as a random selection can have the result that the best ideas are not being selected and evaluated in the end. The questionnaire asked the participants to rate each idea on its novelty and importance on a Likert scale between one (not novel/unimportant) and five (very novel/very important) as novelty and importance are two major attributes that always come up in the definition of creativity.

In order to evaluate the influence and impact that the ideas had on the project, a second questionnaire was distributed and filled out 18 months after the initial workshop by three key project experts. These were not present in the previous workshops but could give feedback about the influence of ideas on the current prototype of the project. At this point, the project was already in the stage of the development of a second prototype, thus the influence of the generated ideas was known and visible.

The experts were not present in the creativity workshops themselves and the ideas that were presented to them could be novel and abstract, as they did not make it to the development stage. This led to the implementation of a question regarding the “understand ability” into the questionnaire, as ideas can sometimes be too complex or not described enough to be understandable by third parties. The second questionnaire contained 40 ideas that were identical to the ideas from the first questionnaire, once again ten from each technique. Additionally, ten randomly selected requirements from other sources were included to see if the ideas from workshops have a higher influence on the project than ideas/requirements that were created based on other inputs.

The outcome of the analysis reveals that creativity techniques have a different effectiveness in producing viable use cases/ideas that can actually influence the project and that the amount of generated ideas highly varies. In total, 195 ideas were generated through the workshops, which is higher than the total amount of requirements generated from all other sources (172) like interviews and observations that were performed during four months prior to the workshops. This shows that workshops are very effective regarding pure idea generation.

Legend: RR = Round-Robin; CT = Creativity Triggers; CR = Constraint Removal; SP = Solution Presentation

	RR	CT	CR	SP	All ideas from the workshop	All requirements from other sources
Mean influence	2.8	3.0	1.3	2.4	2.4	2.7
Range	1 – 5	1 – 5	1 – 5	1 – 5	1 – 5	1 – 5
Std deviation	1.62	1.39	1.38	1.33	1.56	1.89
% of ideas understood	90%	97%	63%	100%	88%	83%

Table 1: Ratings of influence for ideas generated during workshops (Jones et al., 2008)

	RR	CT	CR	SP	All ideas from the workshop	All requirements from other sources
Total generated	22	38	108	27	195	172
Associated with use cases	11	22	24	13	70	58
Percentage	50%	58%	22%	48%	36%	34%

Table 2: Proportions of ideas associated with use cases (Jones et al., 2008)

Creativity Triggers seem to have the highest effectiveness regarding the percentage of ideas that were converted into use cases (58%, see Table 2). Constraint Removal produces by far the most ideas (108) but only 22% of those are useable. The pure number of generated ideas that were associated with use cases is for both techniques similar. When comparing the mean influence of the techniques in Table 1, one can see that Constraint Removal had the least influence on the produced prototype. All other use cases and ideas had a similar influence, with Creativity Triggers coming out slightly above the rest. One explanation for the low influence can be that experts simply did not understand the presented idea and thus concluded that it had no influence on the current project.

Additionally, ratings of the ideas itself were compared against each other to determine the creativity technique that provides the most novel and important ideas. Ideas were classified as novel or important when they received a rating of four or five. Ratings of one or two were considered unimportant or not novel. Ideas that received a rating of three were not considered in this table and no further information is available about these, which is to some degree concealing the effectiveness of the ideas, as moderately rated ideas provide some value too. It is also not clear whether the provided data is correct or not, as the total of ideas summed up in Table 3 does not equal the total amount of ideas generated in table 2. It was also stated that the questionnaires consisted of 40 ideas, 10 ideas from each technique, which raises the question of which data in table 3 was used.

	RR	CT	CR	SP
No. of novel, important ideas	27	27	10	26
No. of novel but not important ideas	9	2	16	10
No. of important but not novel ideas	25	26	20	15
No. of unimportant and not novel ideas	15	16	18	18
Total	76	71	64	69

Table 3: Creativity of ideas (Jones et al., 2008)

The presented results show that all techniques apart from Constraint Removal produce an equal amount of both novel and important ideas. Constraint Removal, despite producing the most ideas overall, only produced ten ideas that were rated novel and important. As mentioned earlier, the reason for this could be that ideas for the questionnaire were selected randomly, which lead to an exclusion of the best ideas.

Overall, the analysis shows that a significant amount of ideas and use cases was discovered during the creativity workshop. Workshops have the capacity to discover both novel and important ideas, but also unoriginal and useless ones. Creativity techniques have different strengths and outputs when regarded under aspects of novelty, importance and influence on the actual project. The report shows that Creativity Triggers are especially efficient in generating ideas that are influential, novel and important. Constraint Removal on the other hands seems to be a very good technique to generate a waste amount of ideas which are not necessarily useful for the project, but which have the potential to bring out other ideas. One also has to consider that Round-Robin and Creativity Triggers were conducted in the first workshop, and thus the best ideas could have been already used by the participants by then.

It is to be seen if these results are limited to one workshop or if they are valid in general. One has to consider multiple attributes when evaluating the effectiveness of creativity workshops and creativity techniques used in these workshops. To get an idea of how effective a technique is, one has to conduct workshops with different but similar participants so that ideas that are generated in one workshop will not be reused in the next one. Additionally, the efficiency measured during the creativity workshop only applies to the generation of novel requirements and use cases but it is not researched if it applies to the design of websites, where the factor creativity in design plays an important part.

One area that is directly connected to social design processes but not necessarily creativity techniques is the participatory design process. As workshops in APOSDLE were performed with stakeholders of the projects, the stakeholders were automatically integrated into the design process of the product. Such a design process is called participatory design process. The next section will investigate the overall use of workshops in the context of participatory design in literature.

2.6 Workshops in Participatory Design

What purpose do workshops serve in Participatory Design?

Co-design or participatory design (PD) is a design approach that involves stakeholders actively in the design process. The main idea behind the approach is to empower users to participate as equals in the design process alongside the designers in order to draw on the experience of the users (Sanders, 2002). Users usually already have a wide range of experiences and expectations with systems in a specific field and these experiences can help in designing and verifying new systems. Even though users normally do not have any expertise or skills in designing products, some conceptual design techniques like scenarios and storyboards can be easily acquired and used to communicate different aspects of a design (Rogers et al., 2011).

In participatory design, workshops are usually held to communicate shared goals and to commit to strategies and outcomes in a neutral workplace. Workshops are also often used to introduce new working practices such as creativity techniques that are yet unknown to the participants (Muller, 2003). According to (Muller, 2003), one of the best-known workshop formats in PD is

the technique “Future Workshops” which was previously described in the section creativity techniques.

Workshops in PD usually bring diverse participants together, who work together to produce common outcomes. Preparation, mutual understanding and communication are crucial for the success of workshops, thus it is important that all participants have the same conditions regarding familiarity with settings.

Four advantages of performing workshops in participatory design are stated by (Muller, 2003):

1. Development of new concepts that have direct impact and value for the product design
2. Engagement of involved and interested stakeholders in the outcomes
3. Combinations of various stakeholder’s ideas into one single concept
4. Production of outcomes that are useful and approved by stakeholders for the next stage of development

As participatory design is well-known and well-researched field, various scientific publications were published about the integration of creativity and innovation into Participatory Design. The following section will review how creativity and creative processes are viewed in the context of Participatory Design.

2.7 Creativity in Participatory Design

How is creativity handled in the context of PD and software engineering?

Creativity has many definitions in literature, which consist mostly of three components, the individual (or group), the creative process itself and the outcome of the process, the product. (Warr et al., 2004) try to come up with their own hybrid definition of creativity in order to improve the creative process of Participatory Design. Their first attempt defines creativity as

> *“[…] the combination of two or more matrices of knowledge to produce a novel and appropriate product/response.” (Warr et al., 2004)*

They then evaluate their own definition in order to improve it and adjust it specifically to the use in Participatory Design (PD). In order do that, the concepts of “product”, “novel” and “appropriate” are identified and changed to fit with the given scenario.

The product of PD is defined as a design solution that addresses a software development problem. This may be true for software projects, but participatory design can be used in various situations that may not be specifically related to software, which raises concerns of the validity of the proposed definition.

Novelty is a common factor of creativity that was already defined by (Boden, 1996). Boden defined three different types (in contrast to categories, see Chapter 2.2) of creativity that are distinguished by their various forms of novelty:

1. P-Creativity: Novel to the person, but not to humankind. Has been thought of before by others.
2. H-Creativity: Novel to humankind; has never been thought of before by anyone. An example is the theory of relativity by Albert Einstein.

3. S-Creativity: Novel to the specific task or situation, but not in general. This kind of creativity often occurs at workplaces, where ideas are applied to problematic scenarios, which creates a novel solution in the specific situation.

(Warr et al., 2004) define another class of creativity to distinguish between individual and group novelty. Individual Novelty and Group Novelty are forms of P- and H- Creativity that are limited to a working group in the context of Participatory Design. We no longer look at novelty to humankind but only to the limited group that participates in the PD.

The result of this evaluation is an improved definition of creativity specifically in the context of PD:

"Creativity in PD is the generation of design decisions, which are a combination of two or more matrices of knowledge, which are considered unusual or new to the mind in which the ideas arose and conform to the requirements defined during the software development process." (Warr et al., 2004)

The creative process that has the most relevance in a Participatory Design is the situationalist creative process as it takes into account social aspects of a problem and the interaction and collaboration of individuals in teams. (Warr et al., 2004) state that the situationalist creative process has a disadvantage as it fails to identify and to take into consideration social and environmental influences.

To investigate this disadvantage, the next section will review literature on the impact of social influences on creativity in the context of collaborations. The findings will inform the design of activities and formalities for the planned creativity workshop.

2.8 Creativity in Collaborations

What impact do social influences have on creativity in context of collaborations?

A major question that comes up in literature is what effect collaborations of stakeholders have on their capability to generate creative ideas.

Academics (Osborn, Paulus and Yang) claim that in theory, the collaboration of multiple individuals must have a positive effect on their creativity as ideas are exchanged between the participants and thus, can inspire others and help extending or exploring the creative space of each individual.

(Warr and O'Neill, 2005) also argue that a group has major advantages compared to single individuals as so called "real" groups have access to matrices from each group member and thus, have more possibilities of combining them. In their theory, they distinguish between nominal groups and real groups. Nominal groups consist of individuals who are not capable of sharing their matrices with each other. Real groups consist of individuals who share a common space of matrices and are, therefore, able to combine their own matrix with the matrices of other participants. This results in a clear advantage for real groups, as the possibility to produce a higher quantity of ideas arises, which by definition makes the process itself more creative. Even though in theory real groups are more efficient, practical studies have shown that individuals come up with more ideas when working by themselves. (Warr and O'Neill, 2005)

Indeed, real groups are influenced by multiple social phenomena, which affect the creativity of the group negatively. They have the problem of not being able to communicate their ideas or

matrices effectively. Externalizing ideas with words, sketches or other means is not as effective as it could be, as some meanings and deeper insights might go missing during the transformation.

We can classify three social influences, which are affecting the creativity in social groups.

1. **Production Blocking**: Buffering of ideas that occurs while another participant is verbally communicating his ideas to the other participants. As verbal communication is asynchronous, participants have to wait until the talking participants is finished before presenting their own ideas, which can cause discourage among participants and distract them from listening as they might internally continue thinking about their own ideas.
   Possible solution: The use of synchronous communication, for example, writing down ideas simultaneously.
2. **Evaluation Apprehension**: Evaluation Apprehension occurs when participants are afraid of being judged (negatively) for their ideas when presenting them to others. This influences the number of ideas that are being presented and generated by participants negatively. As the number of created ideas leads directly to a measurement of creativity, one can say that the creativity decreases in groups when ideas are evaluated publicly.
   Possible solution: Anonymisation of ideas to overcome fear of criticism and judgement.
3. **Free Riding[5]:** The phenomenon of participants relying too much on the other group members to come up with ideas leads to participants being less productive and "lazy". Diehl and Stroebe performed a study that showed that participants who were assessed in groups produces fewer ideas than participants who were assessed individually.
   Solution: Add identification to ideas so that participants have a connection to their ideas.

There is a trade-off between the solutions to Evaluation Apprehension and Free Riding. One needs a form of anonymisation; the other has anonymisation as the main cause. (Warr and O'Neill, 2005) state that there is no real solution for this problem, as it is unclear which of the two phenomena has a higher influence on creativity.

These three social influences are the main cause for a worse performance in creativity of real groups compared to nominal groups/individuals. This is true for the quantity of ideas that comes up during social creativity activities, but one can argue that quantity is not the main factor that says something about creativity and that quality comes before quantity. Evaluation Apprehension can have its benefits, as ideas that are neither novel nor appropriate or important, are eliminated immediately even before being proposed, which raises the quality of the overall generated ideas. On the contrary, multiple ideas can be used by other participants to combine their own ideas with the presented, which possibly results in the generation of high-quality outcomes.

This discussion leads to the question of how creativity can be measured. Is there even a measure of creativity? The next section will cover literature about different types of measurements of creativity.

[5] First described by: Olson, Mancur, Jr., 1965, The Logic of Collective Action, Cambridge, MA: Harvard University Press.

2.9 Measuring Creativity

How can creativity be measured?

Creativity can be measured by either looking at the persons who are performing a creative process or by analysing the outcomes of a creative process. One practical rating method that gives a score to the creativity of a person is the Creativity Personality Scale (CPS) by Gough. In this test, the participants use chosen adjectives to describe themselves and their personalities. Each adjective is associated with a negative or positive effect on a person's creativity. Based on the amount of positive and negative adjectives that were chosen, the result displays if a participant is creative by nature or not.

(Warr and O'Neill, 2005) summarize the different opinions from Ward and Amabile, who criticize that test scores of the CPS should not be considered as measurements of creativity; the ability of a person to be creative is not something that is measurable by scores or scales. Every individual is creative and capable of creating novel and appropriate ideas and solutions to problems. One has to differentiate between the frequency of generated ideas and the quality of these ideas as one astonishing idea could be worth more than 100 mediocre ones.

In contrast to that, Elam and Mead argue that personality tests such as CPS are suitable for assessing some attributes of creativity in order to "compare the potential for creativity of different people", which (Warr and O'Neill, 2005) agree with.

Even if (Warr and O'Neill, 2005) argue that "considering generated ideas as the creative product can help provide a basis for measuring or assessing the nature and extent of the creativity that has occurred.", they do not provide a clear framework that can be used in order to measure the extent of creativity.

Properties of a creative product are identified by (Warr and O'Neill, 2005) as novelty and appropriateness. An idea is considered appropriate if it fits the defined characteristics of a product, in other words if it can be considered a requirement for the desired product. Another approach to measuring creativity is to identify and count all ideas generated through a creative process. (Warr and O'Neill, 2005) write that if the outcomes of a creative process are considered as the creative product, then an objective measure can be given to some degree.

In addition to measuring the creativity as a property of something, many researchers take the line of measuring the degree of creativity support that people can be provided with.

2.10 Measuring Creativity Support

What measures can be taken about creativity techniques?

An aspect that is being looked at by multiple authors is the degree of support that creativity techniques, tools and workshops provide to individuals. (Dove and Jones, 2013) identify the need to collect evaluation data directly from the participants during a workshop. Such a direct interaction with participants, for example the distribution and filling out process of questionnaires, can influence the results of the activity as it can interrupt current activities, thoughts or the creative flow. To avoid those obstacles, evaluation methods have to be part of the workshop activities.

One of those was designed by (Dove and Jones, 2013), who outline an evaluation method that captures data similar to a questionnaire but in a more personal, creative, short and familiar way to the participants. The method consists of individual "reflective postcards" with specified

prompts to evaluate aspects of the workshop without giving the participants the feeling that they are being assessed. These postcards assess the support that single techniques or technologies provide during the workshop by asking questions that were designed to contain aspects of other popular questionnaires. As an example, one of the prompts contains aspects of the Creativity Support Index that are very similar, such as the engagement and collaboration of individuals. The limited space that a postcard provides controls the breadth of answers but leaves enough space to allow creative and productive answers.

The designed postcards were used in a workshop that was part of a research project for the energy concern E.ON. Three postcards with three different questions were handed out to participants after the use of a visualization technology in order to get their reflection on the technology. The first postcard addressed the engagement and collaboration of participants during the technique or the usage of technology. The second postcards addressed idea generation, exploration of alternatives, and the learnability. The third postcard was specific to the visualization technology used and asked about the ability to identify relationships, patterns, and to get a general overview over the data.

The analysis of the reflected postcards was mainly positive, as most of the participants took time to answer the questions and included both positive and negative aspects. However, the responses to the second postcard mainly included only feedback on one aspect of the question, neglecting feedback on idea generation and exploration of alternatives. The reasons for that are identified to be too ambitious as three aspects are being considered or not clear enough given the scenario.

In conclusion, (Dove and Jones, 2013) argue that the results are comparable to open-ended questionnaire questions and are thus not sufficient to perform a systematic qualitative analysis. However, reflective postcards can be effective substitutes for questionnaires during a workshop without drawing attention to notions of assessment, making the participants feel more at ease. In addition, the postcards provide more space, thus allowing answers that are more creative. Participants responded positively about the postcards and felt at ease using them. The way they are used maintains the atmosphere of the workshop and is effective in “assessing the support provided to participants as the creative person.” (Dove and Jones, 2013)

These results inform the investigation of creativity techniques, which is an objective of this study, as two different creativity techniques will be used in design workshops to generate ideas for the digital showcase. With the help of the described prompts and postcards, feedback can be collected from the participants of the workshop directly and compared with each other.

One last aspect that deserves consideration and attention is the relationship and attitude between stakeholders, especially in the context of learning technologies or academia. The next section will review publications in this special area.

2.11 Co-Design Techniques in the Design of Learning Technologies

Are student-teacher hierarchies influencing the effectivity of Participatory Design?

Co-design or participatory design is already being used in order to design learning environments with the participation of both students and teachers in the design process. The importance of student views on learning technologies that are mainly used by students is largely acknowledged, but not incorporated into design processes. Students can have a large positive

influence on the design of learning technologies, but if their perceptions and opinions do not match the opinions of their teachers and head designers, they will be ignored (Könings et al., 2014).

The paper describes a need for better methods on how to improve the collaboration between different stakeholders such as students and teachers. Several articles on collaborations between teachers and students in a co-design process are analysed and summarized by (Könings et al., 2014). The outcomes are overall positive, as teachers as well as students benefit from developing new insights and skills through direct collaboration. He reports that the one thing that is missing is the influence of the stakeholders on the actual designer, as these effects were not investigated by any of the analysed articles. Overall, the author states that participants of participatory design, especially younger students, need to be trained for a successful collaboration with higher authority stakeholders like teachers and that more research is required to create guidelines on the collaboration between students and teachers.

As a result of these findings and because of the difficulties to access lecturers, it was decided not to include any teaching personal in the design workshops for this project.

2.12 Summary

This chapter reviewed relevant literature on creativity and its incorporation into design processes. It pursued the objective of gaining a better understanding of creative design processes to identify suitable creativity techniques for two design workshops. This was achieved by introducing creativity workshops as an activity for stakeholders to generate ideas by following the creativity process from a situationalist perspective. Creativity workshops are presented as workshops that use creativity techniques to support idea generation. In order to identify suitable creativity techniques, an overview of existing creativity techniques was given.

To get a better understanding of all the factors that play a role during creativity workshops, participatory design, social influences in collaborations and student-teacher hierarchies were investigated.

Finally yet importantly, methods to measure creativity and the degree of support that creativity techniques provide were reviewed to be able to compare results of used creativity techniques in design workshops (see 1.2 Objectives).

3 METHODS

3.1 OVERVIEW

This chapter describes in detail how this project was carried out. It describes three data gathering methods that were performed to inform the design of an innovative student showcase. The three methods were the following: 1) a review of existing showcases to get an overview of how universities present their student's work, 2) stakeholder interviews to get general input on student showcases and feedback about existing showcases, and 3) two creativity workshops that were performed each with four participants. Additionally, the chapter describes how the two used creativity techniques are compared with each other and how the gathered data is analysed and converted into a working prototype of the digital showcase.

3.2 REVIEW OF EXISTING SHOWCASES

In order to find out what a good student showcase is and if there are existing showcases that can be used as an ideal example for other showcases, various online showcases were reviewed.

The selection process of showcases occurred semi-randomly via Google-searches for the keywords "student showcase", "student project showcase", "university project showcase" and other combinations with words as "design", "digital" and "online". All searches were performed from the location "UK, London" and with a logged in Google account, which could have affected the range of results.

Only showcases that display their student's work on their website digitally were included in the review. Websites that give information about physical showcases only were excluded. Showcases of design or human-computer interaction focused faculties received preference to non-design showcases.

The selected showcases were reviewed for their content, features and design; content analysis focused on information about the showcased work. Showcases were reviewed on the provided details of the work such as creation process, results, authors and project brief or module background. Features covered additional functionalities that are not directly connected to student work such as share buttons, slideshows and comment features. The design of showcases covered mainly how the showcases structured their content, which types of media were used to communicate the outcomes and how the look-and-feel of the websites was.

The results gave a basic impression and definition of how a student showcase should look like and what functionalities it could include. No requirements were directly extracted from the reviewed showcases. Three of the reviewed showcases were selected and presented as showcase examples to stakeholders (see Stakeholder Interviews). Multiple showcases were additionally presented as examples during the introduction of creativity workshops (see Creativity Workshops).

3.3 STAKEHOLDER INTERVIEWS

In order to get initial input from stakeholders on existing showcases and feedback on the general idea of displaying student work publicly on a website, data was collected directly from stakeholders. The data collection method followed a semi-structured interview approach to collect qualitative data and address necessary areas directly from stakeholders while still

remaining flexible to deepen questions and get additional input from interviewees when required.

Participants were chosen primarily from the course MSc Human-Centred Systems 2013/14. This limitation was comfortable for the researcher and more reliable to find willing participants who are already quite knowledgeable in displaying work through own design portfolios. Identified potential students were also contacted. Potential employees and current lecturers where difficult to interview as this methods was time-intensive.

Recruitment occurred via an email on the 8th of August 2014 to the main student mailing list. The email explained the background of the project and asked for participants who are either interested in displaying their student work/projects, or who already have their own portfolio. An information sheet (see Appendix E) with the project outline, risks, benefits and other project related data was attached for further inquiries.

Details of interviews were communicated with the participants via their chosen communication means. As location, City University London premises were preferred to ensure a safe and familiar location. Participants who could not meet with the researcher were interviewed remotely by using either Skype or Google Hangouts as video-conferencing tools.

Participants were provided with consent forms (see Appendix E) which informed them of what data would be collected and how it would be treated. Interviews were audio-recorded to capture raw data that could otherwise be altered by writing down notes during the interview. Interviews were performed in the time span of one week during the 9th and 16th of august 2014.

The interview questions (see Appendix O + P) were adapted for current students and perspective students. Five questions for current students focused on previous experiences with showcases and portfolios to extract knowledge of what currently works and what does not. This knowledge informs the future design of the showcase and is thus an important step in building it (see Objectives). They further inquired about components of their work that they would like to show others. The interview concluded by showing three showcase examples and asked the participant in three questions, what they think about it and if they would be happy to display their work in such a way. As the interview was semi-structured, follow up questions or questions about related subjects were inserted when needed.

