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Participatory Design with Children in Science Centers

Master's thesis

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ABSTRACT

Children participation during design process, where young people are assigned the role of a design partner, is challenging traditional power relations between the adults and young people. In order to address these issues, application of Participatory Design as an approach and the methods, provides a set of guidelines focusing on democratic practices. These in turn can empower marginalized user and contribute with deeper understanding of the use and the user itself. Literature concerning existing practices in the museums and science centers about visitor participation, is arguing for various ways of user inclusion. Though, the visitor as a design partner is rather challenging existing understanding of what is the role of the visitor.

This study examines how children participation during redesign process of an installation in the science center, can contribute to deeper understanding about the user experience. In order to apply Participatory Design approach and the method Future Workshop, I chose to analyze initial design process of the installation through theoretical framework called, Actor Network Theory. The analysis will provide an overview over the actors, which contributed to the design process, but also will help to identify who was marginalized during the development of the installation.

The application of the theoretical framework enabled planning and designing of the intervention method, Future Workshop. As a result the method established deeper understanding of user´s experience of an installation, and empowered marginalized children during the design process. Inclusion of museum professionals into the redesign process, addressed also the issue of power relations, where all invited participants had to co-design as design partners. The outcome of the study was giving a *say* to younger participants, where they could reflect and elaborate on the use and redesign of the installation together with the museum professionals.

ACKNOWLEDGEMENTS

Foremost, I would like to thank my supervisors, Dagny and Maja, for being great support for me during whole writing process. Dagny´s patience and acceptance of million of my weird ideas, running through my mind while we were having supervisor meetings, is priceless. Also, Maja´s ability to structure my chaotic thoughts two weeks before submit is something I´m and will be grateful for. I would also express my gratitude to science center in Norwegian Museum of Science and Technology in Oslo, for giving me opportunity to carry out the workshop with children. Also, I am grateful for help from maintenance team from science center, which fixed the installation right before the workshop. Without you, guys I wouldn´t be able to gather data for my thesis.

The time spent on this thesis has been characterized of both ups and downs. During this period I have forgotten about my friends and in general real life. Even though, my dear Line and Neeruja haven´t forgotten about me and were bravely listening to my boring and monotone talks about my problems and dilemmas concerning thesis and life. Also, my sincere thanks go to my dear beloved – Persijn. Without your support and positive disturbance I would never be able to relax during this time.

Chciałabym także podziękować moim rodzicom którzy mnie wspierali przez cały ten czas. Mamo, bez Twojego spokoju i Twoich rad nigdy bym nie skończyła pisać magistra. Tato, dziękuje Ci za podtrzymywanie mnie na duchu i za przynoszenie mi czekolady kiedy jej najbardziej potrzebowałam ☺. Bez Waszego uporu w namawianiu mnie do nauki, i ciągłego dążenia do wymarzonego celu nie byłabym tu gdzie jestem dzisiaj. Kocham was!

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1 INTRODUCTION

This thesis is exploring introduction of participatory methods, specific focusing on the Future Workshop at the Norwegian Science Center in Oslo, with children and employees as a co-designers. The method of Future Workshop is a part of Participatory Design methodology, where the main guiding principles are focusing on how to support democratic practices and how to empower the participants during processes of technology design. In this study the installation named BioEnergiPinBall was under joint examination with children and employees. The installation is a result of collaboration of the Norwegian Forestry Society and the Norwegian Science Center in Oslo. The product of cooperation was designed and developed by a team from the science center, and was given as a gift from the Norwegian Forestry Society to all eight science centers in Norway. The gift had as aim to teach children what are the elements of the photosynthesis, and how they contribute to the production of building material and source for energy. I want to focus on how science centers can design user experience *with* children *for* children by applying Participatory Design approach and methods such as Future Workshop.

1.1 MOTIVATION

The project called Expand (Utvite)[1], which focuses on research in Norwegian Science Centers, was great opportunity for investigation of the existing design practices in the science centers. The project was initiated by *Statoil* in 2011 together in collaboration with the INSPIRIA[2] Science Center, Section for Learning and Teacher Education, Department of Mathematical Sciences and Technology, Norwegian University of Life Sciences, Norwegian Centre for Science Education and Norwegian Research Council (UtVite, 2015b). The project has three different objectives 1) Science centers as learning areas; 2) Science centers as engagement and 3) Development of reflective practices. I´m involved in the second objective, where I am a part of focus area concerning "*A*

[1] http://utvite.org/en/about/
[2] http://www.inspiria.no/

participatory youth action research" (UtVite, 2015a), which further unfolds into different subjects like e.g. youth participation (UtVite, 2015c).

My study is based on an interest in Participatory Design approaches to design (PD) (Simonsen & Robertson, 2013), especially notion of inclusion of end user into the design process. Originally, the methodology was used in the projects, which had as an aim to empower workers at their working place, while introducing new technology (Kensing & Blomberg, 1998, p. 167). During the first PD project, the researchers introduced democratic practices, where workers could express their *say* (Bratteteig et al., 2013, p. 129) and contribute to the design of supporting their practices technology. This entails that the methodology is focusing into large degree on how application of democratic practices can empower the user during the design process; and how user´s knowledge and skills can be used as a source for new ideas (Ehn, 2008). With time the PD approach was adopted in other contexts like community planning (DiSalvo et al., 2013), and can also be found in the literature concerning museums and science centers (Iversen & Smith, 2012; Taxén, 2004).

My motivation for application of PD methods and approaches in the study was driven by the notion that it allows to design better solutions, because of the high user participation. Close collaboration and co-design with the end user as a design partner supports deeper understanding for the user itself, but also his or her use of particular technology, like in my case the BioEnergiPinBall installation.

1.2 THE BIOENERGIPINBALL CASE

The thesis will explore the case of an installation, which is placed in the Norwegian Science Center in Oslo. I´m particularly interested in the installation, called BioEnergiPinBall, which is a part of a bigger exhibition called "Energi Tivoli"[3] or "Energy Amusement Park". The exhibition is consisting of several individual installations, which are representing a mini version of an old-fashioned amusement park. The exhibition has as a goal to communicate challenges with today´s energy, and present future´s alternative energy

[3] http://www.tekniskmuseum.no/utstillinger-3/697-energitivoli

solutions. The installation is a result of cooperation between the Norwegian Forestry Society (NFS) and the Norwegian Science Center in Oslo. In this collaboration, the NFS came with the idea and topic, while the science center contributed with a proposal of what kind of medium could be applied for communication of the NFS´s message. The NFS was interested in telling different social classes in Norway the benefits of the forest and it´s contributions to the environment. Through process of evaluation the NFS established a project, where they wanted to contact some institutions, which could help them in communication of their message. As a result, collaboration between the NFS and the science center in Oslo was established and work on scope and installation begun (T. Lohre, personal communication, October 17, 2014).

The next section will provide an overview of the actors that had impact on formation of the installation. In the end I will present a description of the installation and its characteristics.

1.2.1 THE NORWEGIAN FORESTRY SOCIETY

The NFS is an important participant, in my study. It is a society, which have as an aim to promote understanding of how forest resources can be used in a sustainable way (DnS, 2014a, p. 16). Through their work, they want to teach others values of the forest for trade, climate and society (2014a, p. 16). In order to reach their target group, they are working in different ways through various activities that are both for youngsters and adults. The NFS is providing meetings at schools with children, but also invite whole classes to have lessons in the forests in order to e.g. learn how to survive in the forest (DnS, 2014b). They are interested in alternative ways to communicate with their audience. The NFS is benefiting from social media like Facebook, but also developing together with other organizations mobile applications in order to make the NFS and their goals more visible (DnS, 2014c).

In 2012 the NFS had several projects going on, but their most important aim was to improve the general knowledge and attitudes towards forest management. In the article from 2012 in *"Skog og Miljø"* (Lohre & Venn), the authors points out that there is general misunderstanding of how forests should

be used, based on what media are presenting (p. 8). Lohre and Venn explains that a lot of people have some knowledge about climate challenges that we are meeting today; but basic understanding concerning application of forest resources is lacking.

The absence of fundamental awareness, is restraining reasonable usage of wood. The NFS (Lohre & Venn) points out that, children at elementary school learn some basics about how photosynthesis is working; but when young people reach high school – they are missing further and deeper discussion about the subject unless they choose to study natural science or biology (p. 8). Further, when we are adults - we are encountering forests through trips and sports. We are using fireplaces, in order to have cozy time without bigger thought that we are actually burning stored carbon dioxide in the wood (Lohre & Venn, 2012, pp. 8-9).

In order to work more proactive and enhance knowledge, the NFS has chosen to create a project, which is owned and led by them. The project was based on cooperation with all eight Norwegian Science Centers (Lohre & Venn, 2012, p. 9). They established closer relationship to the science center in Oslo, where its team had responsibility for design and development of the installation called BioEnergiPinBall.

1.2.2 THE NORWEGIAN SCIENCE CENTER IN OSLO

Norwegian Science Center in Oslo became a partner for the NFS because of their previous experience with development of various installations (T. Lohre, personal communication, October 17, 2014). The science center had both knowledge and resources for design of the installation, because they actually build their own exhibitions. The science center has several different exhibitions, where they invite visitors to actively participate in the exhibitions and explore natural science and its principles (NTM, 2012). The installation that I am interested in is a part of larger exhibition named “EnergiTivoli” as described earlier. The science center has its own design team, which is inventing and developing their installations and exhibitions when it´s necessary (J.A Andersson, personal communication, October 16, 2014).

1.2.3 THE INSTALLATION – BIOENERGIPINBALL

The installation, which resulted in collaboration between the NFS and the science center had as an aim to communicate the three basic components of photosynthesis: water, light and carbon dioxide; and how together build a source for energy and building material (Lohre & Venn, 2012, p. 9). The target group of the installation are children between 5th and 7th grade. The installation is based on the traditional Pin Ball game concept, which is about playing as longest as possible in order to gain as much as possible points (Edwall, 1982). These types of games are also called arcade games, since they require that the user puts some coins into it, in order to play with it (Kelly et al., 1997). The installation at the science center has some similar reasoning, which is playing as longest as possible in order to gain resources to produce photosynthesis. The player has to collect three different elements, which are light, water and carbon dioxide.

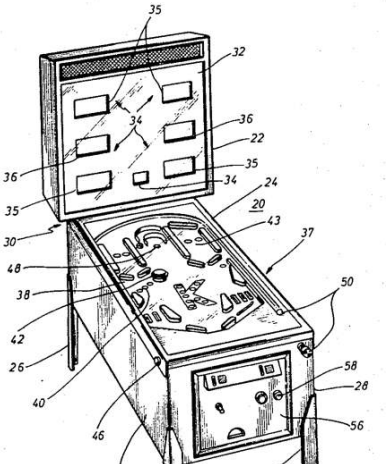

FIGURE 2: ORIGINAL PIN BALL GAME (EDWALL, 1982)

FIGURE 1: SCIENCE CENTER´S PROTOTYPE OF THE BIOENERGIPINBALL (LOHRE & VENN, 2012)

The game it self, is started with a short presentations of its functions and the rules. Here is explained that in order to produce the photosynthesis – you have to collect the three elements. While the user is playing the game, he or she gets feedback about what kind of resources they are missing and should try collecting more of. The player has three balls to play with during one session. After these three balls are used, the user is presented with his or her result in form of amount of green wood. Thereafter, the player has to choose between

either to build a house from collected wood or produce energy by burning the wood as an energy source.

1.3 RESEARCH INTEREST

This section will provide a deeper overview of interests, which I am concerned with. In the first place I will describe why I want to apply Actor Network Theory (ANT) as a theoretical framework. Thereafter I will move to PD and explain how I want to use it as a methodology together with a method called Future Workshop (FW) during my study. End of this section will contain specific research interests, which will lead my exploration.

The ANT framework can be understood, as a lens for analyzing given situations, were the main purpose is to capture existence of different actors that are contributing to the end result (Quan-Haase, 2013, p. 55). Through this type of perspective the researcher is able to identify who is responsible for which actions and outcomes. The ANT lens, is giving an overview of both human and non-human actants, whom are shaping the socio-technological assembly (Akrich, 1992; Ehn, 2008). The framework can be used as a way to tell the story of a specific technology, just like Latour has done in his research (Latour & Porter, 1996, p. 57; Quan-Haase, 2013). By analyzing design of the installation I will be able to reflect upon the earlier processes, and identify how I should design my research in order to introduce a design intervention method.

As mentioned in the start I am interested in how PD´s democratic practices, and resourcing from end user´s skills and knowledge can contribute to the design process. The case of the BioEnergiPinBall is focusing on children as the end users. This entails that participation, which I will be interested in will be around children inclusion and their opportunity to participate in decision-making during participatory design (Bratteteig et al., 2013; Bratteteig & Wagner, 2012). This implies that the end user will participate in the design process as a designer, and design for use before use (Ehn, 2008, p. 93). Also, based on introduction of the methodology I want to explore the issue of equalization of power relations of the participants during the design process (Kensing & Greenbaum, 2013).

My research will also benefit from co-creation (Ehn, 2008, p. 93; Sanders & Stappers, 2008), where participants will act as a co-designers. The methodology will be supplemented with application of the FW method (Taxén, 2004; Vidal, 2005). The FW will create an arena for co-creation where invited employees from the science center together with younger participants will co-design alternative solution and discuss issues around the installation. The method will be used as an intervention in to existing ecology of the installation at the science center in Oslo. Through application of the FW I will be able to obtain deeper understanding about how young participants perceive the installation, and reflect upon it. Also, the FW will enlighten the issue of equalization of power relations between children and adults (Downes, 1999; Druin, 1999b). I will apply methods as they were originally designed, without any modifications.

Section can be sum up with these specific research interests:

1) **How can Actor Network Theory provide deeper understanding of the design of the installation at the Norwegian Science Center?**
2) **How can Participatory Design in the Science Center contribute to the re-design of an installation and contribute to a deeper understanding of how visitors experience an installation?**
3) **In what ways can the Science Center benefit from including children in the design process of an installation?**

These interest cover large research field, in order address these I have focused on the aim of how to design user experience *for* children *with* children in the science center.

1.4 CHAPTER GUIDE

The outcome of this study is deeper understanding of how can PD approaches and methods contribute to empowerment of young participants, where as result children are able to reflect and elaborate upon the use. This provides in-depth knowledge about children´s use, but also explores the issue of designing *for* children *with* children. But, before entering the next chapter I would like to present a brief description of each of them here.

Chapter 2: Literature Review: This chapter will provide an overview of existing forms of visitor participation in museums and science center. Thereafter I will present challenges with high user participation in the institutions, where it will be followed by overview of children´s participation in design projects I terms of roles they can be assigned. I will end chapter with presentation of earlier PD projects with children inclusion.

Chapter 3: Theoretical Framework: Chapter will present the ANT and the concepts such as *inscriptions* and *translations.* I will also discuss the issue of power as an effect of heterogeneous network processes.

Chapter 4: Methodology: In this part of thesis I will provide an overview of PD methodology and its guiding principles. Thereafter I will move to challenges and opportunities the methodology is presenting through high user participation. Also, I will provide the overview of the connection between the PD and ANT. This will be followed by presentation of methods for data gathering and design intervention method – the FW. Also, I will present how I formed my research site, and how the data gathering went.

Chapter 5: Original Design Process: Data and Analysis: The chapter will go through the data gathered during interviews with the NFS and science center. I will also include analysis of these based on the ANT framework.

Chapter 6: Design Intervention: Data and Analysis: I will provide presentation of the FW and analysis of the data based on the relevant literature.

Chapter 7: Reflection: Here the goal is to answer my research interest presented in chapter 1, and argue for how the earlier present literature can support the findings.

Chapter 8: Concluding Remarks: Section will summarize the thesis with what I have done during the study. Also I will explain what I have found and what can be done during future research.

2 LITERATURE REVIEW

Museums traditionally were meant to display collections of artifacts that had historical and cultural value, and show how time has moved (Baldock, 1995; Dindler & Iversen, 2009; Taxén, 2004). Science or technology museums didn´t show *science,* but rather the fact that some machines were not longer in use, where the message was given through a static text placed beside the exhibit (Baldock, 1995, p. 286). Museums, galleries and science centers are often associated with informal learning (Hawkey, 2004, p. 8), but as well learning which is combined with mandatory materials at schools (Bandelli, 2014). First science center like *Exploratorium* (Oppenheimer, 1968), was focusing on how visitors could increase the knowledge about the science and technology in a direct manner (Allen, 2004).

On the other hand, science centers and museums saw the digital technology as a possibility for new ways of communication and engagement styles with the visitors (Dindler & Iversen, 2009, p. 1; Hornecker & Stifter, 2006; Hsi & Fait, 2005). The digital technology gives a lot of opportunities, but one of the most essential is the fact – that the technology allow for completely different interaction and activities that otherwise wouldn´t be feasible (Hawkey, 2004, p. 2). Hawkey (p. 8) emphasize the power of the technology when it comes to learning, and that different range of media can disseminate knowledge. Taxén discuss the wide variety of the technology that is used in the museums, and points out that application of these has as a goal to "*enhance, augment or replace traditional exhibition techniques"* (2005, pp. 6-7). Also, Sharp et al. (2009, p. 280) underlines that usage of the technology in the museums and galleries will change existing visitor experience.

The introduction of different digital devices into the museums and science centers, requires experimenting with the technology´s possibilities and affordance (Taxén, 2005, p. 7). In order to contribute to affordance or the other design principles such as visibility, constraints or consistency that are vital for the user experience (Sharp et al., 2009, pp. 29-33); there is a need of perspectives and knowledge from the field of interaction design. Also, user

participation can be valuable for revealing user´s needs and requirements and support new design, but as well embrace the end user´s empowerment during the design process (Dindler & Iversen, 2009; Hsi & Fait, 2005; Taxén, 2004).

Within the interaction design there are a lot of different views and approaches of how to include the end user during different phases of the design process. Studies from User Centered Design (UCD) seeks for iterative processes, where the needs and requirements of the user are tested, during development through e.g. observations or interviews (Druin, 1999b; Petrelli et al., 1999). On the other hand PD is focusing on the issue of how to empower the visitors during decision-making (Iversen & Smith, 2012; Taxén, 2004). Also, interesting contribution from the field of Computer Supported Cooperative Work (CSCW), can be helpful to examine how design of technology may encourage to more collaborative interaction with the exhibitions or installations (Hindmarsh et al.,2002). But the traditional perspective of CSCW does not put weight on participation. The difference between these approaches is the degree of the user involvement, and the focus on the balance between power of the designer and the user over the design proposal. The issue of participation is debated by several authors (Nielsen, 1994; Sharp et al., 2009); where with time separation of the user into two different user groups such as children and adults was accepted (Druin, 1999b; Iversen & Brodersen, 2008).

