# ”I would say that the user is the king”

## Indian student designers´ conceptions of a design process and potential implications for schools

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*Design education and the design process have been focuses for research in recent studies in developing innovative solutions to problems and challenges worldwide as well as in educational contexts where there is a need to develop pedagogical design and innovation processes in educational settings. The current Finnish Core curriculum for basic education 2014 (FNAE 2016) emphasises design education and design process in craft, design and technology learning. To understand in-depth design methods and the meaning of design in a different cultural context, this study was executed at a distinguished design community, the Indian Institute of Technology in Kanpur. The study is part of the FINDIgATE project, which aimed for Finnish and Indian Well-being through Education. Design and craft have a common goal to aspire towards well-being and coping with life. The project created a new research community between Finland and India. Several studies were conducted within the project: Indians studied the Finnish education to develop their own activity and comparative study was also conducted. This study focuses on exploring the conceptions of Indian design students.*

*The theoretical background of this phenomenological research consists of defining design and design processes, also design education and design as part of a holistic craft process. The data collection method is a thematic interview. The data collection was carried out in three group interviews and as an additional individual interview. The interview material was analysed by data-driven content analysis.*

*According to the results, Indian student designers (N=14) see design as a multidisciplinary collaborative user service in different areas of life. The design process is structured through the definition of the design task and the problem to be solved, through user research, ideas, prototyping and testing. Documentation is an important part of the whole design process. The different phases of the design process of Indian student designers seem to be applicable to pedagogical design and innovation processes as well as holistic craft processes in the context of education. The user-oriented design process seems a potential approach to Craft, Design and Technology education and cross-curricular design processes across pedagogical contexts.*

Keywords: design process, design education, craft design and technology (CDT), user research, documentation, India

### Introduction

Design and crafts have a common goal of pursuing well-being and life control (Nuutinen, Soini-Salomaa & Kangas 2014). Design and designing skills, process-oriented work and multidisciplinary collaboration are part of the Craft, Design and Technology subject according to the criteria of the current Finnish National Core Curriculum for Basic Education 2014. The mission of the subject is to guide pupils to master a holistic craft process. (FNAE 2016) “A holistic craft process embodies a design process where the same person works simultaneously as a designer and a craftsman when he designs and manufactures the product.” (Laamanen & Seitamaa-Hakkarainen 2014, 13) The subject aims to offer meaningful and

relevant learning experiences to pupils based on open-ended problems and challenges. The material range is wide and related to the pupils' own material environment. (Hilmola & Lindfors 2017) According to Lindfors & Hilmola (2016) the holistic craft process can also be seen as an innovative learning process that aims to develop new solutions.

According to Seitamaa-Hakkarainen design and designing develop creativity and problem solving skills (2007b). These skills have a role in future society and working life. The change in society and working life requires more creative ways of working and CDT provides opportunities to learn these skills. Essential design skills can be learned through authentic design challenges, iterative process and expert working methods. (Nuutinen et al. 2014.) According to Lindfors & Hilmola (2016) students must be taught skills and knowledge on how to solve design tasks from their area of interest. According to Marner (2005), CDT has the opportunity to achieve a new position in the school through creative processes and societal perspective. Design and technology is seen to bring depth into creative and cross-curricular processes (Marner 2005).

According to Lindfors (2012) artistic and practical subjects in Nordic primary and secondary education support design learning, but more lessons are required in order to achieve the goals. In Finland, Arabia comprehensive school is design-oriented. Design-orientation in Arabia is a reforming model in teaching and a versatile tool for learning. The design emphasis is cross-curricular but goes deeper in CDT, arts and optional subjects. (Hatanpää 2016.) In order to meet the objectives of the curriculum, teachers need expertise in teaching design. Students' product design seems to depend on the teacher's attitude and competence in design. Design-oriented teachers appreciate design and motivate students to design. Although the curriculum emphasizes the importance of design, not all teachers give value to design as part of craft. Teachers should look at the subject's goals, content and timing in a new way in order to find balance between designing and making. (Rönkkö, Mommo & Aerila 2016.) Craft teachers feel that teaching design is challenging (Laamanen & Seitamaa-Hakkarainen 2014). Teacher is required to have knowledge of design processes so that he can control the design learning (Hilmola & Syrjäläinen 2014).

This study originated with the FINDiGATE project (Findigate, 2018). The purpose of the cooperative project between Finnish and Indian universities was to promote well-being through education. Multicultural and multidisciplinary expertise enabled development work in both countries. The student designers in the Indian Institute of Technology in Kanpur provided an opportunity to explore understanding of design in their culture and a possibility to find a new perspective on Nordic thinking. The purpose of this study was to learn about design methods in Indian designers' education in order to find possible new ways to enhance design methods in the Finnish primary and secondary education and teacher education. A main research question is: What are the conceptions of the Indian student designers about a design process? The sub-questions are: 1) How do the Indian student designers articulate their understanding of design? 2) What are the phases of the design process based on the Indian student designers' experiences? and 3) What are the challenges for the Indian student designers in the design process?

In the theoretical background, we refer to the design process in craft, design and technology education context as well as design as a part of manufacturing processes in professional design contexts. The discussion looks at the suitability of the methods and perspectives of the student designers´ design process to the holistic craft process, design education as a cross-curricular phenomenon, and further examines the connection between design and craft education.

## Theoretical background

To form a theoretical frame for the study we present first the concept of design and users´ role in it. Then we look at the existing design processes. Third, we examine the pedagogical aspect of design as design education and its theoretical and practical ground.

