

Prototyping in the in-between. A Method for Spatial Design education

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Abstract: A challenge in today's design education practice is to formulate and use methods that support competences in the in-between-space between basic form training and learning that is relevant for designers in the future society. The aim of the paper is to discuss and to evaluate prototyping exercises in design education placed in that in-between space. Four different approaches to prototyping exercises are described, examined and evaluated in the paper. The prototyping exercises are engaging the students in the learning cycle phases of *learning by experimentation* and *learning by experiencing*. The result shows that the prototyping exercises did support learning of diverse competences in that in-between space but were also counterproductive and met different kinds of resistance in the students. This paper invites to a dialogue on how different prototyping techniques in design education might be used when educating designers.

Keywords: design education; spatial design; prototyping; body involvement

1. Introduction

In a panel discussion on Design and Innovation in 2015, a person in the audience asked the panel of design researchers:

In the good old days, design was about aesthetics and function, but you are talking about relations, users and services. Have you forgotten about form and function?

The content of this question is central for the paper. First, it points at how design is understood in parts of society in 2015. The students that are applying to a BA in Information Design - Spatial Design have a challenge to orient themselves today in defining design and design competences, and some are referring to design as styling (judging from the motivation letters from the last decade of students applying).



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The question is secondly pointing at the challenge to form a design education curriculum and teach design education today. We believe that form and function are still important, but considering the societal challenges in the future, the repertoire of a designer has to include a wider range of competences. Information design as a subject involves basic knowledge that is overlapping the education in for example interior design and architecture. The reasoning within this paper is thus not limited to information design but can also be of value for design education in general. It has been argued that subjective, elitist, ideological and master-apprentice models still control many architectural design education studios around the world (Salama 2015, p. 9). That model is said to promote invention over innovation, promote individualism and subjectivity over creative collaborative processes and community based learning (ibid). Working in the context of design education for information and spatial design at university level we strive to form an education, that meet the needs in society of designers who can design information in and with spatial environments. We are obliged to provide students with an education that gives necessary competences to work professionally with information, especially in spatial design and to provide conditions for advanced studies at graduate level in Information Design (Study Plan for a BA in Information design, n.d.).

A challenge in information design education is that design is often seen as problem solving. The students are, for example, trained to do incremental improvements in different public spaces from an information design point of view. This is a description of the design process as a problem-solving improvement process close to the definition of Simon (1970). To support an explorative innovative mind-set, in order to educate spatial information designers that can be able to develop competences for explorative innovation instead of incremental improvements, a different kind of attitude to design is needed. To prepare the students for explorative radical innovation, competences such as installing a culture of playfulness, be permissive in groups, building on others, risk taking but also to radically questioning and understand the what, the how and the why of their role and the role of design in a future society, are important (Peschl and Fundneider 2014). The extended role of architecture as a profession is described as to provide better living for individuals and societies (Salama 2015, p.159). This includes knowledge in knowing why it is better, better for what, and better for whom. It is also to understand what constitutes a creative act, when creativity is appropriate, and what can be done with it (ibid.). Based on studies on designers in action, the design process can be described as radically transformational, involving the development of partial and interim solutions which may ultimately play no role in the final design, intrinsically discover new goals (Caroll and Rosson 1985). The education needs to train the students creativity in how to define and identify a problem, rather than to solve a problem. One goal for design education is then to find methods to facilitate the 'voice' in learners and give the students possibility to talk and experience more than the teacher as discussed in Ghassan and Bohemia (2015).