On the other hand, inclusion of the participant during the design process is raising both challenges and opportunities for the designer. Sharp et al. (2009, p. 424), discuss the dilemma which is tied up to inclusion of the user during the design process. They are mentioning that involvement throughout development, can both initiate advantages and challenges. It is described that application of the user participation during design process can introduce the benefits that outweigh the costs (Kujala & Mäntylä, 2000). This entails that often the user inclusion can take very long time and take up the economical resources – but on the other hand contribute with necessary knowledge about user, which can support the final design. Nielsen (1994, pp. 2-3), argues for this claim through presentation of several projects which turn up very well because of the end-user engagement. On the other hand Heinbokel et al. (1996) are discussing that highly

collaborative projects are often missing flexibility, have fewer design alternatives and are in general little effective in action. Other authors like Scaife et al. (in Sharp et al., 2009) are pointing out that involvement isn´t the problem itself; rather the main challenge is at *which* stage of the development should the participation happen.

2.1 UNDERSTANDING OF PARTICIPATION IN MUSEUMS

Stuedahl and Smørdal (2011) point out that there are several ways for visitors to participate in the museums activities; through contribution, collaboration, and co-creation. Black (2010) and Salgado (2009) explain that application of social media is becoming more popular as a part of visitor participation. Usage of platforms like Flickr, Facebook, Twitter or YouTube is becoming a tool for mediation of the communication and engagement between the visitors and the museums or the science centers; where they as well represent openness of the institutions (Dicker, 2010). In the book of Nina Simon (2010) the reader is presented with several different forms of the visitor involvement. Visitors are asked to respond to the exhibition through a video recording (Simon, 2010); or to rate the installation by throwing a ball in to a the *voting bin* (Simon, 2010, p. 1). On the other occasion the visitors are asked to make posters on their own based on the exhibition about rock music posters, and hang them around (Simon, 2010, p. 7).

A different definition of participation is used by Taxén (2004) and Tzibazi (2013), where they are applying in their studies participation happening while designing or redesigning the technology together with the end user as a equal collaborator. The definition is grounded in principles from PD and participatory action research, where the end user is invited to join the design process as a co-designer together with the educators from the museum (Taxén, 2004) or with the artists (Tzibazi, 2013).

In the museums, knowledge about visitor´s experiences has traditionally been gathered by applying *museum visitor studies* (Bandelli, 2014). These focus on the demographic data gathered during assessment of an exhibition. The development and design of the exhibition and museum outreach programs itself,

has traditionally been based on the knowledge and assumptions of the museum-staff, like curators or subject specialists; in some cases including educators, designers, artists or technicians (Taxén, 2004, p. 205). The end-users were taken to account in the testing activities when the installation was complete or in a beta-phase, where testers were selected by the museum-staff (2004, p. 205). Taxén explains that with time employees like educators and evaluators where included in the development process, so that they could contribute to the "visitor knowledge" in earlier design phases (2004, p. 205). The end users of the installations are rarely invited to participate as a *design partners,* as a lot museums haven´t acknowledge fully the meaning of this type of participation (2004, p. 205).

Also, Taxén points out that the existing visitors studies doesn´t present any research, which would elaborate on approaches and methods that support current museum design practices, and empower the visitor. He indicates that PD methodologies would be suitable to access necessary knowledge (2004, p. 206), where he implicates that PD has great potential for strengthening the position of the visitor at science centers through high visitor participation. This leads to shift in museum´s approach to be more *visitor – focused* with complementation of *visitor-designer dialogue* (Taxén, 2004, p. 206).

Inclusion of the visitors during the design process in the museums or science centers is challenging (Taxén, 2004, p. 205). Such institutions have more superior role in relationship to the visitor, where they are fully in charge of communication of the message, which supports the asymmetrical power relations. Even though, Taxén (2004) is emphasizing that there is "*very few documented research projects"* where there is applied PD methodology, there has been a development in this particular field since 2004. During this time authors like Tzibazi (2013) or Iversen & Smith (2012) have experimented with the visitor participation during design process. But, as mentioned this field is challenging, and their results supports this issue. Tzibazi described problem of museum professionals whom didn´t fully understand the value of visitor participation. While Iversen and Smith, had issues concerning traditional power

relations between the adults and young participants during co-design. The next section will present issues tied up to children participation.

2.2 CHILDREN AS PARTICIPANTS

Traditional field of interaction design has been criticized for assuming that every user is average middle age user or a fully able worker (Markopoulos & Bekker, 2003). This generalization had influence on what kind of methods; tools or methodologies were used during e.g. data gathering. Markopoulos and Bekker (2003, p. 141) are pointing out that interest in the universal design and more focus on the special groups has lead to changes in how design is focusing on the children participation. Also, the development of technology, has gone much further; and today there is a lot more of various technological devices that are designed especially for children (Druin, 1999a, 1999b).

In order to meet young users there is need to include the children in the design process, so that they can express their likes and dislikes, instead of asking these questions teachers or parents (Druin, 2002, p. 1). Downes (1999, p. 335) underlines, that designers saw need of inclusion of marginalized user groups such as younger users in order to enhance their position. This implicates that earlier, children´s voice and power to influence was inhibited based on the traditional power relations between the children and adults, and because children were defined as a minority group (Downes, 1999, p. 335). As a result of those factors, researchers became more aware about marginalization of the children, and have begun to search for new approaches, of how to include the children as an equal partner during decision-making in the design process. On the other hand involvement of the children in such cultural activities, is empowering young people´s position in the society, giving them a say and embracing the Convention on the Right of the Child (Downes, 1999, p. 333; Unicef, 1989).

The introduction of children into the design process has happened through a process of evolution. With time researchers has understood that children can also participate in the design process as a users, testers, informants or a design partners (Druin, 2002). The next section will provide overview on

the field of Child Computer Interaction, and present different roles children can be assigned during the design process.

2.2.1 Development of Children´s Role in Human Computer Interaction

The field of Child Computer Interaction (CCI) as a subfield in Human Computer Interaction (HCI), is aiming at problems concerned with involving children in the HCI design (1999a, 1999b). Initially many people doubted in children´s abilities to contribute in a design process. Druin (2011, p. 23) has written a lot about this issue, and she is mentioning problems like: How can children come up with something that is *pedagogical* and *fun*?; Why should one consider opinions of children at all?; and Should they be *stakeholders* or *informants* during development? Some authors describe this research field as separate from HCI, but at the same time it has a lot of similarities in the main multidisciplinary focus (J. Read & Markopoulos, 2013). Others like Brekker et.al (2013, p. 2) are treating CCI discipline as a field within HCI. Iversen and Brodersen (2008, p. 85) argues that this kind of research is not distinct discipline, but rather a methodology that can benefit from PD and add new insights into PD. On the other hand, CCI is into a large extent driven by PD researchers (2008, pp. 83-84).

The reason for this discrepancy between the authors is the understanding of children´s abilities as human beings and their role as meaningful contributors. First of all Bruckman and Bandlow (2008, p. 84) are arguing that children have different ways of experiencing, learning and acknowledging the world from adults – which makes it impropriate to use the same methods in working with children as when working with growing-ups. Allison Druin argues "*As obvious this may seem, we designers of new technologies for children sometimes forget that young people are not ´just short adults´ but an entirely different user population with their own culture, norms and complexities.* " (2008, p. 84). In her view it is important to thinking about children in different ways as the participant, and to create methods and activities suitable for them. She underlines that the designer should consider children´s thoughts and meanings as valuable, even though they are only *human becomings* (2002, p. 1). Acceptance of children as equal

participator isn´t an easy task (Druin, 2002; Markopoulos & Bekker, 2003), *traditional power relations* (Iversen & Brodersen, 2008, p. 85) inhibit how adults are treating children. Traditionally, young people where obligated to listen to adults. Result of these relations, were cases were children could test some prototypes for the growing-ups; where they were given a certain task to say what they like and dislike, but not to contribute with new ideas or modifications (Druin, 1999b).

Druin (2002), describes each role children can have during participation and what are the consequences of introduction of these. Figure 3 is an illustration created by the author, and is showing the degree of participation children can be assigned while developing new technology.

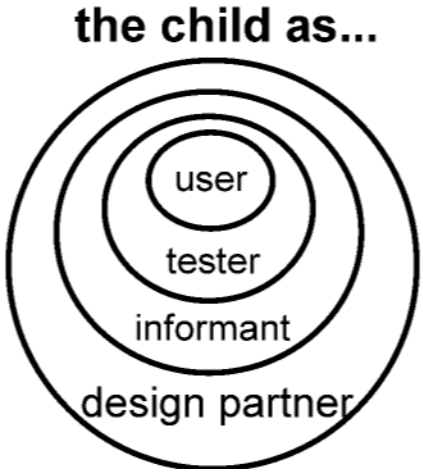

FIGURE 3: LEVELS OF CHILDREN PARTICIPATION (DRUIN, 2002)

The *user* is a role, which has least of power to influence the design, since children are only observed; where the researcher or designer is in charge. This kind of participation is the oldest and is very common to apply during development. Druin points out that the aim of this role is to conduct proof of concept and understand how children are e.g. learning in order to enhance the existing technology. Also, during observation researcher can examine the influence technology has on youth. Through this kind of participation there is almost no contact or collaboration between the adult and young participant (2002, p. 4).

This kind of perspective is strongly in contrast with the co-design and PD tradition, which was emerging simultaneously in Scandinavia (Druin, 2002; Sanders & Stappers, 2008). Co-design is focusing on collaborative creativity between the designer and the user; where users don´t have any previous knowledge about working within the design process (Sanders & Stappers, 2008, p. 7). This kind of mindset is challenging traditional *user role,* where designer and user have both insight and expertise about the different parts of the field (Halloran et al., 2009, p. 247). On the other hand co-design is often criticized for being time consuming, little effective where the user don´t always have the right expertise (Cederman-Haysom & Brereton, 2004; Truang et al., 2004 in Halloran et al., 2009).

The next role which Druin is discussing in her article is *tester* (2002, p. 7). This kind of participation give a little more of power to influence the product, since children are asked to test products that aren´t commercial yet. The children are observed during testing of the beta-product, and later are asked questions about how they liked the artifact. In this case the researchers are waiting with inclusion of the children, until the prototype of the product is after primary development phase (2002, p. 7). This approach is often used in UCD, where usability testing plays significant role (Druin, 1999b, p. 28; Markopoulos & Bekker, 2003, p. 145).

Another type of role, that the children can acquire during the design is being an *informant* (Druin, 2002). During this type of participation children have much greater possibility to influence the design, because they are asked to give some input before any technology is developed; later when the product is in some way finished they are again asked to express their opinion (2002, p. 10). Downes (1999) in her article is also describing this role, where she is mentioning that informant is the person "*whose views, opinions, concerns [...] are taken to account and used as rich sources of data within evaluation studies.*" (1999, p. 331). Issues that arouse from this kind of participation, where e.g. *when* should children be included in the design process; and *what* kind of contributions should young participant add (Druin, 2002, p. 10).

Last role, which is explained by the author is the child as a *design partner* (Druin, 2002, p. 12). The role is very similar to the *informant* role*,* but being a partner gives opportunity to be a part of the research or design process throughout the whole period (2002, p. 12). The aim of this participation is to create better usability and design; children have contact both with the technology and the adults during whole design process (2002, p. 12). Further, Druin explains that children are treated as equal participants during the design process, and can add valuable contributions in the same way as included adults in the development (2002, p. 12). Issues concerned with this type of involvement is the fact that researchers haven´t the same possibility to observe technology´s impact on children; but they can examine the influence children have on the technology design (2002, p. 12). This perspective on the users, as a partner is very similar to earlier described co-design; where the designers and users are equal contributors – but at same time the designer is contributing to empowerment of the end user (Druin, 2002, p. 13).

All of these roles present both benefits and challenges. Often choice of the particular role is based on the assumptions of the designers or the researchers in the specific context of use. The next section will provide a discussion of several authors about the issues and concerns tied up to inclusion of the children during the design process.

2.2.2 Benefits and Challenges with Children as Participants

As mentioned before, there is an ongoing discussion concerning, if the users should be included at all in the design process; at which stage participants should be invited; and how should they participate. In this part I want to discuss how different children participation influences in general children and researchers or designers during the design process.

When it comes to the researchers there are several issues they can encounter. First of all children are very honest, and as Druin explains – if the researchers chose to include children while the product is almost finished; and the youngster will dislike it – they will probably hear it (2002, p. 19). In such situations, the researcher can be surprised by children´s reaction, but also set

focus on how important it is to include the end users during the earliest design phases, in order to avoid situation like this. Another problem, which can emerge during inclusion of children, is the issue of *when* to include? Should one invite them, in the beginning, in the middle or in the end of the process as testers? Druin (2002, p. 19) argues, that if we chose to include children late in the process – we are limiting the scope of participation of the youngsters. On the other hand if we chose to include them in the beginning there is a bigger chance that the finished product will be more useful at satisfying – but there is also a possibility that we will use much more resources than we have expected (2002, p. 19).

Druin is giving an advice to include children in the starting phase of a project, like brainstorming. There is a chance that the researchers will be less surprised by children´s reaction to the end product when its actually corresponding with children´s expectations (2002, p. 19). On the other hand if the design team chose to include children early in the design process, they have to also be careful with how *much* they want to hear from young people (Druin, 2002, p. 19; Scaife & Rogers, 1999, p. 5).

Also inclusion of children has influence on power relations, and especially if one is choosing to include children as equal design partners. This role demands that both children and designer "[…] *put aside their assumptions of superiority based on age and cognitive maturity.*" (Downes, 1999, p. 337). When these and other assumptions such as race, class and gender are gone – it will decrease the *social distance* between the stakeholders (1999, p. 337). Which in turn, will make it easier to include on equal terms all of the participants. Druin points out that assigning role of a design partner to the children, might be time consuming and in turn influence the usage of economical resources during the design process (2002, p. 19). On the other hand if one choose to go for a role where there is an asymmetrical relationship between the young participant and the designer, there might arise an issue of right translation of the data that have been gathered together with children (Druin, 1999b, p. 29; 2002, p. 20). This entails that the designer has responsibility for analysis and interpretation of the data, which in turn influence which ideas and opinions will be included in the final design.

But what about the children, what are the challenges for them during participation in the design process? First of all, because researchers are still in control – they decide what kind of role youngster will be assigned (Druin, 2002, p. 19). As mentioned in the paragraph above, asymmetrical relationship will always influence the process, and especially when the children are given a role of a user. This role gives very low degree of empowerment. During long testing sessions, children can be irritated because they are lacking control over the situation they have been pulled into (Druin, 2002, p. 20). Another issue that is problematic is the fact that tasks that children are given by the researchers can be very uninteresting, which in turn can lead to boredom and little motivation for accomplishment of the assignments (2002, p. 20). Further while the tasks can be quite interesting, the technology itself can be too difficult to understand by young people. Though, by inviting children to the testing they can contribute to enhancement of the user experience by saying that "this is to difficult" (Druin, 2002, pp. 20-21).

It is important to remember that, different user participation during the design process doesn´t only have challenges. There are also benefits, which can contribute to the user experience, self-reflection or empowerment. Druin (2002) in her elaboration is also distinguishing between the profits of participation both for researcher and children.

When there is an asymmetrical relationship, the researcher has control over the study – and as long children do the tasks that they are assigned for – there will be sustainability of researcher´s control (Druin, 2002, p. 20). When youngsters are assigned the role of the user, the tasks given to the children are pretty defined, resulting in control over study´s resources such as time and budget. On the other hand, by including children in the design process as informants, the researchers have opportunity for flexibility while planning the session with the children (2002, p. 20). They can schedule activities in such ways, so that it is suitable both for the researchers and participating children. The great advantage of having children as a partner is that researcher know from the beginning which path to take.

Either way – as long researchers go for any participation it will have a positive effect on the user experience. Different types of children participation can contribute with valuable data, which can support the final design (2002, p. 20). Similar, children will also benefit from all participation, resulting in higher self-confidence and self-reflection upon the process – which in turn will have influence on child´s learning and development (Druin, 2002, p. 21). Also, cooperation with adults will make children more aware about notion of cooperation and negotiation with others (2002, p. 21).

Druin underlines that any kind of participation gives chance to find out new things (2002, p. 21), children aren´t thinking about efficiency, sustainability or budget – they apply completely different norms in their lives (Berman, 1977 in Druin, 2002), and they seek for fun and laughter. They have unlimited fantasy that activate creativity. All of that is a great benefit for user experience when it comes to the technology design (2002, p. 21).

2.2.3 CHILDREN PARTICIPATION WITH APPLICATION OF PD

As mentioned in the section above, several different authors have given some thoughts to the issue of children engagement during various participatory activities. Projects that introduce new methods like BRIGDE (1999, p. 337), Cooperative Inquiry (Iversen & Brodersen, 2008) or Participatory Action Research (PAR) with young people (Tzibazi, 2013) are just some of them. Papers are diverse in many ways, but all of them are focusing on the enhancement of the children inclusion in participation, so as a result they are influencing child´s position during the design process to be more solid. Studies presented in this section are focusing particularly on application of PD with inclusion of children as participants.

Taxén (2004) has written about introduction of the PD into the museums, where he was experimenting with application of Future Workshop (FW) (2004). One of the aims that Taxén was trying to achieve in his study was to create more solid position for children during design process. Another significant aspect of his work was to enhance current design activities of the museums.

Taxén discusses application of FW in three sessions where each phase has it´s own session. In the first session children were asked to be critical and list good and bad exhibitions at the museum on red and green post-its. This session was done without engagement of the employees. The result of this workshop was that in general, the exhibitions were successful – but there were some properties that could be enhanced. The second session was conducted with educators and teenagers. The goal of this collaboration was, to create low-fidelity prototypes that could present how the given installation should look like in a fantasy world. The last session was focusing on modification of prototypes from phase two, to be more applicable in reality. Results of this study have showed, that all participants were pleased with cooperation. Also, the students were positive about the chance to influence a real exhibition. The benefits of adult participation was notion of control of the scope during the design (Taxén, 2004, p. 206). Researchers underlines, that though adult control was needed in some cases – in the other it was unnecessary in relationship to the general direction of the work.

Another study was conducted by Iversen and Smith (2001, p. 123) with application of PD; where participants were invited to design interactive exhibition. The researchers were exposing participants for very close collaboration over longer period. The participants involved in this study were teenagers, designers, programmers, curators and anthropologists (2012). The researchers conducted a study where the teenagers were design partners together with the designers or consultants, of an exhibition at the science center. The groups, which consisted of the participants, were based on a matchmaking workshop. The goal of this, was to "[…] *give the participants responsibility for their own work, creating design space for dialogue between the designers and youngsters.*" (2012, p. 106). When the groups were created, designers had to be *responsible* and *disciplined,* so that they could form space for collaboration and give a say to the teenagers. On the other hand, youth had to be open minded for the alternative ideas that came from the designers. This kind of setting was new for both of the participants, where this in turn created a baseline for the collaboration.