### Perspectives on design

Traditionally, the design field has produced artifacts. Our environment consists of artifacts, which are products designed by people. Design aims to influence the functioning of the object environment and aesthetics. The design of the object environment can affect people's well-being, encourage action and bring joy. (Vihma 2008.) Design is not a permanent thing, as the responses to the needs of people change. Science, technology, materials and fashion change, so design may age. (Norman, Cubitt, Urry & Whittaker 2000.) There is no one right solution from a technical or a form perspective (Vihma 2008). Design is consciously finding something new. It is improving the living environment and social relationships, meaning design is the key to good living. By modifying its habitat, a person modifies at the same time their lives. Design can be said to be an important part of human evolution. However, all aspects of human activity, or design, are difficult to reach. (Koh, Chai, Wong & Hong 2015.) Nowadays design is more human-centered, more social and linked to technology and science than before (Norman & Klemmer 2014) and expanding from the product world to services (Vihma 2008).

Design is multidisciplinary, combining business, engineering, social sciences and art (Norman & Klemmer 2014). Multiprofessional cooperation seems to be essential in design. Successful design requires shared expertise. (Seitamaa-Hakkarainen 2007b.) From the perspective of a company, a designer offers solutions, but does not decide the final production model. Ideal at the beginning of a project is co-operation between a designer and an engineer, for example, they both will introduce shape and technical solutions. (Vihma 2008) The difference between a designer and a craftsman is that the craftsman makes the final product by himself while the designer may remain in the prototype level since the final product can be manufactured by some other or production machine. (Risatti 2007.) In design, the manufacturing may be prototyping. Design can be seen as a holistic craft if the same person carries out the design and the production (Kojonkoski-Rännäli 1998; Lepistö 2004).

Designer cooperates with the users who play a significant role in design development nowadays. Users are the experts of the user viewpoint, essential to the success of design. (Seitamaa-Hakkarainen 2007b). The designer constantly faces decision-making. There is a need to consider technical as well as human oriented requirements and constraints. In addition, there is a need to weigh local resources and requirements. (Norman et al. 2000.) Multidisciplinary cooperation in addition, the crossing of materials, methods and professional boundaries is typical for design nowadays. A designer must understand holistically all the phases related to a product´s complete life cycle: manufacturing process, product in use, and multidisciplinary project possession. (Vihma 2008.)

Design is a multifaceted word that describes a thing, an object, an action, or a creative process (Norman et al. 2000). According to Kojonkoski-Rännäli design depicts the term at its widest, including technical and aesthetic design and manufacturing process (Kojonkoski-Rännäli 1998). According to Vihma design is an object or a space based on usability design, which also combines cultural meanings and aesthetic values. Design describes both the purpose of the designer and the outcome of the design process. (Vihma 2008.) Lindfors summarizes the scope of the design: "Design is a process which connects creativity and innovative work, and the form of contexts of problems and solutions" (Lindfors 2012, 160).

**Design for users**

All products and systems are designed to interact with humans (Norman et al., 2000). The product always creates a user experience in use (Garrett 2011). Nowadays use of design is so obvious that its meaning is most noticed when understanding of the user during the product development process is missing or incomplete (Kutvonen 2015). Traditionally in product design, the product has been considered from an aesthetic or a functional point of view (e. g. Rosenblad-Wallin 1983).

Usability describes the product's functionality from the user's point of view. Usability builds up in a relation with a user, a product and an environment. (Lindfors 2008.) When looking at the product from the user's point of view, it tells you whether the product works in practice as desired and successful. If the user experience will be left without attention, the impractical details can cause frustration in users and negative attitude towards the product. (Garrett 2011.)

User research is a process designed to identify the usability, usefulness and successfulness of the product or service. Information is collected from users and research data is used everywhere, such as in consumer electronics, on the websites, medical equipment or banking services. User research can help to improve a product on a market or to develop something completely new. (Goodman, Kuniavsky & Moed 2012) User information is a refined image of buyer groups and an overview of product use. User information can be used to create a product for users, a device or a service, that is desirable, useful, usable and pleasant. The use of user information is important for the technical implementation of the product, marketing, for business, planning for maintenance and technical support, and for users. Getting familiar with users and to user-environments helps product designers to eliminate unsustainable solutions and enhances detail design. (Hyysalo, 2009.) The importance of using a product or a service can be considered self-evident. However, even large companies may fail to meet the needs of a product, a service or customers. (Goodman et al. 2012.)

**Perspectives on design process**

The design process is both creative and rational (Lammi 2005). According to Lawson (2006), any pattern is probably too simplistic to describe such a multidimensional mental process as a design process (Lawson 2006). Design processes have recognizable similarities, although they are ambiguous chains of events. Design processes vary depending on products and companies. (Hyysalo 2009.)

Researchers use different terms for the phases of the design process. According to a common understanding, the process gradually begins to proceed spiraling. (Seitamaa Hakkarainen 2007a) Often an attempt has been made to describe the design process as distinct identifiable steps logically proceed from start to finish. With the help of the functions, the designer progresses to solve the problem. (Lawson 2006.) However, the design process is not just designed as repeatable production processes (Frye 2017). In practice, the process work cannot only proceed according to a plan, while problems emerge during the process and solving them will guide the process. However, general process description models can support the process. (Hyysalo 2009.)