Prospective students were confronted with questions about previous experiences with showcases. Instead of asking about which components they would like to show others, questions focused on what kind of components they would like to see from others and what they were looking for on websites when looking for a study course and university.

After the interviews, the recordings were transcribed (see Appendix Q) and the answers analysed qualitatively. The goal of the analysis was to come up with requirements and suggestions for a showcase website that would fulfil their needs.

3.4 Creativity Workshops

3.4.1 Introduction

Literature review revealed that additional data had to be collected about general usage of creativity techniques in workshops. Two creativity workshops were carefully planned and performed with the objective to collect data on used creativity techniques.

Eight people, stakeholders of the project, participated in two separate two-hour lasting creativity workshops. The workshops were performed with two different groups of four individuals to ensure objectivity and to be able to compare the creativity techniques from an initial idea generation perspective. Using the same participants would allow them to incubate between the two workshops and ideas that were used during the first workshop could not be used during the second workshop.

During the recruitment process, participants were provided with a digital information sheet that outlines the purpose and procedure of the study along with additional information. Recruitment occurred via email on the 8th of August, identical to the recruitment of participants for interviews. As four people were needed for a creativity workshop, coordination and communication had a high priority. Out of all potential workshop participants, four participants were needed to be available during the same two-hour slot and on-site in a prepared room. Coordination between the researcher and potential participants occurred via email and Instant Messaging. A Doodle[6] was created with timeslots where people who expressed interest in participating in the workshop could select their desired date and time. In case that only one person was missing for a workshop to booked, single targets such as friends were approached and asked to participate directly. This backup plan ensured the execution of workshops and minimized the risk of not finding any willing participants to perform both workshops.

Once a date and time was set, a room with a big table, whiteboard and projector/screen had to be booked and prepared. The City University London library offers group-working rooms that are bookable for two hours. These rooms are accessible even during the weekend and provided thus an optimal location for the workshops. Workshop utensils such as markers, sticky notes and whiteboard paper were obtained and provided to participants to not restrict their working and thinking flow.

Upon arrival, consent forms were distributed to the participants and had to be signed in order to proceed with the workshop. The whole workshop session was video-and audio recorded with a Logitech C910 webcam and the software Camtasia to capture the screen-output. The researcher did not actively participate in any workshop activities in order to avoid influencing the research results. Raw data collection in form of video- and audio recordings was necessary to be able to analyse unclear workshop outcomes and to be able compare in detail the two used creativity techniques (see Objectives).

At the beginning of the each workshop, a PowerPoint presentation (see Appendix J) was held to welcome the participants and to outline the workshop. The concept and purpose of a digital showcase was introduced by highlighting opportunities that stakeholders might experience by utilizing a modern, efficient showcase. Examples of existing showcases of other universities and teaching facilities were shown and shortly presented.

The introduction informed the participants and gave them the necessary input to get an overview over the subject. In reference to the literature review of creativity processes, the data collection phase is the first step and a necessary requirement to proceed to the creative part, the idea generation. The “collect” phase is a big part of the creative process, but as the duration of this project was rather limited, the presentation was main data gathering method of the participants. The introduction intended to transfer the collected information by the researcher

[6] http://doodle.com/ - Doodle simplifies scheduling

to the participants of the workshop and thus ensure that the transition from data collection to idea generation took place.

Afterwards, participants performed a personality self-assessment test known as the Gough Scale. The test aimed to measure the participants' creativity affection. Participants were presented with a printout containing 30 adjectives (see Appendix M) and had to select the ones that they thought describe their own personality. The participants should not have been aware of the scoring key in order to avoid manipulation of results. The measurement of the participants' creativity was necessary to be able to compare the used creativity techniques relatively to each other and avoid results that were produced as a result of participants of one workshop being more creative than the participants of the other workshop. The Gough Scale is a quick and easy method that does not require extensive explanation or execution and was thus an optimal fit for a two hour-workshop.

3.4.2 Workshop 1 - Creativity Triggers

The first creativity workshop was performed on the 17th of August 2014 during the timespan of two hours, using exploratory creativity stimulated by the use of the creativity technique "Creativity Triggers" (see Creativity Techniques). The choice to use creativity triggers fell due to the following reasons:

1. Creativity Triggers produced the highest amount of both novel and important ideas that had actual influence on the outcome of a project (Jones et al., 2008).
2. The technique itself is fast to learn and use, thus it is an optimal fit for a workshop that is limited to two hours.
3. Creativity Triggers can be used with four participants
4. Creativity Triggers aim to produce immediate ideas and concepts, which is necessary for the project to create a prototype that can build on the generated ideas.
5. Own experience shows that creativity triggers produce results reliably, which ensures a successful outcome for the further development of the showcase.

In the first creativity workshop, creativity triggers were used to support idea and requirements generation. A PowerPoint presentation (see Appendix K) introduced the technique to the participants and explained how to use it to explore new ideas around the target domain. It contained explanations and questions for each trigger. Note that the creativity triggers were adjusted for the use in the specified scenarios to help participants to understand how they should be applied. One trigger (green) was completely removed as it was inapplicable in the domain of a student showcase and was unlikely to produce any results.

The following six triggers and questions were used to trigger idea generation:

1. **Service** - What extra service can you provide to users of a showcase?
2. **Information and Choices** - What do users want to know? What information would they find useful?
3. **Participation** - How can users be encouraged to participate in the showcase?
4. **Connections** - How to keep users connected?
5. **Trust** - How can users tell that they can trust a website and its content?
6. **Convenience** - What can a showcase do to make the lives of its users more convenient? What is a step that could be done for the user in a showcase?

The slides also contained illustrations to give examples of existing products and items that are representative for the triggers (see Appendix K). When participants were still unclear about the

use and appliance of specific triggers, careful guidance with additional examples was offered by the researcher.

Ideas generated collaboratively were collected and written down by participants in any way participants desired. No identification of the individual that came up with the idea was written down on the outcome to avoid judgment towards single participants.

After going through all six creativity triggers, the generated ideas were evaluated and rated for novelty and importance, as these terms are generally used in literature to define creativity. A Likert-scale of five values ensures a wide enough rating possibility and gives the possibility to choose a neutral value for less decisive participants. The participants were able to choose if they wanted to rate the ideas individually or as a group. This approach allowed post idea-generation discussions about ideas, which could be analysed afterwards with the help of video recordings.

At the end of the workshop, participants received two reflective postcards which were designed by (Dove and Jones, 2013). The first card contained a question that aims to collect data on the general impression on idea generation, the exploration of alternatives and the learnability of the creativity technique. It aimed to identify the perception of the participants concerning the technique. A second postcard collected feedback data about engagement, collaboration, fun and conflict of participants during the workshop. The data collected through reflective postcards aimed to take into account the opinion of users on the usefulness and effectiveness of the used creativity technique. The collected data from both workshops was compared qualitatively with each other to determine advantages and disadvantages of both techniques.

The outcomes of the workshop were digitized and improved by making them readable and understandable for other parties.

3.4.3 Workshop 2 - Circle of Opportunity

The second creativity workshop was performed on the 23rd of August 2014 during the timespan of two hours, using the creativity technique “Circle of Opportunity” (see Creativity Techniques) which stimulates combinational and exploratory creativity. Circle of Opportunity was chosen as the second technique due to the following reasons:

1. It is a technique that focuses on aspects of initial idea generation
2. It combines aspects of combinational and exploratory creativity and is thus similar and comparable to Creativity Triggers
3. It is designed to be utilized in small groups
4. It has playful aspects (throwing dice) which could have a positive influence on the atmosphere and teamwork of the workshop
5. It was used in university classes to generate creative ideas but lacks broader recognition as research papers and workshops tend to ignore it. No practical evaluation could be found on it, which lets this workshop approach contribute novel insights about the technique.

The technique was introduced to the participants with a PowerPoint presentation (see Appendix L) after the initial introduction and execution of the personality self-assessment test.

The presentation describes the technique and its three stages, which were performed in the workshop. The first step of problem formulation was already performed by the researcher, as

the goal of the workshop was already defined to be “Create a student showcase”. The following three stages were presented and explained to the participants:

1. Draw a big circle on a whiteboard and numerate it from one to twelve
2. Select twelve common attributes or attributes relevant to the formulated problems and associate each one to a number. Throw one dice to select the first attribute, two dice to select the second attribute.
3. Free-associate or brainstorm both attributes individually and combined until your trigger and generate an idea. Search between for a link between associations and the challenge.

The presentation slides provided examples of how to draw and numerate the circle, how a free-association works and examples of common attributes that could be selected. An additional slide was provided with guidance questions that could be asked to discover new links between associations and the formulated challenge.

After each stage was explained in detail, participants went through each stage with the guidance of the slides and used the provided utensils to write down their generated ideas and concepts. Each participants threw the dice at least once if an attribute was chosen that was already brainstormed by the group, the dice was thrown again until a novel attribute was chosen. This approach by the participants ensured that as many attributes as possible were combined to trigger new ideas and connections. The participants brainstormed on two attributes until they decided collaboratively to select new attributes.

Prompted by a communicated time limit by the researcher, participants reviewed and rated their previously generated ideas. The rating consisted of a Likert-scale from one two five on novelty and importance, exactly as during the first workshop so ideas and their ratings could be compared with each other during analysis. Concluding the workshop, reflective postcards were distributed to and filled out by participants, identical to the procedure in the first workshop. All generated outcomes were collected, summarized and digitized in a Microsoft Visio document to capture the format of the free-association.

3.5 Requirements

Large amounts of raw data were collected during interviews, showcase reviews and workshops. This data had to be reviewed and analysed to generate requirements for a digital showcase.

Showcase reviews produced factual descriptions of the targeted websites. In order to avoid personal opinions of the researcher towards what was good or bad about the websites, no ideas were extracted from showcase reviews. Inspiration on functionalities and design of a digital showcase was taken from showcase reviews but no requirements were extracted.

Stakeholder interviews were analysed qualitatively in order to derive requirements. Transcribed interviews were gone through word for word to look for positive and negative comments on existing portfolio and showcase platforms. Statements that contained design suggestions or critique of lack of content were also used to derive requirements. Positive comments such as “I like that I can do xyz...” were directly transformed into a requirement “Showcase shall allow xyz xyz...”. Negative comments such as “I don’t like that there are no xyz...” were transformed into requirements such as “The showcase shall have xyz...”. The process of analysing statements was performed on each complete transcript of the five interviews.

The results were transformed into functional and non-functional requirements on a digital showcase and the source of origin was defined as “Interviews”.

The outcomes of both workshops, which were written as feature suggestions by the participants, were converted into requirements of the form “The showcase shall have/allow/provide/etc.” and added to the requirements specification. Requirements that already existed from the interviews were merged together and provided with an increased frequency rating. In case of a merging, novelty and importance ratings for the requirement were taken from one of the workshops as no ratings for requirements extracted from interviews were available. If a similar requirement came from both Workshop 1 and Workshop 2, their ratings were merged together as an average value.

The requirements (see 4.5 Requirements Specification) were given a priority based on the average values on novelty and importance ratings of the participants and the frequency that requirement came up (e.g. Interviews + Workshop 1). Requirements had to be checked for duplicates and similar items to merge them together to unique items. Each duplicate raised the standard frequency of one by the value of one. The following three priority ratings were defined:

1. Low – Average of novelty, importance and frequency below 2
2. Average - Average of novelty, importance and frequency equals 2
3. High – Average of novelty, importance and frequency above 2

The averages were rounded to the nearest full number. Some requirements did not receive any ratings as they were part of interviews or as they were overlooked during workshops. These were considered individually to define their priority. Workshop outcomes that were defined as irrelevant by participants were not considered as requirements.

After defining all of the requirements, a categorization was performed. Six functional requirements categories and one non-functional requirements category were defined. Requirements were inserted into the corresponding categories and sorted by priority from high to low.

The requirements specification was compared with gathered data during the two performed design workshops in order to quantitatively analyse the used creativity techniques. An excel spreadsheet was created to compare Creativity Triggers, Circle of Opportunity and Interviews as main requirements sources. It calculated the percentage of ideas converted into requirements and showed how many requirements were generated in each category.

The especially novel (rating higher equals four), important (rating higher equals four), and novel and important (rating of both higher than three) ideas produced by each creativity trigger were counted and compared with each other.

Requirements were compared with existing showcases to be able to determine if any ideas were generated that are truly novel, meaning that no other showcase has this feature or functionality. The requirements specification mainly consist of ideas that have creativity workshops as source, thus it is important to see if the integration of creativity techniques into the design process produced any really innovative ideas or not. This comparison provides answers to the research question RQ1: “Does the integration of creativity workshops into the design process produce any creative ideas that no other existing showcase has?”.

The analysis helps to compare the results of both workshops and ultimately to investigate the two used creativity techniques, which is one of the objectives defined in 1.2 Objectives.

3.6 Prototype Design

An initial design was come up with that would eventually satisfy the majority of requirements. The layout, initial design and content was explored on paper for each element of the prototype (see Attachment Z). Design requirements and requirements with a high priority were main influencing factors. Inspirations from existing showcases contributed to the feel and look of the sketches rather passively.

Not all requirements had to be implemented; it was up to the designer to decide which of the requirements were going to be included. Requirements that were not working together with each other or that were unreasonable to implement into a prototype were ignored.

Afterwards, the sketches were converted into digital interactive wireframes with the software Axure RP 7.0 Pro. To include design aspects and basic functionalities, an Axure widget library called "Flat UI Kit"[7] by Marc-Oliver Gern was used.

Flat UI Design is a minimalistic user interface genre that removes stylistic components that give the illusion of being three-dimensional. It is focused on simple elements and typography. One of the big strengths of Flat Design is its native support of Responsive Design, as elements can be arranged according to screen sizes and orientations (Requirement FR32, "The showcase shall adapt to different screen sizes"). The minimalistic design approach also ensures fast loading and response times, which fulfils requirement NFR10 ("The showcase shall have fast loading and response times").

The pages and functionalities of the prototype were all linked together to create the impression of a full-functional website. Details such as profile pictures, project examples and module descriptions were used to strengthen this impression. To convey the full range of functionalities of the showcase, which could not be shown through the prototype, description texts and annotations were composed to accompany the wireframes. The interactive wireframes were additionally uploaded to the servers of Axure Share in order to allow simple access for participants of user testing.

3.7 Evaluation

Evaluation of the created prototype was performed via different evaluation methods. A five-second test was performed with the help of the website usabilityhub.com[8]. Five-second tests are quantitative evaluation methods and generally used to collect user's first impressions of websites. They are also used to get insights if users understand the design and purpose of a website by asking them specific questions about the content they saw. The five-second test was performed to get an initial understanding of the quality of the created prototype. Three questions were asked after displaying the detailed view on a student work:

1. "What do you think this page was about?" -> Tests initial impressions and understanding of the layout of the page
2. "Which element on this page did you most focus on?" -> Are distracting elements present?
3. "Rate the quality of this page from 1 to 5." -> General quantitative measure of quality

[7] http://wearebridge.co/ux-tools/ - "Flat UI Kit" by Marc-Oliver Gern
[8] www.usabilityhub.com

Positive feedback on the questions reflects an appropriate design solution of the showcase (see Objectives).

To have a more detailed understanding of the user experience and the usability of the prototype, local and remote user testing sessions were performed. The participants received an information sheet to inform them of the procedure and the tasks that they are being asked to perform. A consent form retrieved consent for audio- and screen recoding of participants while performing the evaluation. On-site and remote evaluations were performed on the following computer system:

- Computer platform: Intel Core i5 Processor with a non-touch 15.4" display
- Browser tested: Version 37.0.2062.120 m (64 bit)
- Screen resolution: 1366 X 786
- Operating system: Windows 8.1
- Connection speed: Wireless, 50mbit
- Usability logging tools: Camtasia Recorder
- Remote communication tool: Google Hangouts

The following three participants took part in the user evaluation. Due to restraining time limits, they were approached and recruited directly by the researcher via private messaging. Participant U2 and U3 took part in the creativity workshops (different ones) and knew, in theory, what to expect.

Participant ID	Gender	Occupation	Web-savvy	Method	Workshop participant
U1	Female	MSc graduate	Very	On-site	No
U2	Female	Postgrad student	Very	Remote	Yes
U3	Male	MSc graduate	Very	Remote	Yes

Table 4: Participants of the user evaluation

The instruction stated that not the user was tested but the site and encouraged them to think aloud during the user testing. Thinkalouds help with understanding the thoughts about elements of the site and the meaning behind actions performed by the participant. Having the user say aloud what they think also allows it to record thinking processes with a microphone. During the test, participants were reminded to think aloud, if they remained silent for a continuous period.

Three different user tasks were designed for evaluation purposes. Tasks centred around high priority requirements in order to measure if these requirements were met or not.

The first task focused on finding the best projects submitted by students in a study course to see if the users are able to navigate to the project overview of a module and if the filter functionalities are clear.

The second task described a scenario in which the user wants to find suitable students for an internship. To fulfil the task, the user has to go to a student profile and download a printable copy of the CV.

The third task tests the Information Architecture of the navigation bar. The user was told log in and to create a new project for the portfolio. The creation of new showcase items is an important part of the showcase and it was thus tested if users understand how the procedure works.

The designed tasks were read to the participants and any upcoming questions were discussed. Afterwards, participants were encouraged to perform the given tasks. The participants was not provided with any guidance except for a number of probes. These probes were chosen beforehand in order to avoid asking leading questions or giving information about tasks away. The probes (see Appendix H) included questions about the layout of the page, provided options, and the visual design and if the purpose of the site was clear.

After all tasks were complete, the participant was thanked and the evaluation ended. No quantitative data in form of questionnaires was collected as the low number of participants would not be representative and there was not sufficient time to evaluate more users.

During the evaluation, notes were taken about usability problems such as disorientation, general questions and misinterpretation of elements and functionalities. These observations were further analysed through video recordings. Positive and negative feedback that participants provided was recorded along with targeted and uncertain actions to find strengths and weaknesses of the prototype.

As the evaluation was performed with only a prototype with limited functionalities, it was not useful to identify and count usability problems. The evaluation concentrated on discovering areas that can be improved or changed in case of a real realisation of the showcase.

4 RESULTS

4.1 INTRODUCTION

This chapter reports the results of all the methods reported in Chapter 3. The results are shown and described with emphasis on important parts with regard to the project objectives (1.2 Objectives). Full-scale results and raw collected data are attached as appendices and are referred to throughout the report.

Results of showcase reviews consist of factual descriptions of existing showcases. The findings are summarized to passively inform the designer of how content of showcases can be structured and what basic functionalities it should provide. No requirements were directly extracted from the showcase reviews.

Important parts of transcribed interviews are presented and set in context with the study. Afterwards, they are being analysed and combined with findings from the showcase review to establish requirements on a student showcase that is influenced by direct feedback user feedback on existing showcases.

The outcomes of the two performed creativity workshops are shown in both raw and digitally enhanced forms. The workshops generated in total 70 ideas with only a few duplicates. Ideas were filtered and the majority of them were rated by the participants.

The ideas were filtered, converted into requirements and merged together with requirements produced by interviews and showcase reviews. A statistical analysis was performed to be able to compare the two used creativity techniques, Creativity Triggers and Circle of Opportunity with each other. Requirements that resulted from interviews were also taken into consideration to compare efficiency of creativity workshops themselves.

Requirements were then given a priority, which informed the design of prototype sketches. These were converted into an interactive prototype, which was evaluated by user testing sessions and a 5-seconds test.

4.2 SHOWCASE REVIEWS

4.2.1 Royal College of Art[9]

The Royal College of Art has a general showcase for two schools and five programs. Student works can be filtered by school, programme and year, which allows various ways to explore content. The user is provided with a search option in case he is looking for something specific or already knows exactly what he is looking for. The search not only works with the name of the project, but also with the name of the author. This allows visitors to look specifically for a person's profile. The profile does not list all available projects that a user participated in.

The individual projects are built from a single template that divides the page into three main areas: Project title, image slideshow and description. This solution limits the capabilities of displaying different types of projects, as the deliverables have to be reduced to images and a short description text and are thus not representative of the overall project scope and artefacts. The descriptions outline the project aims only shallow and do not mention or describe any

[9] http://www.rca.ac.uk/showcase/rcanow/ - Royal College of Art

processes or approaches that were used. Projects can be shared directly with a button via Twitter, Facebook or Email and are thus easy to show to others.

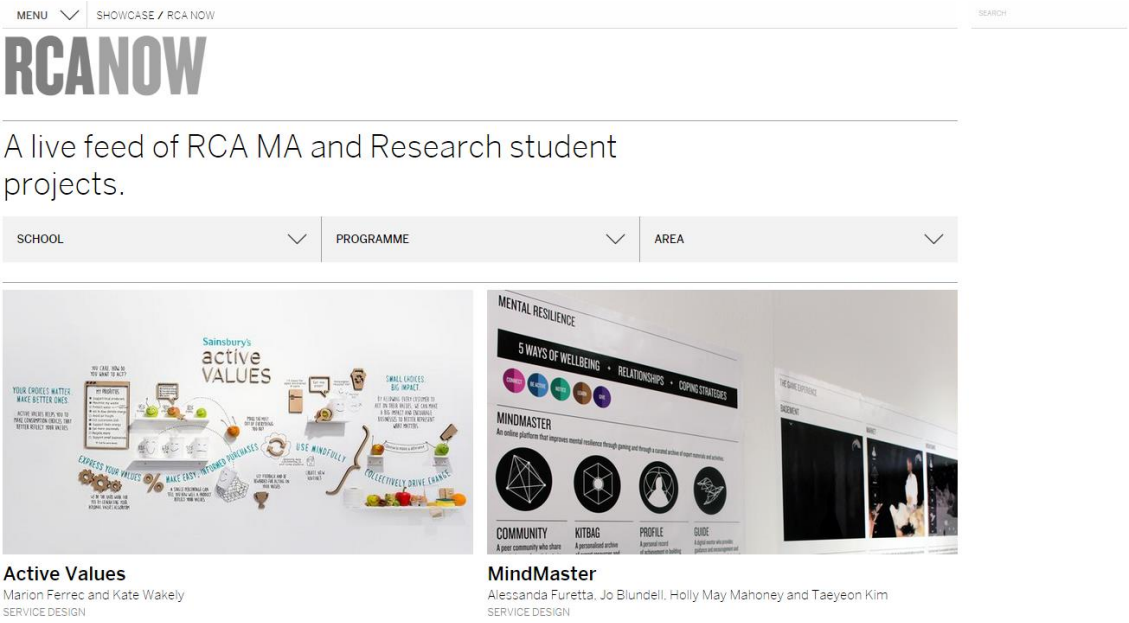


Figure 1: Showcase of the Royal College of Art

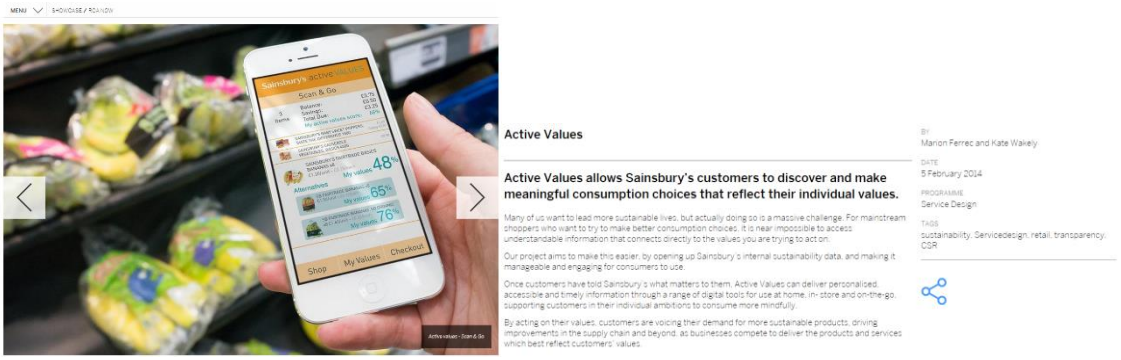


Figure 2: Detailed view of one project (RCA Now)

4.2.2 Design Research Lab[10]

The Design Research Lab website displays projects from four different research areas of the Berlin University of the Arts. The project overview consists of single small images and a topic that appears on a mouse-over event (see Figure 3).