The interesting findings from the research were, that designers were less open for discovery of some ideas that were generated by the teenagers. On the other hand some of the youngsters felt that designers didn´t trust them, and wanted to lead them during the development process. The results of these events were conflicts, which had to handle by the facilitators. The authors point out, that in order to create good communication between the participants there is a need of putting a side assumption about each other. They are indicating through this study, that even though there are differences between the participants; there is a need of understanding that every actor have the same rights to *participate fully in the negotiation process* (2012, p. 109). Also there is an explanation that designers had problems with putting a side their role as an experienced PD designer, while conducting the co-creation with the youngsters.

As mentioned in the study above, establishment of trust can be challenging, especially when it comes to establishment of trust between the adults and young people. Taxén et al. (2001) have conducted a study which focuses on co-creation between the teachers and children during redesign context at school. The researchers whom conducted the study were also participating, together with others in various activities, in addition to their own tasks like assessment of the study. Authors had formed an approach which had as a goal to create environment for critical thinking, but as well teach both adults and children how to become design partners (Taxén et al., 2001). Project lasted for two years, and had 3 types of activities: educational sessions, evaluation sessions and brainstorming. All of these were conducted in mixed groups with growing-ups and youth (2001, p. 120). The interesting part of this study was that, the first year had few activities tied up to the invention and brainstorming, since children and adults weren´t used to cooperation with each other. But, during the second year of research, brainstorming increased with 36% (2001, p. 120). Invention session was based on low-fidelity prototyping. The authors discuss that it is important to balance power relations between the adults and children, so that nobody will be completely in charge over the development process (2001, p. 122). Another important issue was, that establishment of the relationship between the involved adults and youth – took 12 mouths. The last

note that authors are pointing out is how significant it is to have enough adults that can work with children. Researchers are indicating that there shouldn´t be more then three children per adult – otherwise it can be very difficult to balance power relations (2001, p. 123).

2.3 SUMMARY

This chapter is presenting different issues concerning different forms of children participation during various design projects. Aspects that I am interested in are first of all what kind of participation I am occupied with. As presented in the section 2.1 there are different ways of engaging the end users in the design process. I want to define my application of participation, similar to what Taxén (2004) and Iversen and Smith (Iversen & Smith, 2012) are describing in their studies. The end user is given a voice though the whole design process, where the development can embrace participant's role as an equal design partner. Simultaneously, the end user´s previous established skills and knowledge would be a source for the new design ideas. The given overview of children as participants during the design process, presents a challenge where involved adults has problems with embracing young participants as equal design partners. The issue of balancing the power relation between the participants is a challenge, which is highly discussed in PD literature.

3 THEORETICAL FRAMEWORK

This chapter aims to present the theory and belonging concepts that are important for me in order to understand my research field, and are meant to be tools to answer research interests. I will use these further in my thesis, as a help to analyze earlier design processes of the installation at the science center, which will provide understanding of how to apply intervention method later. First of all I will explain the theory, which is called Actor Network Theory (ANT). Main cause for application of the ANT, is to give me overview of involved actors, which have influence over such factors like the shape of the installation, user experience of the installation and children inclusion during design process. Thereafter I will present the two concepts, which are important in my context, which are *inscriptions* and *translations.* This will be followed by exploration of network´s effects in form of power.

3.1 ACTOR NETWORK THEORY

ANT can be seen as a lens to understand the history of the project, where it can provide overview of actants that had importance for the development of the installation. ANT is a theory which focuses on both humans and non-humans as a equal actants (Law, 1992), resulting in analysis of heterogeneous networks – or in other words socio-technical assemblies (Akrich, 1992; Ehn, 2008). Which entails that e.g. technology device is never a result of human´s work, but actually collaboration based on negotiations between both social and technical factors.

As mentioned, an important characteristic of this theory is the principle of symmetry, which implicates that all actors are equal, and in turn they are treated during analysis in the same way – whether it is technology or a human (Law, 1992, p. 2). But, it is important to point out that while in the milieu of ANT, symmetry principle is desirable, in others is criticized (Hanseth, Aanestad, & Berg, 2004, p. 118). Hanseth et al. mentions that this critique is often concerned with the fact that one shouldn't claim that humans and technology are at the same level. While Star is explaining that ANT is turning humans into *"primitive realism"* and is dehumanizing us (1996, p. 82). But, as a defense to this, the theory is not about comparison of different actants with each other, or studying

them individually; but rather about understanding the relationship and power mechanisms between these as a whole – since they are creating the socio-technical network (Hanseth et al., 2004, p. 118; Aanestad, 2003, p. 7). This means that in my case, I am not interested in how theory is defining children or installation individually, but rather how they together negotiate their interests and how those actions influence the design process. Another argument for the critique of leveling the humans with non-humans is the notion of understanding how technology and society is interwoven with each other. In the article of Star (1990, p. 93), she is referring to Latour, where he is explaining that ANT and it´s principle of symmetry is an important property which presents "[…] *way of braking down reified boundaries that prevent us from seeing the ways in which humans and machines are intermingled."*.

Further, the theory is very complex and defining the scope of research while applying ANT can be challenging – since every node in the network is next actor-network (Law, 1992, pp. 3-4; Yaneva, 2009, pp. 276,283). In order to simplify the network one can apply *punctualisation,* introduced by Law (Law, 1992, p. 5), which has as a goal to create black boxes of some networks. On the other hand, based on this simplification theory is again criticized, because network becomes more complex and incomprehensible for others who might try to analyze it (Law, 1992, p. 5; Star, 1990, p. 84).

When it comes to my case, I decided to restrict my research interest and focus on some specific concepts and notions from ANT that will actually help me during the analysis. I chose to focus on *inscriptions*, *translation* and power as an effect of the network. Inscriptions helps me to understand the possible framework of actions of a given actant, while the translation process provide me an overview of the negotiation process between the actats based on their inscriptions. Power as an effect, supports understanding of the power relations, and identification of the actant which is marginalized in the network. Yaneva (2009, pp. 283-284) in her study is referring to several benefits of ANT such as the fact that the theory gives us opportunity to investigate negotiations between the actants; complexity and wide view on all dimensions of the network; and last but no least the possibility to reveal different factors united together to

contribute to inscriptions of the actant. This implicates that in order to understand how we can design *for* children *with* children in the science center, we have to understand how the existing situation was caused – the first step to this, is to study the pre-scribed characteristics of the included actors, which are the inscriptions.

3.1.1 INSCRIPTIONS

It is important to understand the concept of inscriptions in my case, since it is enlightening various discrepancies between the actants like NFS and science center. Without understanding the definition of the concept, and specific description of actant´s inscriptions we don´t have necessary knowledge to understand how further processes and relations between the actors unfolds.

Aanestad (2003, p. 7) is describing *inscriptions* as a *"[...] attempts to define a framework for possible action [...]".* She is also adding that these inscriptions can be more or less strong, and at the same time they are not completely fixed – this means that they are not stable all the time, depending on the delegation process of different tasks to given actant in the network. This implicates that when the designer creates e.g. an artifact, the designer does not finally define the properties given to the object, these can be e.g. changed during unexpected use. Akrich (1992) explains that inscriptions of particular actant can also *groom* (1992, p. 218) others. Grooming in this context indicates that inscriptions of e.g. technology represent certain rules that allow users to do some actions, but at the same limit other actions – in other words as a *the method of regulation* (Akrich, 1992, p. 218). Akrich is presenting a case of solution which suppose to generate electricity in a village in one of the developing countries (1992, p. 219). There she points out how bad decisions of the designer situated in product´s inscriptions groomed actions of the residents. Simultaneously, those bad decisions, which can be found in inscriptions, were resulted on the fact that the designer never visited the real context of use, and never meet the real target group. When the inscriptions meet the real context of use, the designed electricity device broke down very often. This, in combination with non-standard components and rare visit of person responsible for maintenance – resulted in transformation of the inscriptions, so that all actants in the network were

pleased. The residents could fix problem on their own, while the technician didn´t have to come to the village so often as before.

This example is showing how tracing inscriptions of the particular technology, can give answer for how and why the residents weren´t pleased with the new solution. At the same time, the example is also presenting how different inscriptions of the technology, designers, residents of the village and technicians clashed together during the use. In order to solve this situation and give residents electricity, there was a need for new negotiation between actants, where the inscriptions of the technology were changed during modification process conducted by the technician. While applying ANT we are able to discover such interesting situations, and design e.g. new technology more conscious.

3.1.2 TRANSLATION

Translation is an important concept and process in the theory, author like Crawford (2004) point out that this is a core of ANT; the reason for this statement is the fact that a lot of important activities are included in this process. In order to understand the concept, it is vital to know what it means - namely: "*transport with deformation*" (2004, p. 2). This implies that certain actors in order to be aligned with the other actors in the network have to convert e.g. their rules so that they fit with mindset of the other actants. In addition to converting, there is possible other actions like simplification of some entities, such as black boxing (2004, p. 2). This can be concluded with the notion that translation is about association of heterogeneous entities (Callon, 1986a, p. 24, in Horowitz, 2012, p. 808).

The process of translation includes several activities. These are called *problematization*, *interessement*, *enrollment* and *mobilization* (Callon, 1986, in Asdal et al., 2007). Problematization implies how to become indispensable for the others, by finding out whom are the relevant actors for the translator and "*[…] defining their identities in such way as to establish themselves an obligatory passage point in the network of relations they were building […]*" (Callon, 1986, in Asdal et al., 2007, p. 59). This is central process, where other actants can identify that they have the same goals as the translator. Further the next step is

interessement, which involves coming in-between two entities and establishing an alignment; this is done by becoming attractive for certain entity by presenting translators desires and goals (Callon, 1986, in Asdal et al., 2007, p. 62). This also includes exclusion of other goals that the other actants might have, and in some way becoming un-loyal for their own original aims (Horowitz, 2012, p. 809). Third moment in translation process is enrollment, which is an effect of interessement, and concerns application of roles defined by the translator into other actants (2012, p. 809). Last step is mobilization, which deals with the notion of convincing actant´s constituents in order to go with the translator´s division of roles, which is based on the notion of displacement but also maintenance of the network (Callon, 1986, in Asdal et al., 2007, p. 71).

All that is happening because of the translator´s needs to become "*obligatory passageway*" (in Callon, 1986a, p. 27, in Horowitz, 2012, p. 808), which entails the process of definition of what the others want to obtain; and then persuade the others that the only way to achieve their goals is through approval or assistance of the translator (Horowitz, 2012, p. 808). Further this leads to the fact that while the translator becomes a spokesman for the rest, they become unified; this has again influence over the fact who will be heard in the future negotiations (Callon, 1986, p. 223, in Star, 1990, p. 96).

An important question one should ask is: What defines the process as a successful one? Horowitz (2012, p. 809) in her article points out that well accomplished translation happens when the actors play their roles which were assigned to them. The translation is often called *perpetual battle,* which entails that some of the actors resist the enrollment or any other activity during translation. This crucial process in ANT is often called for power struggle, as the translator is trying to persuade and coerce others and override their original aims and goals.

3.1.3 POWER AS AN EFFECT

There are several different authors who are explaining the concept of power in ANT (Bratteteig & Wagner, 2012; Callon, 1986; Crawford, 2004; Horowitz, 2012; Law, 1992; Star, 1990). Law (1992, p. 6) in his note is pointing

out that ANT isn´t about power as a set of causes, but rather as an effect from the network. Law and Latour (in Horowitz, 2012, p. 809) describes also that the concept of power isn´t about *possession* or *capacity* of a single actor, but rather about persuasion or coerce between the participants in the network. Authors such as Crawford (2004, p. 2) or Law (1992, p. 5) implies that power is "*generated in a relational and distributed manner as a consequence of ordering struggles*" (Crawford, 2004, p. 2). Further these assumptions leads to the fact that nothing in the network is actually stable, because actants and their individual goals are in *perpetual battle* (Horowitz, 2012, p. 809). The battle or competition between the actants, is based on the notion of ordering, stabilization and maintenance – which is called for process of *translation* in ANT (Law, 1992, p. 5).

But, what exactly entails the notion that power is distributed, and that power is *measured* in number of actants that are networked with each other (Crawford, 2004, p. 2)? This aspect of ANT is often criticized for being Machiavellian (Whittle & Spicer, 2008, p. 621), which means that network is expanding through actants that have larger amount of aligned entities, and stronger alliances (2008, p. 621). Asdal et al. (2007, pp. 31-32) underlines that ANT follows only the strong alliances, and simultaneously making the weak ones invisible and less worthy. The same authors are referring to Star (2007, pp. 32-33) and remarks that because ANT is based on Machiavellian perspective, it is avoiding the weaker entities or those who are on the margins of the network and sees only perspective of the strong one. Simultaneously, in the book of Quan-Haase (2013, p. 63), there is mentioned a *multiple factor principle* which is focusing on the notion that often people are blind and doesn´t see that behind an inventor or scientist there are others whom might have contributed to the work of this one person. The concept was emphasized by Latour where he was stressing the importance of ANT, which sets larger focus on all heterogeneous actors contributing to the final invention (Quan-Haase, 2013, p. 56). As mentioned in the start, ANT is supporting analysis with the right lens to discover heterogeneous actants of the network.

3.2 SUMMARY

In case of my study the ANT framework will be applied both to analyze the process before the initiation of the intervention method, but also during the FW. By applying the ANT lens on the earlier design processes I will be able to identify inscriptions of the heterogeneous actants. These will provide information about their possible framework of actions, which have influence on the negotiation process during translation activity. Power definition originating from the ANT, will provide tools for identification of the marginalized actnat – who is unseen in the network of the installation.

The ANT lens will also support understanding of the processes happening during the workshop and its individual phases. During the workshop, children´s inscriptions in form of their expectations, will meet already established inscriptions of the installation. The FW will create an arena for translation process between the actants, and present the negotiations between these.

4 METHODOLOGY

This section´s aim is to give an overview over the methodology and methods that I have chosen to apply during my study. In the beginning I will provide overview of the methodology Participatory Design, where I will explain guiding principles of PD, and in the end the challenges and opportunities that approach is representing. Thereafter I will move to section about documentation methods that I have used as my tools in order to gather data, which are needed in order to aim my research interests. I will go through interview, focus group and future workshop. I will discuss both advantages and disadvantages with these – in order to provide deeper insights to my decisions. The methods will be accompanied by description of how it was conducted in my case.

4.1 PARTICIPATORY METHODOLOGY AND RESEARCH APPROACH

The methodology emerged between 70`s and 80`s in Scandinavia and with time the PD spread out to the rest of the world in different formations (Iversen & Smith, 2012, p. 113). Approach is focusing on several different aspects, such as emancipation of workers at their working places (Spinuzzi, 2005). Also the PD aims to explore how introduction of computer-based systems into the existing working places influence the conditions of the workers (Kensing & Greenbaum, 2013, p. 23) - especially when it comes to avoidance of deskilling issue, where human workers are replaced by technology (Iversen & Smith, 2012, p. 107; Kensing & Blomberg, 1998, p. 167; Quan-Haase, 2013, p. 106). The methodology can be sum up with three areas of concern *politics of design*, *the nature of participation* and *method, tools and techniques for participation* (Kensing & Blomberg, 1998, p. 169). The next section will present guiding principles in PD, which helps researchers or designers to steer the project in a democratic manner.

4.1.1 GUIDING PRINCIPLES

The methodology is embracing such values as emancipation, empowerment, co-operation, communication between different actors and knowledge co-construction. In the book of Simonsen and Robertson (2013) we can find one specific chapter, which is describing guiding principles. As the

authors (Kensing & Greenbaum, 2013) of this section explains, these principles aren´t fixed, they are just theirs interpretation of the PD´s heritage.

The first principle is called *equalizing power relations,* which is focusing on the awareness of giving a say to the participants that are invisible otherwise. *Democratic practices* are about actually applying methods that are giving the voice to the stakeholders. Then, there are *situation-based actions,* which are concerning, that the research or workshop should be conducted at site that is in context with the product that is developed or redesigned. The context has great value for how the future solution will be, as it implicates how it can be used in relationship to the rest of the existing environment. Fourth principle is called *mutual learning*, and is considering very important factor both for the participating end users and researchers or others who are facilitating the workshop. It is about how all actors in the design process are learning from each other. The facilitators can learn what kind of tasks the workers have to do, and what kind dilemmas they have; while workers can learn from the designers or researchers what kind of technologies can solve their issues. Further authors are explaining *tools and techniques,* which are focusing on the understanding of the methods that can be used by the facilitators during development process, and how can they help participants to express their needs and ideas about future solution. The last principle is called *alternative visions about technology*. This is a natural cause of application of various tools and techniques, where participants are able to thinking outside of the box, in order to design alternative solution for their community of practice.

By applying those principles into the design process of the exhibition or installation we are creating opportunities for young unheard participants to *have a say*. Bratteteig (2013, p. 129) underlines that having a voice is not the same as having a say. Giving a say is about empowering participants in the project through assigning them the role of being an equal design partner. Druin and Fast (2002) explains that a lot of research, which can be found, is focusing on children participation in form of informants or testers, which gives them a *voice* during development process. But, as explained in chapter 2 (see section 2.3.1) these roles doesn´t represent opportunity to influence the design in a direct manner.

So, in order to give young participants the power to influence the design decisions there is a need of application of PD in the museum context, where in result youth will become an equal *design partner* together with the design team (Bratteteig et al., 2013, p. 129). On the other hand, inclusion of participants based on the PD values introduces also challenges. In the next section I will explore the advantages and drawbacks while applying PD methodology.

4.1.2 CHALLENGES AND BENEFITS

PD is representing a lot of different guidelines that support user during design process. In order to collaborate with participants in justifiable way, it is important to reflect on the subject of ethics. Simultaneously, ethics aren´t an extra goal in PD, it´s an immanent property of the methodology where it:

> "[…] *has at its core an ethical motivation to support and enhance how people can engage with others in shaping their world, including their workplaces, over time."* (Robertson & Wagner, 2013, p. 65).

Ethics in general have as an aim to explore meanings of life and what makes our life worthy living (2013, p. 66). My role as a researcher in this case, is to provide the right milieu for the well being of participants (Thomas & O'kane, 1998, p. 337). Based on this notion section´s aim is to investigate questions presented by Robertson and Wagner (2013, p. 71):

- *Who do we engage with in a Participatory Design project?*
- *How do we engage with participants?*
- *How do we represent participants and their work?*
- *What can we offer participants?*

These concerns are expanded with discussion of other issues about children involvement from the other authors (Phelan & Kinsella, 2013; J. C. Read et al., 2013; Thomas & O'kane, 1998), in order to provide wider overview of the field.