In the design process, a problem definition is ambiguous. A design task area, i.e. a context determination, is often done at an early stage. In order to find a solution, it is important to define the user, the intended use, design constraints and context. The definition guides design and the context is specified throughout the design process. (Seitamaa Hakkarainen 2007a.) Product development is often cumulative to existing knowledge and previous design solutions. Previous base guides the process but may also act as a limiting factor. New products can be iterated even after the launch, as there may be more prototypes that could meet users' wishes. Users also customize their products for their own activities and needs. (Hyysalo 2009.)

*Design problems* are often solved by teamwork, so communication and collaboration are important in the design process (Hero, Lindfors & Taatila 2017; Koh et al. 2015). In a product development process, participants can be divided into four roles: customer, designer, author and user. A prerequisite for a successful product development process is an effective interaction between the role representatives. (Norman et al. 2000.) For student designers it may be challenging to develop an understanding of the process with all the stakeholders. While studying, projects can be self-reflective projects apart from the needs of the real world. In the professional world, designers must work with customers who have real problems, doubts, budgets and time constraints. (Lawson 2006.)

In *user-oriented design*, product usability is built *by involving the user in the design process.* The designer is trying to learn to get to know the user and to find out needs that the user does not know to tell. The environment and the function of the product must also be known when designing. Usability is tested and evaluated during the design process in collaboration with the user. (Kettunen 2000.) The knowledge needed for the design process is done by observing, ethnographic methods and systematic documentation (Vihma 2008). The user-oriented design process does not end when the product is finished, instead the testing and evaluation will continue to ensure the best usability. Critical evaluation of the product's function related to the user, allows deeper understanding of the product. (Lindfors 2008.)

Human-centered design process (IDEO 2015), Nielsen Norman Group´s Design Thinking process (Gibbons 2016) and Double Diamond model (Design Council 2015) describe the design process as creative problem-solving through phases that lead from problem area to solutions implementation. Lawson (2006) describes the design process as a negotiation between problem and solution, with help of analysis, synthesis and evaluation. The steps are central between the problem and the solution, but not proceed linearly. It is more likely that the problem and solution will develop together during the process. (Lawson 2006). According to Fryen (2017), design processes require improvisation, solutions that do not go fully planned as improvisation happens unexpectedly and is the productive part of the design process, which can create something new.

*Human-centered design* is creative problem-solving which does not follow a linear process (IDEO 2015). However, there are three main phases: *inspiration, ideation and implementation.* During inspiration, the designer gets to know people to understand their lives and desires. In the idea phase, the knowledge learned from people is identified and redefined into ideas. Solutions created from ideas are tested and redefined. The implementation is to put the final solution into practice and market. (IDEO 2015.)

Nielsen Norman Groups (2016) *Design Thinking Process* is called user-centered and in six stages. Information is collected from users; artifacts are created for real needs and are tested with the right users. The framework is divided into three sections: *Understanding, Experimenting and Materializing.* The understanding is created by empathy mapping the users' needs and desires, then defining the problem they face. In the experimenting section, the design team ideates, constructs prototypes and develops them. In the materialization section, the prototypes are tested with real users. Implementation is the most important phase, while the design thinking comes authentic. True innovations can be achieved only through implementation. (Gibbons 2016.)

Design Council's (2015) *Double Diamond model* explores the creative design process flow. Although creative processes are different, they contain similarities. In all creative processes, a large number of ideas are created (divergent thinking) and the best are being selected (convergent thinking). In the Double Diamond model, the definition of the problem is done with the corresponding divert-convert method. According to the model, the problem proceeds to the solution through four stages. First, take a broad look at the problem (*Discover*). Next, an area is defined, which focuses on (*Define*). At this point,

the design function is formed, and the problem is determined. When the problem is clear, a large amount of possible solutions is being developed (*Develop*). In the last step (*Deliver*), working solutions are selected. (Design Council 2015.)

The design process also brings feelings of uncertainty to the surface when thoughts move from concrete observations to abstract thinking. Diverging and converging perspectives are done a few times during the design process until the market-friendly solution is reached. (Design council 2015; IDEO 2015.) In human-centered design, the desirability, feasibility and viability of the design are important when balancing towards a successful and sustainable solution (IDEO 2015). Intelligent utilization of human-centered design can promote the design process through better understanding of the user and greatly prevent potential negative consequences (Page & Thorsteinsson 2017).

Depending on the author, design processes have different names and emphases (Seitamaa Hakkarainen 2007a; Fryen 2017), but also similarities (IDEO 2015; Gibbons 2016; Design Council 2015). Collectively it can be said that the design process proceeds from problem to solution through various steps (Lawson 2009; Lindfors 2010; IDEO 2015; Design Council 2015). The steps give structure to the creative process that involves improvisation and the creation of something new (Fryen 2017). During the process, the perspectives on problem, ideation and solution are examined through divert-convert method (Design Council 2015). Users are also involved in designing (IDEO 2015). The user research data is collected in prototype testing phases and final products usability testing (Gibbons 2016; Kettunen 2000). The design process is still ongoing after implementation as evaluation and redesigning (Lindfors 2008; Hyysalo 2009). The design process is built in collaboration and utilizes the shared expertise (e.g. Hero & Lindfors 2019; Koh et al. 2015).