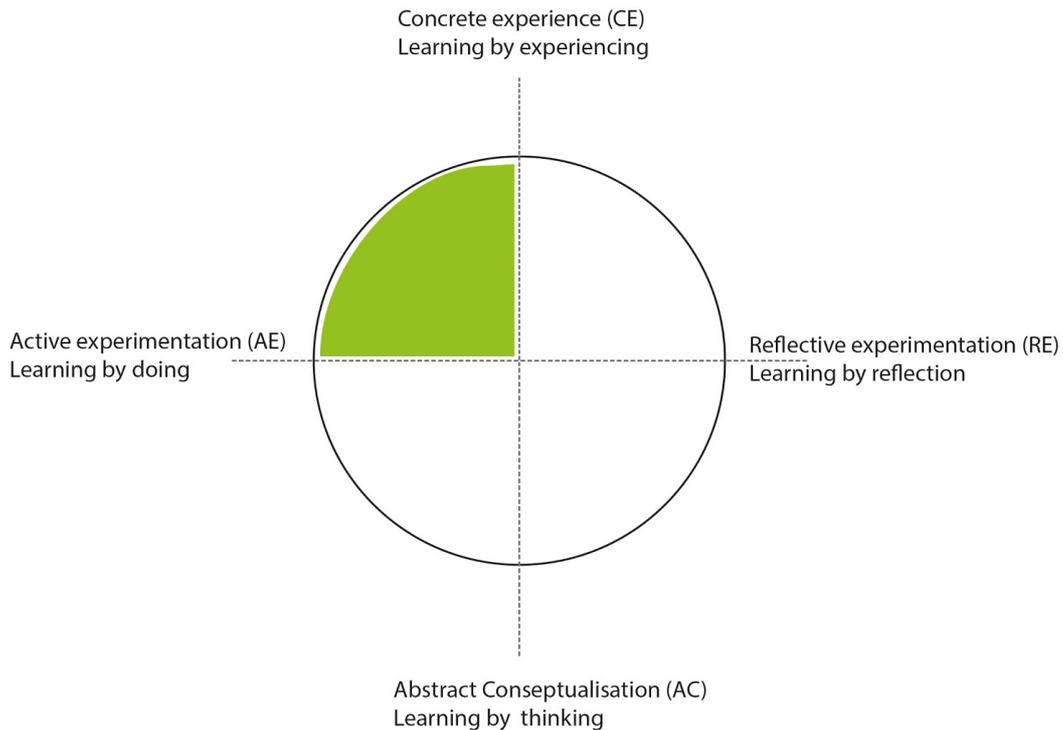


Figure 1 The learning cycle (adapted from Salama 2015). The green field marks where the main focus of the prototyping exercises presented in the paper can be placed into the learning cycle.

In order to be able to work as a designer, to find ways to navigate in an unknown future of design in society, the students should be provided with possibilities of exploring different ways of learning and designing. In the strive to develop spatial design education methods that supports innovation and creativity, to train collaborative processes and learning that both is relevant for the society but also gives the possibility of basic form training we have developed different kinds of prototyping exercises. In the early stages of the design process, we used methods and materials that aim to support understanding and definition of the problem and support the idea process rather than proposing solutions. The design process then becomes iterative, and includes artefacts and materials to explore and experience both basic form training the design space in the early phases of the design process. The exercises acknowledge different aspects of learning, such as learning by experiencing and learning by experimentation (Figure 1). The aim for the prototyping exercises was to stimulate the students' active experimentation with basic training of volumes, composition etc. but also learn about future form and exploring ideas by experiencing and experiment with materials.

The aim of the study was to examine the effects of the exercises and to evaluate them. We want, with this paper, to open a dialogue on how the different prototyping techniques can stimulate learning by doing and learning by experiencing in relation to future design competences.

2. Method

During 2008-2015 we developed exercises to support active experimentation and learning by experiencing. The examples are chosen to cover a diversity of the exercises. In all examples presented the student group consisted of 15-22 students, in majority female, and most between 20-30 years old. They all have passed one semester or more of their BA in information design before the exercises were introduced. Most of the students have prior knowledge of design from college but have limited experience in the basics of handicraft of designing. The material presented here is based on observations, student presentations, course evaluations, and discussions with the students, photos from the processes and of the prototypes. The processes were introduced and followed by the authors. We analysed the whole material from a perspective of how the exercises supported students' active experimentation in basic form training. We have analysed the material to find out if it supported collaborative processes, a culture for radical innovation and possibility to exploring ideas by experiencing and experiment with temporary materials. In example 2 and 4 the students also wrote reflections on the whole design process and those reflections has been analysed systematically noticing any reflections about the prototyping exercises. We are using fictitious names in the article, when referring to the students written reflections.