4.1.2.1 WHO DO WE ENGAGE WITH IN A PARTICIPATORY DESIGN PROJECT?

While I was deciding what kind of users to involve in my workshop, I was in the first place thinking about the children, which were studying in the high

school. The reason for this first thought was tied up to my worries about the fact, that younger children would be unable to focus and give me critical feedback. But, my mindset has change during further investigation and discussion with my supervisors. Also, the PD methodology is encouraging to invite the real end users, so that they can provide realistic information and skills concerning future practice (Robertson & Wagner, 2013, p. 71).

The authors (2013, p. 71) underlines that researchers should think about how much time participants have to disposition, especially when it comes to their work and payment. They are emphasizing the notion of user engagement and use of their free unpaid time, and the consequences of these for their well-being (2013, p. 71). As mentioned above, since we, as researchers are responsible for the study, we are forced to think about such cases. Reflection around the influence of inclusion of different users is crucial in establishing trust, respect and cooperation between the researcher and the participant. So, as we can see we have to be careful when it comes to defining whom we want to include in our research. On the other hand, it is also vital that we can see those who are excluded from the possibility to share their opinions (2013, p. 71). In my case, where I want to include children in the workshop participation, I am a gradually introducing young people whom were unheard earlier, for the new possibility to be more empowered during the design process.

Simultaneously, it is important to think about the responsibility and accountability coming from participants (2013, p. 72). While we are reflecting whom we are going to include in the design process, we have to consider if they are able to represent their social group with their opinions. In my case, such examination is based on the age of the children. The age group, participants are representing stands for being an expert in this particular field when it comes to knowledge level and definition of fun. As mentioned in the start, I wanted to include older children – whom weren´t the target group for the installation. Choosing those who are meant to use the installation at science center, is much more appropriate when it comes to representation of the actual end users and their needs. An 18 years old young adult will never be able to reproduce the

same needs for knowledge and fun, as the 12 years old youngster (Druin, 2002, p. 1; Robertson & Wagner, 2013, p. 72).

At the same time, in order to aim researcher´s responsibility while including participants who are accountable, the researcher have to confront some particular issues. In the article of Read et al. (2013) we are presented with several critical questions, where the researcher is encouraged to answer them while working with young participants. Some of these were"*5. Which children will we design with?*" and "*6. Why (with these children)?*" (2013, p. 189). These questions has not only as a goal to reflect upon the participants it self, but also are emphasizing the self-reflection of the researcher and his or her true intention lying behind the study.

4.1.2.2 HOW DO WE ENGAGE WITH PARTICIPANTS?

When the researcher is sure whom he or she will include in the research, the next step might be to write an inform consent. Authors like Phelan & Kinsella (2013) and Thomas & O´Kane (1998) discuss that the key factor while including children in the PD study, is to make them aware about the consequences of certain research. In addition to asking children´s parents about permission, there is a need of clarifying for children different issues and especially emphasizing the notion that children can decide to stop participation whenever they want, or to take a break when it´s needed (Phelan & Kinsella, 2013, p. 82; Thomas & O'kane, 1998, p. 339).

It is also important to make children aware that they can ask questions which they are wondering about, when they feel for it (Phelan & Kinsella, 2013, p. 82). On the other hand, creation of circumstances that are too comfortable for children can contribute to disclosure of some issues that shouldn´t be discussed. Vulnerability of children during the study is something one should reflect. Creation of balanced milieu for children is a challenging task for the researcher (Phelan & Kinsella, 2013, p. 84). Through application of such precautions we are building trust between the young participator and the researcher (Robertson & Wagner, 2013, p. 72).

In order to engage with the user during the workshop one has to choose some assignments and tasks. Defining the right set of activities for children has great influence on the matter of child´s feeling of empowerment, making their voices visible for others; but also contributing to increased trust (Robertson & Wagner, 2013, p. 73). As mentioned earlier, researcher has responsibility for participant´s well being. While working with children, in order to make them feel empowered – there is a need of mechanisms, activities or actions that control the power balance, which is often discussed as biggest issue while cooperating with young people (Thomas & O'kane, 1998, p. 337).

Application of PD principles (Kensing & Greenbaum, 2013, pp. 33-34), is in general already a good starting point for reduction of power imbalances between adults and children (Thomas & O'kane, 1998, p. 343). By establishing group of end users, meeting children in the right context and using methods and tools that support their opinions and creativity, we are building an environment where they can feel more empowered while working with adults in the same project (Phelan & Kinsella, 2013, p. 85). Applying PD, which is considering user as a design partner, and embracing co-design between heterogeneous participants during the design process; we are creating equal conditions both for the children and employees (Sanders & Stappers, 2008, p. 6). On the other hand, it is important that the researcher explains to all participants notion of mutual learning originating from the PD approach – so that everybody is aware that cooperation they are participating in is based on respect for each other. The aspect is discussed by Halloran et al. (2009, p. 247), where authors underlines that combination of mutual learning and respect for each others opinions and contributions is necessary in order to benefit from co-design it.

Other aspects, which have influence on power balance, are what we are wearing, how we are talking or how we are behaving (Phelan & Kinsella, 2013, p. 85). These aren´t so obvious, but still they have great importance for our results and the feeling children are experiencing. But, on the other hand Phelan and Kinsella (2013, pp. 84-85) argues that by creating a sense of false friendship – can confuse children and lead to unnecessary disclosure. This entail, that we

have to be careful with how we plan, implement and carry out our research, where main challenge is to find the right balance in our actions.

4.1.2.3 HOW DO WE REPRESENT PARTICIPANTS AND THEIR WORK?

In order to understand how the end user does the work, there is a need of mutual understanding. I have mentioned this principle earlier, but this time it´s concerning not the understanding of each other's visions or ideas, but rather awareness of how the work is done by the specific end user. The awareness the researcher creates based on co-creation, can also be called representations (Robertson & Wagner, 2013, p. 75). Such representation of the end users work, have great value for common comprehension of what the future system or device should do. Without this type of understanding the designer will probably be confused and will design something completely useless because of the lack of the right representation (2013, p. 75). In my case when it comes to the FW, children have to show others how they want to e.g. form or use the future installation. After that is done, both the employees and I will be able to talk and discuss various solutions for the problem – since everybody has the same representation of the issue in their mind.

But, Robertson and Wagner (2013, pp. 76-77) points out two issues tied up to production of such representation – *invisible work* and *residual categories.* The first one is defined as the work or activity which isn´t so visible because e.g. it is happening in user´s mind. An example in my case would be the question if children really learned something new about the photosynthesis through the installation – or are they just pretending. In order to aim this problem, one could design workshop activities that ask children directly what they have learned and work further on that knowledge. The second issue are residual categories (Robertson & Wagner, 2013, p. 77), this can be an aspect of e.g. work practices which are difficult to place because it´s invisible or because it doesn´t have any specific description that would make it easier to categorize and order.

4.1.2.4 WHAT CAN WE OFFER PARTICIPANTS?

The best reward for children during this study would be application of changes they had introduced during the workshop of the installation. But

unfortunately this isn´t possible, because of the resources I have to disposal. At the same time I´m not the only one who is struggling with this type of issues (Robertson & Wagner, 2013, p. 77). This problem can be seen from two different perspectives, which provide various overview of child´s situation.

The first perspective is more narrow and entails rewords in form of personal development, including wider knowledge about photosynthesis, creativity and obtained experience concerning cooperation with others who have different views and background (Robertson & Wagner, 2013, pp. 77-78). Deeper understanding shaped through critical discussion with other participants about the topic, is good starting point for further work with material concerning both the photosynthesis and the issue of designing. Robertson and Wagner (2013, p. 78) argues that participation in the PD research can give experience of fun and creativity based on the activities that the researcher has chosen for the workshop. Choosing assignments that are grounded in collaboration and critical evaluation can be much more engaging for young participants than a simple semi-structured interview. Also application of co-design can contribute to rewarding, because of its great value for children´s development of self-confidence while working with adults. The dialog together with the educator or designer at the science center about the re-design of an installation can also lead to children´s feeling of rewarding, where their opinions and thoughts have the same value as the one produced by the adults. Feeling of responsibility for other´s learning and experience, and for the design it self has also importance for young participants (2013, p. 78).

When it comes to a wider perspective, while we are giving children more power to influence the design and the research by applying various PD methods and tools – we are contributing to enhancement of children position in general. In *Convention on the Rights of the Child* (Unicef, 1989), there is an article that entails that children should have the same rights to participate in various cultural activities, as adults. The article defines that youngster should be provided with opportunities for participation and engagement appropriate for their age group. By providing for children opportunity to participate in a small master thesis, we are actually contributing to children´s awareness about the fact

that their voices and opinions are as valuable as the others (Downes, 1999, p. 333), also we are making children more conscious that traditional power relations doesn´t necessary apply for all situations (Bratteteig et al., 2013; Downes, 1999; Druin, 2002).

4.2 DESIGN OF THINGS

Application of ANT as tool for analysis, and PD as approach for encountering the end user is a combination, which enlightens the issue of designing the Thing. The ANT obligates to appreciation of both human and non-human actor. Framework is focusing on understanding of how heterogeneous stakeholder shapes sociotechnical assemblies. Bjögvinsson et al. (2012) suggests that in accordance to PD while designing *for* use *before* use, one should focus on design of a Thing as socio-material assemblies, rather than on thing as a object. Originally, the concept of a Thing is referring to "*governing assemblies in ancient Nordic and German society*" (Bjögvinsson et al., 2012, p. 102). This involve democratic choices carefully negotiated, where different views, concerns and interests are main motivation for discussion (2012, p. 102). PD has inherited these characteristics of an ancient Thing, where guiding principles reflect such values (see section 4.2.1).

Main motivation behind design of the Thing is awareness of both human and non-human contributors during the design process. Non-humans can be prototypes, sketches, practices, workshop or a certain technology like Pin Ball machine. All of these together with users and designers contribute to establishment of new ecology of a device (Ehn, 2008, p. 93). Since design process viewed as a Thing, has democratic values as guidelines – every stakeholder has naturally a say during the development. Based on that, technology or prototype becomes an equal participant of a design process where they can enact various roles. Prototypes or existing technology devices can be medium for communication between designer and the end user. Where e.g. prototype as a participant has a role to present thoughts and ideas of the end user for designer or researcher. Also, the activity of creating possible visualization of the future solution is supporting such activities as *design-by-playing* and *learning-by-doing*

(Ehn, 2008). Through such participation, non-humans are becoming active actants of the design process together with the end user and his or her practices (Bjögvinsson et al., 2012, p. 106). Reusing existing skills and applying knowledge obtained in *community-of-practice*, can also contribute to the prototype during development (Ehn, 2008, p. 94).

View like this is making designer more aware about impact of non-humans on the final design. Seeing development process as sociotechnical assembly is contributing to more conscious choices, were we have insight in how different stakeholders can impact a design or environment, and vice versa.

4.3 METHODS

The choice of which methods I wanted to apply were grounded in my research interests (see section 1.3). In order to get overview of earlier design process conducted by the NFS and the science center, I chose to carry out a semi-structured interview. Based on the gathered data from this session, I was able to plan activities for the intervention method – FW.

4.3.1 INTERVIEW AND AUDIO RECORDING

In my study I used interview as method for data gathering, in order to map the history of the installation and involved actors. In some books, interviews are presented as methods that guide us in order to design something new (Lazar et al., 2010, p. 178; Sharp et al., 2009, p. 298). But, my approach was more concerned about how people thought before, during and after design process. In the book of Lazar et al., authors emphasizes this method for the characteristics which allows us to go deeper into the domain (2010, p. 178). Interviews can be structured in various ways (Lazar et al., 2010, pp. 178-213; Sharp et al., 2009, pp. 298-299), I have chosen to go for a combination of the semi – structured interview, with both closed and open-ended questions. This means that I had some more specific questions that I wanted to ask my interview object, but at same time I had some less certain questions that let me explore the domain together with the participant.

The structure of the interview guide (see Appendix A), is based on the guidelines from Sharp et al. (2009, p. 307). When it comes to interviews in general they are giving an opportunity to go in-depth, and ask the interview object all questions that we are wondering about. Face-to-face meeting is providing possibility for flexibility, where we can direct our conversation in the direction, which is interesting and most valuable for the research. On the other hand, having all to open approach during interview can create situations where we have little control (Lazar et al., 2010, pp. 188-190), and the interview object will suddenly talk about things that aren´t so relevant for our research. In order to retain control on our side – it is important to be prepared for the interview through careful planning of our questions and topics that we want to explore in order to answer our research questions or interest.

During the interview the researcher can take notes, but better solution for capturing our data is to audio record it, so that we have also a backup. Lazar et al. (2010, p. 198) discuss the there are both benefits and challenges tied up to the audio recording. They are mentioning that great advantage with this type of recording is that we can retain eye contact with our interlocutor. This is in the first place a gesture of respect for the person we are listening to, but on the other hand the recording is also allowing us to actually follow the conversation. Also, having possibility to lift our heads above our notebooks, provides us with better opportunity to control the interview situation, and observe the interview object and his or her reactions (Lazar et al., 2010, p. 198). On the other hand there are also some disadvantages and challenges tied up to audio recording. One of the biggest issues the researcher is meeting after data is gathered is transcription of the recording (Lazar et al., 2010, p. 198).

4.3.1.1 PLANNING INTERVIEWS

In order to get an overview over the field and the potential actors, I chose to start interview round with the NFS, since they were the initiators of the project resulting in the installation. My goal with this conversation was to find out what kind of needs and requirements the NFS had in relationship to the BioEnergiPinBall. On the other hand I was also curious about their assumptions concerning the end product, and the experience they had with the end users. I

chose to ask also questions, which concerned the design of the user experience and their collaboration process with the Norwegian Science Center. I have chosen to conduct a semi – structured interview with a various questions that were both open-ended and closed (Sharp et al., 2009, pp. 299-300).

The second interview, which I conducted was with the Norwegian Science Center, and had more informal type. Before the interview I prepared list of interests areas, which I wanted to discuss with the interview objects. The areas of concern were about:

- When we could conduct the FW?
- Who of the employees could participate in the workshop?
- In which room we could carry out the experiment?
- The design process of the installation.

4.3.1.2 CONDUCTING THE INTERVIEW WITH THE NFS

The interview was conducted with Trond Lohre who is marketing and development manger at the NFS. Before we meet I decided to send list with questions to the interview object before the interview, so the person could prepare him self for the meeting. In return, he sent me a short description of the project history concerning *BioEnergiPinBall* (personal communication, October 6, 2014). The meeting was conducted in the office of the NFS, on 18 of October 2014. I planned to record whole session using my mobile, and it lasted for about one hour as planned. The interview object was handed consent form, which informed him that this work was connected to EXPAND project, and that the interview will be taped and used for further data analysis (see Appendix B for consent form).

4.3.1.3 CONDUCTING THE INFORMAL INTERVIEW WITH THE SCIENCE CENTER

Before I carried out the FW, I had to discuss the issue together with employees at the science center. The meeting was on 16 of October, 2014 and lasted for about 45 minutes. The interview objects were Jon Alfred Andresson who is a manager and educational administrator at the science center, and Aiyana Hudgins who is a head of educational team. I didn´t record the

conversation, since the meeting was informal, but I made notes for my personal use.

4.3.2 FUTURE WORKSHOP AND VIDEO RECORDING

The intervention method, which I wanted to introduce in the science center, was the FW. The reason for choice of this method is grounded in its capacity to invite the participator to think critical about certain issue. Also, it is leading the user to reflection and action in relationship to the problem´s possible solution. Taxén (2004) has used the method in similar way, where instead of taking a critical look on one installation, he addressed all exhibitions in the museum in order to enhance these. The FW will be video recorded in order to have opportunity of later analysis of both results considering the design proposals, but also the co-creation process between the workshop´s participants. In this section I will also provide precautions one should take while conducting the focus group interview. The reason for this is, because the last phase of the FW is creating similar environment for discussion.

4.3.2.1 THE METHOD FUTURE WORKSHOP

The method has origins in the applied urban development in the 70's in Germany. The FW isn't designed with technology in mind, it was rather designed for empowerment of groups of citizens, but it has been adapted into the PD approach after some time (Vidal, 2005). The method is a tool, which helps researchers facilitate and create an arena for collective creation (Kensing & Madsen, 1991) and solve the right problems instead of the wrong ones, in community of practice. Kensing and Madsen (1991, p. 155) explains that the method is helping end users to generate alternative visions for future technology use at their workplace. The method is based on three phases *Critique*, *Fantasy* and *Implementation phase* (Kensing & Madsen, 1991, p. 157). Aim of this method is to look from different positions at the well known problem; generate future solutions; and discuss these together in plenum in order to create proposal which can be implemented in real life (Vidal, 2005, p. 2).

4.3.2.1.1 DESCRIPTION

The background for this method was to *give a say* to citizens, which were marginalized when it came to the decisions about public planning (Kensing & Madsen, 1991). The method allows cooperation based on shared understanding. It is closely tied up to PD guidelines mentioned in section 4.1.1, and is based on notion that the researchers facilitates the workshop by giving every participant equal possibility to share own ideas with the others.

The big advantage of the method is that it's easy to conduct. There isn't any necessity for extra tools, apart from paper and something to write on. The phases, which are included in the Future Workshop (FW) are enough, and gives almost a priori knowledge about what are the tasks for each phase. On the other hand, the method requires that participants show willingness to join the discussion and to create new visions about the future solution. Through dual willingness and collaboration of participants and researchers or designers, there is possibility for mutual learning. By placing the FW in the appropriate place, which is tied up to the future application area, makes it easier to embrace the existing practices, knowledge and skills in order to create suitable prototype, which will support the end user.

4.3.2.1.2 PHASES

The first phase focuses on the problems, which are tied up to the specific area. It should *reveal* and *unmask* areas that aren't good enough (Kensing & Madsen, 1991). In this part of the workshop the participants are asked to list as much problems as they can in order to be aware of the existing situation. Results from this part helps to keep the workshop on track and focused on the most problematic cases, which need improvement.

When the existing situation is mapped and the issues are prioritized, the participants are told to move to the next phase, which is the fantasy phase (Vidal, 2005, p. 3). In this part of workshop the participants are not allowed to think negative or criticize. The starting point for them is that the universe is perfect, and that everything is possible. As Kensing and Madsen are describing, participants are encouraged to imagine ideas based on *what if* questions (Vidal, 2005, p. 7).

Further the brainstorming from fantasy phase is "*a base for a plan for action, where the participants discuss what can be done to move towards the vision, given the present day*" (Brandt et al., 2012, p. 152). After participants are done with the brainstorming, the workshop is moved to the last part – implementation phase, which can also be called realization phase. Here participants have to agree on specific ideas and solutions from fantasy phase. This becomes foundation for further work, where the participants have to find out how to adjust these to the real world. The end result of this phase can be prototypes, sketches or scenarios of their future visions supporting their existing work practices and knowledge.