**Pedagogical aspects of design**

Design education and design-based learning aim to develop design skills and design understanding, which are needed in today's society (Hatanpää 2016). Design can be emphasized in school in primary and secondary education in different subjects, often in connection with art and technology (Kangas 2014). In general, design education introduces the industrial and artistic aspect of design. Designers, manufacturing and user perspectives are taken into account. In addition, the environmental perspective is involved. Design education is cross-curricular and combines also with media and entrepreneurship education. Design education is a teachers' resource to support pupils' overall growth and development. (Kenttälä, Nurro, Sortti 2009.) Design thinking challenges pupils to think in a new way and affects their commitment into the learning process. (Carroll, Goldman, Britos, Koh, Royalty & Hornstein 2010) Design education promotes pupils' activity and participation in shaping the surrounding reality in order to become conscious consumers who understand the meaning of design as part of life (Lee & Breitenberg 2010). The goals are to influence the habitat, raise consumer awareness, and to observe and enjoy the environment (Kenttälä et al. 2009). Multidisciplinary design in learning allows working with complex problems in real and meaningful contexts (Seitamaa-Hakkarainen 2011) with authentic design problems and challenges.

Design education utilizes the design process for teaching and learning (Hatanpää 2016). Experienced designers build the design process on a routine basis based on practical experience. The question is how to teach such creative, complex, open and personal skills. (van Dooren, Boshuizen, van Merriënboer, Asselbergs & van Dorst 2013.) Teaching of design is more demanding due to the creative and unpredictable character of design. There is no similar process to repeat when each project is unique. (Lawson & Dorst 2009.) Design projects require teachers' knowledge and understanding of how to support pupils' design process and problem solving (Seitamaa-Hakkarainen 2011). Without experience, there may be a misconception that a logical solution will be achieved and that all the problems will be resolved at once in a mystical way. Pupils have to learn design as an experimental process where it is possible to learn from mistakes. (van Dooren et al. 2013.)

Lindfors' user-centered design process (2010) is an example of combining theory and practice to implement innovative and usable solutions. From a pedagogical point of view, the model can be applied for students to learn to solve real problems in user environments. In the focus of the user-centered design is usability, which forms in between a user, an environment and a product. The three dimensions of usability create a design process, which consists of eight stages: 1) research and analysis of user needs, 2) idea generation, 3) options testing and evaluation, 4) optimizing the chosen solution, 5) development of usability, 6) implementation and realization of the solution 7) usability assessment and evaluation in real use environment and 8) further development. (Lindfors 2010.)

Seitamaa-Hakkarainen has developed a model for Learning by Collaborative Designing (LCD) to support students' design learning and design processes. The model describes design as a cyclic process, which focuses on cooperation and shared expertise. The goal is that all participants (students, users and other stakeholders) combine their expertise in product development. The design process´ steps are following: 1) Creating a design concept, 2) Defining the design problem and possible constraints; 3) creating conceptual and concrete ideas, 4) evaluating ideas and constraints, 5) experimenting with ideas and testing with sketching, modeling, and prototyping, 6) evaluation of prototypes´ functions and 7) working on with the ideas and re-designing. (Seitamaa-Hakkarainen 2011.)

Salonen and Heikkilä have produced design-oriented *Muoto & Käsityö* teaching material for CDT primary and secondary education. The goal is to bring more designing and design thinking into teaching. The study compares the holistic craft process (Pöllänen 2006) and the design processes of Aspelund (2010) and IDEO (2014) and finds out that processes are similar (Salonen 2016). In the *Muoto & Käsityö* teaching material, the design process is divided into five sections: background, idea, development, production and evaluation (Heikkilä & Salonen 2016).

In Finland, design education can be seen as a pervasive whole (Kenttälä, Nurro, Sortti 2009). Especially the design content is included in Craft, Design and Technology education. (FNAE 2016; Hatanpää 2016). The subject aims to guide pupils to master a holistic craft process starting from the first grade (FNAE 2016). The holistic process consists of a product idea, aesthetic and technical design, production and evaluation. When the same person completes all the steps, it is called a holistic craft process (Kojonkoski-Rännäli 1998; Lepistö 2004). A holistic craft process, designing, production and evaluation, can also be carried out communally (FNAE 2016). Central in craft is to complete the process from designing to final products (Seitamaa-Hakkarainen 2011). Crafts can be seen as a product design -oriented activity, where the starting point is the design task or the problem to be solved. Different stages of the problem-solving process can include changes to plans, and the process is not linear. The plan is evolving with the process. A teacher should support the understanding of the design when the goal of the activity is not completely unambiguous. (Pöllänen & Kröger 2004.)

Open and complex design problems are characteristic to craft, design and technology education. Assignments should have diverse starting points instead of focusing on a specific one material or technology (Laamanen & Seitamaa-Hakkarainen 2014). Sources of inspiration and motivation are needed in the ideation phase (Pöllänen & Kröger 2004). Innovative ideas are created by looking at things from new perspectives (Laamanen & Seitamaa-Hakkarainen 2014). The designing phase includes information retrieval, experiments, problem solving and reflection. The goal is to achieve an enjoyable, a useful, workable and feasible product (Pöllänen & Kröger 2004). Design is built on both thought and material. Through practical research, prototyping and making, ideas can be understood and developed by giving them a tactile shape. (Seitamaa-Hakkarainen 2011.) Thinking process can be presented externally with help of sketches and prototypes, which reduces the cognitive burden (Koh et al. 2015). Practicing three-dimensional modeling supports design capabilities (Lahti et. al. 2016). Experiments lead the idea towards the final product. The iterative nature of the design process means returning to ideation from experimentation if the design requires changes. (Laamanen & Seitamaa-Hakkarainen 2014.)