3. Result

Below, four examples of prototyping exercises that can be placed in the field between active experimentation and concrete experience are presented.

3.1 First example, masking tape exercise. Spatial taping prototype.

In the field of spatial design analogue or digital scale models are frequently used to create understanding of a three-dimensional environment. The models can be used as prototypes in the students' own processes, but also to communicate different ideas in a three-dimensional representation. To understand, for example, the principles of volume and proportions is necessary, since they are a part in training the ability to define and bring together different spatial components into a (spatial) whole.

The aim of the taping exercise was to provide a way for the students to explore, experience, and discuss spatial issues and highlight spatial functions. Teaching materials in the form sketches, drawings, photos, or models can be used as a visual support in teaching. To gain a bodily understanding regarding spatial relationships, the students need to also be able to explore and relate to a place on the scale of 1: 1. The masking tape exercise was developed from such a need.

20 students were divided into groups of 3-4 students, and they received a total of 150 meters of masking tape. (In the exercise shown in figure 2, there were also rolls of linerboard available). The instruction was to create spatial features in existing public spaces using masking tape. In about 30 minutes, each group presented their "rooms" and their reasoning on their choices.



Figure 2 Spatial taping outside the university library. The actual location was a starting point for a project in cooperation with the Campus Department.

Students in this exercise did not focus on a specific design, specific materials or spatial expression. Instead they explored the social aspects of space and new ways to think about information and spatial design. The temporary designs provided opportunities to discuss how a spatial boundary could control different movements, show directions and create spaces. This became especially noticeable because the students' own bodies could be used as tools. We could observe that the students with great dedication took on the task, within the limited timeframe. The students researched numerous aspects in a public setting and were immersed in the activity. They examined the physical boundaries of spatial units, they took decisions on where the boundaries could be placed and tested. They experimented with whether and how they could stop people going through the premises, and the consequences of that. They investigated the effect and experience of different spatial boundaries and their understandings of a place.

One reflection from a design teacher perspective is that it is an advantage to sometimes use simple materials that do not associate with ready-made solutions. These kinds of materials can represent spatial functions, rather than have a specific function. The materials' impermanence, in this case, the masking tape, gave opportunities to discuss and draw attention to how the perception of the space was affected by the taping in for example modifying volume and proportions, and to highlight relation between solid mass and spatial void in the current space. The exercise supplement experimentation with different volumes in a scale model.

3.2 Second example, multiple material prototyping

As a basis for the second example *multiple material prototyping*, two different exercises of rapid prototyping with a large amount of low / occasional / scrap material as a base are presented.

The first exercise was to prototype future spaces in municipal administration for ideas and innovation. The exercise was made in the second day of the course. The project started by defining the task, on the basis of written reflections of innovation leaders working in different parts of the municipality. In order to question norms of how a workplace in municipality could be designed in the future, the choice from a design education perspective was not to start the design process studying for example existing office spaces. The students were discussing, reading reflections, writing and sketching on big sheets of paper. They had the task to create a word from their analysis that was new to the world and make a prototype visualising that word. The students discussed what functions, spaces, experiences, movements, and visions that were coming forward from the innovation leaders, then the multiple material prototyping was introduced. The aim was to use a method in the early phase in the design process that motivated the students to both be intrigued by users' stories, different materials and shapes and to be inspired to work with the shape, colour and volume for a spatial context. Additionally, the exercise strived to let the students not to be fixed in the state of talking about possible solutions and then just executing them. The materials were chosen in order to facilitate for the students to enter into dialogue with the material, in that the experience and experimentation with the material would work as an inspiration to prototype innovative spatial designs that is unknown to today's society.



Figure 3 First prototype from one student group, prototyping future spaces in municipal administration. They were exploring different ideas and understandings of the context on the base of users' reflection stories and with support from "low materials".