4.3.2.2 FOCUS GROUP

As mentioned in the introduction, the last phase of the FW is realization phase. The last session ends up with discussion – where everybody can share his or her thoughts. Such discussion is very similar to the same situation, when an interview is conducted in focus group. Because of that I want to present some issues tied up to such collection of material.

The *focus group* (Lazar et al., 2010, p. 192) is a powerful method for data gathering in form of collective interview, which allows discussion in plenum. Both Lazar et al. (2010, p. 192) and Sharp et al. (2009, p. 302) points out that the method is requiring that users have to feel free or comfortable with each other – so that they actually express their thoughts. One of the benefits of the method is the fact that it gives possibility for being flexible and allows for open-ended questions, so that all participants can join the discussion without any concerns (Lazar et al., 2010, p. 193; Sharp et al., 2009, p. 302). But, at the same time it is vital that we don´t open up for the situations where conversations about sensitive topics are introduced. The focus groups aren´t made for this kind of usage, which can be uncomfortable for some of the participants. (Lazar et al., 2010, p. 194). Therefore it is important that the facilitator of the focus groups have control over the relevance of the discussion.

4.3.2.3 VIDEO RECORDING

In order to capture important events or situations during the workshop, I decided to video record the whole session. The video recording provides great opportunities for capture of everything what is happening in a given room, but at the same that particular type of data recording can also be intrusive (Sharp et al., 2009, p. 295). Participant´s awareness concerning notion of being recorded, can influence how they will behave and can introduce bias. The bias can be in form of better or worse performance of the participant. Also, some challenges introduced by video recording are logistics, the researcher has to be prepared to have with him or her a tripod in order to place the recorder in the right place (Lazar et al., 2010, p. 198). Simultaneously, the researcher should check the place where the session will be captured, in order to identify possible factors that could decrease the quality of the recording; and maybe reconsider to apply several video cameras (Sharp et al., 2009, p. 295). The challenges with the video recording are during later analysis, especially interpretation of what the participants and their thoughts. Also, the video recording can limit our view and perspective (Sharp et al., 2009, p. 295), because we can´t see outside of the lens – to address such problems, it can be helpful to have several video cameras placed in the room.

4.3.2.4 PLANNING THE FUTURE WORKSHOP

I wanted to conduct a FW with participation of the main target group and employees from the science center. The target group was supposed to be young people in age of about 12 years old. Fortunately, my supervisor had a son in this particular age group. The choice of participants addressed the issue of the end user inclusion, where the PD methodology commits to inclusion of participants who will actually use the particular technology, in order to design the right functionality for right practices (Ehn, 2008, p. 94). Her son and his five friends were supposed to participate in the workshop. We agreed that I would be reasonable to have three boys and three girls. Also, my supervisor underlined that it´s important to invite children whom are able to focus a little extra, even though they were earlier at school.

While, when it comes to the representatives from the science center, I wanted to be people who had something to do with the installation. During the

interview with the science center, it became clear that three employees could participate in the workshop. The combination of both adults and children addressed the issue of co-design, but also the challenges of equal power relations. I applied the FW in its original form, but within the different phases I divided several activities into smaller tasks, to support younger participants while co-designing with the employees.

Taxén (2004) is one of the researchers that has applied FW as a method for the redesign of the exhibition at science center, where he has also obligated to adjust method for his context of use (2004, p. 207). In my case I had to choose and divide activities carefully, in order to obtain some certain scope of work material and at the same time give engaging tasks to the children. Also, I had to remember that youngster were earlier this day at school and that theirs potential to focus almost 3 hours at ones, is limited. I decided to create timetable, which was very detailed in order to give me support through every phase and activity (see Appendix C for timetable). In the schedule, I included both exact time for activities and phases, maximum duration of these; and description of what I will do and say to the participants. I

The first phase, as described earlier was focusing around critique of the installation. During that part of the workshop, the children were working alone. I wanted youngsters to play for a while with the installation, and afterwards they would be asked to come back to tables and brainstorm, first of all about the installation it self. Brainstorming´s role was to just find out and clarify what was the installation about? This activity's goal was to give children little more confidence around adults, and to make sure that every participant knew what photosynthesis is, and what installation was trying to communicate. After this, I wanted to move to next task in critique phase, which was about finding out which of the five concepts are weakest communicated to children. These were:

- capture of CO_2;
- storage of CO_2;
- energy production;
- building material;

- clean air.

I wanted to introduce these, in order to provide some material for children, which they could work with. These were meant to be a support for young participants when they weren´t sure how to go further with the analysis. Based on the concepts, I wanted to sort these from the ones that were strongest communicated to those which were weakest presented.

Based on that list, and the concept that came up lowest in the ranking I wanted to move to the next phase, which is called fantasy. Here, both children and adults would be working together, in mixed groups. Participants would be asked to brainstorm about utopian solutions, which are only possible in the perfect world without any limitations. During the fantasy part of the workshop I wanted participants to draw a scenario or storyboard about how the installation can be enhanced were the starting point would be the concept – which was weakest communicated. I planned that children had to show two aspects in their scenarios and/or storyboards; it was how the installation saw and how the other children used it. The last activity of the phase was to write down some characteristics of the prototypes they came up with.

In order to move to the next phase, first of all I would ask the groups to present their final fantasy design alternatives. Based on these presentations, I wanted to engage all participants to discuss in plenum these alternatives and find out which of them is most doable in the real world with some small modifications. This discussion would provide good starting point for co-creation of the final design alternative, which would be a result of compromises between all the actors participating in the workshop. As a tool for formalization of these thoughts, I would use again method of storyboarding. In the end, I would also ask users to form some specific characteristics of the low-fidelity prototype. As a reward for participation, children will receive cinema tickets.

When it comes to video recording, I prepared three cameras to have with me so that I could capture the workflow of each group. I wasn´t sure how many children and employees would come on the final day, so I was prepared for everything. The same thing was with tripods, so that I could place the cameras

where it was needed. I was aware of the fact, that I wouldn´t have time to take notes, because of my facilitator role – so I was prepared to only take pictures when needed.

4.3.2.5 CONDUCTING THE FUTURE WORKSHOP

The workshop was conducted on 10 of December 2014 at Norwegian Science Center in Oslo between 3:30 P.M and 6:30. P.M. The representatives from the science center were two employees – one educator and one designer. The educator had unfortunately no connection to design of the installation, but knew a lot about the installation and the exhibition – *Energi Tivoli* (Energy Amusement Park). Educator had previous experience with children, which was a great benefit while working with young participants during the FW. The designer was a member of the team that was responsible for development of the *BioEnergiPinBall,* and was one of the designers that proposed to use PinBall concept as a base for the installation. Both of them were voluntary participating in the workshop, since they wanted to experience different design methods.

For the workshop came six children, who were in age of 12. It was three boys and girls, since they were close friends they felt comfortable with each other. They were handed an inform consent in advise, where their parents had to signed it, and deliver to my supervisor (Lazar et al., 2010, p. 199). Formulation of the inform consent, and information about it wasn´t part of my duties, these were done also in advise by my supervisor who knew both young participants and their parents.

Since there were only two representatives from the science center, I decided to form two groups during the workshop, where each had one adult and three youngsters, this kind of setup is also suggested in one of the reviewed studies (Taxén et al., 2001, p. 123). Based on that I prepared two tables, two cameras, which could capture activities of both groups and two tripods. Whole workshop was recorded so I ended up with to video recordings, which lasted for about 3 hours. Further, these two groups were put up together rather randomly, where nobody had any specific preferences. Also, the notion that children knew

each other addressed issues concerning interviews in focus group, were everybody could say what they thought without any precautions.

5 ORIGINAL DESIGN PROCESS: DATA AND ANALYSIS

In order to plan how to carry out the intervention based on the FW, I was obligated to gather background data about the earlier design process of the installation. Presentation will describe the interview results from two meetings, with the NFS representative and with the science center´s employees. The chapter will provide overview over the original design process of the installation. During the presentation, I will also analyze the development through ANT lens, in order to set focus on different aspect of the design. These will enlighten choices made by the involved actors, but also how they influenced children´s position during the design process. The chapter will end with the description of the end result, which is the BioEnergiPinBall installation.

5.1 BACKGROUND FOR THE NFS´S PROJECT

As mention in the chapter 4, I chose to send the interview guide in advance to Lohre – so that he could prepare him self; in return he sent a short history of the *BioEnergyPinBall* game and it´s development (T. Lohre, personal communication, October 6, 2014). His description was partly answering my questions, so based on that we skipped some of them during the interview. The main message the NFS wanted to communicate was the role of tree´s for climate and energy production, and the role of foresting. This, they wanted to communicate to all social classes in Norwegian society. Lohre argued that there is a lack of knowledge, and a lot of misunderstandings about use of trees and how they can enhance our climate and energy situation. This is also something that they have presented in their magazine *"Skog og Miljø"* (Lohre & Venn, 2012) which he gave me during the interview. So, the NFS is representing values and ideas that are vital for further development of the Norwegian forests. They believe that how they promote and present forests and issues tied up to them has great influence on how people in general will perceive role of foresting for climate (DNS, 2007).

On our meeting, Lohre explained that media are communicating biased information to the people e.g. about rain forests, and people in general get the

wrong understanding of the situation. As a result it is difficult for people to accept that activities in the forests are actually important for carbon storage, and in turn our climate. He pointed out that knowledge about the role of forests to our climate is almost absent in urban societies. He underlined that such societies have very little contact with forests or people that are working in the forest industry. Lohre, also emphasized that NFS finds it difficult and challenging to fight against media´s presentation of unfair image of the forests. Also another important challenge was that children in schools learn very little about forest. Lohre explained that children are learning some basics about e.g. the photosynthesis when they are in the elementary school, and that´s about it – unless they choose to have biology in the high school.

The NFS initiated project where the organization visited and interviewed several museums and science centers and discovered that museums only displayed history of forest industry in Norway, while in the science center there was presented history of sewing machine and it´s consequences for the environment. Also, Lohre mentioned, that the forest museum in Elverum[4] exhibits an installation, which is also focusing on photosynthesis. But, he argued, this museum isn´t the right place for theirs project, because NFS did not want to associate their installation with museum object.

To sum up, the NFS mentioned several factors that contributes to peoples misunderstanding:

- media´s communication of biased information;
- poor follow-up of education at schools;
- and weak representations at institutions like museums and science centers

The combination of these factors supported their project, where the NFS goal was to tell everybody everything about forests and it´s advantages for climate, though every project need clear boundaries. Knowing who is your main target group, and what you want to communicate is helping to create a specific scope,

[4] http://www.skogmus.no/

but also is minimizing chance for failure (Sharp et al., 2009). Such simple choices and regulations makes work easier, and can be established by application of simple design principles from interaction design (2009, pp. 20-33). In case of the NFS, the initiators of the project had very wide understanding of the issues they were achieving as well as their target group. The only thing that wasn´t clear was the scope of their project.

5.2 UNDERSTANDING THE NFS´S INSCRIPTIONS

During NFS´s project, they started search for a collaborator whom would share their concerns and goals, they were conscious about two clear messages they wanted to pursue and, that can be described as NFS´s inscriptions (Akrich, 1992). The first message the NFS wanted to communicate to the others, was concerning how forest industry could contribute to climate changes. While the second, was concerning where they shouldn´t display their massage. As described, they didn´t want to associate their project with old and forgotten museums artifacts (Baldock, 1995), because of that they were willing to choose a place which is promoting learning and science enquiry through dialog with the visitor, like science center (Feder et al., 2009, p. 2; Taxén, 2004, p. 206). These strong inscriptions describe the "*framework for possible action"* (Akrich, 1992, p. 208) and give us allusions for how the actor, NFS, is going forth to choose their collaborators. These two inscriptions concerning the message and the right place for their presentation are strong and dominating, and they are engraving the choices of the NFS but thereafter also the whole process of the design of the installations.

Also, these inscriptions are the *method of regulation* (Akrich, 1992, p. 218), by which the actants keep control. In this case the actant is the NFS, and if they don't regulate their actions to their inscriptions they will end up with the notion that their message will be displayed at e.g. a learning space not associated with inquiry learning and science. In that way they risk not to communicate their message as they wanted – through science inquiry – but, rather through a static text on a blackboard without any dialog with the visitor. The potential of the message to be communicated in a museum was risking to send completely

different message to the visitor, connecting the foresting with the past and not as a future opportunity for sustainable actions towards climate change. Akrich (1992, p. 218) explains that methods of regulations establish norms, where the norms are either punishing or rewarding the user. As the example is indicating, if the NFS won't obey their inscriptions – the punishment will be in form of wrong communication of the message to the target group.

During the interviews with the science centers, the NFS found out that these institutions are interested in having more of exhibitions or installations concerning the subject of forest and it´s connection to the energy and climate. On the other hand the NFS saw science centers as a great opportunity and arena for communication of their message. The NFS decided to cooperate with Norwegian Museum of Science and Technology in Oslo based on two motives. First of this, science center in Oslo worked on an exhibition about future energy and climate challenges, called "EnergiTivoli" or "Energy Amusement park". The second motive was that this particular science center builds their own exhibitions and installations. Lohre explained in the interview that other science centers bought a lot of their installations from external producers, which made it impossible for the NFS to come in. In addition the NFS didn´t have any knowledge about design of the installation, and they had no idea where to begin with the development of a proper mediating tool for their message. On the other hand the NFS had limited budget, which had also influence on their decision about who they would cooperate, in the end.

5.3 Understanding the Science Center´s Inscriptions

During the meeting with the science center in Oslo, we were discussing very briefly the installation and it´s development. The installation is a part of the exhibition, which is based on idea of old-fashioned amusement park where there are various stations with different carnival activities.

The employees explained that they wanted to add a Pin Ball machine, to their exhibition, in order to complete their vision of an amusement park. But, they were missing the right kind of content they could translate to the machine. When the NFS presented their project, the science center had already a plan for

what kind of installation that would fit the content and message. The Pin Ball machines, which are used in the exhibition, were recovered form a person who collected old Pin Ball machines. When it comes to development of the game, the science center´s employees did the coding job. They applied RasberryPi as a base, while graphics were created by Swedish design company *Co-design*[5], which they have collaborated with in some other projects like KlimaX[6]. Also, they added that, often they are meeting problems of the maintenance of the machine versus money and time they have to disposal.

In the short interview I conducted with the employees, I mentioned for them that every time I was in the center the installation was broken. In defense, they were arguing that it is often broken – not because of technological components, but because of the old mechanics and rubber bands that are controlling the "kicker arm" in the game.

The institution represented several inscriptions, which had significant impact during development process of the installation, and on translation process between the NFS and science center. First, the science center had already ongoing development of the exhibition about future energy solutions. Second, they wanted to apply Pin Ball concept, but they were missing a message. Third important inscription is notion that they had previous experience with design and development of installations and exhibitions. These inscriptions defined the framework of action, when the science center became collaborators of the NFS (Akrich, 1992, p. 208).

5.4 TRANSLATING FORESTING AND ENVIRONMENTAL ISSUES IN AN INTERACTIVE INSTALLATION

The interviews between the NFS and science centers, where playing vital role in persuading science centers into reaching together with NFS for societies primary goal. Through these activities science centers established deeper

[5] http://codesign.se/
[6] http://codesign.se/arkiv/klimax/

awareness about issues concerning foresting, and were willing to enhance existing situation. Agreement between the NFS and the science center at Norwegian Museum of Science and Technology in Oslo, lead to the translation process where the actants became collaborators.

The translation process can be explained as a *social ordering* (Law, 1992, p. 5). Law remarks "*In short, it is to explore the process that is often called translation which generates ordering effects such as devices, agent, institutions or organizations.*" (Law, 1992, p. 5). This section will explore how the process of translation was achieved in case of the BioEnergiPinBall.

The first activity during translation process is *problematization* (Callon, in Asdal et al., 2007, p. 59). The activity is focusing on *definition of the problem and its solution* (Horowitz, 2012, p. 809). In this case, definition of the problem was done through analysis and prioritization of large message that the NFS wanted to communicate to their audience. The NFS and science center, created a list with five categories:

1. **Foundation** – The photosynthesis is foundation for all life on the earth. Green plants and trees capture energy and the sunlight. The energy is driving power in the process of photosynthesis, where CO_2 and water is transferred to sugar molecules and oxygen, which in turn is released to atmosphere.
2. **Climate Giant** – The forest is crucial for climate struggle. Growing trees capture CO_2 from the air through process of photosynthesis. The oxygen is released to atmosphere, while carbon is stored in form of timber.
3. **Replacer** – The timber as building materials, which can replace concrete, steel or aluminum. In addition to storage of CO_2, it can be recycled in production of new materials and energy.
4. **Storage** – Norwegian forests absorb up to 50 % of human´s CO_2 emission, which is stored in the timber.
5. **Reinforce forests** – precautions that contribute to climate changes.

Based on that list, the NFS and science center decided to focus on only the first aspect, the Foundation. The reason for this choice was based on the fact that

the NFS thought that it would be good starting point for their work. Lohre argued, that when people will understand the basics, it would be easier to build more complex knowledge on that.

Also, the target group had to be changed, since it is challenging to create something for all social classes in Norway, reaching from upper to lower class. Based on the cooperation with the science center the target group was narrowed down from everybody and identified as youngsters, aged 10 – 13 years old. The NFS was familiar with educational activities with children in this age group, because of their close collaboration with various schools. They have developed several learning programs for lessons at school or outside in the forest. But, as Lohre points out they haven't the same experience as science centers when it comes to installations. He emphasized that 6th or 7th grade is actually best time to teach children about photosynthesis – since this is the time they are learning this topic at school, and is in coordination with the national educational plan and pupil´s textbooks. He was also explaining that when they chose to go for cooperation with the science centers, they knew that the target group would be clearly defined. However, he was also emphasizing that while youngsters are playing with the installation – their parents or other adults are also benefiting from that in form of learning and repeating knowledge that they might have forgotten.

When the definition was ready, they were also obligated to find a solution to their problem. The science center, propose to apply PinBall machine concept as a medium for the final massage about the photosynthesis, but Lohre expressed that he was surprised, when the science center introduced this particular idea. The NFS had some assumptions about the technology that could be used for this aim, but it was rather limited to the touch screen where the interaction was happening. I asked him what he means with *interaction,* and then he answered that they imagined some game with several activities. They wanted to communicate their message through experience of fun gaming, touching and observing. They also wanted to create something that would be also esthetically appealing. An important factor for the NFS was that the user would be able to

connect gained knowledge about photosynthesis at the science center with future activities in the forests.