Design process in a pedagogical context consists of several phases that a teacher has to consider and master to be able to guide pupils throughout the process. In addition, it seems that collaborative problem solving seems to be a central element in design. In collaboration, the team faces the risks together. Team's empathy skills develop when the goal is common. Meaningful learning projects and learning by doing help pupils to understand the topic to be learned. (Carroll et al. 2010.) Education through design is student-led project work in a social context. At the same, individual abilities and creativity are under review and evolve (Hero & Lindfors, 2019; Lawson et al. 2009.)

## Methods

This study originated from the FINDIgATE project, in collaboration with Indian Institute of Technology in Kanpur. Interest in this study focused on the conceptions of high-graduate student designers in the field of design and their experiences on the design process. The research was qualitative and approached with a phenomenological research strategy. Central to phenomenological research is to examine human experience (Virtanen 2006). The focus is on the perspectives, meanings and views of the subjects. The aim of the research is to gain a holistic understanding of the topic under study. Data collection takes place in interaction with the target group in their natural environment. Research analysis proceeds inductively from selected cases to general, from practice to theory. (Creswell 2007; Kananen 2014). The results of phenomenological research can be considered as a researcher's construction of a phenomenon, as inevitably the researcher's relationship to the phenomenon under study affects the review. The aim, however, is to form a construction to correspond as identically as possible to the experience of the person being studied about the phenomenon. (Perttula 1995.)

FINDIgATE -collaboration enabled the data collection by using thematic interview in Kanpur in January 2017. The research context was new and unfamiliar for the researchers. Before carrying out the interviews, a few days were used to get to know the Indian Institute of Kanpur, people and the culture. After that the purposes and possibilities of the study clarified. The interviews were conducted in English within three group interviews and in one complementary individual discussion. The total number of students was 14. The group interview duration was approximately an hour per group and the extra discussion took about half an hour. Themes for discussions were the same but discussion flow emphasized differently depending on groups´ experiences.

The first interview group consisted of the first year Master of Design students who did not yet have a special orientation. Participants in the second interview were master's students of the second year. In the third interview participated those students who had continued their doctoral studies in the field of design. The interviews were recorded and transcribed word by word. The data was analysed with a data-driven content analysis. After studying the material, it was a matter of reduction. Original expressions were extracted and tabulated into a new file. The expressions were followed by a symbol (R1, R2, R3, Y2) to indicate the certain group discussion. A summary describing the original expression was reduced to a column in the table. After reduction, similar expressions were grouped together from the concentrated original expressions. By clustering, expressive subclasses were created, from which clustering was continued to create upper classes. Through the combination of classifications and the theoretical conceptualization or abstraction phase, results describing the data were generated. (Tuomi & Sarajärvi 2013.) In the content analysis of the second sub-question, the clustering and abstraction phases were supported by the design processes and their phases presented in the theoretical background of this study.

## Results

The three main categories, design, design process and its challenges from students' perspectives, are presented in the following paragraphs. First main category consisted of three categories and six sub-categories. In the second main category, each of the five categories was structured from three to seven sub-categories. Third main category consisted of two categories with two and three sub-categories.

### Design defined by design students

One theme that was obtained through the categorisation of the interview data was students' different definitions for design. The concept of design defined by Indian student designers (N = 14) was structured with six sub-categories. They saw design as utilizing creativity, art, technology and science. It was understood as an essential part of life, as a service, as a creation of something new, solving problems and improvement, cooperation with people and users. They also pointed design for a specific task and purpose and context. The sub-categories emerged into three categories: art and technology in every aspect of life; creative development work in collaboration and contextual solutions for the benefit of users.

> Now when I'm a designer I try to fit myself in someone else's place, realise his problems, empathise. (R3)

> The art and science of creating something for anyone. (R1)

The analysis points out that the Indian students considered design as a multidisciplinary collaborative user service in different areas of life. Design was considered as art and technology in every aspect of life. It was also considered as creative development work in collaboration and as contextual solutions for the benefit of users. In all its dimensions, design was seen context- and perspective-bound.

Design was seen as art and technology in every aspect of life, describing a multidisciplinary and broad field of design. It was also considered as creative development work in collaboration, including the importance of collaboration and versatility in design work. Contextual solutions were seen for the benefit of users, since it reveals the purpose of design being solving the users' problems in different contexts and branches of life.

### Students' understanding on the design process

The categorization of the students' experiences of the phases of a design process revealed five categories. The design process started from defining the design problem and ended up to prototype testing with users, Based on students' experiences, phases of design move forward in order even if they partly overlap. Documentation was seen to be related to various phases of the design process.

Students' understanding of different phases of a design process was structured as a multifaceted whole. The starting point in a design process was considered a definition of a design problem to be solved. The design problem needed to be identified and reviewed first broadly. Wide problem area had to be limited to be able to find the key problems. The design problem had to be redefined based on (user) research data. Problem definition with different steps and phases was considered as important because the students experienced that for the user it would be difficult to define problems he/she is facing.

User information was seen to be gathered by various methods. Before the actual user research, all involved and influential participants in the process, stakeholders, had to be identified. Different users were seen easier to understand by categorising them. Interviewing and observing users were seen as methods that provide information about users' needs. Versatile user research considered to ensure that all essential information could be taken into account for the design process.

> Yes, so then we redefine the starting statement -- The problem that we thought is not actually the problem faced by the people. This is what we have to solve. (R1)

The user research results were grouped in the optional areas where different solutions could be designed. In the ideation phase, one way was that old concepts were forgotten in order to be able to consider new ideas without restrictions. The students considered that to achieve something that no one had invented before. For evaluating ideas, the focus was user's' point of view in the desirability of a solution, the technical and financial feasibility and applicability to the desired purpose. Project had to be related to participants and stakeholders, to integrate their ideation and evaluation to achieve the best outcome.