Figure 3: Design Research Lab - Overview

[10] http://www.design-research-lab.org/?page_id=7 – Design Research Lab

The detailed view of a project consists of a project title along with a short description text that includes the aims and outcomes of the showcased project. The description text is complemented by a limited number of small-scale images without annotations, which is not always successful in illustrating the outcomes and content of the project.

The content of each project view seems to be generated by individual people and not by one standardized instance like an administrator, which results in a great difference in quality and content between each projects.

The search functionality is limited to the entire site, it is therefore not possible to simply search for projects or authors as the results contain entries from the entire domain and not only from the showcase.

4.2.3 Digital Interaction at Culture Lab[11]

Digital Interaction, a School of Computer Science research group at Newcastle University, is displaying their work in an online showcase. The showcase consists of multiple categories such as “Things”, “PhD Projects” and “Research Projects”. Each category contains a list of projects sorted by the publication date (see Figure 4).

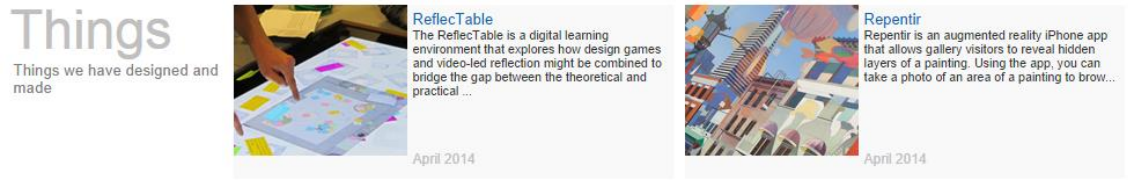


Figure 4: Digital Interaction projects overview

The amount of details with which the projects are being displayed ranges heavily. Some projects contain a picture that describes the content of the project along with a description text and a link to a more detailed project homepage (see Figure 5). The project pages are mostly publications from PhD students that contain a download link to the published research paper along with an embedded video that shows the design in rich detail. The showcases with videos are very detailed in communicating the aims and contents of the projects compared to the video less versions.
Overall, the showcase only displays bigger projects of research associates and lecturers at the university. Each project provides links to the authors and the author page provides links to published papers and associated projects.

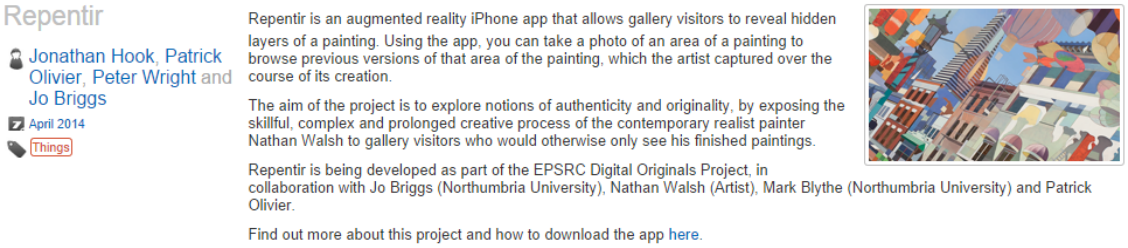


Figure 5: Detailed view of the project "Repentir"

[11] http://di.ncl.ac.uk/projects/things/ - Digital Interaction at Culture Lab

4.2.4 University of Sussex[12]

The Informatics department of the University of Sussex provides a showcase for several different categories. Categories vary from student and staff achievements to undergraduate projects, postgraduate posters and interdisciplinary research. Each category provides a different view of projects or items that are being showcased. There is no consistency in the way the items are displayed in the different categories.

Student and staff achievements are described with a short paragraph, mentioning the award category, prize and the name and picture of the student/staff member that earned the achievement (see Figure 6).

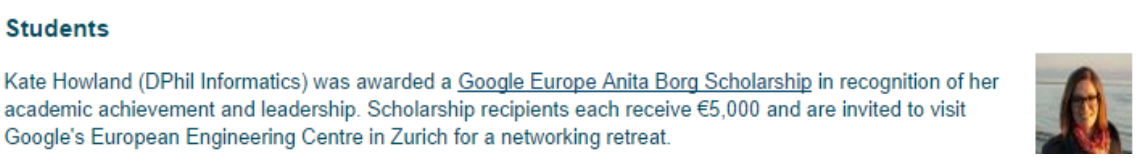


Figure 6: Student achievements

The projects are not being summarized and displayed in an appropriate way. In most cases, only the project title and author are being presented and the content of the project itself is linked to the full-text pdf-file of the project, which is in most cases over 50 pages long (see Figure 7).

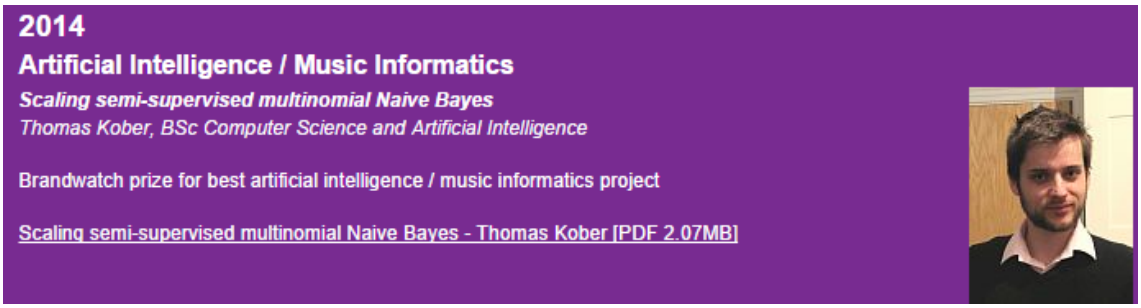


Figure 7: Prize winning undergraduate projects

4.2.5 UTC Sheffield[13]

The showcase section of the UTC Sheffield website consists of several videos that were specifically produced to introduce the visitor to specific subjects and degrees. Current students and professors explain main ideas behind why one should choose to study engineering or creative and digital. The showcase is not meant to show student courseworks or related material that is being created during the modules. No other forms of presenting student-created content is available on the website.

4.2.6 University of Santa Cruz - Digital Arts – New Media[14]

The faculty of digital arts and new media at the University of Santa Cruz does not have a specific website to present student projects and instead chooses to integrate student work into the main homepage of the faculty. The front-page includes a gallery of pictures that are taken from

[12] http://www.sussex.ac.uk/informatics/showcase
[13] http://www.utcsheffield.org.uk/showcase/ - UTC Sheffield
[14] http://danm.ucsc.edu – UCSC – Digital Arts – New Media

student projects (see Figure 8). When clicking on a picture, it is described by a title and linked to the actual project, which allows additional gathering of information upon interest.

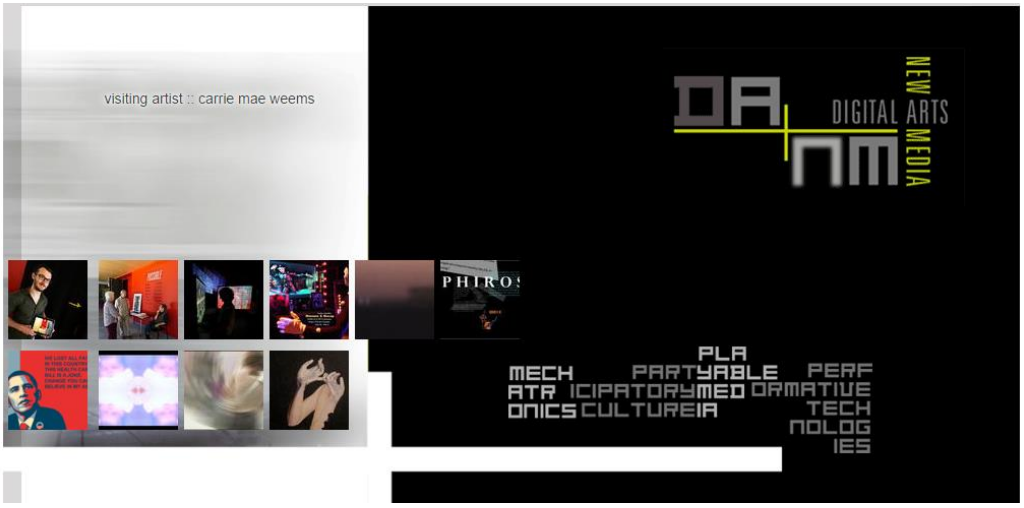


Figure 8: Work presentation in form of pure images - UC Santa Cruz

The project pages differ individually from each other in regards to the provided content and information. Some projects provide media content such as videos or a very detailed project description (http://danm.ucsc.edu/gallery/map-free-territory). Some projects only provide a title and the picture, without providing any further details (http://danm.ucsc.edu/gallery/takes-stage). One common link of all the projects is a link to the author's page. Each student and staff member has his own profile, which provides a section with selection of work that are represented as pictures and a description that seems to be customizable by the people themselves (see Figure 9). Profiles allow visitors to view all work done by an individual and can be used as a portfolio by students to present themselves to other instances.

Figure 9: Student profile with a selection of work

4.2.7 Vancouver Film School - Showcase[15]

The Vancouver Film School provides a showcase with a selection of outstanding final year projects of their students. The projects are categorized by their programs and are all in the form of short movies. Each category provides a list of movies, which can be sorted by date or popularity. The items itself have various attributes that are being displayed to the visitor, such as duration, title, number of views and a rating (from one to five stars). The number of views and the rating give the visitor a very fast impression of the quality and popularity of the short movie (see Figure 10).

[15] http://vfs.edu/showcase - Vancouver Film School - Showcase

In order to investigate where the ratings come from and who can actually give a rating, a short analysis had to be performed. An aspect that was uncovered is that the video content and its metadata are representations of a video entry that was uploaded on YouTube. The Film School uploads its selected videos on its own YouTube channel and writes a short description text containing the name of the film and its author. The number of thumbs up calculates the rating and the comments displayed on film item site are also directly linked with YouTube. This technical solution has its up- and downsides, as the items become publicly available and everybody with a YouTube account can vote and leave comments.

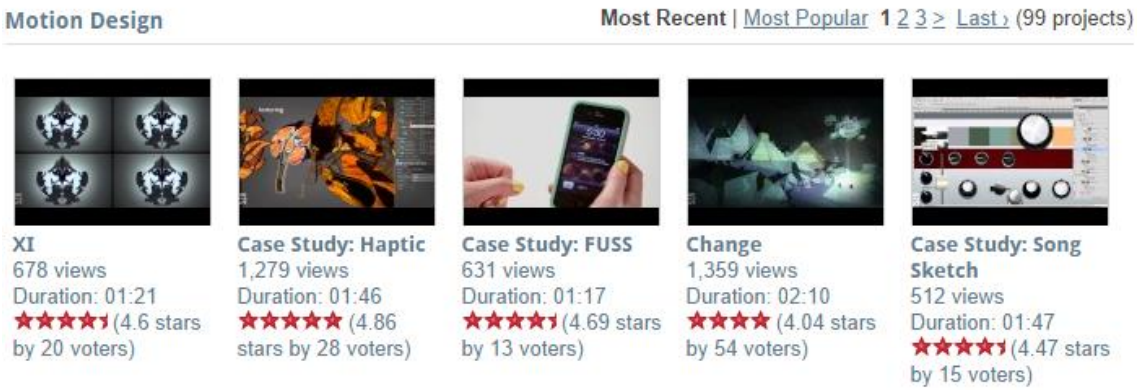


Figure 10: Student work presentation - Vancouver Film School

No search or filter options are provided to view content created by specific authors. When a work catches the visitor's eyes, it is not possible for him to view additional content created by the artist without further research by himself.

4.2.8 University College London – Interaction - Centre[16]

University College London displays their MSc projects that were awarded with a distinction on their main internet website (see Figure 11). The projects are grouped by year and sorted alphabetically according to the author's name. The content available for displaying purposes is the title of the project and a link to the full pdf report that was submitted by the student. No student profiles or other forms of student work are present.

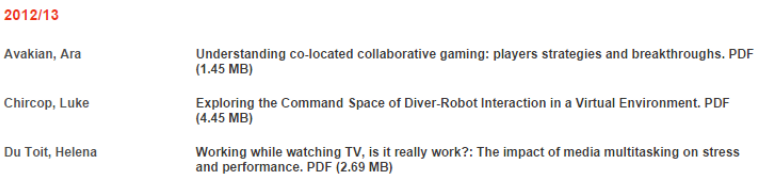


Figure 11: UCL - MSc projects showcase

4.2.9 Copenhagen Institute of Interaction Design[17]

The Copenhagen Institute of Interaction Design has a large showcase that includes work from the interaction design programme since the year 2008. Each year contains several courses that were done by students during the year. The courses are divided into an overview of the course and a list of submitted projects (see Figure 12).

[16] www.ucl.ac.uk/uclic/studying/taught-courses/distinction-projects - UCL - Interaction Centre
[17] ciid.dk/education/portfolio/ - Copenhagen Institute of Interaction Design

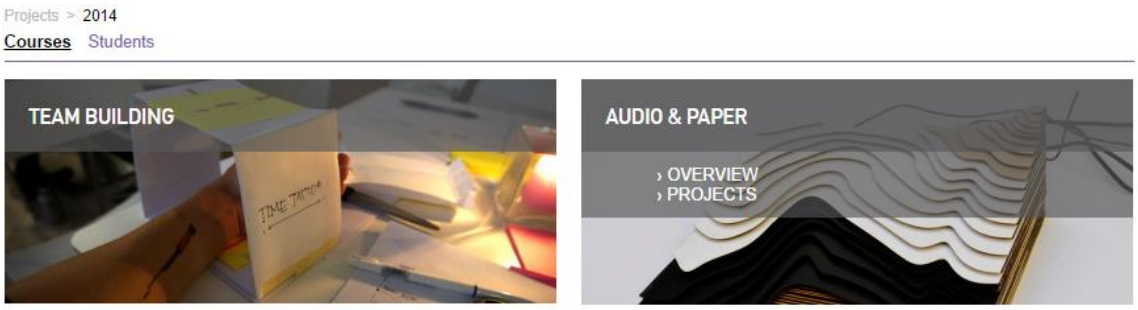


Figure 12: CIID - Showcase overview 2014

Each projects has four different aspects that are presented to the user:

1. A short description text about the selected project
2. A list of students who participated in the project
3. A slideshow of relevant images
4. A short (on average one minute) video clip about the project.

Almost the entire content fits into the size of as screen, which results in a good immediate overview and makes scrolling obsolete. The design of the page is very clear with a white background and clearly defined content areas. The used template makes sure that the user knows exactly where to expect, no matter which project he chooses from the vast range of available projects (see Figure 13).

Description texts or annotations for the images are not provided. The user is presented with images but has to figure out by himself what the content of the photo is and what it wants to communicate.

The videos are a very good way to present content to its viewers. One can see that the production of the videos is included into the project process, as each project contains a video to show it to a broader audience.

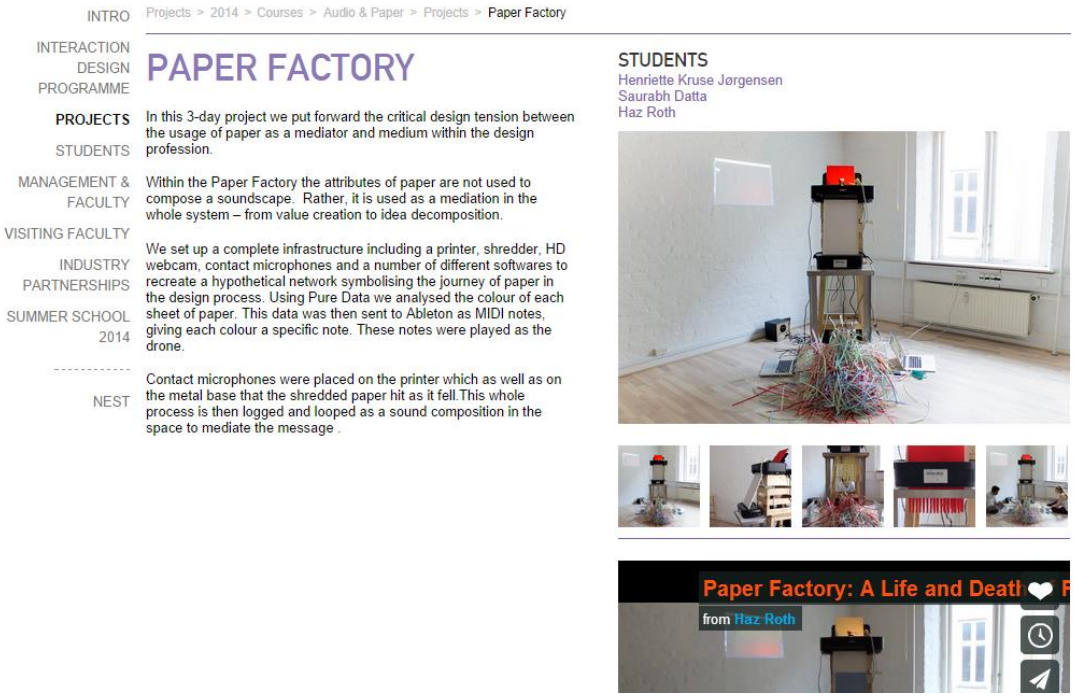


Figure 13: CIID: Detailed project view

The websites also includes a list of the current students and customized profiles for every one of them. The profile page of a student has a portrait photo of the student along with his country of origin and area of expertise. This content is accompanied by a description text, talking about the student as a person, his career and accomplishments. Some profiles of former students also include a list of projects that the student submitted during his study time, along with links to the specific projects (See Figure 14). Current students lack such a list; their projects are not summarized in one place yet.

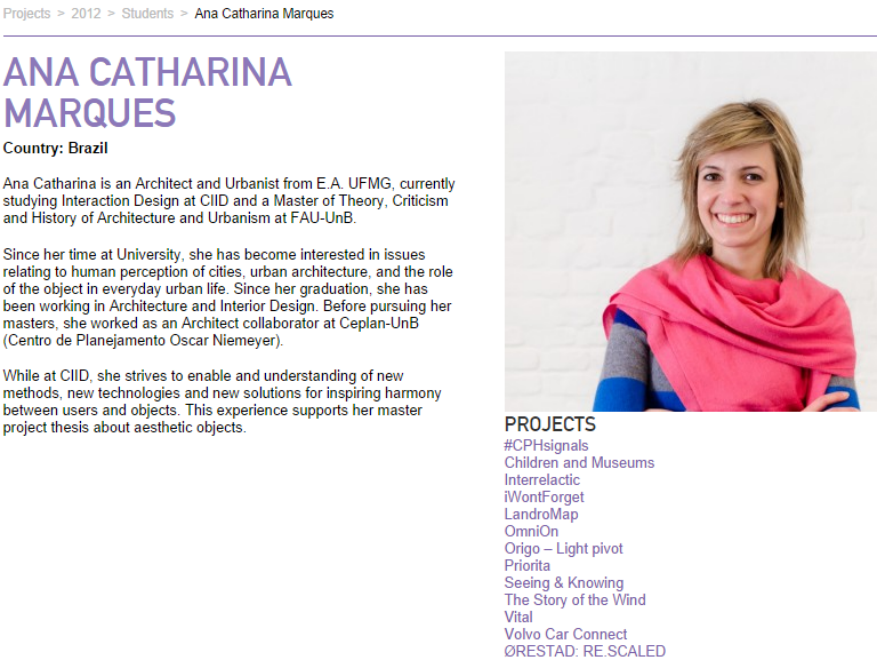


Figure 14: Alumni profile with past projects

4.2.10 Summary

In summary, one can say that the majority of universities and their faculties lack an appropriate, modern way in presenting their students work to the public audience online. Universities such as King's College London, University College London or City University London are only a few of the universities that do not provide any kind of online student showcase. When looking for student projects or showcases, one can only find actual physical showcases and exhibitions, where the faculty displays physical objects and project outcomes.

The showcase of the Copenhagen Institute of Interaction Design excels in presenting their students work. Their showcase provides an archive of past projects; all projects from each group in each module are presented with rich use of media such as video presentations, and module overviews communicate the module aims. In addition to that, profiles give information about current students and the projects they took part in, which allows seeing additional work by a student if desired without having to look for the work by yourself.

The showcases that are presented above vary in the amount of information they provide, content that is displayed and other formal and informal aspects that matter to users. In order to be able to say whether the showcases are informative and useful or not, one has to be able to compare the attributes of a showcase with a set of attributes or guidelines that an optimal showcase possesses.

The following desirable functionalities were extracted from existing showcases as results of the researcher's opinion:

1. Search and Filtering capabilities -> Author, Subject, and Module (4.2.1)
2. Connections between items -> Authors linked to and accessible from projects, projects are linked to and accessible from authors (4.2.3)
3. Project overview gives a feeling of the projects' content (4.2.9)
4. Project details are rich in content, describe project in detail and provide viewer with additional information and deliverables (Project outline, Project stages, outcomes and deliverables) (4.2.9)
5. Rich use of media such as videos (4.2.9)
6. Elements are positioned appropriately (Elements where you expect them to be, no big changes between pages) (4.2.9)
7. Easy to find and recognized by university (4.2.9)
8. Responsive Design -> Flexible and usable with big/small screens (4.2.1)
9. Accessible Design -> Usable by keyboard, font size adjustable, no text in images -> screen reader friendly (4.2.3)
10. Project archive over past years (4.2.9)
11. Individual profiles for students (4.2.9)

These functionalities were not incorporated into the requirements to focus on requirements generated by creativity techniques and stakeholder interviews. It would have been reasonable to use some of these ideas either as requirements, or as design ideas to satisfy requirements, as requirements can come from the own experience as a designer, from design guidelines or from examples of similar systems. As generated ideas by stakeholder interviews and creativity techniques were quantitatively and qualitatively satisfying, no need necessity existed to come back and generate new requirements from the reviewed showcases.

The listed functionalities and showcase reviews were compared with results of workshops and interviews. It was analysed if any truly novel ideas were generated in the design process of the showcase or if the generated ideas were already present in some form in showcases of other universities. The results of this comparison can be seen in 4.6. Workshop Analysis.