One group explored how they could support communication via several senses in a spatial environment. The students invented and prototyped the word *Sinuation* a combination of senses, *sinu-* (*'sinnen' in Swedish*) and *-tion*, from communication, a word based on the reflection stories of the innovation leaders. In figure 3 the first prototype is shown, that according to the group was “a form with glasses that represented different spatiality’s and different senses” (Laura), “represented different words with different senses in focus” (Anna). They were able to construct something which one student expressed as hanging “bells” which, when working with the prototype collaboratively led them into new ideas of spaces and users in relation to different senses, mirrors, grass, enclosed spaces, open spaces, permission, curiosity and movement (Ella). One element of this first prototype that could be recognized in their final design 4 weeks later, was the swinging pedalling movement back and forth. The method did contribute to the design process, but as one of the students expressed “The prototype did not help me in a great extent, it was too early to develop our ideas in an object” (Laura). Another group member put forward that it promoted a common development, and created less misunderstandings but, as the student wrote, the experience of the process of prototyping/brainstorming with these kinds of materials is just *seemingly* easy:

The thing that is firstly perceived to be easy is in reality painful and loaded with distress. What I mean is to generate ideas and to be creative in a certain amount of time create anxiety. For me it does not mean that the joy or the will is not there, rather, my suggestions do not always agree with my real opinion [...] The hard part for me is to come up with ideas that the group should think about, which I think is the reason I get performance anxiety, and that the ideas or opinions I give away come out of the fly, without having been processed. (Anna)

In the citation the student associates the exercise with anxiety. To give away and share an interim idea that the student was not in full control of was painful, and blocked the student’s creative process. The exercise, in combination with the reflection stories from the innovation leaders, elicited reflection on the competence of a future designer:

Can you manage to create new procedures and standards in a workplace that is quite structured and restricted? It could be that one must start in how the organization is structured to perhaps make changes in it, but so far this is not our area of expertise as designers yet. (Lena)

Another work with *multiple material prototyping* is based on a workshop with the aim to develop a prototype of a head-mounted projector screen (Figure 4). The workshop was a part of a larger research project in computer science (Kade et al 2015). The purpose of the multiple material prototyping in the course process was to get the students familiar with different design methods as a general tool for design processes. The material used was paper, empty packaging, objects of various sizes intended for other purposes such as recycled plastic, fabric, glass, metal and other miscellaneous materials. The 15 students participating in the workshop were in the third year of their BA in information design. They had the task going from sketch to a three-dimensional object, a “quick and dirty” prototype, in one day. Although the exercise was based on a product and not a three-dimensional

environment, there are similarities existing methods and approaches in the spatial design process and the students were encouraged to involve the learning in to a spatial design task later in the course. The students were supposed to bring different and unexpected materials for prototyping to the workshop.

Most students appreciated the phase of idea generation, brainstorming and to talk about different solutions based on a three-dimensional object but not working with multiple material prototyping and sketching with temporary materials. Only one of the students brought some material. When we talked about why they didn't bring materials, they said they did not have access to material and couldn't afford buying any. They expressed a limited interest in working with these kinds of materials. They perceived the materials as debris. As in the previous example of multiple material prototyping, the students explained that they wanted to have progressed further in their process in order for three-dimensional prototype to be perceived as meaningful. The students could consequently not see the rapid prototyping and quick & dirty exercises an important part of the design process.