> But there are many things that you won't understand unless you talk to the user. I would say that user is a king. Or I would believe users in the design process are the core of all of the processes I do. Because unless you define or understand what the user actually regards, you´ll be working on a product that nobody wants. (R3)

According to Indian design students, the production and testing of prototypes are important steps in combining the ideation and reality. Students experienced that to this phase they have to invest a lot to get a functional product from the user's perspective. In practice, low-fidelity prototypes were produced with smaller resources and later with high-fidelity prototypes with higher resources in actual manufacturing processes. User testing was used to develop prototypes together with the users towards the final product. An Indian frugal way of prototyping called jugaad was presented as an example.

> So if you want to redesign a chair, you´ll come up with something which is very close to chair. If you want to redesign something to sit on, probably will come up with something unconventional. (R3)

> You have to do the testing also like after you prototype it, the first prototype. You need to test your solution if it will even solve the problem or not. So from there you can you will be getting lot of insights, when you test it in the field with the user. So again you come back to the trying board and you again redesign it. (R2)

Documentation was seen as one tool to carry out a design process, as a support of memory and as a proof of how things worked. Students found it challenging but important to describe ideas and thoughts. A designer documents processes as work reports and their own expertise to a portfolio.

> So the whole way, the whole process from you started project 'til the end, you have to document it. Because that´s where you can also remember ok I have tried this way, I have tried all this 24 things and the 25. one worked. (R3)

The analysis shows that Indian students highlights in design process were 1) the collection of user information with various methods to get to know the user, 2) the definition of a design problem to be solved based on user information, 3) ideation phase where the old concepts were forgotten, 4) the production and testing of prototypes since they were seen important steps in combining the ideation and reality from user's point of view and 5) the documentation as an integrated part of the design process to memorize and keep in mind user needs and various phases of the process.

**Challenges faced by students in the design process**

The challenges faced by students in implementing the design process were structured into two different categories: developing the marketing and work community skills and meeting the working life reality. Marketing was considered as a challenging part of the design process. The process seemed to be left halfway if the marketing or commercialization is not considered. Teamwork skills were seen essential in multidisciplinary design work. The design process does not move linearly. It is constantly changing. Compared to studying, in working life, the process was seen limited by the lack of time and research. Slow product development was perceived as a limiting factor in ideation in constantly evolving technological environment. The research phase of the process was seen to constrain the emergence of new, unconventional ideas.

> So the skill sharing thing is not happening much, so maybe like there´s something where I am lacking, but there´s someone in the department who has that skill, but I don´t know that (R3)

> And lastly I would say design is not easy. Because in real world there are lots of constrains involved in order to get your product to market. (Y2)

The analysis reveals that the Indian students saw marketing and work community skills as well as meeting the working life reality the challenges for themselves in the design process. Students' perspectives on studying and developing themselves as designers were mainly expressed based on experiences in internships and working life.

## Conclusions – Indian insights for the concepts of design and design process

The purpose of the study was to understand the design process through the experience based conceptions of the Indian master and doctoral student design (N=14) as well as to discuss the findings in relation to a pedagogical context. The design process was examined through the students´ verbal descriptions on design definition and on different phases and challenges in the design process.

In line with earlier studies (e.g. Seitamaa-Hakkarainen 2007a; Norman et al. 2000; Hyysalo 2009) the results of this study highlight design defined as ambiguously and depending one's perspective. The Indian student designers combined the artistic with the technological side in design that is commonly agreed (Rosenblad-Wallin 1983; Norman & Klemmer 2014; Lindfors 2010). They also extended design being part of every aspect of life like Koh, Chai, Wong & Hong (2015) and Vihma (2008) have earlier mentioned as design being part of evolution and human environment. The Indian student designers emphasized that design is creative and multidisciplinary cooperation (Hero & Lindfors 2019; Koh et al. 2015) in order to create solutions for users (Norman et al., 2000) and that changing contexts affect design. Cooperation with users was seen especially central in design. According to Lindfors (2012) user needs and purposes are one sector in design. In line with the Indian students, Koh et al. (2015) defines design as being present throughout human activities. As an answer to the first research question we can state that on the basis of the Indian student designers' consideration, design as the concept means collaborative multidisciplinary presence in a certain context throughout human activities by developing and prototyping solutions for various needs with users and in service for them.

In the Indian students´ design processes, a lot of attention was paid to a user. They saw defining the problem as an important factor since users hardly know how to define the problems they encounter. User research (Goodman et al. 2012; Hyysalo, 2009.) was considered important to get user information to understand user needs. The idea was to consider the desirability from users´ perspective. Besides users, it was seen important to map and involve other stakeholders in the project as well. Earlier studies state that collaboration in design is necessary (Lawson 2006) and a requirement for a successful product development process (Norman et al. 2000). Teamwork in both professional and school context (Kangas 2014) seems to be engaging to collaborative problem solving and/or constructing common knowledge. Prototypes (Lahti et. al., 2016) mentioned to be tested and developed with users and other stakeholders. An Indian frugal way of prototyping called jugaad was mentioned as one new method for prototyping. The results of the study emphasize understanding the people, users, and utilizing the user knowledge in ideation as is also recognised in IDEO human-centered design model (2015) and in Hyysalo (2009).