When the definition and solution were established, also the *obligatory passage point* (OPP) (Callon, in Asdal et al., 2007, p. 59), was defined. In case of the BioEnergiPinBall, the science center had an installation, which needed a message that could complement the PinBall concept and the exhibition. The obstacle between the science center and the finished exhibition was notion that they were missing a massage. On the other hand, the NFS had a massage, but they were missing a medium that could communicate it; and can be identified as an obstacle. In order to accomplish both the science center´s and NFS´s goals, the Pin Ball machine became an OPP. In that way the machine made itself indispensable for the science center and NFS (Callon, in Asdal et al., 2007, p. 60).

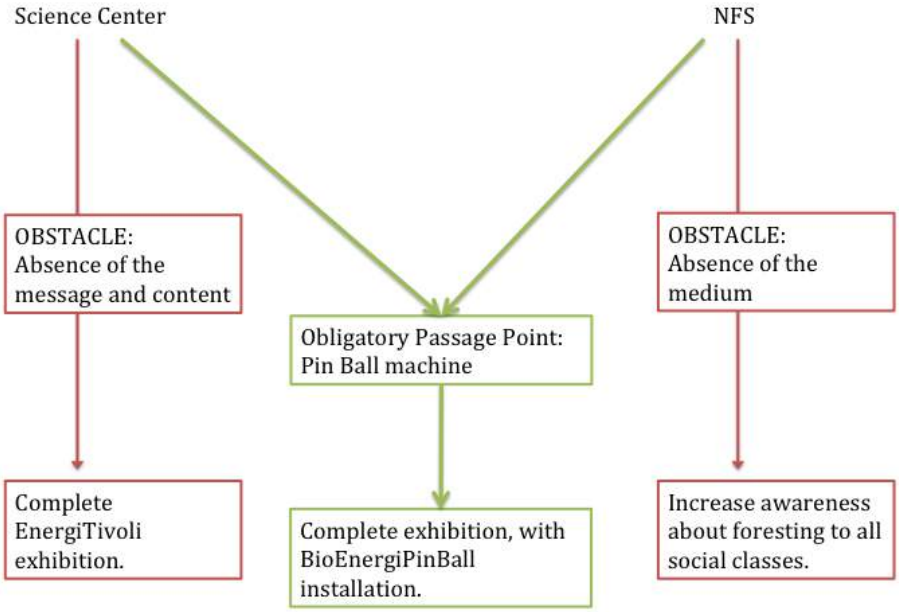

FIGURE 4: OBLIGATORY PASSAGE POINT IN CASE OF BIOENERGIPINBALL

Further, the translation process involves activities of *interessement* (Callon, in Asdal et al., 2007, p. 65); where in my case the science center comes in-between the NFS and the finished installation. Also, as result of this alignment the NFS had to exclude their desires and goals. Because, of the science center´s experience with development of the installations, they knew that it is challenging to say everything to everyone. During the process of narrowing down both the

scope of massage and the target group, the NFS had to exclude and betray the original idea of communicating everybody everything (Crawford, 2004, p. 2). Callon (in Asdal et al., 2007, p. 63), describes this process as result of "*seduction or a simple solicitation*" where the science center is persuading the NFS to let go of their original scope and accept their definition (Horowitz, 2012, p. 809).

Next step in the process of translation, is the activity of *enrolment* (Callon, in Asdal et al., 2007, p. 65). The process involves putting into action, planned roles during the problematization phase. In case of the BioEnergiPinBall, the NFS is assigned role of an actant who is providing a message, while the science center have responsibility for development of the installation itself. If someone will fail to enact, their roles the process of translation will not succeed (Horowitz, 2012, p. 809). In result, if actants won´t cooperate based on their roles – there won´t be any alignment, and in turn no installation. But, because there is strong correspondence between the actors and the delegation of roles was successful, the alignment was achieved (Horowitz, 2012, p. 809). The strong correspondence between these two heterogeneous actors, was based on the notion that both of them needed each other in order to obtain their individual goals.

The last step in the process is *mobilization* (Callon, in Asdal et al., 2007, p. 71), which is including activity of convincement of the other actors that are relevant for the achievement of NFS´s goals. In this case there are actually several actors that are vital to enact on behalf of the others (Horowitz, 2012, p. 809). Designers and developers from science center chose to apply *Raspberry Pi*[7], in order to program necessary functionality. This means that a non-human actor was needed in order to achieve the final product. Another non-human actant is the design company – *Co-design.* They were playing vital role when it comes to design of visible graphics on the table of Pin Ball game. Without integration of necessary technology and design aspects, final product wouldn´t be possible. In other words, without delegation (Aanestad, 2003, p. 7) of various tasks to heterogeneous actors in the network – installation wouldn't exist. Delegation of

[7] http://www.raspberrypi.org/

tasks to Raspberry Pi and Co-design is grounded in the notion that these actors, as Aanestad (2003, p. 7) is explaining - have needed competence, which contributes to achievement of the translator's goals.

This explanation describes how in my case all actors such as NFS, science center, Co-design – team and Raspberry Pi were ordered in such ways that they managed to collaborate with each other over longer period in order to develop a final product. But, it is important to point out that this is not necessarily a final structure (Law, 1992, p. 5). An example of possible breakdown of existing network can be illustrated, when the rubber bands from the kicker arm cracks because they are not robust enough.

5.5 IDENTIFYING THE WEAK ACTANT IN THE PROCESS OF TRANSLATION

The process of translation, which is focusing on ordering and stabilization processes of the heterogeneous actants in the network is generating a relational and distributed power effect (Crawford, 2004, p. 2). This entails that the NFS doesn´t possess the power in the network, in order to control the other actants like science center. Rather the power is based on processes of persuasion measured in the amount of entities speaking in *unison,* which will be heard by the others (Callon, in Asdal et al., 2007, p. 75). The persuasion process, is based on the perpetual struggles between the heterogeneous actants like the NFS, science center, design company Co-design; and the technology in form of RaspberryPi and Pin Ball machine which form a socio-technical assembly (Ehn, 2008, p. 92). Also, the negotiations during the translation process that arise between the heterogeneous actants, is inherent power struggle between them (Horowitz, 2012, p. 809). The translator, in this case the science center is trying to convert its goals to correspond with the goals of the others in order to obtain as much as possible networked entities.

If we study earlier explained translation process between the NFS and science center we can observe that persuasion is rather coming from the science center than from the NFS, though the project was started by the NFS. The science center managed to persuade the technology like RaspberryPi and Pin Ball machine – to enact on behalf of them, delegated roles of construction of the final

installation. This entails that the spokesman for the network is the science center (Callon, in Asdal et al., 2007, p. 75), and in result the unison, which will be heard is the science center and its networked entities. But, if we look closer on the translation process, the target group, which will be the using the installation, isn´t considered as an important actant.

ANT is criticized for being Machiavellian – where only the perspective of the strongest unison is seen and heard (Asdal et al., 2007, p. 32). By applying ANT as a lens for analysis of earlier design processes of the installation, we can observe that the perspective of younger participant is unseen because they are marginalized in the network. The ANT framework can be used in reverse matter, in order to identified who is under-represented in the network of the BioEnergiPinBall installation. The next section will analyze the role of children in the primary design process conducted by the science center and the NFS.

5.6 USABILITY TESTING OF THE INSTALLATION: CHILDREN´S ROLE

When the shape of installation and target group was identified, they begun with development of the installation. The NFS wasn´t involved in every step of development, but before the end product was exhibited in the science center, the museum and NFS conducted together a pilot testing with accessible young people. Both the NFS and the development team from science center wasn´t sure if the idea with the Pin Ball concept was actually interesting for the end users. NFS explained that during user testing they used their own children, like e.g. Lohre´s son, who was at that time 18 years old.

When children were finished with pilot testing, the development team asked testers about their opinion. Lohre describes that his son, had a lot of fun playing old-fashioned Pin Ball game, since he never played this type of game before. Lohre concluded that in general the installation worked very fine, but they had to change a little bit graphics and narration, which is introduced in the beginning of the game. Also, he pointed out that during user testing some of the users understood what the game was about, but there was also some who didn´t understand the message. But, he concludes, during user testing they were aware

of the fact that there will be always someone who would not understand the message.

There are two interesting aspects of this certain pilot testing approach:

- *Who* was chosen to participate in the testing?
- What kind of *role* young people had during the testing?

Both of these issues are central in the literature on children involvement. First of all it is always good to test, adults will never be able to think like children and vice versa (Druin, 2002). Testing can be conducted in various ways, but most importantly it have to be done properly, where children are treated as knowledgeable individuals whom can participate on the same level as adults – because they are also humans (Staksrud, in Fossheim et al., 2013, pp. 74-75). Also, in order to provide the same rights for children as for adults it is important to build up the right ethical framework, which is carefully planned through whole process of research. But, because of that people consider children participation as a challenging and are often avoiding such issues (Phelan & Kinsella, 2013).

Children participating in the pilot testing were assigned role of a *tester* (Druin, 2002, p. 7). This type of participation in the design process is characterized by the fact that young people are testing devices or technologies, which are new and not commercial. The development of the BioEnergiPinBall is exactly this kind of context. In this sort of setting the relationship young people have to the adults is in form of feedback and is indirect (Druin, 2002, p. 7). This means that during testing of the installation at the science center, children were observed and asked questions after usage. Such participation doesn´t include any dialog or discussion between the designer and children. Questions in the case of BioEnergiPinBall were concerning, if children liked the game and what they didn´t understand (T.Lohre, personal communication, October 17, 2014). During the pilot testing of the installation, majority of the children thought that the concept was interesting itself, since it was something old fashioned – but at the same time something new, since they haven´t played the real Pin Ball game.

In this case, the conducted testing can be criticized for several reasons. Invited children whom were chosen to participate, first of all didn´t match the original target group. It is understandable that often it is difficult to recruit children (Dindler et al., 2005) to various researches or testing, but either way there should be testing on the right target group – which are children in age of 10 to 13 years old. The user testing has as a goal to identify flaws of the design and improve user interface for the certain user (Lazar et al., 2010, pp. 252, 254). If one is testing the device on completely unsuitable group, the results might not reflect the reality, and in turn don´t reveal areas, which should be reconsidered for the redesign. The issue, of wrong user group entails problems around accountability and responsibility of the user (Robertson & Wagner, 2013, p. 72). This implies that, the designer is responsible for the design and choice of the suitable tester; but at the same time the tester is responsible for representation of his or her community. The question the science center and the NFS should ask them self is whether an eighteen years old boy is the right representative of a young people between 5th and 7th grade?

Based on the role young people were assigned during user testing, they naturally didn´t participate in the initial phases of the design of the BioEnergiPinBall installation. This kind of participation has it´s advantages and disadvantages for the designers. The participants of the user testing could respond to the installation in more negative manner, were they could dislike the whole idea – which can happen during usability testing (Druin, 2002, p. 19). Because of that, it could be more advantageous to include children earlier in the design process in order to eliminate such situations, where the designer is surprised by the negative reaction. But in this case, most of the young testers understood what the installation was communicating, and the changes that the designers had to apply on device were minor. As a result, the design team concluded that the installation would apply for several user groups, since the Pin Ball concept is often unknown and is considered for being fun (T. Lohre, personal communication, October 17, 2014).

The conducted pilot testing made design team content with the installation, and as a result they introduced only minor changes to the narration

voice, which is telling a story in the beginning of playing session. But, how can we relate such forms of children´s involvement from user testing to part of the literature, which is dealing with empowerment and *having a say* during the design process (Bratteteig et al., 2013, p. 129)? User testing setting, was making room for children´s voices; young participants had possibility to express their thoughts and opinions. During design process these thoughts were considered when needed, this entails that the designers had the authority to conduct final design decisions. In this context, one could argue that both the NFS and science center had a lot of experience with the target group and design – but, is it contributing to children´s possibility to participate in decision-making concerning design (Bratteteig & Wagner, 2012)? In order to make place for children´s having a say, one have to apply both methods and approaches which can contribute to such changes. These will be discussed in the next chapter.

The first BioEnergiPinBall game was introduced to the children in 2012 as part of the Energy Amusement park exhibition at Norwegian Museum Science of Technology in Oslo. After one period of pilot testing was finished at the science center in Oslo, copies of the game were produced for the other science centers in Norway, in total seven. Lohre underlined, some of these copies were improvements based on observations made of use of the original machine exhibited in Oslo. Lohre was emphasizing several times, that this installation individually isn´t good enough as stand-alone installation. The NFS wanted to have some educational pre and post work. In that way, children would have longer session about photosynthesis´s influence on climate and energy and establish more fundamental understanding and awareness.

In the end of interview I asked Lohre about future changes of the installation. The NFS was generally pleased with the results, and how the installation is working. But, the NFS wanted to evaluate the installation in the end of 2014. According to the agreement with the science centers, which have accepted the installation, they would conduct evaluation studies of the installation in form of observations. These evaluation will perhaps lead to change of e.g. the narration in the beginning of the game – but Lohre wasn´t sure until they received the evaluation results from the other Norwegian science centers.

5.7 BIOENERGIPINBALL´S INSCRIPTIONS

Inscriptions of the installation are grounded in the alliance between the NFS and the science center. This aren´t accidental choices but, actually results, which were carefully negotiated between heterogeneous actants in order to merge together mainly two different concepts of Pin Ball mechanisms with photosynthesis. As mentioned earlier, the NFS together with science center had developed five different teaching goals, where the *Foundation* was the main message the installation had to communicate to the audience.

The installation it´s self is based on the notion of competition, where the user is invited to gain as much as possible points in form of CO_2, light and water. By playing the game children are meant to learn how three different elements of the photosynthesis are necessary for production of biomass for either energy or building material. These inscriptions of the installation are results of negotiations between the NFS and science center considering message´s shape. On the other hand the Pin Ball concept it self comes together with already pre-established inscriptions. One of these is the notion of collecting as much as possible points one can, based on the competence of the player (Edwall, 1982). Originally Pin Ball game is meant to have a successful session while the player is playing as longest as possible, which is followed naturally by grater amount of points (Edwall, 1982). The same notion is used in the BioEnergiPinBall game, but instead of collecting points, one is collecting three element of photosynthesis, where the success is when the player has produced biomass for further manufacture.

Since Pin Ball machine, is designed as a competition game, high score table is fundamental for finding out who is the best. The installation at the science center, doesn´t include any high score table, which isn´t indicating if one visitor is better then the other one. This inscription indicates, that the installation isn´t presenting directly for the user the notion that the game is designed around the competition.

I have mentioned that the Pin Ball machines that are used for this project came from a collector. The man had great amount of old machines that could be

reused for this project. This entails one vital inscription, which has great influence on the user experience - the age and ruggedness of old game machines. Recycling old machines, is of course a great act (Van der Velden, 2014), but it has consequences for the user experience. The machine has potential to fail while playing with it, and contribute to worse user experience of both – installation and exhibition. Result of such situation is notion that the installation is not enacting it´s role in the network, which was assigned through translation between entities (Horowitz, 2012, p. 809) like in this case – science center. This entail that the non-human actor is not always going along with the strongest actant (Whittle & Spicer, 2008, p. 621) in the network – and in result leads to breakdown of the previous established alignment.

5.8 SUMMARY

This chapter has provided overview of the actors that has contributed to the development of the installation. Described inscriptions of the actants are supporting deeper understanding of the translation process and the negotiations between the actors. Even thought the ANT framework is applying Machiavellian lens, it helps to identify who is marginalized during the design process of the installation. The analysis is providing in-depth information, which helps to design the intervention method.

6 DESIGN INTERVENTION: DATA AND ANALYSIS

This chapter will provide the presentation of the results from the FW. The aim of this part is to get better understanding of children´s translations processes while encountering the installation, where the FW is an arena for the process. I will start with description of the activities done before the workshop in order to prepare my self. Thereafter this will be followed by the description and analysis of the different phases included in the workshop. During the analysis I will discuss how the literature is supporting the practices.

6.1 PREPARATION

Before I came to the science center to conduct the FW, I sent an email to those who wanted to participate in the experiment. In the email, I explained to the employees what kind of role they are going to have during the workshop, and that it is important that they put aside their *original roles* and *assumptions* about the children while they are working with the youngsters (Downes, 1999, p. 337). I emphasized the notion of co-design, and that they are going to collaborate with children as their design partners and vice versa. This had as purpose to address the issue of equalization of power relations, during the workshop, in order to empower young participants. Also, right before the workshop I reminded the adults again what is their role.

The aim of the FW wasn´t to create new prototypes for re-designs of the installation, but rather to establish deeper understanding considering user experience. The FW is showing how installation´s inscriptions encounter children and their thoughts and opinions. These children whom were participating in my FW, are representing how a potential visitor and user of the installation is thinking and reflecting upon the BioEnergiPinBall. Through application of methods and approaches which were originally designed for adults (Greenbaum & Kyng, 1991), I was experimenting how these would apply for children. Future Workshop with activities supporting PD principles like equalization of power relations, situation based actions and mutual learning (Kensing & Greenbaum, 2013) was an intervention aiming children´s empowerment during design process. Workshop is also illustrating *what if*

design situation (Kensing & Madsen, 1991, p. 157), where we can imagine how the results of it could contribute to science center´s awareness about children´s knowledge and it´s co-creation

During the warm-up, before the work with different phases started, I wanted to explain the children the purpose of the workshop. Main reason of doing so was to give youngsters motivation, especially emphasizing the fact that they are actually one of the first groups of children who goes through this kind of workshop. In the introduction we introduced our self, where employees, children, my supervisor and I presented short who we are, and what we are doing. Also, I explained that before we begin the work with the phases, we are going to play with the installation. This part was kind of preparation before the workshop, since not all children were familiar with the exhibition or with the installation it self.

As described in the methodology chapter (see section 4.3.2) I wanted to be prepared for everything. In order to address all my insecurities in relationship to the installation, I wanted to play it before the workshop. I visited the science center twice with hope to interact with the installation. Unfortunately, every time I was trying to play the game, it was broken. During the workshop, while I was explaining to the children that we are going to play the machine, it was discovered by one of the designers that the installation was broken. I asked the designer what happened, and he said that the rubber bands that are holding the kicker arm in the game were broken. In the meantime, while children were waiting – they decided to explore the rest of the exhibition about climate and future´s energy solutions.

This illustrates the first encounter children were experiencing with the inscriptions of the BioEnergiPinBall, where the game is not fully working, because of it´s age and ruggedness. Recycled machines were not enacting the assigned roles to them by the translator, which shows how the network is breaking down (Horowitz, 2012, p. 809). Also, this is an example of how small problems can influence the stabilization process in the network. Because the installation is not enacting delegated roles, it is influencing the user experience

of whole “EnergiTivoli” exhibition, the learning outcome for the children; but not least the installation self. Also, when the installation is not working, there is an absence of the translation process between the young visitors and the installation. This leads to the notion that the visitors didn´t have chance to confront the installation, and in result there wasn´t any negotiation process between the actants. But, luckily, after about 10 minutes the designers sorted out the error, and children could start to play with the machine.