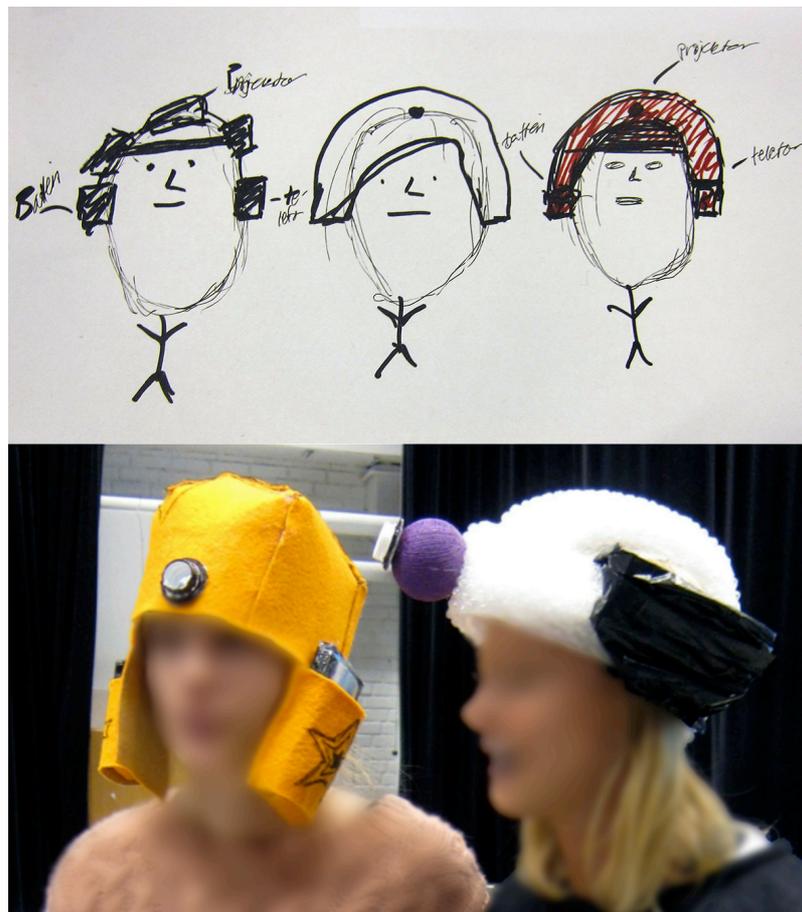


Figure 4 Students with prototypes for head-mounted projector display. The picture above shows two-dimensional sketches as the basis for the design of the three-dimensional prototypes in scale 1:1.

Some students expressed difficulty with choosing materials, when there were so many materials and thus many choices. Instead of inspiration, they felt locked and inhibited. They would have welcomed a more limited range of materials. The aversion to the quick and dirty prototyping did not concern all students though:

The exercise that appealed to me the most was quick & dirty prototyping, which I thought was really fun. To rapidly produce something with the material you have available and get to work more with hands made my creativity started more than when I only sat with pen and paper. The pressure fell and it was easier to create freely. This I believe is because different materials can create different associations that make it easier for me to elaborate on or coming up with new ideas than when I merely draw. I also thought it was very cool to see how many different prototypes we all had managed to do in such a short time. (Sarah)

The students expressing that they did not have access to material and couldn't afford buying any, indicates a real difficulty to see the possibilities in the free material close to them. The limited interest in working with these kinds of materials pointed at the student's challenge to let the materials inspire them. They also had difficulties to transform temporary materials or artefacts intended for other uses into something usable in prototyping. Despite the negative experience expressed by the majority of the students, the results from the workshop were a wide range of unexpected design ideas and interesting outcomes for the prototypes of the head mounted display.

3.3 Third example, bodily involving multiple material prototyping for museum exhibition

20 students, in the end of their first year, took part of the prototyping exercise presented here. The goal of the design task was to create 5 sound and sensor based stations for interaction in a county museum. The students were supposed to add their stations to the standard exhibitions at the museum. As a starting point for their process they analysed the current exhibitions from a norm critical perspective to create an addition that would not reproduce a dominating norm of gender, ethnicity or age group in the exhibitions. Their task was also to reflect over if there was a special part of the body that seemed to be the norm - and part of the body that was underrepresented - when the visitors interacted with the exhibition. Therefore, the students were encouraged work with different materials in order to try out, experience and build early suggestions of ideas. One prototype explored how the visitor could to enter into in some kind of human shaped form to activate a story. The students played along with the character of the material used (Figure 5). The student group quickly came up with an interesting concept and they modified it during one afternoon in order to make it accessible even if the visitor was a child in a wheelchair. They used their bodies when prototyping, entered in to discussions about inclusion and exclusion and tried out height and placement of the body form in order to exclude adults. They thought of the form as some kind of passage from current time to the past and that the head and shoulders would activate sound.



Figure 5 Students exploring visitor involvement in a museum exhibition with bodily engaging prototypes. In the prototyping the students are exploring a way to enter into in some kind of human shaped form to activate a sound.