The mentioning that the user is the king in the design process highlights the Indian students' conceptions on the user's role. However, the challenge was that in the user data collection phase, previous knowledge and user experience can limit the creation of new ideas. At the same students stressed that in the ideation phase, the old concepts should be forgotten in order to achieve something that has not been invented before. Correspondingly, according to Hyysalo (2009) an earlier basis for product development may be a limiting factor when existing knowledge and previous design solutions guide the process.

IDEOs model (2015) for desirability, feasibility, and viability was also recognised in the results of this study in evaluating the ideas towards the desired purpose. This is in connection to a wide problem ideation and definition in relation to a user. Thus diverging and converging are important during the

iterative design process and allow redefining the problem to enhance usable solutions. This method is also figured in the Double Diamond model (Design Council 2015).

On the basis of the analysis documentation was seen as one of the most important tools to carry out a design process. It was seen as a support of memory and as a proof of how things proceeded and worked out. The Indian students found it challenging but important to describe ideas and thoughts during a design process. The knowledge needed for the design process needs systematic documentation (Vihma 2008). A designer has to document details and phases of processes as work reports to be able to go back and forth during an iterative design process and incubate various solutions to accomplish a final one. The other perspective on documenting was seen to show and sell their own expertise with a portfolio. Portfolios are important in the professional world, where designers must work with customers (Lawson 2006).

As an answer to the second research question the Indian students' conceptions on the design process included common features and functions with many theoretically described design processes (Design Council 2015; Gibbons 2016; IDEO 2015; Lawson 2006; Lindfors 2010; Seitamaa-Hakkarainen 2007a). However, users' role and documentation were emphasized more than in the earlier research. The new observations of this study are the role of a user and documentation as a support and enhancement of various phases (e.g. idea generation, prototyping, evaluation) during the whole design process. The documentation itself is not mentioned in earlier models (e.g. Lindfors 2010; Seitamaa-Hakkarainen 2011) as an essential and integrative part of the design process.

As an answer to the third research question, the challenges for the Indian students in the design process were linked to working life and design constraints. Challenges might partly be due to the lack of experience and were mostly about facing the reality of the working life. When studying, the projects are also made in collaboration with the outside world. Yet, for example the implementation of the design (e.g. IDEO 2015) was not central in their studies and did not emphasize it as part of the design process. But the students felt that they only got halfway in the process without the implementation. This is in line with Lindfors (2008) and Gibbons (2016) who emphasize the importance of implementation and design´s function in use. Studying may be detached from the right world where designers are dealing with customers' real problems, doubts, budgets and time constraints. Lawson (2006) supports the idea that it might be challenging for design students to develop an understanding of a process involving the stakeholders. In the results, students knew and stressed that in the work life context participants from different sectors would be involved in the process. Students emphasized teamwork and multidisciplinary design work as challenging working life realities, which they should learn.

## Discussion

### Limitations, generalizability and credibility

The target group of the study consists of 14 student designers from one university in India, which means that the data is limited. However, as the qualitative data it offers a multicultural and multidisciplinary view for international design research in the form of Indian student designers' conceptions. Data-driven content analysis (e.g. Creswell 2007) was chosen as the analysis method since the aim was to get a conception of the design process from the designers´ point of view, without classifying their experiences according to existing views and theories. There were also two researchers who analysed the data and discussed and agreed the categorisation which is considered as a way to enhance credibility (e.g. Tuomi & Sarajärvi 2013).

The theoretical part of the study was largely constructed during and after the analysis of the data and many similarities were found with the data in terms of design and design processes and the existing theories (e.g. IDEO 2015; Lindfors 2010; 2012; Seitamaa-Hakkarainen 2007a). However, the data-

driven content analysis turned out to be a successful choice since it revealed the strong user information use and the role of documentation in the Indian student designers´ processes. Even if the results cannot not be generalised widely they open an interesting view to understand design and the design process in the contexts of design education.

The Finnish researchers came from a different culture and educational background in relation to the target group of Indian student designers. The research plan was more like a draft when the research journey began as it was difficult to predict what conditions and expertise would be expected in India. The research material was collected in IITK campus and the research language was English. There were differences between the researchers and the interviewees´ English accents and vocabulary, but common understanding was reached. Carrying out long interviews with other than your mother tongue required careful concentration for the researcher working alone. During the analysis of the material, reflections were made in both English and Finnish. Translation from English to Finnish was dependent on the researcher's interpretation and knowledge of the subject, which contributed to the results in naming classifications and describing methods. The presence of two researchers gave an opportunity to consider and discuss options and choices to avoid misconceptions.

The Indian research context offers many opportunities for further research. More research on the nature of design learning and its pedagogical applications is absolutely needed. This study is scratching the surface of the design process defined by the target group. Next step could be the exploration of a more limited area focusing deeply on a specific method or phase of the design process or using participatory data collection to understand design more deeply in Indian context. Then it would be interesting to study the applicability of those methods in primary and secondary schools´ design and craft technology education and compare results internationally. Leading hands on -design projects in Indian and Finnish schools with help of student designers would be a potential advantage of this study. An interesting subject would be also to study on how users accept and adopt new ideas in their traditional environment.

**Implementation of the results in primary and secondary school**

The results of the Indian student designers' methods and perspectives of the design process could be applicable to craft, design and technology education in primary and secondary schools. Design-skills and understanding (Hatanpää 2016) as well as methods to teach them (van Dooren et al. 2013) are needed in the field of education.