As mentioned in the chapter above, installation isn´t directly indicating that it´s made for competition. While children were playing, they made the game both competitive and collaborative. Children where working together in order to play as longest as possible. Also, they helped each other, when one of them didn´t hear the feedback from the installation while playing with it. They also kept track of how much timber was produced by each of them, and on which level they ended up. I asked children after session with the installation, if they heard what the narration voice from the installation was saying:

> *Me: Did you listen to what the man [voice] was saying while you where playing?*
>
> *Children: Yes!*
>
> *Boy: [Beginning to cite what he remembered] “Can you manage to create a photosynthesis?”, “Can you manage to collect ….”*
>
> *Children: [Laughing] Yes!*

Several times, while we were having workshop, children were referring to the voice, which was giving instructions about what the gamer should do and collect. I was surprised that they were aware about these instructions, and that they followed them. When everybody was finished with their round, children were invited to go back to the room where the FW was held. Children were so occupied with the installation, that they were almost surprised and disappointed that they couldn’t play more with it. This is indicating that even though the user testing wasn´t conducted in a questionable way and that the end users weren´t participating in the design of the installation – the BioEnergiPinBall was

appealing for the participants, as Lohre was explaining in the interview (personal communication, October 17, 2014). Which means, that the translation process between the participants and the installation was established. The inscriptions of the BioEnergiPinBall concerning the competition, excitement and fun were successfully transferred to children, because these were in correspondence with the young participant´s goals of experiencing entertainment.

6.2 CRITICAL PHASE: REFLECTIVE THINKING AND MUTUAL LEARNING

One of the activities, which lead to being critical about the installation, was the discussion about the BioEnergiPinBall´s message. This activity also addressed critical translations between the actants, which means those inscriptions of the children and installation which didn´t correspond with each other. In order to accomplish that, I asked children to create a mind map. The main purpose with this activity was to give children self-confidence about the topic, so that when they were in the group with the adults – they would feel more free to say anything and in general not be shy.

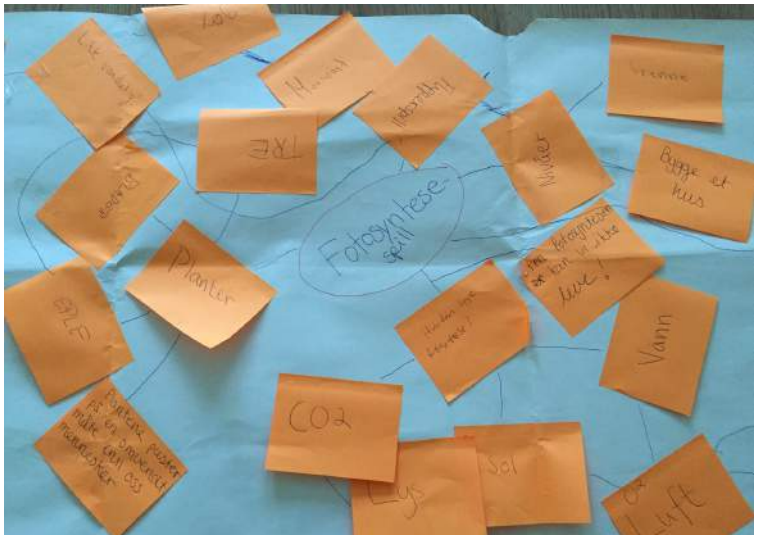

FIGURE 5: MIND MAP CREATED BY CHILDREN

The first question I asked children was "What is the installation trying to say? What is it trying to teach you?". Based on these questions they begun to suggest various keywords and sentences like *photosynthesis*, *water*, *CO_2*, *trees*,

flowers, *humans*, *plants are breathing other way around than people*, *where is it stored? – wood*, *fun*, *levels*, *breathing*, *life*, *leaf*s, *less trees – less clean air*. The interesting part of their contribution was that they reflected upon the installation and its message very careful, where they were discussing different issues around the photosynthesis and the installation itself. They begun with the obvious aspects like *trees*, *sun*, *burning wood* to more abstract keyword like oxygen in form of a chemical formulation O_2. Also, they began to sort different words in groups, in order to establish some categories on the mind map.

> *Me: Why air [referring to keyword on the post-it]?*
>
> *Girl: Because, when the photosynthesis is ….I don´t know … then we can breathe…?*
>
> *Boy: Oxygen! [writes down "O_2" on the post-it and makes a connection on the mind map between the keyword oxygen and air]*

The installation doesn´t say anything about the air or its chemical formula, which is indicating that the children knew the fact from before. Also, the mind map is showing that they were aware of the three main elements of the photosynthesis, and what kind of importance they have in a wider perspective. Interesting was how children carried out segregation of various characteristics, but also identified how information is related to each other based on levels. I was surprised how children used reversed thinking about photosynthesis, when it comes to plants in general. One of the participants wrote, "*Plants are breathing in reverse matter than people.* " This shows that children were conscious about the importance of plants for humans and vice versa – which isn´t communicated

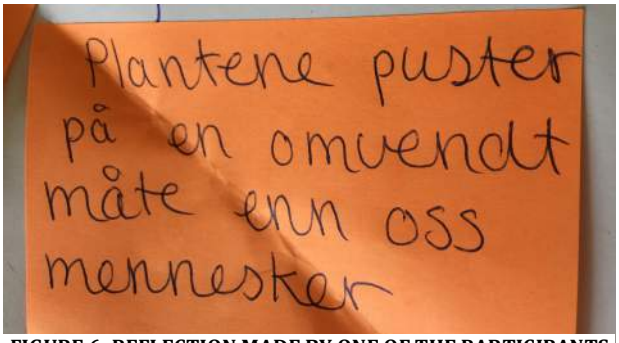

FIGURE 6: REFLECTION MADE BY ONE OF THE PARTICIPANTS

directly through the installation – but, is rather a conclusion or a reflection made on their own, through further and deeper work with the installation´s topic. Similar, applies for the keyword O_2.

Since children had time to explore the rest of the exhibition, they were naturally comparing the BioEnergiPinBall installation with the rest, and pointing out that the voice, which is used in this particular installation is very useful in order to understand what is happening in the game. They demonstrated that a lot of children might be unable or don't bother to read the posters, which can be found besides the other installations in the "EnergiTivoli" exhibition. Having the narration is making installation more approachable for majority, but participants were more interested in how the chemical reaction is actually happening. They thought that there should be more information about that, on e.g. a poster. This discussion was interesting because children were trying to see the installation though different perspectives of the other users:

> *Boy: There is maybe possibility to have, like in the wind power thing [installation] – like a small board with some …*
>
> *Girl: … where there is information about photosynthesis …*
>
> *Boy: … about how this is happening… like besides the wind power installation…?*
>
> *Me: That you have a description … ?*
>
> *Children: yeah …*
>
> *Girl: But, there are probably a lot of others who won´t bother to read it. If you are together with a school trip… If there could be something more of this… voice …*
>
> *Girl 2: That the man is saying it! [the information about the chemical reaction]*

Further in critical phase, children pointed out that if younger children than them played the game – they wouldn´t be able to understand the message. Children´s conclusion is reflecting earlier decisions of the NFS and science center

about the scope of target group. Through reviewing the installation, children made their opinion about who is able to interact with the installation; which concepts are difficult to understand for younger users; but as well how the interaction between the user and installation should be shaped in order to communicate as much as possible. Young participants concluded that it was interesting to play the game, because it was fun – and when something is fun it is also making learning easier. On of the girls said:

> *Girl: It WAS fun to play, and I think that when it´s fun to play it is also very informative.*

During brainstorming, we ended up with a conclusion that children did understand that there are three different elements that contribute to the photosynthesis, but they did not understand why they e.g. needed more *sunlight* when they played, and how the process of transformation of elements during the photosynthesis happened. Two girls said that:

> *Girl1: […] I learned what I needed to photosynthesis, that there are three elements, but I didn´t feel that I understood how it happened.*

> *Girl2: Yeah, that you need some more information e.g. you need more CO_2 because…*

While another boy commented later on the same issue:

> Boy: […] *I feel that you just gather water, mixed in the bucket and you have a tree.*

The next step of the critical phase was the definition of the critical elements more precisely. I presented earlier prepared concepts for the children:

- capture of CO_2;
- storage of CO_2;
- energy production;
- building material;
- clean air.

I asked the children to sort the cards from these, which are best communicated, to worst. This started an eager discussion between the participants. They debated every concept very carefully, and ended up with a list where concept best communicated was in the top:

1. Catch CO_2, light/sun and water;
2. Create buildings material;
3. Produce energy;
4. Storage CO_2, light/sun and water;
5. Contribute to clear air

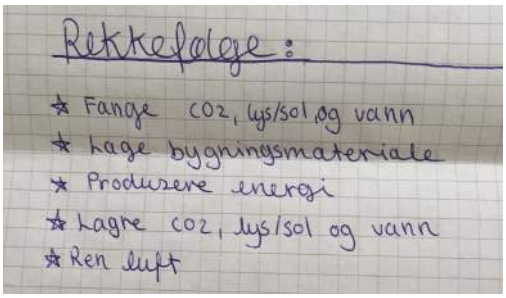

FIGURE 7: CHILDREN´S LIST OF CONCEPTS

During discussion about these concepts, they asked various questions and were trying to answer them together. For example when they were questioning the concept of *energy production* and *building material* they were explaining that the voice which narrated gaming session, asked the player what he or she want to do with gathered material. In one of the dialogs between participants there is mentioned:

> *Boy: Creation of a building material is communicated very good…*
>
> *Girl: … In the end you can press … like …[girl is showing how to press two buttons on the installation, in order to choose the action]*
>
> *Boy: Yeah right… Then they ask you in the game "Where do you want to use it, like… either build a house or burn it?", so it is well communicated that you can build a house…*

The result of sortation was that production of clean air was worst shown. This was starting point for next phase in the FW – where they were asked to co-create together with the employees utopian ideas considering re-design of the installation. They were asked to improve incorporation of concept of clean air as an effect of photosynthesis into the exiting technology. Thereafter children were divided into two groups together with employees from the science center. I asked them how they wanted to be grouped, and if they want only boys and girls groups or mixed. The children decided that it would be better to have mixed groups. Since they were good friends, it wasn´t a problem who will be in a certain

group – so we counted participants randomly. After that we assigned the educator and the designer to each group. I asked them also, which group they want to work with, and they decided to just stay with the table they have been seated from the start of the workshop.

The translation process in this phase is about how children´s inscriptions meet the installation. Here it becomes visible which aspects of the installation are not corresponding with children´s understanding. This means that some of the aspects of the BioEnergiPinBall, like communication of message that clean air also is a consequence of the photosynthesis, don´t conform with children´s expectations.

The first phase of the workshop, can be sum up with two important notions:

1. The FW is contributing to children´s personal development.
2. The FW is providing deeper understanding of the user and use.

The first point is about children´s ability to reflect, learn, cooperate and structure information. All of these activities were illustrated during the workshop, while children where working with the tools their were provided. The FW was supporting their abilities, but also contributing to their personal development, which has influence of their future work with similar projects or with domain about the photosynthesis. Even though I was using their personal time (Robertson & Wagner, 2013, p. 77), the FW was rewarding the participants in an indirect manner. Through application of PD approach and method, children were experiencing participation through activities embracing fun, creativity and reflective thinking (Robertson & Wagner, 2013, p. 78). Robertson and Wagner are emphasizing how PD approaches are especially supporting reflection.

In case of my FW, children are reflecting upon two issues; the first one is about knowledge concerning photosynthesis, while the second is about how they reflect upon other children visiting the museum. When it comes to the knowledge reflection, they are unconsciously extending their knowledge about the photosynthesis through discussion in plenum with each other. Also, my role

as a facilitator becomes valuable because I was asking critical questions about their keywords, and indirectly forcing them to argue for their decisions. On the other hand, children were also reflecting about other users like them. The ability to see perspectives of the others is valuable, and is emphasizing the notion of accountability and responsibility (Robertson & Wagner, 2013, p. 72). The awareness tied up to children´s responsibility to make choices on behalf of others, reflects their ability to care for others but also understand that they are representatives of their specific community.

The second notion, concerning how the FW is providing deeper understanding about the user and use is rather vital for the science center; and can be connected to one of the guiding principles in PD – *mutual learning* (Kensing & Greenbaum, 2013, p. 33). The principle is supporting understanding of different actors whom are participating in the workshop. The PD approaches makes it easier to reveal users existing knowledge about the domain like photosynthesis, but also contribute to deeper understanding of the user experience the user´s expectations. The FW revealed what children knew about the photosynthesis from before, but also shed a light on the aspect, which were unclear for them – such as the interest in knowing how the chemical reaction is actually happening during the photosynthesis.

6.3 FANTASY PHASE: SUPPORTING DEMOCRATIC PRACTICES AND CO-CREATION

The fantasy phase started with my explanation of what all participants will do, where I emphasized the notion of visualizing fantasy ideas. I had planned two activities for this part of workshop. The first activity was about drawing a scenario or a storyboard of how the installation can be enhanced when it comes to the property that was communicated worst. This activity, had as a goal to invite children to change the inscriptions of the installation, so that they were in correspondence with children´s expectations. I asked the groups to try to visualize how the installation will look like when it´s modified and how other children like them would play with it. The second activity was to make a list with characteristics of the low-fidelity prototype. Each group begun with their

brainstorming, but each of them had their own approach. During this part of the workshop I moved between the groups, in order to clarify various questions and to observe the brainstorming.

The first group was consisting of one female educator, two boys and one girl. In this group, one particular boy had in some way run over the others with his participation. He had a lot of different ideas at once, while the others together with the educator tried to follow them. Since the group had unlimited amount of ideas, the educator decided to brainstorm in the start of the session and then choose the idea they liked most in the end. The group had a lot of ideas, which were very large extensions of the existing installation.

The interesting aspect of this group was, that they saw no limitations at all; they had very imaginative ideas – which was very surprising. While I was facilitating the workshop, I saw that the group begun to focus on completely different aspect of the installation instead of focusing on promotion of the concept, which came out weakest during the prioritization. In order to take group back on track, I asked some question about how the particular functionality of their prototype would help in understanding that photosynthesis is relevant for clean air. During co-design, the educator was very engaged in the collaboration process with children, where she often asked question to clarify functionality and appearance. The educator attempted to segregate these ideas, and find final basis for further development – but it wasn´t an easy task. In order to clarify misconceptions about their design, the educator was asking children questions about how functionality should look like:

Educator: That the man is sitting in a chair and does the task?

Boy: Yes! And…

Educator: Okay, should we try to draw it?

Also, in order to give control to the children she asked who want to draw the final low-fidelity prototype, since she "isn´t so good at drawing". The boy with most ideas took control over the drawing where he decided most of the functionality and appearance of the new installation. At that time, it seemed that the other two participants were uninterested in his drawing, while the educator was trying to catch up with his ideas, which were more out of scope.

FIGURE 8: BOY´S ATTEMPT TO TAKE OVER CONTROL

On the figure above, we can observe that boy and girl in gray sweaters begun to be interested in something else, while the educator and boy in the red sweater was working with the installation. Children were uninterested, since the boy didn´t ask them about their opinions, instead he decided to go with his ideas. Prototype which was designed by this group, mainly focused around the user experience, rather than learning. Ideas generated during this part of workshop, were definitely utopian, where there was a lot of special effects and celebrities.

The second group was consisting of male designer, two girls and one boy, and they were the very opposite of the first one. They had already a plan and they knew very well what they wanted to draw. The designer who was assigned for this group was very quiet, but asked some questions about natural science when he saw that children were in doubt about some details. In this case the adult did not involve in maintenance of the scope. The fantasy notion was less overwhelming in this group than in the other one.

FIGURE 9: GOAL ORIENTED GROUP

Also, based on my observations, the designer who was assigned for this group, was interested in hearing children´s ideas and reflections about the installation it self – but also about the new prototype. Because he was so focused on listening to the children, he didn´t participate in co-creation so intensely as the educator in the other group. At the same time the group didn´t need as much facilitation as the other group, since they were goal oriented and the scope was decided very early. At some point children decided to include into existing installation quiz and a movie or animation about the photosynthesis. Player was supposed to be introduced with questions about the installation´s message in order to make him or her more aware about photosynthesis and it´s importance:

Designer: What happens, if you answer wrong to these questions?

Girl: Than, you have to see the video! [funny movie about photosynthesis]

Their idea was carefully designed, were every detail was important for whole user experience and learning outcomes. Children were especially focusing on the notion of learning of new knowledge while playing the game. On the other hand, through extended work with the movie, they began to analyze how to present for the other children the process of photosynthesis and it´s environmental influence in most logic way.

Through redesign process of the installation´s inscriptions children were trying to negotiate their way into the translation process. By applying different

changes to the Pin Ball machine, they were trying to bring the actant on their side, to become aligned with children´s goals. Through different modification of either user experience or learning outcome, children where illustrating their goals and desires – which the installation should accomplished according to them.

There was clear difference between the degrees of involvement when it comes to the employees from the science center. In the first group one of the participators were very active and had a lot of ideas, and the employee took responsibility for prioritizing to establish the end results. When it comes to the other group, they were very sure what they are going to draw – and based on that fact – the designer saw no reason for interrupting of their project. It was difficult to end this phase of the workshop, since children had a lot more to add to their storyboards and sketches. Also, the list with characteristics which I asked for wasn't done, because of the fact that children weren´t finished with their prototype.

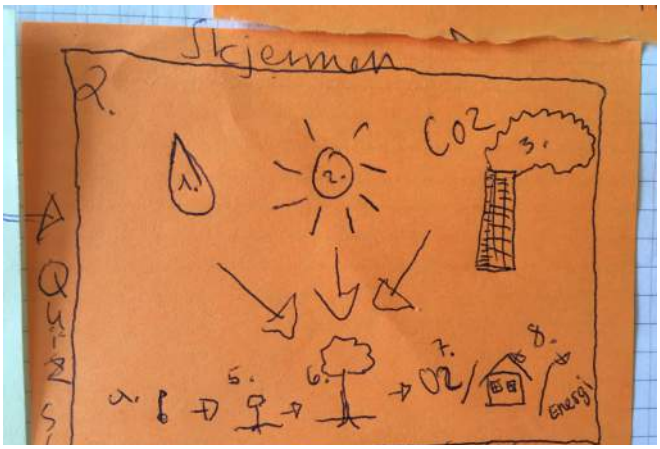

FIGURE 10: THE SCENARIO OF THE ANIMATION SUGGESTED BY THE CHILDREN

I have conducted several times before the FW, but it was with adults and students. During this particular workshop I was surprised how fanciful children really are, and that it's difficult to stop the fantasy phase. During this part of the workshop, children were assigned the role of an equal design partner and were given a lot of freedom when it comes to form of the prototype but also how they wanted to present it. Even though everybody got the same starting point for their

work, the results from each group were very different and it is challenging to find similar results in literature.