4.3 Stakeholder Interviews

Interviews were performed with five stakeholders, consisting of four current students of Human-Centred Systems (two full-time students, two part-time students) and one perspective student who applied for HCS at City University London. The full-transcribed versions of the five interviews can be found in the Appendix Q. The answers to the participants' answers can be qualitatively summarized in the following way:

Have you ever used or seen anything similar and what did you think about it? Have you looked if other universities showcase their work before coming to City?

- The interviewed people did either not look for any showcases while applying or did not find anything relevant.
- The perspective student went to an open day at a university where she could view some of the presented projects in their physical forms. She stated in a follow-up question that an online showcase would have definitely helped her to make a choice about the right university. This statement confirms the need for a student showcase and supports the importance of this project.

Do you have any kind of portfolio or website that you use to display your work? How do you use it and what are the advantages and disadvantages of it?

- Two interviewees did not have any platform or personal online space to display their work. One person had an offline portfolio that consists merely of text descriptions and images. The person complained that it does not allow the inclusion of videos or interactive prototypes, which is one requirements that was extracted from the interview.
- Two interviewees use the platform Behance[18] that allows the creation of online profiles and portfolios. The stated advantages of it are that it provides an already created space or template and that people can focus on showing strengths of own projects and not worry about the visual design or the coding of the showcase. One can also easily share the URL to a project or the user profile with other people. These strengths were interpreted as main requirements for a showcase.
  Main disadvantages are the limited possibilities to present content with the provided layouts of Behance. If the project content does not fit into the templates of the showcase, it becomes difficult to adjust one's outcomes for the showcase. Slow loading and reaction times were named as one disadvantage.

What are some of aspects of previous student work that you would like to show others?

- The feedback on this question was very versatile. Every interviewee had different concepts of displaying their work. Participant A stated that it depends on who is going to see the work or the portfolio. If you want to use the showcase/portfolio for a job interview, you have to filter the content that you show in your portfolio according to the job description.
- Other responses varied from "just everything" to interactive prototypes or full-working software solutions. Participant D on the other hand said that the process of how the project was researched and performed was more important than the actual outcomes.
- One major point that was mentioned by interviewees is the requirement of student work being acknowledge officially by the university. If student work is hosted by the university

Have you ever looked at a showcase of other people's work? What did you look for?

- All participants looked at other people's portfolios and work already to inform them about the content and structure for their own portfolios. Participants were also interested in how to combine academic work and professional work in a portfolio.
- Participant A mentioned a university showcase that was impressive and inspiring, she was still amazed by it even one year after seeing it. The CIID in Denmark (see Copenhagen Institute of Interaction Design) offers a showcase archive of all the current and past projects that were created as part of the study course. The impressions of the showcase were very positive and made the participant want to apply for the course and be part of it. This aspect highlights the potential that a good showcase can have on prospective students and how the university could benefit from it.

Feedback on showcase examples (Royal College of Art, Copenhagen Interaction Design Showcase, UC Santa Cruz – Digital Arts & New Media)

[18] https://www.behance.net/ - Online Portfolios

- Feedback about existing showcases resulted a variety of different pro-and contra arguments, which led to the generation of many ideas and requirements for the student showcase. Feedback of design consisted of lacking content optimization for small screens, as single objects such as pictures tended to fill out the majority of the available screen space, which made initial scrolling mandatory.
- A problem that Participant B mentioned is the lack of possibilities to showcase content formats that do not fit into the used design formats such as text based reports. These have to be somehow integrated into a showcase, which makes downloadable attachments a desirable feature and requirement.
- Share functionalities to share a project on various social media platforms and project specific tags/categories were regarded as desirable features and added perceived value to the showcases.
- A first glance shallow understanding of project context and content was recognized as a very important attribute of a showcase, as users lose interest rapidly and do not want to read a lot of text descriptions unless really necessary.
- A problem that was described from the perspective of potential employers is the need to distinguish between good and bad projects. If every project from a course module is displayed in a showcase, filtering and sorting capabilities become a necessity in order to deal with focussed needs.
- Videos were regarded as highly positive among all interviewees. Internet users tend to spend less time reading description texts and more time watching videos, as the required amount of attention and focus tends to be less demanding. Videos as a media offer also more possibilities such as showing outcomes such as interactive elements in action with the full range of features and possibilities. Time that was spend on animations and interactive items is not wasted and can be presented to others.

In summary, interviews showed that stakeholders would like the idea of having a digital showcase. Current students could have an official platform, recognized by the university, to display their work to the public. As the interviews were performed at the end of the study year, interviewees were concerned with building their own portfolios for job applications, as a presentation of previously done work is in most cases required. The aspect that current student were most concerned with is the need take care of the visual design of their portfolios. A platform or website that would support them in the generation of showcases for their work is highly desired.

The interview with a prospective student showed that a showcase could also provide help and guidance for students who are looking to apply at the right study course and university. The interview revealed that aspects that one would normally not think of, such as the feedback that lecturers provide their students with, are desired. Such feedback and information can be the decisive point for prospective students to choose a university over another.

It is unfortunate that the project scope did not provide enough space for the participation other stakeholder groups such as teaching personal and employers in this study. Their feedback and insights on this subject would have been surely enlightening and highly beneficial.

But even without other stakeholder groups, interview results were highly informative and most of the inputs were transformed into actual requirements. In total, 24 out of 60 (40%) requirements have interviews as only or partial source. The other 60% were the results of creativity workshops. Their results will be reported in the following section.

4.4 Workshop Outcomes

4.4.1 Workshop 1 – Creativity Triggers

The first workshop was performed with four participants during two hours. Creativity Triggers were used as a technique to generate ideas for the showcase. Four stakeholders participated in the workshop.

	Gough-Scale-Result[19]	Professional background
Participant A	3	Web design / HCS student
Participant B	1	Product design / HCS student
Participant C	1	Psychology / HCS student
Participant D	-2	(web) project management / HCS student
Average	0.75	

Table 5: Background information on participants – Workshop 1

The participants were all current HCS students. One student participated in the Creativity in Design module and had prior experience with creativity techniques and Creativity Triggers in particular.

The results of each creativity trigger were written on post-it notes and stuck to white DIN A3 paper. Each paper represented a creativity trigger and each post-it note contained one or multiple ideas. Figure 15 and 16 display the outcomes of two creativity triggers, "Participation" and "Service". Raw material of the remaining triggers can be found in Appendix T.

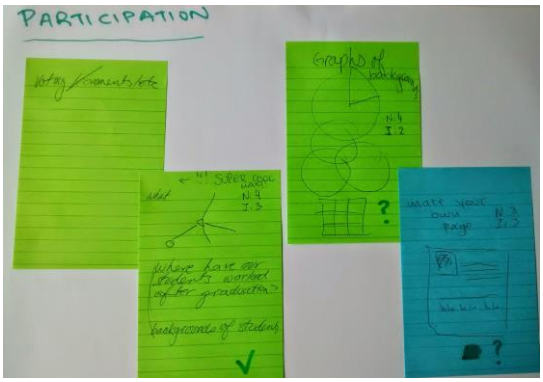


Figure 16: Outcomes of Creativity Trigger: Participation

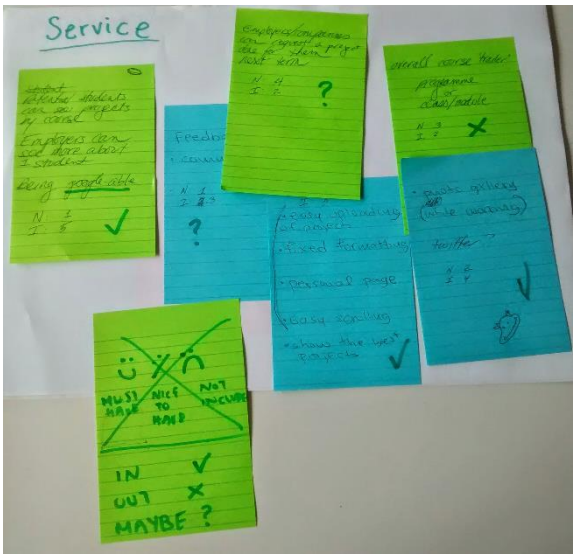


Figure 15: Outcomes of Creativity Trigger: Service

Each idea was given a rating on "Novelty" and "Importance" relative to a student showcase by the participants cooperatively. Each participant gave an initial rating of their own and the others discussed it until the group agreed on a value.

Afterwards, each ideas was reviewed for a second time and classified as "In", "Out" and "Maybe". "In" ideas get to be implemented into the showcase and are thus converted directly

[19] Positive values result in a tendency to be creative, negative values result in a tendency to be less creative

to requirements. “Maybe” ideas stand for nice-to-have features that would improve the showcase but are not a must criterion of the showcase. The classification “Out” was given to ideas that were identified as not reasonable or doable and were thus abandoned.

All outcomes were transcribed and adapted to make the description more precise and understandable for other parties that were not present during the workshop. Each table represents a creativity trigger. The generated ideas by the participants are written in the first column. The next three columns provide a novelty rating, importance rating and a status of whether the ideas should be implemented or not. Single ideas are lacking these ratings, as they were either forgotten by participants or selectively ignored to not have to rate or exclude them.

The result is the following:

Legend: √ = In; ? = Maybe; X = Out; N = Novelty; I = Importance

Novelty and Importance ratings out of five; five being the highest value.

Participation

	N	I	Status
Vote (+/-) on quality of projects, be able to write comments and give feedback -> social aspects			
Where have our students worked after graduation? Backgrounds of students (e.g. current job)	4	3	√
Graphs of backgrounds -> Visualization of background data/information in form of graphs	4	2	?
Make your own page -> Each student has a private space where he can create his own page with his own content -> Own portfolio for private projects	3	3	?

Connections

	N	I	Status
Alerts; get notifications about subscribed projects/tags/students -> Ability to subscribe to content to follow it -> Receive updates	1	3	?
Connect user profiles to Mendeley or Goodreads account to show others what you read (for each project, module and in general)	4	2	?
Internships project -> Companies post projects for students who are looking for internships	3	3	X
Profiles for businesses -> Companies who are willing to take interns create a profile page for them and write about themselves + their work and who they are looking for.	4	2	?
Awards system -> Projects receive awards from lecturers -> e.g. Best Wireframes, Best Customer Journey Map, etc.	4	3	?

Trust

	N	I	Status
Should be IN City University website (part of the official site to be authentic and official)	1	5	√
Should be updated frequently (to be considered serious and maintained)	2	5	√
Testimonials (linked to their LinkedIn accounts) + With name and quote "Advice for…" / "I learned that…" -> Real testimonials, no marketing speech	3	3	√
Lecturer's profiles with photos	1	5	√
Human nice photos (not stock photos) -> Authentic, realistic photos	1	4	√
Pictures from classrooms and lectures	1	4	√
# (hashtag) for each course -> Each course has a hashtag, so people can look up updates/tweets that are being done about the course to see if its good/what kind of content there is -> Live tweeting from courses e.g. #InteractionDesign13/14	5	1	?
Guest lecturers information -> Information about lecturer, background, company	5	1	?

Convenience

	N	I	Status
Free webhosting for personal student portfolios	3	5	√
Download CV and portfolio option as printable versions	1	4	√
Slideshow for projects as an option to explore content	1	5	√
Links -> Ability to copy the URL and give it to others so they can access projects/profile directly -> Sharable	1	5	√
Default formatting -> You know what content to expect where -> Usage of templates	1	4	√
Automatic tagging/suggest/correct -> Upload a file and get an automated design suggestion for it	1	3	?
Contact form for each student -> Ask stuff about student/project, connected to email	1	4	√
FAQ searchable			?
Ask a question box (e.g. IKEA) -> Type in a question and get an answer from someone	3	3	√

Information and choices

	N	I	Status
What books/sites did student find useful for this module/project?	3	5	?
Project brief/basic information (name of project, name of student, name of supervisor, background info etc.)	1	5	√

Request presentation for project -> Request a PowerPoint presentation or recording for the project	4	1	?
Project specific graphs “click for more” -> Graphs showing something about the project e.g. productivity	5	3	? or X
Professional interests of students (google, medical, etc.) -> More details in student profile	1	2	X
Living portfolio for students – upload work as you work | Showcase selects student portfolio once a week and -> Upload current status of work weekly/daily	2	2	X

Service

	N	**I**	**Status**
Potential students can see projects by study course	1	5	√
Employers can see more about one specific student	1	5	√
Being google-able -> Search engine optimization	1	5	√
Users can leave feedback, comments about projects	1	3	?
Employers/companies can request a project done for them next term as a coursework	4	2	?
Easy uploading of projects, fixed formatting, personal page, easy/minimal scrolling	1	5	√
“Show the best projects” option	1	5	√
Overall course ‘trailer’ programme or class/module (short video for a module/class)	3	2	X
Photo gallery (while working) of the classes/modules/projects (via twitter + hashtag)	2	4	√

The results from workshop one were transformed into requirements and merged with requirements that resulted from stakeholder interviews and showcase reviews. The idea ratings were also transferred to be able to prioritize requirements based on their ratings.

After the creativity triggers were utilized and the ideas filtered and rated, the participants received reflective postcards. The complete raw versions of the provided feedback can be found in the Appendix V.

Question One:

Please reflect on how the technique supported you in coming up with new ideas. Write a few sentences, thinking in particular about how easily you were able to explore possible options and come up with different ideas. Did you have any difficulties understanding and applying the technique?

Participant A: “I think the technique was helpful because it forced you to think about what would be useful. Also – it kept us from going too far down a rabbit hole, resulting in more rounded ideas. Some of them were boring (trust).”

Participant B: "The concepts/technique was easy to understand. Application was more difficult as it was hard to work on a website with a clear purpose of "showcase". I think at least sketching out ideas would have worked better."

Participant C: "Very useful to have a focal point of discussion so that you can begin. Technique was easy to apply."

Participant D: "No difficulty in understanding the technique. The supplementary sentences describing each word helped us realize what was it about and what was requested. Not many ideas since the words were a bit similar or concluded to same thoughts."

Question Two:

Please reflect on your involvement in the previous activity. Write a few sentences, thinking in particular about how engaged you were, how absorbed or distracted, and how easily you feel you worked with other members of your team. Try to think about the extent to which the technique helped or hindered you in this regard.

Participant A: "Some questions/triggers were hard to come up with ideas for. Leads to distraction as you hit idea blockages. Helps to have other members of team to discuss."

Participant B: "The team worked together nicely. It was easy to get distracted however. Since this was a research project with separate workshops it was required for the researcher to not be involved, but I think the convergence would have worked better with assistance."

Participant C: "I tend to talk over people, so I feel very cautious about that. But this technique helped me maintain focus and kept us on the same topic. I think it's good because we all focus on the same thing, not think inside our heads and come up with random stuff. But it did feel like there wasn't much room for extra creativity (outside the box). Absorbed 60%, distracted 40%. Worked very well with other members. "

Participant D: " I felt really happy working with the members of the team. I have worked with two of them in the past and we had an excellent collaboration. No distractions. Food was a nice gesture. The technique helped us to communicate with each other, express our ideas."

In summary, Creativity Triggers received mostly positive feedback. Participants stated that the technique provided strong support during idea generation and that it was very useful. It was also regarded as easy to learn and apply, no difficulties in understanding the technique occurred.

Some participants stated that the triggers do not let enough room for thinking outside the box. It becomes difficult to generate ideas that are not connected to one of the triggers, which is limiting the range of one's creativity. Some of the triggers are described as too close, which results in the generation of similar ideas that already occurred with another trigger. Some triggers are also described as difficult.

Creativity Triggers that require some thought and that do not trigger ideas instantly result in blockages, which leads to distractions. As during the whole workshop participants communicate with each other, small distractions of individuals can distract the whole group. In contrast to that, some participants stated that the technique helped to maintain the focus of the group as

it kept the team on the same topic. It helped the team to communicate and lead to inspirations of each other.

4.4.2 Workshop 2 – Circle of Opportunity

The second workshop was performed with four participants during two hours. Circle of Opportunity was used as a technique to generate ideas for the showcase. Four stakeholders participated in the workshop.

	Gough-Scale-Result[20]	**Professional background**
Participant A	1	Teacher / HCS student
Participant B	0	Art & Design / HCS student
Participant C	1	Product UX / HCS student
Participant D	3	Banking / Economics Alumni
Average	1.25	

Table 6: Background information on participants – Workshop 2

The participants were all but one current HCS students. One student participated in the Creativity in Design module and had prior experience with creativity techniques and Creativity Triggers in particular. The participant that is not a current HCS student is closely connected to one of the current HCS students and is thus very well informed about the projects and work that is performed during the study course. The two attributes, which had to be chosen by rolling two dice, were written on the opposite sides of a DIN A3 paper (see Appendix W). The following twelve attributes were chosen by the participants (see Figure 17):

1. Informative
2. Simple
3. Relevant
4. Well-structured
5. Variety
6. Flexible
7. Sustainable
8. Consistent
9. Credible
10. Sharable
11. Up to date
12. Attractive

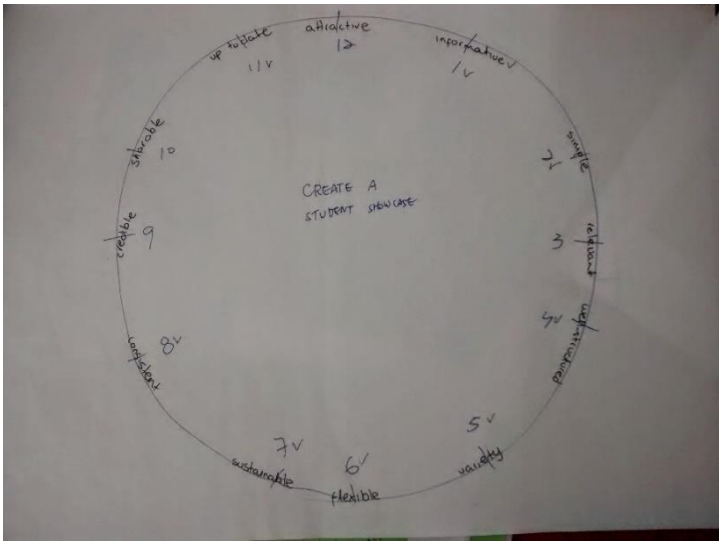


Figure 17: Drawn Circle of Opportunity

The participants then chose one of the attributes and started to free-associate the attribute and brainstorm around it to come up with ideas for the showcase. Eight different attributes were used during the workshop. The outcomes were submitted on DINA3 paper and are attached as photos in the Appendix W. The following figures are digital reconstructions of the submissions:

[20] Positive values result in a tendency to be creative, negative values result in a tendency to be less creative

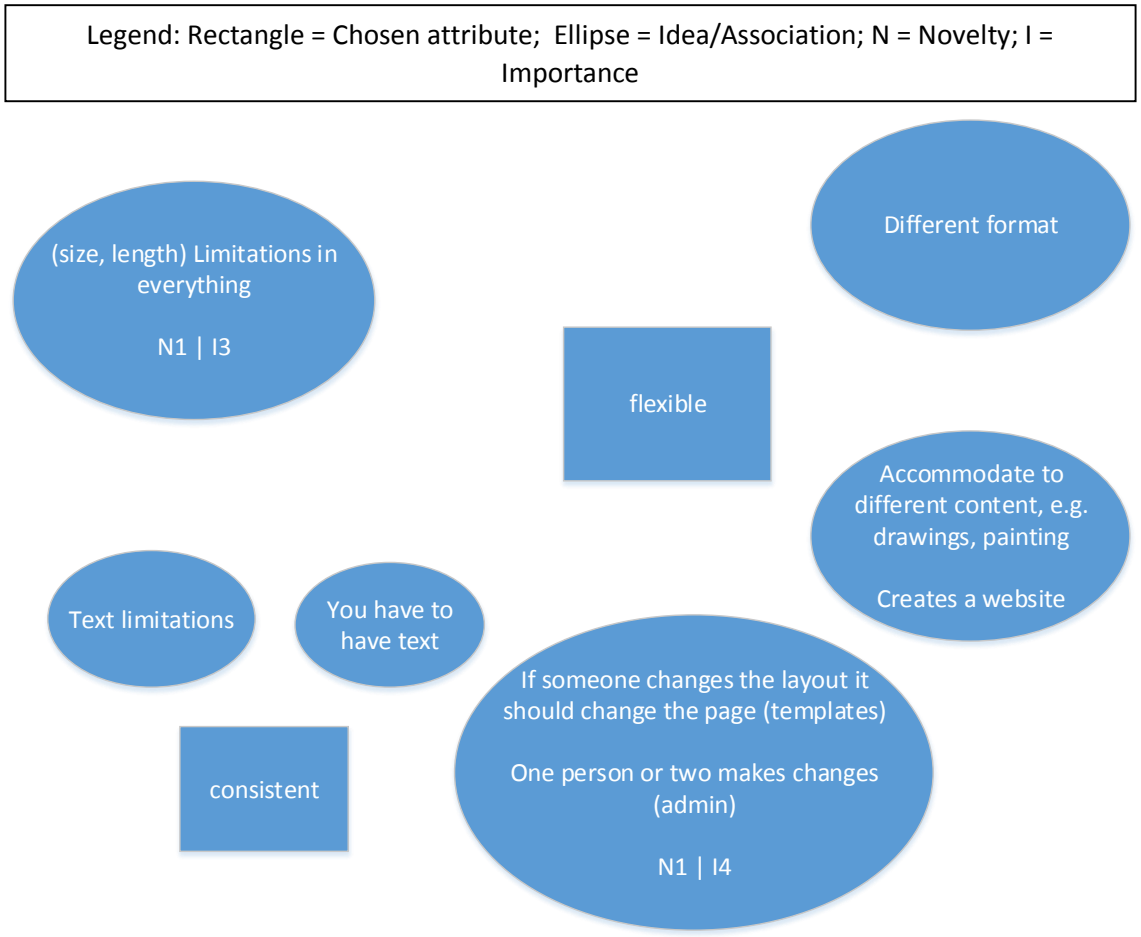


Figure 18: Circle of Opportunity: Consistent + Flexible

Figure 19: Circle of Opportunity: Sustainable + Simple

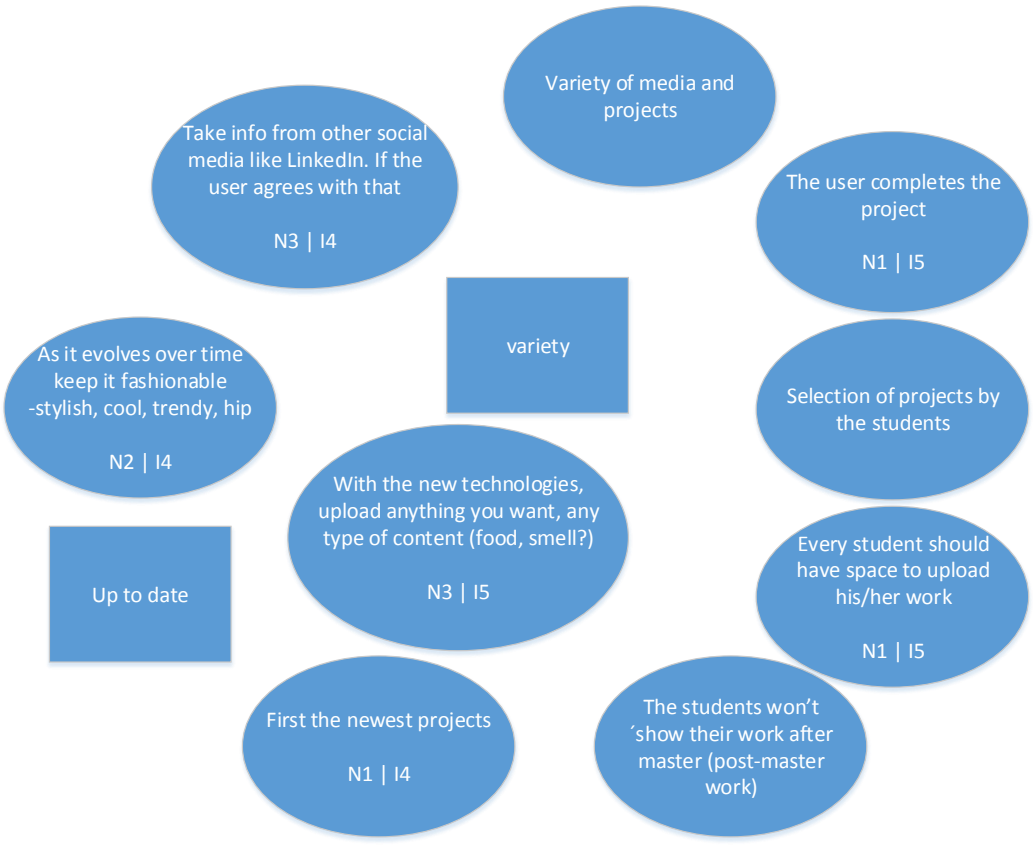


Figure 20: Circle of Opportunity: Up to date + Variety

Figure 21: Circle of Opportunity: Well-structured + Informative

The results from the workshop were transformed into requirements and merged with existing requirements from the previous workshop. In contrary to the first workshop, only a few ideas were rated on importance and novelty. Additionally, no clear filtering of ideas took place. Ideas with ratings and ideas without ratings that resembled something concrete were both converted to requirements and added to the exiting requirements.