What then was surprising was their struggle to connect the raw prototype with something that could actually work in the museum context. Even with supervising and supported discussion the group had a hard time to see any value of the exploration of form in their first prototype and it seemed to be difficult for the students to adjust the idea and take the form further in terms of possible placement and space. It is true that the design process does hold occasions of interim solutions that have no value in the final design (Caroll and Rosson 1985), but the students did not see the form experiment as an asset in the design process at all. Their process proceeded without reference to their initial form ideas. Instead of daring and trying out and continue the work with exploring different solutions with materials, bodies or form, they were stuck in a phase of reflection. The final design was not consistent with the originality and bodily involving aspects of the first prototype.

The value of the prototyping from an educational perspective was that it gave an opportunity to reflection in action, trying out different alternatives, involving the students' bodies into the design process, and made the students come up with unexpected forms. One reflection is that it seems that the method was too far from the norm of how the students thought of the design process, so instead of being incorporated in the design process the prototyping exercise become alien to them.

4.4 Fourth example, bodily involving prototyping

Another example of learning by experience is what we call bodily involving prototyping. It is based on a collaboration between the design education and the choreographer Eva Perbrand Magnusson. The students had the possibility to discover spaces with their own bodies (Figure 6).



Figure 6 During a workshop the students explored possibilities and limitations of a space using their bodies and involving sight, hearing, touch, and smell as tools in their understanding of the space.

One aspect of the design process that is often forgotten by the students is to imagine spatial changes depending on the number of people activating a site. The exercise made the students aware of how various bodies and movements can change a place, and incorporate that knowledge in their design processes and in their two and three-dimensional representations of place.

The choreographer's exercises involved exploring distances, directions, planes, levels, volumes and patterns. Concepts such as symmetry and asymmetry were experienced with the students' bodies as tools for understanding basic shapes of circles and squares. The

exercises contained various formations where the students' bodies were related to the other group members' bodies as well as to the spatial continuations and the spatial limitations.

The exercises were supposed to support the students' awareness of the space, and bodily experience in the design processes. One aim of the workshop was to encourage the students to explore movement and different locations in the space as significant for the perception and understanding of a place.

In the students written reflections from the workshop they described the bodily involving prototyping as a different but useful way to understand a space. Most students participated in the workshop and reflected over different themes, for example movement in space. One student wrote that it was "fun with the dance and movement workshop! You got a good idea of movement in space in different ways " (Linda). Another student put forward the experience of being able to have a learning situation that included the body in an experimental way. She thought that "[t]he dance exercises in the room was a good way to do something other than a traditional lecture." (Maria). A third student put forward that the combination of different approaches to grapple spatial relationships was positive. She meant that it was great to do varied things like sketching and to move and feel the spatial relationship in a space. The students appreciated the exercises of bodily involving prototyping as an alternative way of learning but still the link to the purpose of the workshop in relation to information and spatial design can be further clarified in teaching. A follow-up and reflection may be needed for that experience should be related to the knowledge of spatial design.

4.5 Overview of the results

To sum up the results, the prototyping exercises evoked (at least) two different attitudes towards the exercises in the students. Below we present a table on what draw the students into the exercises and what made them distanced from the exercises, based on the four examples presented above.

Table 1 What distanced the students from the exercises and what immersed them in the exercises

Repulsion	Immersion
To early to transform ideas to objects	Materials impermanence
Frustration in the contradiction between the seemingly easy material and the lack of skills to work with it in idea generation	Material with other functions then modelling
Short time	Short time
No control over the presented	Versatile materials
Performance anxiety	Less pressure
Prejudices on design and design process as stylish	Less misunderstandings in collaborative work

Not attractive	Used as a boundary object for discussion
See the material only as garbage	Work with hands, using bodies, movements
To much material	Common development, shared experience
Interim solutions and modifying is not an important part of the design process	Different materials create different associations
No value of prototyping in the design process	Cool to see different prototypes made by others
Valuating talking over doing	Variation
Stuck in discussions	Having fun

4. Discussion

The prototyping exercises presented here offered an opportunity for the students to be engaged in learning by experience, since they could experience spaces and materials with different senses. The prototyping exercises were also designed to support collaborative exploration of a design scope, and exploration of how material and body interaction could influence the design process and final design.