### *Broadening the definition of design*

As a student designer, a pupil could be in the role of an artist who utilizes technology in their creation or serving the purposes of users as a designer (see e.g. Kangas 2014). *The meaning of design* and presence in all aspects of life could be examined with the pupils. Both theory (IDEO 2015) and the research material include the three dimensions of design evaluation: the desirability from the user's point of view, technical feasibility and viability from resources´ perspective. These are also applicable to education and could support usability evaluation during the design process.

### *Emphasizing the user as part of the authentic design process*

Usability and *user's perspective* (e.g. IDEO 2015; Gibbons 2016) could be taken more into consideration in CDT education. The Indian student designers saw as a freedom or as an opportunity considering users' perspective. User-centered design could be an opportunity to approach the holistic design process at schools (see Lindfors 2010). Orienting to users' needs would allow comprehensive education pupils an authentic problem solving and it could give a direction to ideating and designing. This way pupils could be released from an empty paper anxiety in designing and connect their learning to real life. Design

might challenge pupils to commit to a learning process and meaningful topic could help them to understand their learning (Carroll et al. 2010.)

### *Utilizing the phases of the design process in teaching and learning the holistic CDT education process*

Inquiry and exploratory work belong to the working methods of the CDT subject (FNAE 2016). According to the results, in the *research phase* of the design process, information about the problem to be solved is collected especially by exploring users. In addition, the pupils could get to know users of the craft product to be designed, using different data collection methods. Pupils could practice user interviewing, observation and shadowing. The research task could be presented to pupils as a secret agents job. The research data would be used to guide the ideating and designing. Positioning themselves to the user's position could develop pupils´ empathy (see also IDEO 2015).

*Innovative ideas* could be facilitated by changing the perspective (Laamanen & Seitamaa-Hakkarainen 2014). For a teacher, it is good to remember the point raised in the interview about redesigning and giving instruction to pupils. When redesigning a chair, the result is something very close to the chair. While designing something that you can sit on, you are more likely to design something unconventional. Ideally, the ideating would bring up the pupils full creative potential instead of focusing too much on existing concepts. Align with Fryen (2017) who says that design processes require improvisation in order to create something new.

As the Indian students emphasized, the prototype phase is important to make the ideas concrete and request feedback from users of (e.g. Lahti et. al. 2016). *Prototyping* supports pupils design skills by understanding the artifact three-dimensionally (also Lahti et. al. 2016) and the constraints. The role of prototyping is also important in collaborative design processes. (Yrjönsuuri, et. al. 2019.) An Indian jugaad-prototype, improvised solution, would be an interesting approach to creative problem solving and prototyping with primary and secondary education pupils. Jugaad solutions could be practiced with pupils for solving different problems with the materials from the classroom, school or nature. Quick jugaad prototyping could be used as a warmup for design projects. The exercise could focus on improvisation and teamwork. In addition, to develop improvisation (e.g. Frye 2017) and creative problem solving skills, the purpose would also be to reduce feelings of fear of failure limiting creativity. The exercise could also help grouping the potential design team.

### *Collaboration and documentation support the multidisciplinary design process*

According to the results, *design is at its best collaborating* with the design team and with different stakeholders. A holistic craft process, designing, production and evaluation can also be a group task (FNAE 2016). In user-centered design, pupils work together with the users or other stakeholders in different phases of the design process. Design process requires diverse know-how. Teamwork (Hero & Lindfors, 2019; Lawson et al. 2009) would make it possible to utilize pupils' different strengths.

**Documentation** is also part of the CDT subject in all grades (FNAE 2016). Documentation could make it easier for pupils and teachers to navigate throughout design processes. Pupils could assemble their own designer folder in the sense that they would gather skills learned in CV style, such as craft techniques, teamwork skills, responsibilities in a joint project etc. In that way, they could map and evaluate their own knowledge and skills. Project documentation could be saved to the same platform, depending on the project, a possible description of the problem or user, research data, picture of post-it papers, pictures of prototypes and different stages of work and so on. As in results, documentation could be used to identify ideas that did not work. Pupils could learn from mistakes during the design process that is experimental by nature (van Dooren et al. 2013) and there documentation could be a key-element.

Marketing also emerged with regard to documentation. For the Indian students the portfolio is the way to market themselves and projects were documented as work reports. The link between design and craft could also lead to *entrepreneurship education* or sustainable viewpoint. In schools, the design process could be examined in a longer term from a *marketing* and business perspective. That follows e.g. Lindfors´ (2010) user-centered design process to *implementation* and realization of the solution in real use and further development.

As the Indian students encountered *time constraints* in working life, time resources are also limited in education. There is a limited amount of lessons for CDT and teachers have to ponder how to utilize the precious time. As part of the CDT subject, design education could be a way to face societal challenges in the future (e.g. Hatanpää 2016; Lee & Breitenberg 2010). Enough lessons are demanded to achieve the CDT goals. (Lindfors 2012). It would be advisable and advantageous to utilize cooperation between different subjects in the design process.

### *Summary*

The design process of the Indian student designers gives inspiration to all the different phases of the holistic craft process, assignments for design projects, or for example a cross-curricular design project. Based on the results, it can be said that user-centered and collaborative design were emphasized by student designers´ conceptions of the design process. Documentation could be one key-factor in supporting the design process. In addition, different existing design process models and design education methods are applicable to the craft process and cross-curricular projects.

Besides considering the results of this study in the Finnish primary and secondary education context, they also reveal some ideas to develop professional design education in India. Learning tasks that would be executed in a work-life context in practice might support student designers' in learning to optimise their efforts according to customer constraints while they develop solutions with high usability. This might prepare student designers towards customer projects.

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