After the Circle of Opportunity was utilized and the ideas filtered and rated, the participants received reflective postcards. The complete raw versions of the provided feedback can be found in the Appendix Y.

Question One:

Please reflect on how the technique supported you in coming up with new ideas. Write a few sentences, thinking in particular about how easily you were able to explore possible options and come up with different ideas. Did you have any difficulties understanding and applying the technique?

Participant A: "I wouldn't say I had any problem understanding what I had to do but it was a bit harder to understand how it helps to reach an outcome. It did help in exploring different areas of the design but it didn't feel like it was conclusive or, more importantly, targeted. I.e. I do not

have a complete picture of what we as a group think should happen overall with the design and we were jumping from one place to another. ”

Participant B: “Good for small group of people, too high level. Attributes are not straight to the point, as they’re limited in adjectives. Adjectives are more for evaluating systems, very weak for brainstorming.”

Participant C: “Thinking of attributes was good – allowed for an exploration of the problem. Looking at the relationship between the words was limiting and did not allow for creative ideas to be generated. Also, there was a lot of repetition of ideas despite different words being looked at.”

Participant D: “No difficulties about understanding the technique. The attributes were limited so ideas were limited and overlapping. Exploring possible options was easy. I think that showing other examples before the technique made my thoughts more narrowed down to these examples.”

Question Two:

Please reflect on your involvement in the previous activity. Write a few sentences, thinking in particular about how engaged you were, how absorbed or distracted, and how easily you feel you worked with other members of your team. Try to think about the extent to which the technique helped or hindered you in this regard.

Participant A: “I did feel engaged and absorbed. The structured process and idea exchange helped in that, as well as exploring what others think. It was easy to work with the rest of the team and it did seem to expand my thinking horizon.”

Participant B: “Quick communication. Engagement’s alright. Will be hard to analyse outcome.”

Participant C: “It was easy to engage with others of the team for this activity. I felt that we all worked well together and no one dominated the situation. So everyone was able to express an opinion.“

Participant D: “Engaged fully (I think). No problem with other members. Their thoughts helped me. I think that if we could use another creative technique to create/brainstorm different attributes it would lead us to have more ideas, or connecting this creative technique with others like triggers.”

In summary, the technique Circle of Opportunity received mixed, but mainly negative feedback. According to participants, the technique was very easy to understand and to apply but it was not clear how exactly it helped in idea generation.

Participants describe the attributes as too limiting and not straight to the point. A lot of repetition occurred during idea generation despite the usage of different attributes. The exploration of attributes helped the participants to explore the problem but the whole technique is described as not targeted enough to explore and generate creative ideas.

Participants reported that the structured process helped the team to be involved and fully engaged during the workshop. The teamwork was reported as positive and easy, brainstorming in a group helped participants to come up with ideas by themselves. Participants stated that no single individual was leading the group, everybody contributed to the workshop with his ideas.

4.4.3 Discussion

The two performed workshops generated both a high amount of ideas. To be able compare the two creativity techniques, their results or processes can be compared. A comparison of the outcomes is both workshops is one of the objectives of this study and will now be pursued.

In order to compare the quality of those ideas, the novelty and importance ratings that were given by the participants of the workshops were analysed in Table 8:

	Creativity Triggers	**Circle of Opportunity**
Novelty & Importance > 3	5	4
Novelty = 5	2	0
Importance = 5	8	10
Average Novelty	2.2	1.7
Average Importance	3.577	4.474

Table 7: Comparison of requirement ratings

Creativity Triggers and Circle of Opportunity produced both an equal amount of novel and important ideas. One can see from Table 8 that in the performed workshops, Creativity Triggers produced a higher quantity of novel ideas and the higher average novelty value overall. In contrast to that, Circle of Opportunity produced a higher quantity important ideas and a higher average importance value. The average importance value is clearly higher, almost by one whole point. As the number of generated ideas by the Circle of Opportunity is lower, one can say that the technique produces overall ideas of a higher importance.

These results make it difficult to answer the research question RQ2, as the rating for both techniques differs from the point of view they are regarded. As both novel and important ideas are necessary for a product, one cannot say that one technique produces particularly higher rated results.

When comparing how the workshops and the application of creativity techniques occurred, one can say that creativity techniques provided better support for participants to generate creative ideas. By providing targeted triggers that aim to discover ideas from various spaces (exploratory creativity), the participants were viewing the challenge from different angles and could thus generate a wide range of different ideas.

This was not the case for participants using the Circle of Opportunity. As participants are responsible for coming up with and choosing the attributes that are going to be use for idea generation (by utilizing exploratory and combinational creativity), a not ideal selection of attributes is possible. This was the case in the performed creativity workshop, as participants chose attributes that were too focused on the actual development of the digital showcase. The chosen attributes were too common and close together. Participants expressed the same concepts and ideas despite brainstorming around different attributes. This resulted in the generation of more important and targeted ideas but in less creative and broad ones.

Another factor of creativity techniques that can be compared is the form in which the results were submitted. Participants who used Creativity Triggers knew that there are six triggers to

brainstorm, so participants could plan how they were going to write down results for each of the triggers. They were also provided with questions, which were specifically adapter to the showcase scenario. The questions allowed participants to formulate their ideas as answers to these questions, which made the process of writing them down easier.

In contrast to that, Circle of Opportunity relies heavily on the participants. They know that they have 12 attributes, but they do now know how many of them and which combinations will be chosen. Circle of Opportunity also provides questions to the participants, but they are too general and cannot be specified to the given scenario, as attributes are not defined beforehand. This makes the generation of ideas a cumbersome process for both the participants and the researcher. The delivered materials consisted not only of ideas, but also of all the accompanying attributes, properties and other words that were thought of by participants during the free-association. The process of analysing and extracting the relevant data from these deliverables tends to be challenging.

In summary, Creativity Triggers had an easier and broader process of idea generation, participants were engaged and felt that the use of the techniques greatly supports them in their idea generation.

Circle of Opportunity on the other hand on the other hand was narrower and slower in the initial idea generation. Participants had more difficulties to understand what they were supposed to do and how the techniques would support them during the idea generation. In the end, both creativity techniques managed to produce a high amount of novel, useful and important ideas that were converted into requirements of the digital showcase.

4.5 REQUIREMENTS

4.5.1 Introduction

This section presents the results of the conversion of ideas that were generated in stakeholder interviews and creativity workshops into a requirements specification. This requirements specification contains requirements IDs to identify single requirements and to refer to them through the rest of the report.

The second column of the specification contains the formulated requirements for the design of the digital showcase. The requirements are divided into functional and non-functional requirements. According to best practice, requirements were written in the form of “The showcase shall…” to give a precise statement about what exactly the requirements describes.

Furthermore, the specification contain the source of origin of the requirement, its importance and novelty ratings that were given by their inventors and the calculated frequency gives a measure of how often the ideas which led to the requirement was generated in total.

The requirements specification also contains a color-coding, which communicates the results of a comparison between the generated requirements and the features of existing showcases summarized in Chapter 4.2.10.

The requirements are sorted according to their priority and categories by categories as described in Chapter 3.5.

4.5.2 Specification

Legend: CS = Current student; PS = Prospective student; FR = Functional requirement; NFR= Non-functional requirement; Green shading: Novel idea, not present in reviewed showcases

Req. ID	Functional Requirement (45)	Source	ID	Other appearances	Frequency	Novelty	Importance	Average	Priority
	Individual profiles (7)								
FR08	The showcase shall have authors sites with accomplishments and lists of links to showcased projects	Interviews	PS	Workshop 1 2x, Workshop 2	4	4	3	4	High
FR19	The showcase shall automatically retrieve updated user information from LinkedIn	Workshop	2		1	3	4	3	High
FR21	The showcase shall have lecturer profiles with photos and background information	Workshop	1		1	1	5	2	Average
FR22	The showcase shall provide an option to download the CV and portfolio of an author/student/lecturer	Workshop	1		1	1	4	2	Average
FR23	The showcase shall provide contact possibilities to contact authors of projects	Workshop	1		1	1	4	2	Average
FR24	The showcase shall connect user profiles with reading databases (Mendeley, Goodreads) to provide information about reading material	Workshop	1		1	4	2	2	Average
FR41	The showcase shall be able to combine university and personal/professional portfolios	Interviews	CS		1			1	Low
	Project overviews (6)								
FR06	The showcase shall provide options to see only good projects	Interviews	CS	Workshop 1	2	1	5	3	High

Req. ID	Functional Requirement (45)	Source	ID	Other appearances	Frequency	Novelty	Importance	Average	Priority
FR20	The showcase shall provide a slideshow or presentation mode through projects	Workshop	1		1	1	5	2	Average
FR26	The showcase shall allow to see projects by study course/module	Workshop	1		1	1	5	2	Average
FR27	The showcase shall display newest projects first	Workshop	2		1	1	4	2	Average
FR43	The showcase shall have an overview before going deep into details	Interviews	CS		1			1	High
FR45	The showcase shall contain an archive of past projects	Workshop	2		1			1	High
	Project details (11)								
FR01	The showcase shall be able to handle different media formats such as interactive prototypes, videos, graphs, pictures, printable 3d objects.	Interviews	PS	Workshop 2	2	3	5	3	High
FR02	The showcase shall be sharable via a link with other people for application processes	Interviews	CS	Workshop 1	2	1	5	3	High
FR03	The showcase shall be able to show the process of projects and student works	Interviews	CS	Workshop 2	2	1	5	3	High
FR05	The showcase shall include a project brief/outline	Interviews	CS	Workshop 1, 2	3	1	5	3	High
FR07	The showcase shall give information about reading material found useful by students for each module/project	Workshop	1		1	3	5	3	High
FR12	The showcase shall store and make available all details to a project an author will want to add (descriptions/annotations)	Interviews	CS	2x	2			2	Average
FR16	The showcase shall allow tags/categorization of projects	Interviews	CS	PS	2			2	Average

Req. ID	Functional Requirement (45)	Source	ID	Other appearances	Frequency	Novelty	Importance	Average	Priority
FR17	The showcase shall provide social interactions with components (voting, commenting on projects)	Workshop	1	2x	2	1	3	2	Average
FR30	The showcase shall allow users to request a presentation for a specific project	Workshop	1		1	4	1	2	Average
FR29	The showcase shall be able to display every aspect of a project	Interviews	CS		1			1	Low
FR31	The showcase shall include feedback of lecturers on projects	Interviews	PS		1			1	Low
	Project creation (5)								
FR09	The showcase shall take care of visual design aspects by automatically creating showcases through analysing uploaded files	Interviews	CS	3x Interview Workshop 1, 2	5	1	5	4	High
FR13	The showcase shall require the student confirmation before publishing a student work	Interviews	CS	Workshop 2	2	1	5	3	High
FR14	The showcase shall finalize project content after its publishment	Workshop	2	2x	2	1	2	2	Average
FR44	The showcase shall involve students in work creation	Interviews	CS		1			1	High
FR48	The showcase shall contain a selection of projects, selected by the students.	Workshop	2		1			1	Low
	Bonus features (9)								
FR25	The showcase shall provide webhosting space for personal portfolios	Workshop	1	Workshop 2	2	3	5	3	High
FR33	The showcase shall include a photo gallery of modules/project, via a specific hashtag on twitter	Workshop	1	2x	2	5	1	3	High

Req. ID	Functional Requirement (45)	Source	ID	Other appearances	Frequency	Novelty	Importance	Average	Priority
FR34	The showcase shall allow companies to create profiles with internship offerings	Workshop	1		1	4	2	2	Average
FR35	The showcase shall provide testimonials that are linked to user profiles	Workshop	1		1	3	3	2	Average
FR36	The showcase shall include a question box	Workshop	1		1	3	3	2	Average
FR38	The showcase shall provide information on guest lectures and lecturers.	Workshop	1		1	5	1	2	Average
FR39	The showcase shall provide information about modules and the department	Workshop	2		1	1	5	2	Average
FR52	The showcase shall provide searchable frequently asked questions	Workshop	1		1			1	Average
FR50	The showcase shall provide breadcrumbs	Workshop	2		1			1	High
	Design (7)								
FR11	The showcase shall use different templates depending on the content uploaded by the user	Workshop	2		1	3	5	3	High
FR32	The showcase shall adapt to different screen sizes (Responsive Design)	Workshop	2		1	2	5	3	High
FR46	The showcase shall have a consistent layout / templates	Workshop	1	Workshop 2	2	1	4	2	Average
FR47	The showcase shall have size limitations for contents	Workshop	2		1	1	3	2	Average
FR37	The showcase shall allow subscriptions and notifications for projects	Workshop	1		1	1	3	2	Average
FR31	The showcase shall allow users to request a presentation for a specific project	Workshop	1		1	4	1	2	Average
FR49	The showcase shall not provide a limited amount of preconfigured layouts.	Interviews	CS		1			1	Low

Req. ID	Non-Functional Requirement (15)	Source	ID	Other appearances	Frequency	Novelty	Importance	Average	Priority
NFR01	The showcase shall be official and recognized by the university	Interviews	CS	Workshop 1, 2	3	1	5	3	High
NFR02	The showcase shall be updated frequently	Workshop	1	Workshop 2	2	2	5	3	High
NFR03	The showcase shall utilize screen space efficiently	Interviews	CS	Workshop 2	2	1	4	2	Average
NFR04	The user shall know where to expect which content on each site	Workshop	1		1	1	4	2	Average
NFR05	The showcase shall be search engine optimized	Workshop	1		1	1	5	2	Average
NFR06	The showcase shall have authentic and realistic photos	Workshop	1		1	1	4	2	Average
NFR07	The showcase shall be administrated by one general instance	Workshop	2		1	1	5	2	Average
NFR08	The showcase shall provide simple content creation methods	Workshop	2		1	1	5	2	Average
NFR09	The showcase shall have a good overview of content	Interviews	CS		1			1	Average
NFR10	The showcase shall have fast loading and response times	Interviews	CS		1			1	High
NFR11	The showcase shall be free of charges	Interviews	CS		1			1	High
NFR12	The showcase shall act like a guide for personal portfolios	Interviews	CS		1			1	Low
NFR13	The showcase shall help students to make a choice when looking for universities	Interviews	PS		1			1	High
NFR14	The showcase shall use a readable font for all elements	Workshop	2		1			1	High
NFR15	The showcase shall be accessible by the public audience	Interviews	CS		1			1	High

4.5.3 Discussion

In total, sixty requirements were generated. Forty-five requirements are functional requirements; they describe direct functionalities and features that the showcase shall have. Fifteen requirements are non-functional; they describe properties of the showcase and its features, such as being fast, secure and user friendly.

Twenty-five requirements were given a high priority rating, twenty-nine requirements received average priority and six requirements have a low priority rating. This distribution says that the generated requirements consist mostly of very basic and important elements that one would not want to miss in the final product. Only a small amount of requirements (10%) could be left out without any consequences, if the requirements specification would be a demand and not a guide as in this project.

Forty-two requirements have one single source of origin and received the frequency rating of "one". Eighteen requirements were mentioned in at least two different sources, which results in a higher frequency rating. The frequency counts towards the priority of a requirement but does not necessarily say something about the creativity or importance of it. Basic functionalities are mentioned by multiple sources, as they are necessary parts of a showcase. Very creative and innovative ideas are therefore unlikely to be produced by multiple sources.

Table 7 compares the requirements with gathered data from creativity techniques and stakeholder interviews:

	Creativity Triggers	**Circle of Opportunity**	**Interviews**
Ideas	41	27	N/A
Requirements	27	21	24
Converted percentage	65.85%	77.78%	N/A
Individual profiles (7)	5	2	2
Project overviews (6)	3	2	2
Project details (11)	5	3	8
Project creation (5)	1	4	3
Bonus features (9)	7	3	0
Design (7)	3	4	1
Properties of website (15)	5	6	8
Total (60)	29	24	24
Novel (-> not present in existing showcases)	11	3	5

Table 8: Comparison of requirement origins

One can see that the amount of requirements produced by the two creativity techniques and stakeholder interviews varies only marginally. Creativity Triggers produced 28% more requirements than Circle of Opportunity and 12% more than all stakeholder interviews combined.

The conversion rate from ideas to actual requirements also varies between the two creativity techniques. Only 66% of ideas that were generated during the first workshop (CT) were converted into requirements. In contrast to that, 78% of generated ideas from the second workshop were successfully converted into requirements. Considering the number of generated

ideas, one can assume that Creativity Triggers produced a high amount of broad ideas while Circle of Opportunity produced a lower amount of concrete ideas. Interviews cannot be analysed in the same way, as the transformation from ideas to requirements occurred directly.

When viewing the amount of requirements the methods produced in each category, one can identify some dominance and abstinence of methods in certain categories. Creativity Triggers produced most results for individual profiles and bonus features but were weak in project creation. Circle of Opportunity was on top concerning project creation and design of the page but did not give many results concerning the detailed view of projects. Interviews produced most results in project details and properties of the website itself. No ideas or requirements were generated regarding any bonus features that the showcase could provide to the users.

One can see that creativity techniques provided additional value in areas where interviews could not provide enough data. Especially “bonus features” that are not directly connected to the concept of a student showcase were only generated by creativity techniques.

Sixteen requirements were identified as novel by comparing the extracted requirements with functionalities and features of existing showcases from 4.2 Showcase Reviews. Forty-four requirements were either present in reviewed showcases, or could not be checked (Project creation and administration aspects). This shows that 26% of the requirements are indeed novel and thus creative. Twelve out of sixteen novel ideas have creativity workshops as single source of origin, which supports the statement that creativity techniques produce novel results that are non-existing in other showcases (RQ1).

4.6 Prototype

4.6.1 Initial paper prototype

The prototype was initially sketched on checked paper (see Figure 22, 23 and Appendix Z). These first attempts took as described in 3.6 Prototype Design functional requirements with high priority and non-functional requirements into main considerations to form the design and layout of the website.

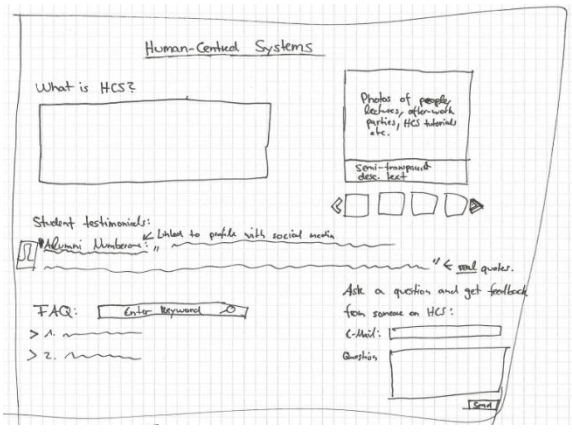


Figure 22: Sketched prototype homepage

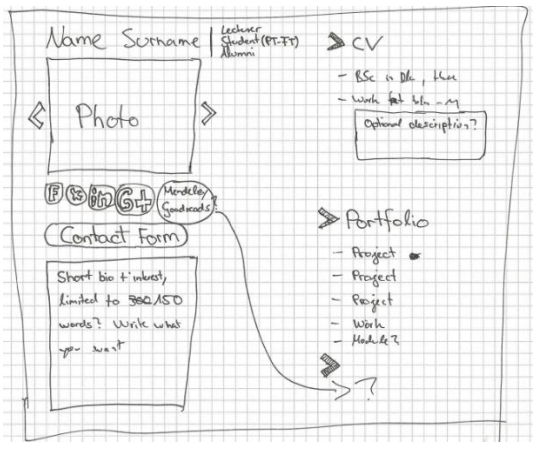


Figure 23: Sketched personal profile page

Paper prototyping is a “fast and dirty” method that is used to bring first designs into a material form to be able to communicate the basics of it to third parties. During this project, sketches were used to have a guidance while developing a digital, interactive prototype.

The amount of details that was included into the paper prototype is minimal, only main components and features were indicated by sketching their vague form and position in a frame that represented the size of the website.

4.6.2 Interactive Axure Prototype[21]

4.6.2.1 Introduction and overview

An interactive Axure prototype was developed by taking the paper prototype as a guidance. Axure provides the possibility to create interactive prototypes without the need for coding. The page is designed by using predefined widgets that can be dragged into the overall page. These widgets are diverse in their functionalities; some of them emulate real interaction and design changes through animations, some of them are simply graphics or forms.

These widgets can be linked to specific actions such as redirects. They allow for example the implementation of a button that redirects the user to another page by clicking on it. It is also possible to attach animations, conditions and scripts to widgets, which enriches the possibilities for prototyping enormously.

The general design and layout of the digital showcase was inspired by flat design and responsive design, as stated in chapter 3.6. The components of each page were designed to be in containers in order to allow the layout to respond to the density, size and orientation of screens. In a finalized and working version of the website, the components would ideally adjust themselves accordingly to fit into predefined layout patterns. This approach fulfils the requirements NFR03 of utilizing screen space and whitespaces efficiently.

The website was designed to be a stand-alone version of the representation of the study course Human-Centred Systems. No integration into the existing course description or structure at the official City University website[22] was intended. To make the showcase a part of the university and officially acknowledged, a link should be provided to the showcase. A city university logo and a link to the main university page in the footer contribute to the impression of the sight being official (see Figure 25, 26).