The exercises did move the focus from a teacher's critique and dominance in, for example, a feedback session towards the possibility for the students to embody, share and negotiate what they were doing, why and what for, and themselves define the design problem. This is all important aspects for a design student to train. It has to be noted though, that some of the students in the most extreme cases were repulsed by the prototyping exercises then immersed in them. The result indicates that the developed prototyping exercises that were aiming to support competences in the in-between-space between basic form training, collaborative design processes, and skills that are relevant for practicing design in the future society, did evoke resistance, repulsion and withdrawal in some of our students. Simplified, the prototyping exercises brought out two different attitudes and reactions towards the exercises in the students, here named 'repulsion' and 'immersion' (Figure 7).

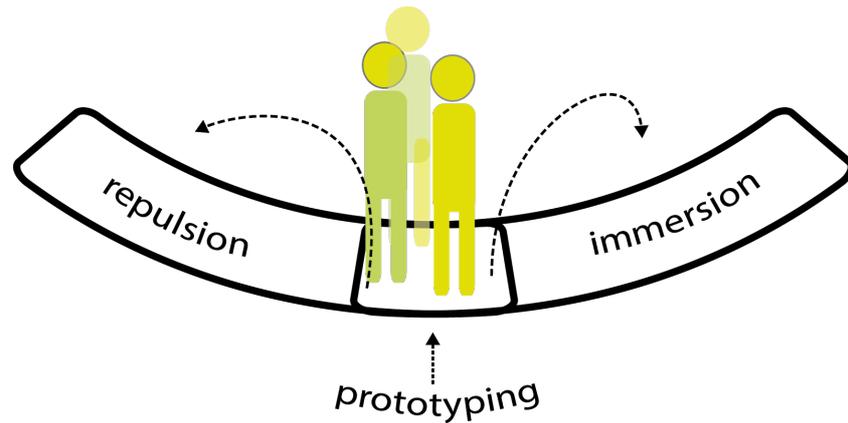


Figure 7 A simplified categorization of the attitudes and reactions towards the exercises here named 'repulsion' and 'immersion' when students participated in the prototyping exercises (illustration J. Schaeffer).

The consequence of prototyping evoking repulsion might be that learning is inhibited by the prototyping exercises rather than supported in the student group that we teach. Judging from the way the students discussed about design, it seems that the *image of design* was blocking the students *to design*. They are not thinking of design in the extended role of architecture, as for example find unexpected ways to provide better living for individuals and societies (Salama 2015) rather, they perceive design as stylish procedure.

On the other hand, when the students were immersed in the processes, the prototyping exercises supported learning to a certain extent. The attitudes that immersed the students into the prototyping exercise (see Table 1) were much in alignment with the description of competences important to create a culture for explorative innovation (Peschl and Fundneider 2014). In a scale from immersion to repulsion, the tape-prototyping and the bodily involving prototyping created more immersion than multiple material prototyping. To make the exercises meaningful for some of the students, it might be important to connect the prototyping exercise to the other phases in the learning cycle, i.e. learning by reflection and learning by thinking in a more explicit way and for example to discuss the role of design and the design process. When the students withdrew from the exercises since they had no control over the result, or when saw the temporary material only as unattractive garbage, the exercises did not create a culture for explorative innovation. In those cases, the students did not consider prototyping, be creative with material and loose control important, or even as a serious part of the designers' competence.

5. Conclusion

The study has examined the effects of 5 prototyping exercises involving the students in learning by doing and learning by experiencing in relation to future design competences. We found that the prototyping exercises brought out two different attitudes and reactions

towards the exercises in the students, here named ‘repulsion’ and ‘immersion’ and the repulsion reaction did not support learning in the time frame of the course.

To make the exercises meaningful for some of the students, it might be important to connect the prototyping exercise to the other phases in the learning cycle, i.e. learning by reflection and learning by thinking in a more explicit way. In terms of design education, we see a challenge in finding design methods for introducing exploration of possible futures. We are open to a dialogue on how different prototyping techniques can stimulate learning by doing and learning by experiencing in relation to future design.

Acknowledgements: The authors would like to thank the over 200 students that participated in our study.

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