A sitemap was created to get an overall understanding of how the prototype was designed (see Figure 24). The main page is called “Home”. This page presents users and gives them an overview of where they landed. This page was mainly designed for new users, as it provides all relevant information about the study course itself. This is also a speciality of the designed showcase, as it is more than just a showcase. It is a web portal for the whole study course.

From the home page, the user has access to the navigation bar. The navigation bar links to the student showcase, to administrative tasks that users can perform and to a notification center that provides the user with information about messages and subscribed content.

The student showcase consists of different modules, which are categorized by academic years. This allows users to view the content and scopes of modules from the past. By selecting a module, the user is presented with an overview of the module. The overview contains relevant

[21] Accessible online at http://8kmuxn.axshare.com/home.html and as HTML files
[22] http://www.city.ac.uk/courses/postgraduate/human-centred-systems

information on the module and provides special features, such as the possibility for employers to propose a project for the next term. The provided media slideshow includes social aspects, as it can be connected to a twitter feed consisting of pictures and tweets about the chosen module (with the help of a module-specific #hashtag).

The user can also see all students who are taking or have taken the course and have direct access to their individual profiles. The last connection from the module are the student works that were submitted by students. The overview consists of all submitted projects and provides users with the possibility of filtering them by categories, grades, ratings and tags.

When a choice is made, the user is redirected to a detailed project view. This view contains information about project outline, the design process and encountered challenges. It allows users to implement media such as photos and videos and provides space for annotations and descriptions. Ratings, comments and sharing options provide the necessary social aspects to engage users with projects. Finally yet importantly, all submitted files can be viewed and downloaded as attachments.

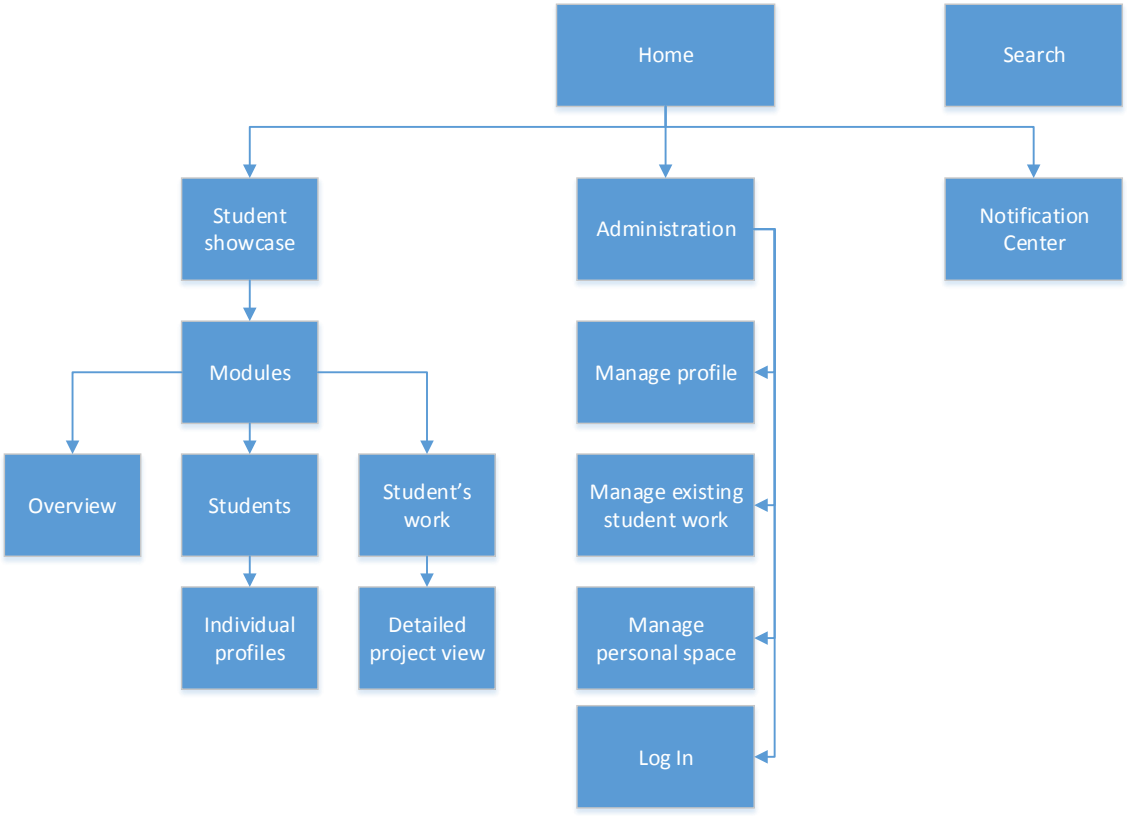


Figure 24: Sitemap of the prototype

4.6.2.2 Home page and navigation bar

The main page informs the user of what Human-Centred Systems is (FR39) and provides a slideshow of images and videos. The media can contain photos of classrooms, lectures, portraits of lecturers or general content about HCI. A description text underneath should explain what content is visible and where the user should focus his attention on. This feature was mentioned often in interviews while reviewing existing showcases and makes up one of the requirements (FR12).

Student testimonials from current students and alumni provide feedback on the course and are linked either to individual profiles (if available) or to social network profiles as LinkedIn. These aspects should provide an authentic impression and are rewarded with the user's trust (NFR06). Testimonials are also useful for prospective students, as they can provide help and guidance in choosing the right study course and university (NFR13).

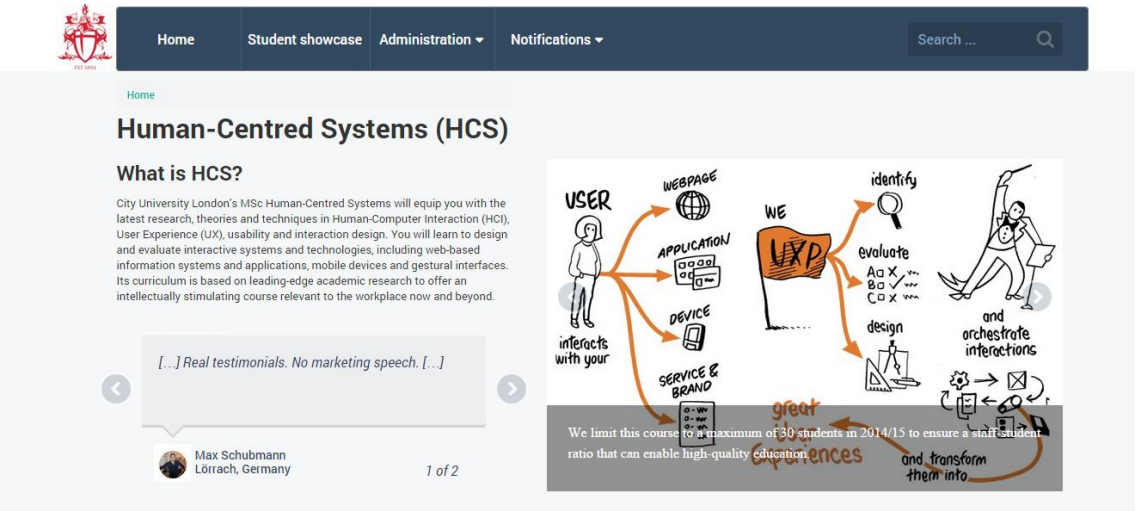


Figure 25: Interactive prototype homepage 1 / 2

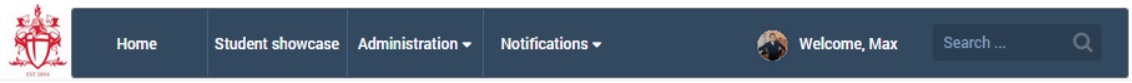


Figure 26: Navigation Bar

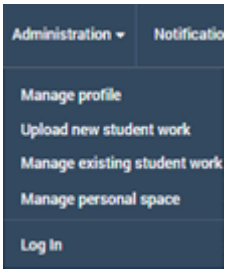


Figure 27: Navigation Bar 1

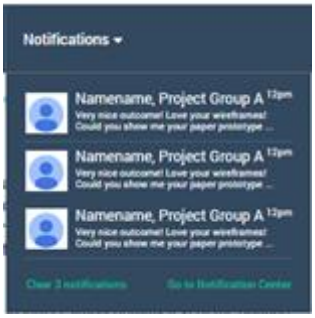


Figure 28: Navigation Bar 2

The navigation bar on top provides links to the student showcase, administrative tasks and a notification centre. Under administration (Figure 27), users with existing accounts can log in. Once logged in, multiple options become available:

1. **Manage profile**: Users can manage their user profiles, add and remove content for their CV and personal portfolio, connect profiles with social networks and reading libraries.
2. **Upload new student work**: Users can create new items for the student showcase. This option was created as part of the prototype and will be described in more detail (FR13).
3. **Manage existing student work**: Users can review their pending student works, perform changes and finalize their projects for them to be available in the student showcase. (FR14)
4. **Manage personal space**: Users can manage their own personal web space. This space can be used by the user in any way they like, e.g. to host their personal portfolios or projects that are unrelated to the study course (FR25).

The notifications tab provides users with notifications about other users' comments and private messages. One of the requirements on the showcase was to include social aspects such as voting on the quality of projects and leaving comments (FR17). Notifications allow project creators to see if any social actions were performed on one of their projects instead of having to check each

project individually. The same applies for the functionality of subscribing to projects (FR37), as the user will be notified about any changes and activities concerning subscribed items.

The search bar in the navigation bar provides search functionalities across the whole showcase, which makes a search for individual profiles, modules and single projects possible. This feature is designed for experienced users who already know what or who they are looking for.

At the top of the page, the user can find navigational breadcrumbs to get a better sense of orientation (FR50). The font used on the whole showcase is Google's "Roboto" sans-serif typeface family. It was designed to provide increased readability on digital screens and is used as the main font in modern applications and mobile operating systems (NFR14).

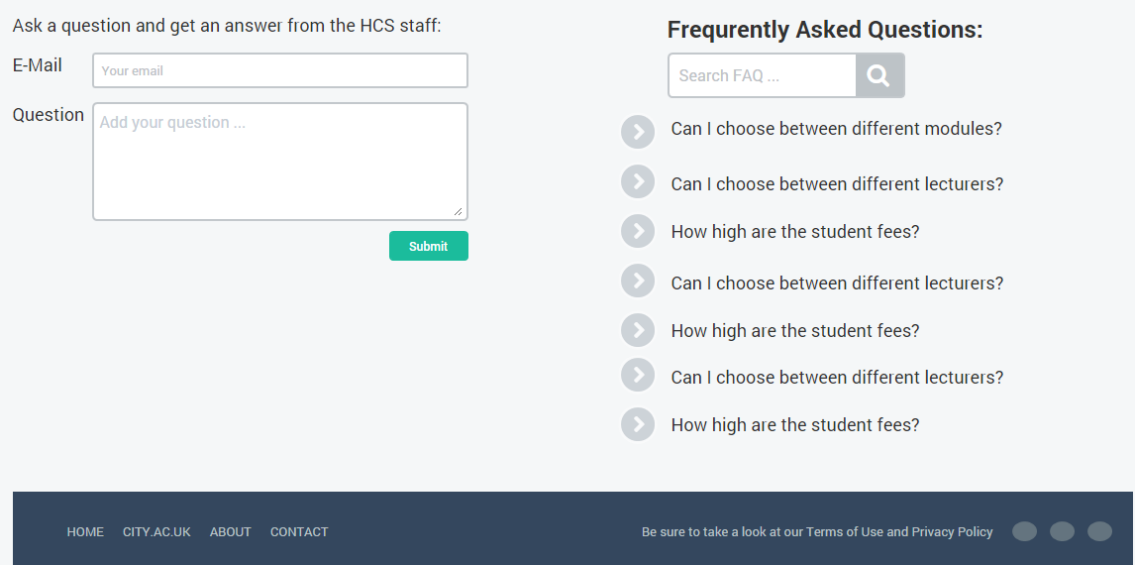


Figure 29: Interactive prototype homepage 2 / 2

The second part of the homepage (Figure 29) consists of a Frequently Asked Questions section and the possibility to submit an own question. The design of the expandable answers to questions was chosen to fit in more questions and make it more compact. The ability to ask a question and the functionality to search the FAQs were present as requirements (FR36, FR52). The user has to provide an e-mail address to ask a question in order to be notified when the question is answered by somebody and to prevent abuse of the functionality.

4.6.2.3 Student showcase

Figure 30: Module and Academic Year selection

The first part of the actual student showcase consists of a selection of course module (FR26) and the academic year that one would want to view. It was decided to separate the selection of the

academic year and course module, as modules can be different throughout the years. Each academic year has its own selection of modules and each module can have a different module content, module outcomes and lecturers. The ability to select past years and projects (FR45) provides current and prospective students with an overview of the expectations of a module, which could help students to make a decision towards the study course and university (NFR13).

The modules are represented by flat squares with pictures as a background. The pictures should ideally be photos from the lectures of each module to be more realistic and authentic (NFR06). The circle in the middle contains a number which can be used either to represent the number of students who attend the module or the number of submitted student works to provide a fast overview of existing content (NFR09).

4.6.2.4 Module overview

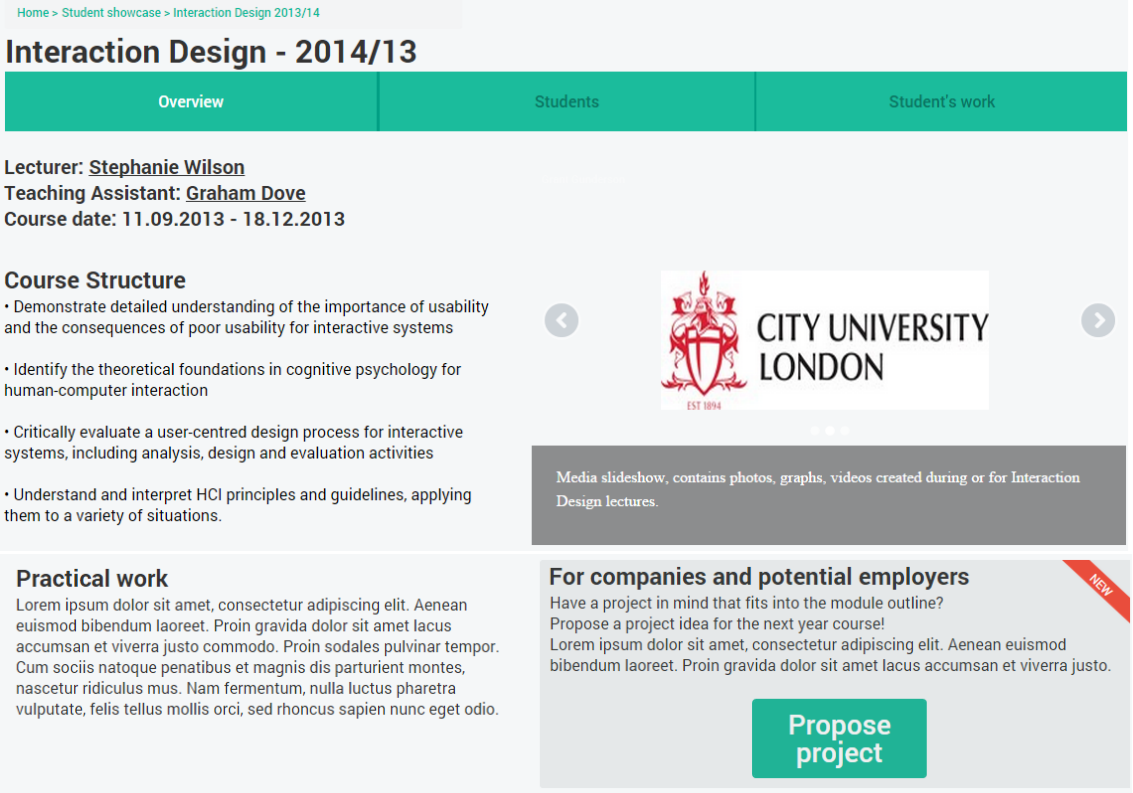


Figure 31: Module Overview

Once a module was selected, the user gets to a page with three different views. The first view contains an overview over the module. The overview provides the user with information on lecturers; course structure and practical aspects of the module (see Figure 31). The lecturer and teaching assistant are linked to individual profiles, which provide background information, accomplishments and photos (FR08, FR22). The practical work should describe scope and brief of projects that students perform during the module (FR05).

A slideshow provides possibilities to show photos of activities and content that happen during modules. These pictures can be automatically imported from twitter, if each module gets its own hashtag combination that students can use while tweeting about the module (FR33). Another use for the media slideshow can be a video archive of lectures. Lectures throughout the

academic year can be recorded and published on YouTube. These videos can be implemented into the course overview to allow users to (re)view specific lectures.

On the bottom right corner, a project proposal option was designed for companies and employers. Interested parties can compose a project proposal and submit it to the lecturer of the module. In case the proposal is accepted, the module's practical part in the following academic year will work towards the completion of the proposed project. This allows students to work on meaningful projects and benefits the university and companies as it creates new relationships and links between the institutions (FR31). The "new" ribbon represents the novelty of the feature and should be used in the future to mark updates (NFR02).

4.6.2.5 Students list

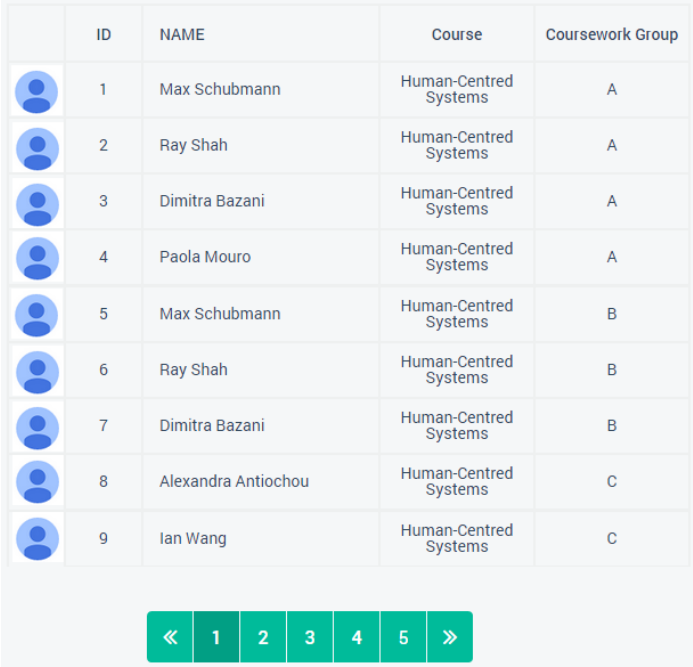


Figure 32: Prototype: Students

The second view of the module consists of a list of students who take or took the module in the selected academic year. Each item in the table contains a photo of the student, its student id or showcase id, in case students with identical names exist, the study course (as students from multiple courses are present in some modules) and the assigned or chosen coursework group.

This view allows users to get directly into student profiles to get information about them and the projects that they have done (FR08). The profile pictures next to the student names should make the showcase more authentic and personal.

4.6.2.6 Individual profiles

An interaction with the student name redirects the user to the individual profile of the selected student (see Figure 33). Individual profiles consist of four different content boxes:

1. The name and profile picture of the individual, along with hyperlinked icons to social media profiles (FR08, FR21).
2. Background information (current occupation, country of origin, area of expertise, etc.) along with a short biography or description text composed by the individual (FR08).

3. A form to provide contact possibilities other than with any social network interactions (FR23).
4. Information about the individual consisting of a portfolio, a CV and a reading list. The portfolio should only consist of the work that was done as part of the modules. The items consist of the module and academic year, the group number or individual labelling and the project name. The items also contain an icon on their right site that symbolizes that the item is linked to an actual student work in the showcase.
   The Curriculum Vitae should automatically retrieve updated information from LinkedIn (FR19). Portfolio and CV are provided with a "Download"-button that generates a printer-friendly version of the complete portfolio or CV of an individual, which should very useful for potential employees (FR22).
   The reading lists are the last part of the individual profiles. User can connect their profiles with reading services such as Mendeley[23], Zotero[24] and goodreads[25] to provide information about what they were reading in the past and what they are currently reading. This service could show what kind of articles and books were useful for specific projects or modules (FR24, FR07).

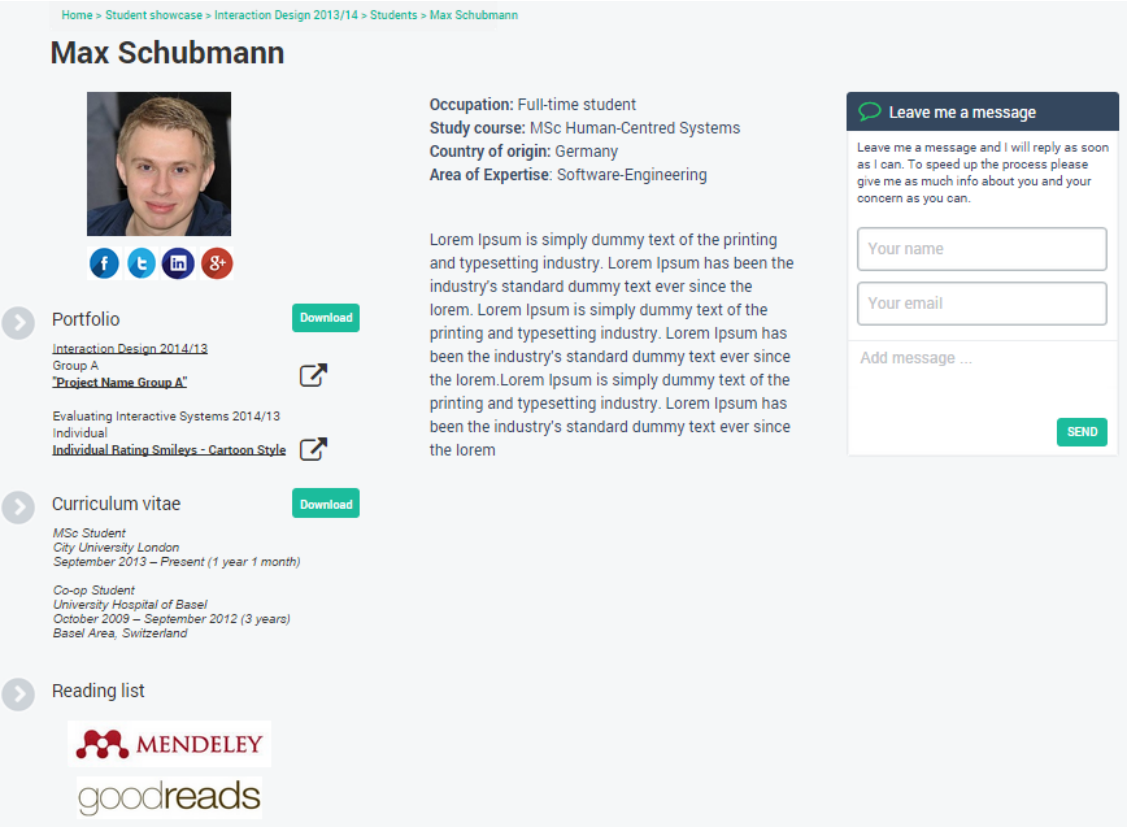


Figure 33: Individual profiles

4.6.2.7 Student work overview

The third view of the "Module overview" page (Figure 31) is a student work overview (Figure 34). It contains all submissions from groups and individuals and is by default sorted to display the newest submissions first (FR27). Submissions are grouped automatically in their submitted

[23] http://www.mendeley.com/
[24] https://www.zotero.org/
[25] http://www.goodreads.com/

categories such as group courseworks, tutorial outcomes or individual courseworks to get a better overview of all submitted works (FR43).

Submission items contain a picture or icon that should be representative of the submitted content. Submission name and the names of individuals who worked on the project are stated below. Lastly, the amount of comments that users wrote for the submission and the average user rating are presented (FR17). Social interactions such as comments and ratings provide the showcase with an active property; users tend to revisit sites more often as social aspects tie them to the page.

On top of the items, a ribbon indicates that the submission belongs to the user who is currently logged in. Own submissions become more distinguishable from the rest of the submissions. An empty and full heart indicate the subscriptions status of the submission. It becomes easy to see if the user is subscribed to one project or not. Additionally, subscription becomes possible with one single interaction step.

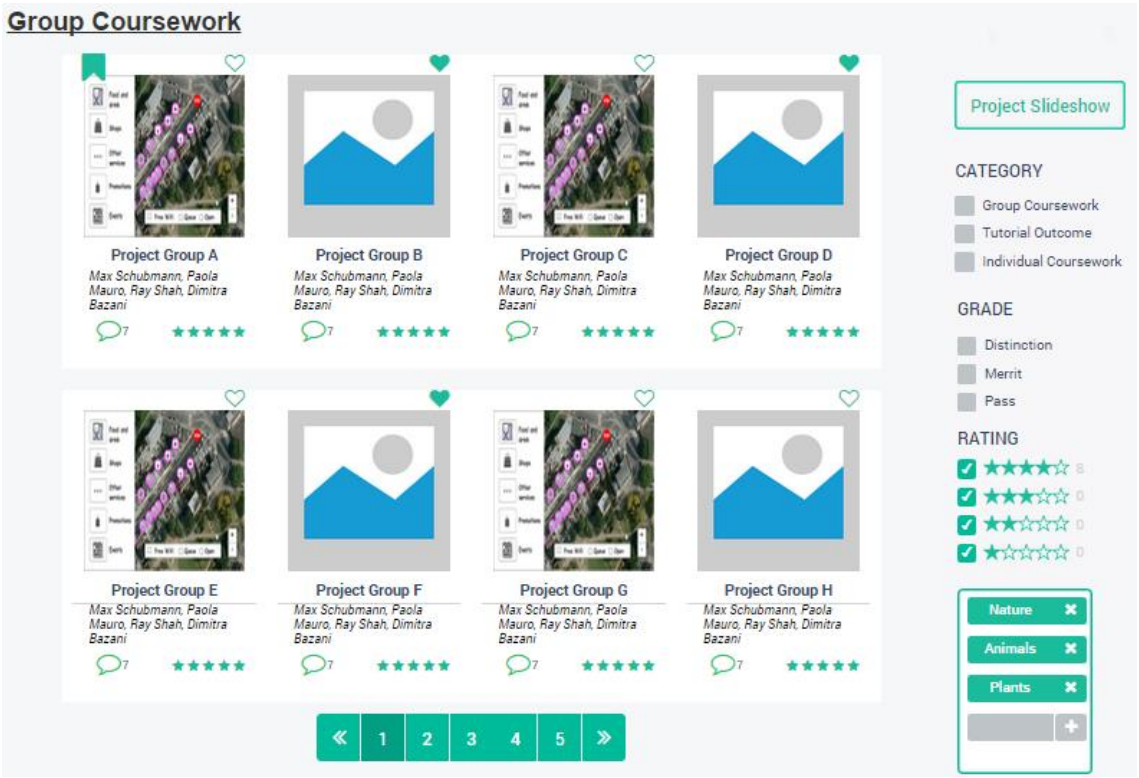


Figure 34: Student work overview

The right side contains a button to start a project slideshow. The slideshow consists of a randomized selection of deliverables from high quality submissions. The slideshow aims to help the user explore content without having to browse for it manually (FR20).

The rest of the sidebar consists of filtering options to allow easier exploration of content. Submissions are filterable by category, grade (if agreed upon by the students) and user ratings. The option to filter projects by their grade or rating allows users to search specifically for very high rated projects (FR06).

Below the ratings, a tagging systems provides the option to filter submissions that have tags of a certain value. Tags can consist of deliverables such as “Wireframes”, “Personas” or “Sitemaps”.

Users who look for projects with these kind of deliverables to inform their own work can efficiently use this tagging system (FR16). This option can also benefit potential employes, as it becomes easier to find projects that fit into their specific demands.

4.6.2.8 Detailed project view

Upon selection of a submission, a detailed view of the project is entered (Figure 35). The first elements of the detailed view is the project name, the subscribed/favourite status and the names of the group members, if any available. The names are linked together with the group members and can be selected to invoke their individual profiles.

Below the group member list, a tagging system is positioned. The tagging system shows automatically and custom added tags that describe and categorize the nature and content of the content (FR16). The tags are equipped with a "+" and "-" icon which allows users to vote on the accuracy and suitability of tags. Tags with a high ratio of plus ratings are positioned at the front; tags with a high ratio of minus ratings get either hidden or deleted. This system prevents abuse of the system by entering non-relevant or abusive tags and unburdens the authors of the project, as they do not have to review every suggested tag by users. The grey "+" icon on the right side allows users to enter their own tags for the project.

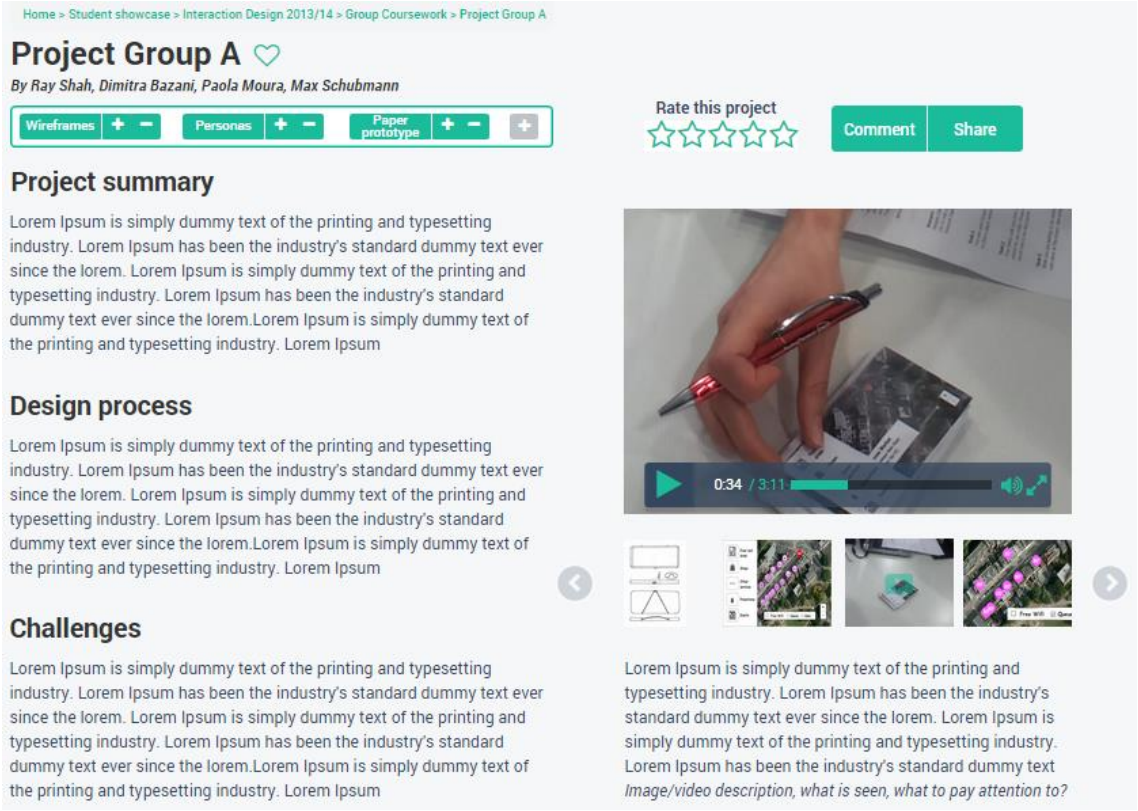


Figure 35: Detailed submission view

The next part consist of three text elements that describe the project's content, design process and encountered problems during the execution from the perspective of the students (FR03). The text elements should have size limitations to force students to be precise in their formulations (FR47). The design process and challenges are something that most reviewed showcases were missing, even though they are very important aspects of a project, in some cases even more important than the actual outcomes.

A 5-star rating element, comment option and a share button are placed on the top right side (FR02, FR17). The 5-star rating was chosen as a voting element to allow a variety of ranged quality ratings. The comments option and commenting section (Figure 36) provide users with the possibility to communicate with the project authors, to leave feedback or ask questions. Interactions between users on the showcase enhance the value of the website and give users a reason to revisit the page continuously. The share button provides basic functionalities to share the content on social media platforms and via E-Mail.

The right side of the page consists of a media-viewer. Authors can display pictures, videos and other browser-compatible formats that are relevant to the showcase of the project (FR01). In contrast to slideshows from previous pages, a media switcher was chosen as presentation mode to allow users to scan through available media while one main media element, such as a video, is active.

The text below the media provides descriptions and annotations to the displayed media. The intention is to inform the user of what is visible, what should be paid attention to (FR12). It can also be used as alternate text for visually impaired users. Most of the reviewed showcases did not provide any annotations or descriptions for images that were used to display projects. It was difficult to know which part of the pictures was relevant and what exactly it displayed.

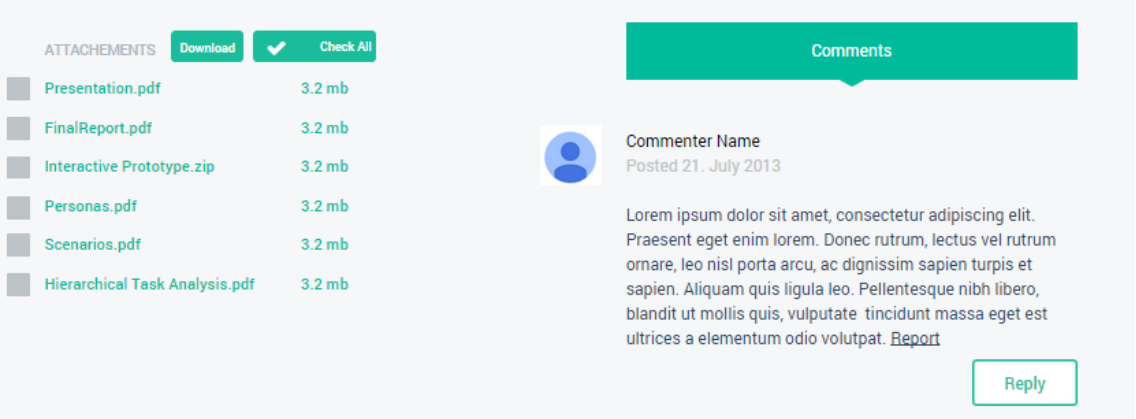


Figure 36: Attachments and Comments

The last part of the page is the attachments section (Figure 36). As the showcase can not display all the components and parts of bigger projects, a functionality is needed to provide users with the ability to view the full range of outcomes of a project. This allows authors to showcase components that they spend time on producing, but which are too broad or simply not in the right format to conveniently display them in the form of a website (FR29).

An attachments section also provides the possibility to add interactive prototypes or software prototypes such as java applets, executable files or zipped html files to the showcase of a project. Media-types such as 3D models for printers could also be made available and would not go to waste (FR01). For a more user-friendly experience, each file type could be connected to a web-oriented viewer that would, in the case of 3D models, directly render and display the object in the user's browser. Such a feature is truly novel and innovative and was not seen on any other showcase online. It is an outcome of a creativity workshop, it shows that workshops are truly useful and provide additional value in feature generation in software and design development.

The downloadable files should contain tooltips that contain descriptions of what the file contains, what importance it has for the project and how it fits into the design process.

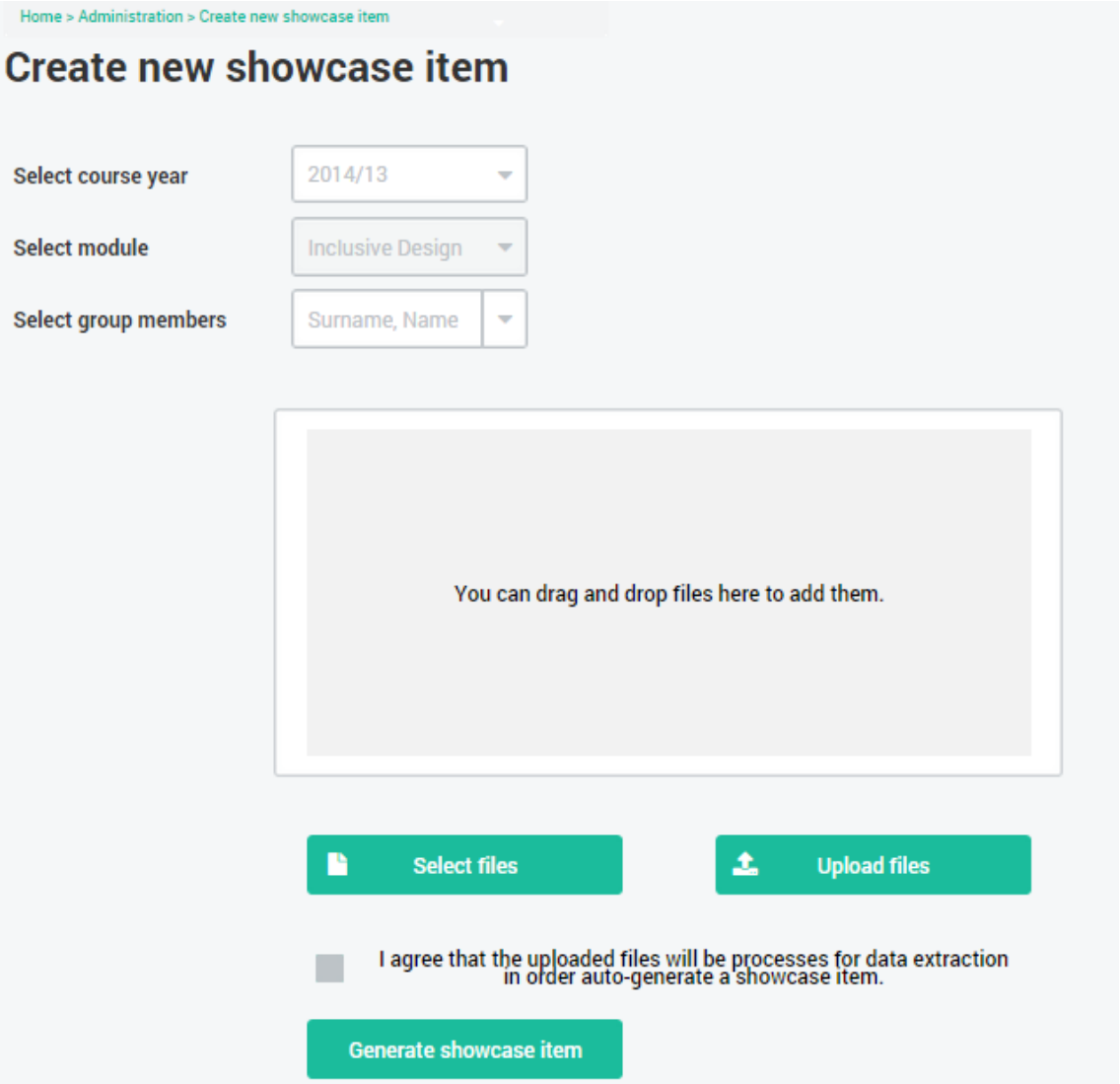


Figure 37: Showcase item creation

The last part of the prototype is the page to create a new showcase item (Figure 37). This page can be accessed when logged in under “Administration” -> “Upload new student work” in the navigation bar (FR44).

To create a new showcase item, the author has to select the academic year and module in which the work was done. Optionally, group members can be assigned if the work was done as a group.

The creation of the showcase item works semi-automatically and is not implemented in the prototype. The author has to select files that he wants to attach to the project. The system behind the showcase analyses the files and extracts relevant data. Media files such as pictures, charts or videos are added to the media viewer. Text elements are scanned for chapters of summaries, design processes and challenges and used in the showcase. All elements are added as attachments for users to download, using the provided functionalities (FR09).

The author received a pre-filled template of the generated showcase item. Changes can be made directly afterwards by the user and each selected group member to modify the automatically generated content and layout of the project. This solution takes care of most visual design of the showcase items and allows authors to concentrate on the content. This feature is the most demanded one, as it was mentioned in both workshops and in the interviews by multiple stakeholders.

Once a project is submitted, an evaluation of the created item is done by a designated administrator (NFR07). The administrator can make changes and suggestions, which are communicated to the project's author. If the author accepts all changes, the item is finalized and made available in the student showcase (FR13, FR14). The administrator's goal should be to ensure an overall high quality standard of showcase items.

4.7 Prototype Evaluation

4.7.1 5-seconds Test

In order to initial impressions and understanding of the layout of the page, a 5-seconds test was conducted with 20 random online users with the help of usabilityhub.com. Users were presented with a screenshot of the project details site (see Figure 35) and asked three questions. The first question was: "What do you think this page was about?". The results can be summarized in a WordArt picture (Figure 38):

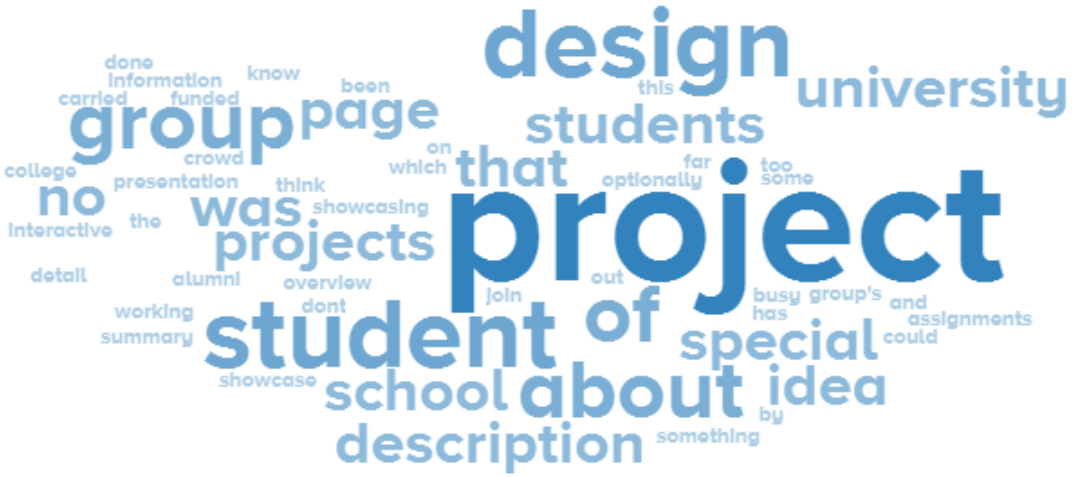


Figure 38: 5 seconds test - Results 1

It is visible that participants recognized the shown content as some sort of "student project" that is related to "university" and "design". This result shows that the overall layout and of the page is understandable.

The next question asked on what element of the page the users most concentrated on to see if any design elements are too outstanding and distracting.

Figure 39: 5 seconds test - Results 2

The results in Figure 39 show that users mostly concentrated on the video, the text, the title and pictures of the project, which is a healthy distribution between all of the existing elements. No single element was named more often than others.

The last question asked the participants to rate the quality of the page on a Likert scale from one to five. The calculated average of all ratings is 3.2, which reflects a high to average initial impression of the presented page.

In order not to rely solely on initial impressions, more quantitative data about the quality and usability of the developed showcase was collected in user tests. The results are reported in the following section.

4.7.2 User Testing

After each user testing session thinkaloud protocols and observational data of system use were transcribed to the computer. This made it possible to enrich them with details from screen capture data that was reviewed shortly after each session (see Appendix I).

The following feedback was extracted from the user testings:

Positive

1. Participant like the media viewer and attachments (Individual profile)
2. Participant likes social network and direct contact possibilities (Individual profile)
3. Participants understand the provided filters and functionalities (Projects overview)
4. Participants are pleased with the familiar drag and drop files function. (Project creation)
5. Participants understand the layout of the pages
6. Participant expect most functionalities to work as they are supposed to work in the final project.

Negative

1. Participant was looking for a “best projects” link but there is none. (Module overview)
2. Participant wanted to see all best projects, not just from one year (Showcase)
3. Participant did not understand the purpose and functionality of the tagging system (Detailed project)
4. Participant does not know what the reading lists are. Is not familiar with Mendeley or Goodreads (Individual profile)

5. Participant noticed that the filter option for 5 stars is missing (Project overview)
6. Participants are not fully familiar with the student work creation. Questions occur what the next step will be (Project creation)
7. Users are not sure about the difference of upload files and select files (Project creation)
8. Participant would expect a note that group members are optional (Project creation)
9. Participant did not expect tasks for students under “Administration” (Navigation)
10. Participants have problems with the mouse-hover navigation menu (Navigation)
11. Participants were confused of where to find “students”. One user was looking for all students from the study course, but this option is not available. (Navigation)

The prototype will have to incorporate user feedback in order to improve its usability and the overall quality of the showcase.

- The students section could be implemented into the main navigation bar in order to provide a student list of the whole study course and to improve its accessibility.
- A link to a preconfigured (best) student work section (only show distinction & 5-star rated projects) could be added to the overview of a module to improve accessibility.
- Tooltips or other explanation methods (question marks?) can be implemented to explain purpose and functionality of content (tagging system, reading lists) to users.
- Add an additional filtering option for 5-star ratings
- Provide an explanation to the project creation page to make the processes understandable to the users.
- Delete “Upload files” option and upload selected files automatically, display a preview when uploads complete.
- Make the group-members selection optional.
- Perform additional user tests for the navigation bar to come up with a better interaction architecture for administration tasks.
- Remove hover-menus and let them appear by clicking on the item.

In summary, the participants successfully understood the layout, purpose and functionalities of the prototype. Single pages such as the project creation page, which were not completely implemented, raised questions of how the next page will look like and how the uploaded files will be analysed. The Information Architecture of the prototype was not intuitive enough, as participants hesitated when looking for a student list. These aspects require more work and additional user guidance to provide a flawless user experience. The question of how well the prototype addresses user needs (requirements) will be further discussed in Chapter 5.

5 DISCUSSION

5.1 INTRODUCTION

This chapter revisits the set out objectives and research questions defined in Chapter 1 and provides a discussion of whether the objectives and research questions were met and answered or not.

The chapter also discusses the results of the work during this project and puts it into a broader context, which is reported about in Chapter 2 – Literature Review. It compares the results with what other people have reported and identifies similarities and contradictions between them.

5.2 OBJECTIVES AND RESEARCH QUESTIONS

5.2.1 Overall aim

The overall aim of this study was to design an innovative prototype of a digital showcase by the generation of creative and innovative ideas using creativity techniques in design workshops. This aim has been achieved.

This aim was split into two high-level objectives, one including the design of a prototype of a digital showcase and the second one ensuring that prototype ends up being innovative by investigating and including creativity techniques into the design process of the showcase.

Creativity and its implementation into design processes to design innovative products was researched in a literature review and executed as design workshops. The results were used to design and to develop an interactive prototype of student work.

A list of objectives was established to test the success of this study, each of which will now be discussed.

5.2.2 To investigate creativity techniques in a design workshop

This high-level objective was decomposed into three more detailed sub-objectives. If all three sub-objectives are met, the high-level objective of investigating creativity techniques for the use in design workshops is considered as met as well.

To gain a better understanding of creative design processes:

The literature review gives an overview of definitions of creativity and how it can be implemented into design processes. Creativity is not only a word. It is the qualification of a person, a process and a product and is thus a part of each of them. It can be facilitated through various methods and people came up with models of processes that integrate creative aspects. Three different types of creative processes are presented. Creativity workshops are covered as a method to implement the creative process from a situationalist perspective.

To get a deeper understanding of how creativity workshops are used and how they aim to support creative idea generation, a review of a past project that implemented creativity workshops is given. Afterwards, influencing factors such as production blocking and free riding are identified and analysed to understand social phenomena, which occur during social creativity activities such as creativity workshops.

A better understanding of creativity as a whole was achieved and the knowledge of how creativity can be fostered in design processes was acquired. As a result, this knowledge informed the design process for this study and was crucial for its success.

To identify suitable creativity techniques:

The literature review summarizes and describes fifteen creativity techniques that can be used in context of interaction design and techniques that were previously used by (Jones et al., 2008) in creativity workshops. Additionally, a classification of a creativity techniques database[26] by (Sutherland, 2010) is reviewed.

As a result, "Creativity Triggers" and "Circle of Opportunity" are identified as suitable creativity techniques. Creativity Triggers is a technique that was previously used in creativity workshops and evidence exists that it produces both novel and important ideas. It produces immediate, diverse ideas and was thus suitable for the planned creativity workshop.

Circle of Opportunity was identified as a technique that is similar to Creativity Triggers, is it uses exploratory creativity for initial idea generation. It is a technique that is rarely used by academics and therefore lacks appropriate evidence and data to inform its effectiveness. The property of being unevaluated and underused provides this study with a possibility to deliver novel data about the use of Circle of Opportunity in creativity workshops.

To compare produced results of used creativity techniques:

The two used creativity techniques produced many useful raw data in form of ideas and desired properties for the digital showcase. These ideas were rated by the participants of the workshops by novelty and importance, which are two main properties of creativity, as defined in Chapter 2. The ideas were converted into requirements, which guided the design and development of the digital showcase.

Requirements were compared with each other and with requirements that were generated from stakeholder interviews. Thirty-five out of sixty requirements originated from creativity workshops, which makes up 58% of the requirements when comparing creativity workshops with traditional data gathering techniques such as interviews.

The comparison of the results of Creativity Triggers and Circle of Opportunity revealed that both techniques have their own strengths and weaknesses. Creativity Triggers produced the most ideas but its converted percentage rate to requirements was significantly lower than the one of Circle of Opportunity.

These results can be interpreted as Creativity Triggers producing more unimportant or infeasible ideas. When regarding the definitions of creativity in Chapter 1, one can on the other hand say that as Creativity Triggers produces more results, it is the more creative and effective technique. It is difficult to say which creativity technique comes out as the better or more effective one. As the discussion in Chapter 4.5.2 shows, the two different techniques have their own strengths and weaknesses when producing results. Creativity Triggers produces more creative and unforeseeable ideas that were not closely related to a student showcase, while Circle of Opportunity produced results that were tightly connected to the way content is displayed and how the whole administration and creation of student work is handled.

[26] Mycoted.com

5.2.3 To develop an interactive prototype of a student showcase for the study course Human-Centred Systems

This high-level objective was met, as a working prototype of the student showcase was developed. To ensure that the objective was met, the decomposed sub-objectives will be tested for compliance.

To generate ideas for the showcase with stakeholders

Ideas for the showcase were generated by performing and analysing stakeholder interviews. Interviews were performed with five participants. All of the participants were somehow connected to the university and study course, be it as current students or as future students of Human-Centred Systems. This was very useful, as the interviewees knew exactly what they were talking about, what a showcase should look like to host their own work and if a showcase is even wanted or not. Especially feedback on existing showcases was useful for idea generation, as participants started to glow up with ideas and opinions about what they like and what they do not like. When asked before presenting actual examples of showcases, participants were not sure what they want from a showcase, but after seeing a few examples, they knew exactly what was missing, what was good and how they would like to change the showcases to make them better for themselves.

A second method to generate ideas was to perform design workshops with stakeholders. These workshops used creativity techniques to support idea generation and produced roughly 60% of the overall ideas for the showcase.

Three different stakeholder groups were included in the generation of ideas. Current full-time, part-time students and prospective students participated in interviews. Current students and closely related individuals participated in workshops.

Overall, more than 80 ideas were generation by stakeholders for the digital showcase, which satisfies this objective.

To synthesise generated ideas into requirements

The majority of ideas was converted into requirements and merged together into a single requirements specification documents, which satisfied the objective. Requirements consist of a requirement ID, the requirement itself, the source of origin and of ratings such as novelty, importance and frequency. Not all ideas generated by stakeholders were not converted as some of them were already filtered out by participants during workshops; some of them were not feasible for an implementation into a prototype. Overall, 60 unique requirements were extracted from over 80 generated ideas, which makes up more than 75%. This satisfies the objective. The requirements were categorized into functional and non-functional requirements. Functional requirements were further divided into five content areas such as individual profiles, project overview and project creation.

The requirements itself were not directly taken as requirements but more as feature and design suggestions. It was up to the designer to implement requirements or to decide to ignore them, as no conditions existed that stated that requirements had to be fully implemented.

To create an appropriate design solution

A design solution for the digital showcase was created and developed as a working prototype. Requirements were converted into a design solution by sketching possible layouts on a piece of paper. These sketches were further refined and modified as interactive wireframes with the help of the software Axure RP 7.0. Overall, nine different pages were developed as part of the prototype. The prototype includes basic content and functionalities such as the home page, the ability to choose and view student works from different modules, individual profiles and an automated content uploader.

To ensure that the design solution is appropriate, a usability evaluation was performed on the prototype. Three user-testing sessions were performed each with three tasks to identify positive and negative aspects of the prototype and to recognize areas that need change or improvement. The evaluation showed that the overall quality of the developed showcase is very high and that users had no major difficulties navigating and operating the website.

A five-second test revealed that even random users that are not familiar with the study course or the university understand the content and layout of the detailed student project presentation. The overall quality of the displayed page was rated between the values of 3 and 4, with 5 being the best quality an 1 being the lowest quality rating.

The performed tests provide not necessarily significant results as only a limited of users was tested. Nevertheless, initial user feedback states that indeed an appropriate and well-done design solution was created, which satisfies the set objective.

5.2.4 RQ1: Does the integration of creativity workshops into the design process produce any creative ideas that no other existing showcase has?

Yes, it did. As one can see in the discussion on requirements in 4.5.2, sixteen novel requirements were generated that were absent from all other reviewed showcases. Ten of the sixteen requirements were integrated into prototype. The workshops developed creative ideas that are absent at other showcases and that upgrade the showcase from just being a showcase to a platform for the entire study course. Ideas to include reading material of students into each module, to link individual profiles to social networks and reading databases such as Goodreads and allowing employers to request projects in modules as a future coursework are just a few of the especially creative ideas that were generated by creativity workshops and their utilized creativity techniques.

5.2.5 RQ2: Which creativity technique produces higher rated ideas?

As stated in the discussion about the comparison of creativity technique outcomes, this question is rather difficult to answer. Creativity Triggers and Circle of Opportunity create results that are focused on different aspects. Creativity Triggers produces more creative and broader ideas, which are not necessarily focused on the set goal. Circle of Opportunity focuses on the other hand on the given task and creates results that are important to fulfil the task, in other words ideas and properties that make up the fundament of a product or solution.

The comparison of idea ratings showed that Creativity Triggers produces a higher quantity of results and ideas that are being rated as more creative. Circle of Opportunity on the other hand produces results with a very high importance rating. Most generated ideas by Circle of Opportunity were rated with the highest importance rating possible.

5.3 BROADER CONTEXT

This project has produced two main results that can be put into broader context and compared with existing work described in Chapter 2 and with existing showcases reviewed in Chapter 4.

Creativity techniques and design workshops

Results about the use and outcomes of creativity techniques in design workshops can be compared with reviewed literature. Creativity workshops were already included into the design process by (Jones et al., 2008) as part of a framework called RESCUE (see Chapter 2.3). In one of the projects where RESCUE was used, data was collected about the ratings and conversion rates of ideas generated during workshops by different creativity techniques. Similar to the workshops performed in this study, Creativity Triggers were used as one of the creativity techniques. The total amount of ideas generated by the use of Creativity Triggers is coinciding with the amount of ideas generated in this study.

(Jones et al., 2008) report that 38 ideas were generated during the APOSDLE project, 22 of them were associated with use cases and thus converted to requirements. The resulting conversion rate equals 58%. In comparison to that, participants in this study using Creativity Triggers generated 41 ideas. 27 of them were converted to requirements, resulting in a conversion rate of 65%. These results are very close to each other, which produces an estimated value of how many ideas Creativity Triggers usually generate.

Furthermore, a comparison that can be made in regard of the outcomes of Creativity Triggers is the amount of novel and important ideas. During the APOSDLE project, Creativity Triggers generated a high amount of novel & important ideas, very few novel but not important ideas and a high amount of important but not novel ideas (see Table 3). These results said that Creativity Triggers produce a high rate of ideas that are of importance to the project, novel or not. In contrast to that, this results of this study shows that Creativity Triggers produced many ideas that were not rated as very important. A lot of extra features and bonus content was generated which is nice to have in a showcase, such as reading lists and the ability to request presentations for showcased projects. These features were all generated by the use of Creativity Triggers and were given a very low importance rating. This result contradicts the findings of (Jones et al., 2008) and presents Creativity Triggers as a more versatile and less quality focused creativity technique.

A comparison of the use and results of the creativity technique Circle of Opportunity is difficult, as there has been little to none research done about the use of Circle of Opportunity in creativity workshops. In literature, the technique is described and presented a very versatile technique that supports very broad idea generation through the combination and exploration of attributes. In practise, the results of the technique were very focused and practical focused, as results heavily depend on the choice of attributes that participants decide on. As the formulation of the problem (stage one) was already taken care of by the researcher, participants only focused on the generation of attributes and their free-association. The process was too focused on solving the problem of creating a showcase. The chosen attributes were chosen as attributes of the showcase itself, which limited the possibility of generating creative ideas.

Participants feedback about the use of Circle of Opportunity was predominantly negative, as they had troubles to understand how exactly the attributes and their free-association was supposed to support them in generating ideas. They described the use of attributes as too limiting and not straight to the point, which resulted in a lot of repetition despite having different

attributes. A pre-selected range of attributes or guidance while selecting attributes would improve the overall quality of the technique. My recommendation for the use of Circle of Opportunity would be the combination of Creativity Triggers and Circle of Opportunity as one single technique. Creativity Triggers produced results that were especially novel; Circle of Opportunity produced results that were especially important. A combination of the two of them can result in higher quality results. As Circle of Opportunity needs 12 attributes to be performed and Creativity Triggers consist of seven adjustable triggers in total, the two techniques can be combined rather easily. Out of the 12 attributes, six or seven of them have to be pre-defined as the creativity triggers. Additionally, each attribute has to be followed by example questions to trigger idea generation. I believe that such a unification of the two creativity techniques could result in a new, highly effective creativity technique.

Showcase prototype

The developed showcase can be compared with existing showcases. The closest existing showcase to the developed prototype is the Copenhagen Institute of Interaction Design (see Chapter 4.2.9). Its website provides information about modules, projects and students and the design of the created prototype is inspired by the design of the CIID Copenhagen.

Nevertheless, the created prototype contains novel ideas and aspects that make it innovative and unique. Overall, the designed prototype became far more than a simple showcase. It resembles more a platform or portal of the whole study course Human-Centred Systems as it provides more than just a showcase of projects. Users get their own accounts with profiles and social network aspects. They can write each other messages and get notifications about subscribed projects. In addition to that, the designed prototype provides content and context to showcased projects in previously non-existent detail. No reviewed showcases were able to communicate the project outlines, design process and outcomes at the same time. The designed showcase can act as the main platform for the study course and be the go-to target of students, alumni and people who are somehow involved with it. If the prototype will be developed or integrated into a working product, the whole City University London and especially the department of HCI can hugely benefit from it.

6 Reflections and Conclusions

6.1 Introduction

This chapter looks back and evaluates the done project work as a whole. It reflects on the difficulties experienced during the project and presents lessons-learned during the process. It also identifies limitations of the project and suggests future work that could be done to overcome these.

6.2 Reflection

6.2.1 Overall approach

In retrospect, several difficulties occurred during the project. The design workshops posed the biggest challenge to this project, as recruitment of participants ended up being a long and bothersome process. Several volunteers agreed to participate in one of the two design workshops. The challenge to overcome was to find a fitting date and time-slot for all four participants of a workshop, as some volunteers where busy working during the day or had other plans on dates that were available for others. A first attempt to find a time slot with a doodle[27] was futile, as the volunteers where not sure when exactly they were free and when not. A more direct approach ended up being far more effective. A date and time was decided and participants were asked directly if they were free during this time-period or not. This approach lead to immediate results and a fixed schedule for both workshops.

Another encountered difficulty was the execution of the second workshop with Circle of Opportunity as creativity technique. I was not as familiar with the technique as with Creativity Triggers, as it was my first time using it myself. After the initial explanation of the technique, participants started to spend a very long time on choosing the attributes. This process was supposed to be a short and quick one, but instead participants brainstormed around the attributes already and generated more attributes than necessary to be able to choose from all of them. At that point, I had to interact a few times with the participants to urge them to continue to the next step, the actual idea generation. During the idea generation, the results were at the beginning not that was I was expecting, which resulted in some additional comments and guidance from my side that could have influenced the outcomes of the results. I think it would have been better to skip explaining the process of the whole creativity technique before actually using it. As participants already knew that they were going to use the generated attributes to brainstorm and free-associate around them, they were putting too much thought and reason into the choice of them. I recommend explaining and performing the steps of Circle of Opportunity step-by-step to focus participants on what is important at the time and not on what will be important later on.

One last point to mention is the need for participants to informed about the target area of expertise.

6.2.2 Prototype

The prototype ended up in a very advanced stage. It has a completely finished design and it provides main templates and functionalities for a finished product. The user testing showed that users had no difficulties navigating through the website and that the layout and content

[27] http://doodle.com/ - Easy scheduling | Doodle

provided met their expectations. User needs were addressed by designing the showcase in a user-centred design process. Requirements were extracted from ideas generated by potential users and stakeholders. The majority of requirements was either directly implemented into the prototype or described as part of the prototype as annotations.

Personally, I would have preferred to spend more time on the development of the prototype, maybe even on an actual working showcase to make it usage. I believe such a showcase would have a real impact on the way students' produce work and how it will being treated afterwards.

6.2.3 Creativity Techniques

The results of creativity workshops and the comparison of creativity techniques are a research aspects of this dissertation. I am confident in the quality of the results produced in this study. Workshops were performed in an academic manner without participation of the researcher to avoid influencing the outcomes and to be able to compare the results objectively. Qualitative and quantitative comparison of creativity technique outcomes followed a scientific approach and considered only raw, unmodified data to provide valid results.

One of the limitations of the project scope was that only two workshops with one creativity technique each were going to be performed. This limitation influences the validity of the comparison of the subjectivity and effectivity of creativity techniques, as any results I observed could be an artefact of the personality of the people who were involved in the workshops. To be able to take personalities and the creativity of participants into consideration, a Gough test was performed with participants from both workshops. Additionally, recruitment of participants took backgrounds into consideration, which resulted in one participant in each module who already knew about creativity techniques and workshops from the "Creativity in Design" module at City University London. Results of the Gough test revealed that the average potential for creativity of both groups of participants was approximately the same. No "especially creative" participants were identified that would somehow influence the validity of results.

To validate the generality of gathered and analysed data, future work and research is advised.

6.3 FUTURE POSSIBLE WORK

More work on research is needed on the use of creativity techniques to be able to compare outcomes quantitatively. One research study is not enough to provide evidence on when exactly to use which creativity technique; it only provides a guide of which technique is more likely to produce which kind of ideas. More design workshops have to be conducted with the different creativity techniques to widen the range of the comparison. Additional workshops should also be performed with multiple stakeholders such as lectures and potential employees to generate ideas from different perspectives and needs.

One aspect that was mentioned earlier is the combination of the two used creativity techniques. Workshops have to be performed with the combined technique to evaluate if the technique produces can be used as described and what kind of results are compared in comparison to the techniques individually.

Further work should also include the next step in the evaluation and development of the current showcase. Results from the performed evaluation have to be implemented into the prototype. This modified prototype should again be evaluated to ensure that no major changes to the design or layout have to be made. The next step would be to develop the showcase as a

functional product, to setup and configure the necessary back-end, consisting of databases and coding foundation to provide basic functionalities.

After the development of the functional showcase, further user evaluations are necessary before actually filling the showcase with real content and releasing the website to the public.

7 BIBLIOGRAPHY

Biskjaer, M.M., Dalsgaard, P., Halskov, K., 2010. Creativity Methods in Interaction Design, in: Proceedings of the 1st DESIRE Network Conference on Creativity and Innovation in Design, DESIRE '10. Desire Network, Lancaster, UK, UK, pp. 12–21.

Boden, M.A., 1996. Dimensions of Creativity, New edition edition. ed. MIT Press, Cambridge, Mass.

Carroll, E.A., Latulipe, C., Fung, R., Terry, M., 2009. Creativity Factor Evaluation: Towards a Standardized Survey Metric for Creativity Support, in: Proceedings of the Seventh ACM Conference on Creativity and Cognition, C&C '09. ACM, New York, NY, USA, pp. 127–136. doi:10.1145/1640233.1640255

Dindler, C., Iversen, O.S., 2007. Fictional Inquiry—design collaboration in a shared narrative space. CoDesign 3, 213–234. doi:10.1080/15710880701500187

Djajadiningrat, J.P., Gaver, W.W., Fres, J.W., 2000. Interaction Relabelling and Extreme Characters: Methods for Exploring Aesthetic Interactions, in: Proceedings of the 3rd Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques, DIS '00. ACM, New York, NY, USA, pp. 66–71. doi:10.1145/347642.347664

Dove, G., Jones, S., 2013. Evaluating creativity support in co-design workshops. Presented at the CHI 2013 Workshop: Evaluation Methods for Creativity Support Environments, Paris, France.

Gough, H.G., 1979. A creative personality scale for the Adjective Check List. J. Pers. Soc. Psychol. 37, 1398–1405. doi:10.1037/0022-3514.37.8.1398

Halskov, K., Dalsgård, P., 2006. Inspiration Card Workshops, in: Proceedings of the 6th Conference on Designing Interactive Systems, DIS '06. ACM, New York, NY, USA, pp. 2–11. doi:10.1145/1142405.1142409

Hollan, J., Hutchins, E., Kirsh, D., 2000. Distributed Cognition: Toward a New Foundation for Human-computer Interaction Research. ACM Trans Comput-Hum Interact 7, 174–196. doi:10.1145/353485.353487

Jones, S., Lynch, P., Maiden, N., Lindstaedt, S., 2008. Use and Influence of Creative Ideas and Requirements for a Work-Integrated Learning System, in: 16th IEEE International Requirements Engineering, 2008. RE '08. Presented at the 16th IEEE International Requirements Engineering, 2008. RE '08, pp. 289–294. doi:10.1109/RE.2008.54

Madsen, K.H., 1994. A Guide to Metaphorical Design. Commun ACM 37, 57–62. doi:10.1145/198366.198381

Maiden, N., Gizikis, A., Robertson, S., 2004. Provoking creativity: imagine what your requirements could be like. IEEE Softw. 21, 68–75. doi:10.1109/MS.2004.1331305

Maiden, N., Ncube, C., Robertson, S., 2007. Can Requirements Be Creative? Experiences with an Enhanced Air Space Management System, in: 29th International Conference on Software Engineering, 2007. ICSE 2007. Presented at the 29th International Conference on Software Engineering, 2007. ICSE 2007, pp. 632–641. doi:10.1109/ICSE.2007.24

Michalko, M., 2006. Thinkertoys: A Handbook of Creative-Thinking Techniques, 2nd Revised edition edition. ed. Ten Speed Press, Berkeley, Calif.

Muller, M.J., 2003. Participatory design: the third space in HCI, in: Jacko, J.A., Sears, A. (Eds.), The Human-Computer Interaction Handbook. L. Erlbaum Associates Inc., Hillsdale, NJ, USA, pp. 1051–1068.

Nguyen, L., Shanks, G., 2009. A framework for understanding creativity in requirements engineering. Inf. Softw. Technol. 51, 655–662. doi:10.1016/j.infsof.2008.09.002

Rogers, Y., Sharp, H., Preece, J., 2011. Interaction Design: Beyond Human-Computer Interaction, 3rd Edition edition. ed. John Wiley & Sons, Chichester, West Sussex, U.K.

Sanders, E.B.-N., 2002. From user-centered to participatory design approaches. Des. Soc. Sci. Mak. Connect. 1–8.

Schlosser, C., Jones, S., Maiden, N., 2008. Using a Creativity Workshop to Generate Requirements for an Event Database Application, in: Proceedings of the 14th International Conference on Requirements Engineering: Foundation for Software Quality, REFSQ '08. Springer-Verlag, Berlin, Heidelberg, pp. 109–122. doi:10.1007/978-3-540-69062-7_10

Shneiderman, B., 2000. Creating Creativity: User Interfaces for Supporting Innovation. ACM Trans Comput-Hum Interact 7, 114–138. doi:10.1145/344949.345077

Sutherland, M., 2010. Classifying Creativity Techniques (for Requirements Engineering) (Master's dissertation). City University London.

VILLALBA, E., 2008. On Creativity: Towards an Understanding of Creativity and its Measurements. OPOCE.

Warr, A., O'Neill, E., 2005. Understanding Design As a Social Creative Process, in: Proceedings of the 5th Conference on Creativity &Amp; Cognition, C&C '05. ACM, New York, NY, USA, pp. 118–127. doi:10.1145/1056224.1056242

Warr, A., O'Neill, E., web-support@bath.ac.uk, 2004. Getting creative with participatory design, in: van den Besselaar, P., Clement, A. (Eds.), Proceedings of the 8th Conference on Participatory Design (PDC) 2004. Presented at the Proceedings of the 8th Conference on Participatory Design (PDC) 2004, University of Bath, Toronto.

Prototype graphics were taken from:

http://www.digidemon.eu/wp-content/uploads/2013/12/social-media-flat-icons.png

http://www.endlessicons.com/wp-content/uploads/2013/11/download-icon.png

http://www.uxpassion.com/wp/wp-content/uploads/2011/12/Services_UX-Design_Interaction-Design1.png

LIST OF APPENDICES