The issue of empowering the children during the design process was addressed by introducing for the young participants the role as an equal design partner (Druin, 2002, p. 12). Through this particular role, children were given opportunity to have dialog with the adults participating in the workshop. They were encouraged to discuss different issues with them in order to re-design the installation, and to create a proposal for possible prototype. In the literature, it is often described as challenge to balance the power relations between the adults and children (Iversen & Smith, 2012; Taxén, 2004; Taxén et al., 2001). In case of my workshop, there wasn´t any indication of adults trying to take control over the prototype generation or at all trying to direct the children in a specific direction, which is quite the opposite of the study Taxén (2004) conducted. On the other hand, Taxén et al. (2001) are describing in their research, that establishing trust between the young participants and adults was challenging because it took very long time. Again, in my case children felt very self-confident with them selves and their ideas. Also, Iversen and Smith (2012) are explaining that during their study it was difficult for the designers to leave behind their roles during co-design with children, where they were trying to convince young participants to their own ideas. During the FW in this project, it was mainly children who came up with the ideas – while the educator and designer asked rather clarifying questions.

The reason for such discrepancy between my results and the result of the other authors might be caused by two factors:

1. Processes supporting equalization of power relations.
2. Work with familiar children

The first factor was addressed in the first phase, by making children comfortable with the domain of photosynthesis through creation of the mind map. Kensing and Greenbaum (2013), describes that it is important to find ways for giving a voice to those who are unseen. My way of finding a way to give the voice to the young people was by introducing the FW. This leads to the second guideline in

the PD approach – democratic practices (Kensing & Greenbaum, 2013, p. 33). The principle is about "*putting into play the practices and the role models for equality "* (Kensing & Greenbaum, 2013), which is represented in my case by conducting the first activity of brainstorming and *anchoring* children´s knowledge so that they felt more secure about their abilities in relationship to the adults. The second factor, concerning notion of knowing each other was also consequential for children´s self-confidence while working with unfamiliar adults. Also, an interesting notion is *design-by-playing* and *learning-by-doing* presented by Ehn (2008). In this case, children could design their visions by drawing and sketching their ideas in a fun and creative way. But also, had to learn to collaborate with adults, and reflect upon the issue of photosynthesis and clean air and the connection between these two concepts. Presented idea of the short movie and the scenario from figure 10, is an example of learning-by-doing. In this case children had to reflect and imagine how to show the process of photosynthesis for others. This requires knowledge about the processes behind the chemical reaction.

6.4 REALIZATION PHASE: REALITY AS CHALLENGE

The last phase was started with presentation of the results the groups have made. They were given five minutes to tell us how the installation will look like and how other children will interact with it. In other words, every group presented installation´s desirable inscriptions, which are in correspondence with their goals and motivations. During presentation and in the end of it we asked questions in order to clarify elements that we didn´t understand. Everybody was encouraged to take a word, during discussion.

The first group, which was consisting of the educator, two boys and one girl, had a prototype, which was focusing into large degree on the user experience. The proposed redesigned installation of the first group was very different for the original starting point of the installation. They decided to have a whole room dedicated to this game. In the dark room they planned to have one big chair, were the player could experience the Pin Ball game in 4D. This entails that when somebody manages to collect e.g. water – there would be a splash of

water in the face. While when the player would complete the first level of the game – she or he will receive a "puff" of fresh air in order to illustrate the result of photosynthesis and address the concept which was weakest communicated from critical phase, which was notion of the production of clean air from photosynthesis. At the same time, there would be animation where the wooden house expands to a larger one – in order to illustrate that building material is produced. In the final level, there will be a castle, which implicates that the player has achieved the highest level in the game.

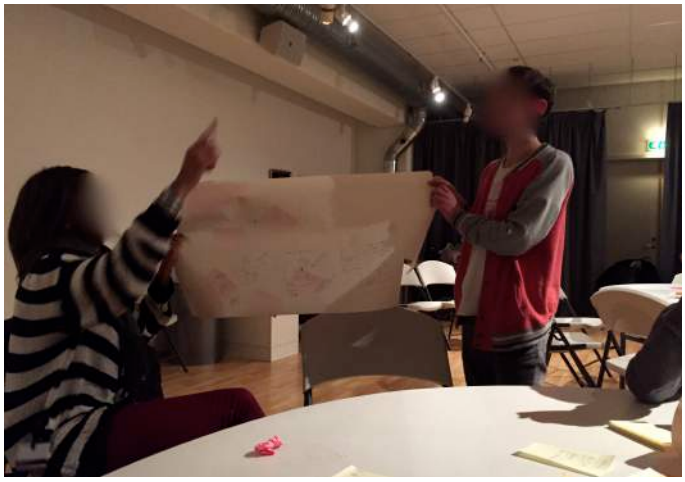

FIGURE 11: PRESENTATION OF THE FIRST GROUP

While the second group was presenting their idea, the whole group was standing in front of the others. They explained that when the gamer will play the installation for the first time, they would be forced to either see the movie or answer to the questions concerning three elements of the photosynthesis. If the person chooses to skip the movie, the player has to answer questions. But, if the person decides to watch whole movie – then there isn´t any need to answer questions. During playing session, the player would be informed about what kind of elements were collected. The children were explaining, that when the element of sun would be gathered – there would be some light or warm going towards the player. While the player would collect CO_2 there would be produced smoke from smoking machine, which would be hidden behind the installation; also while the user would collect water – person would be able to hear waterfall noise. Similar to the first group, they wanted also to show the user what was build during the session. They wanted to present for the player that when the

first level was obtained, there would be voice feedback saying, “You have managed to build a doghouse!”. If the person managed to play through all levels, the feedback would be “You have managed to build a villa!”

FIGURE 12: PRESENTATION OF THE SECOND GROUP

After both groups were done with their presentation, I asked them which idea is most doable in reality. The children agreed that the second group, which had incorporated quiz, was quite interesting. We had a short discussion if there was a need of some modifications in order to apply the prototype to reality. In the first place I wanted both children and adults to draw one prototype proposal in plenum, but during discussion about what should be included and not, children begun to illustrate fantasy ideas again which weren´t really feasible. In order to bring the children back to reality I asked them to draw a new scenario or a storyboard individually where the second idea was used. The interesting finding was that everybody had actually applied the quiz and the movie, introduced by the second group in the beginning of their storyboard,

At the end of the workshop I asked children if they want to do something like that again. There were very positive, and wanted to know if we are going to really change the installation based on their work. They were a little bit disappointed when I said that unfortunately not this time. This can implicate that children felt that they had possibility to contribute with valuable information during the workshop. Also, this can suggest that introduction of the role, as designer partner in this case was successful, because young participants were

able to contribute on equal terms as the adults – which was partly the goal of the workshop, when it comes to issue of empowerment of young visitors in the science centers.

The proposals of the children participants had several similarities between the prototypes, but also some distinctions between areas of interest of various groups. Both groups were interested in enhancing the feedback, by adding features, which could indicate more directly that somebody has collected some of the elements. This leads to notion that every group wanted to change surroundings around the installation, in order to provide for the player more exciting feeling of collecting e.g. water by splashing the gamer with the water or just by adding the noise of a waterfall in a background. Simultaneously, even though children reported that notion of production of energy and building material was well communicated – both of the groups added extra visual features while interacting with the game. Each group wanted to illustrate for the user achievement of the next level by showing what the player has managed to build while playing specific level.

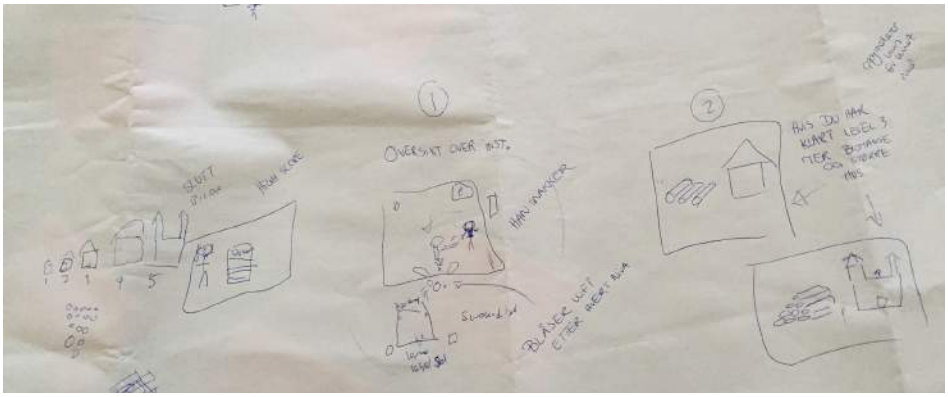

FIGURE 13: PROTOTYPE OF THE FIRST GROUP – FOCUS ON USER EXPERIENCE

On the other hand each group had completely different focus areas. The first group was interested in creating more competitive game, where the score table would be more visible. The user experience would look more like in a real game through addition of joysticks in order to control the flow of the game. Second group was more focused on the learning outcome of the game. They added both a movie, which would show how the photosynthesis is working – but

also a quiz, which would check user´s knowledge. Also, youngsters in the second group were aware about the notion that there are different users. Through application of both video and quiz they wanted to meet both those who already had interacted with the installation and those who haven´t.

The last solution, focusing on the learning outcomes also enlightens the issue of reflection. Brandt et al. (2012, p. 152) argues that the FW method supports participants ability to reflect on everyday practices. Because, children are aware of the fact that a lot of children are lazy and don´t bother to read informative texts – they are actually addressing this issue by creating an alternative design proposal where the user meets either a quiz or informative movie. This entails children´s feeling of responsibility for the design and the process of learning others; which in turn addresses children´s accountability (Robertson & Wagner, 2013, p. 72).

FIGURE 14: PROTOTYPE OF THE SECOND GROUP - FOCUS ON LEARNING OUTCOME

The proposals, which were presented by the participants, had main motive to address installation´s ability to present in a better way, how the

photosynthesis is influencing clean air. But, as the results are showing, children focused on different aspects of the installation like the feedback. Both prototypes were enhancing the feedback of the installation concerning two aspects:

- Indication of which element was collected at given time.
- Indication of the level the gamer is playing currently.

Though, the critical phase don´t correspond with the realization phase, I don´t consider that for something wrong. Either way, the contributions of the participants were valuable for enhancement of the installation. Also, even though the groups were working individually, and the results were very different considering the form of their prototypes, they had very similar characteristics.

While children where explaining their proposals, the challenge was to understand these ideas. Sometimes, they were complicated and because children had very long day the discussion begun to "glide" in all directions. Robertson and Wagner (2014, p. 75) underlines that it is vital for the design process, that every participator of the design process is able to create the right representations. These representations can concern both the design itself, but also the work practice. In the case of the re-design process of the installation, I was at first confused with the first proposal. But, because we had established the milieu of democracy and equality by application of democratic practices (Kensing & Greenbaum, 2013, p. 33) – nobody had any problem with questioning aspects of the design and discussing them in plenum.

The aim of the last phase in the FW, was to find out how both proposals can be merged together – but at the same time create prototype which was doable in real life. This part of workshop was challenging since, children had difficulties with leaving fantasy phase. While we were trying to discuss doable alternatives for some utopian characteristics – children seemed to forget that we were trying to apply solution for the real world. At the same time, they just continued to expand their ideas with new features which weren´t very doable – like e.g. decision about who could be the narrator for the voice in game. Originally I wanted to create a mutual version of the installation, but since the discussion between participants was ongoing – I asked them to draw by each of

them an individual version. What was interesting was that it worked. They became more limited to reality, and at the same time actually everybody included quiz functionality in the beginning of the game.

The realization phase was challenging for children since they were unable to create a solution, which would move to *present-day circumstances* (Brandt et al., 2012, p. 152). Brandt et al. (2012) underlines that the success of the FW is depended of participant´s ability to produce utopian visions. This notion wasn't creating any issue for children, they were quite the opposite of the adults, where they had unlimited resources with various ideas. As mentioned, the last phase was focusing around plenum discussion, which was very similar to an interview in a focus group. As Lazar (2010, p. 194) points out, the facilitator have to pay attention to the scope of discussion when it is structured with an open-ended questions. In the case of the last phase, it was challenging to sum up the ideas and to create a common alternative in co-design with all participants. As described, I was forced to ask all young participants to draw their version of the installation, in order to complete the workshop. If I haven´t done that, children would continue with addition of new ideas to their proposals. This indicates that in some cases when the discussion is dwindling away in unknown directions, adult´s ability to control the circumstances is necessary (Taxén, 2004, p. 211).

6.5 SUMMARY

The chapter is providing a deeper understanding of what kind of role the FW had for children. First, it supported children´s reflection process considering the installation itself, but also the domain of photosynthesis. Also, through application of co-creation and democratic practices during the fantasy phase, children were able to redesign the installation in collaboration with adults as their design partners. The last phase, implies the challenges connected to moving from fantasy phase to realization phase for children. Also, the prototypes designed by children sets focus on the issue of installation´s feedback.

7 DISCUSSION

This chapter´s aim is to discuss the interest areas, which I have presented in the chapter 1. The discussion will provide overview of these interests:

1) **How can Actor Network Theory provide deeper understanding of the design of the installation at the Norwegian Science Center?**
2) **How can Participatory Design in the Science Center contribute to the re-design of an installation and contribute to a deeper understanding of how visitors experience an installation?**
3) **In what ways can the Science Center benefit from including children in the design process of an installation?**

7.1 ACTOR NETWORK THEORY AND THE DESIGN PROCESS

The project sets out to discuss if ANT may function as an analytical lens, and how this perspective provides in-depth understanding and overview of heterogeneous actants, which have contributed to the design process of the Pin Ball installation. As described by Quan-Haase (2013, p. 63), ANT is a theory which emphasize study of *multiple factor principle,* where the effects of the work aren´t assigned to one individual actor, but rather is enlightening the socio-technical assemblies (Ehn, 2008, p. 92). In case of the installation, ANT gave opportunity for uncovering actants like NFS, science center, Pin Ball machine or design company – Co-design. All of these actants had impact on the installation´s development. Without such analysis, potential user will probably consider the installation as a result of one individual actor like science center in Oslo.

The benefit of uncovering the socio-technical assemblies is the possibility to study the relations between these heterogeneous actors. The analysis of relations is presenting opportunity for revealing causes for why things are – the way they are, similar to what Latour has done with the process of pasteurization (Quan-Haase, 2013, p. 57) and the process of developing *Aramis* the personal rapid transmit system in France (1996). In case of the installation the in-depth analysis of installation´s history is presenting us with facts, which are contributing to deeper understanding why the installation is based on the Pin

Ball concept, but also why the exhibition is embracing the idea of amusement park. The inscriptions, which define the actors like NFS and science center, enrich our understanding about how their choices are based on inscriptions which again are building the framework for their possible actions (Akrich, 1992, p. 208). Also, the inscriptions support understanding of causes, when it comes to the Pin Ball medium.

By studying in-depth the translations and inscriptions of the Pin Ball installation of the science center, we can explain why the science center chose to use Pin Ball concept, but also why it is often broken. Through interview with the employees from the science center we obtained knowledge that, the designer team wanted to use the concept earlier but they were missing a theme to be translated into the medium. On the other hand, because the Pin Ball machines were old collection artifacts, we can understand why the installation is often broken. Simultaneously, the knowledge about the NFS´s message, target group and their understanding of the right place for communication of their message; gives us explanation for how the NFS is going to act and whom they are going to ask for help. The knowledge gathered through such analysis can contribute to illustration of the relationships, which are influencing the alliance between these two actors and the translation process (Crawford, 2004, p. 2; Quan-Haase, 2013, p. 55).

The translation process happening between these two actors is providing overview of negotiations and it´s impact on factors like the scope of the NFS´s message and reduction of the target group. The process of translation is a lens to present who is the spokesman for the unified entities (Callon, in Asdal et al., 2007, p. 75), and indicates why the science center had so large impact on the NFS´s inscriptions. Science center´s experience with the development of installations was important factor for why the NFS chose to collaborate and align with them. Also, because the NFS had no previous experience with similar projects, they trusted the science center´s abilities and gave them freedom to decide a lot of aspects of the installation. Science center´s experience reflected NFS´s goals and desires – where the translation process was conducted without any significant resistance (Horowitz, 2012, p. 809).

Also, the process of translation in this case is characterized by high level of convergence – because each of the actors needed each other in order to obtain their goals (Crawford, 2004, p. 2), and almost complement each other through their needs and abilities. The science center had a medium, but they were missing a theme and the content, while the NFS had a theme and content but were missing a medium. In that way they helped each other, but the NFS betrayed its own inscriptions by abandoning (Crawford, 2004, p. 2) the idea of communicating everything to everyone.

Though the ANT is emphasizing the Machiavellian perspective (Asdal et al., 2007), where the strongest alliances are only seen – it doesn´t mean that the researcher also sees only one particular perspective. In my case, through application of the ANT lens, we have been able to observe who is marginalized in the network. Children in this case are actors that are vital for the installation, since they are the main target group. During the user testing, Lohre explained that they had one testing on easy accessible children (personal communication, October 17, 2014), which means that children were rather avoided during the design process. The question one should ask in this case, is whether the NFS and the science center are so sure about what children like and dislike through their personal experiences – that they don´t see the value of systematical testing with the target group. Or, are economical resources limiting their possibility to conduct more intended testing?

Seeing the value of user participation during design process can be challenging for the employees at the museum. Traditionally, science centers and museums had expert knowledge about their domain (Taxén, 2004, p. 205). By inviting the user as a design partner we are reversing the roles, which have over longer period dominated in these institutions. Tzibazi (2013), stress in her article, that the curators didn´t see the value of children´s contributions. Also, she emphasize that often employees knew about the possibilities children were presenting with their participation, but her project only *legitimized* and *reinforced* these thoughts (Tzibazi, 2013, p. 166). This implies that the challenge for institutions is to actually apply democratic guidelines in practice.

Also the ANT is enlightening such actors like economical factors, which have great influence on the design process (Quan-Haase, 2013, p. 55). In the interview Lohre underlined that their project had limited budget, which in turn made it impossible to work with a professional company, which focuses only on installation development. Because of that, the NFS decided to cooperate with science center in Oslo, which had previous experience, and was definitely more reasonable choice when it comes to budget limitations. Also, if the science center and the NFS had this kind of approach for their design development – to conduct reasonable choices, maybe they found out that the benefits of visitor participation didn´t outweigh the costs (Kujala & Mäntylä, 2000).

The ANT lens provides deeper understanding of the involved actants in the network, and supports identification of those who are responsible for certain choices and actions that have influenced the formation of the installation. Also, the theory can help to trace back the design process and identify, whom wasn´t included in the design process, where in my case those who were marginalized were the main target group – young visitors between 10 and 13 years old. Also, the ANT lens is providing an overview of the negotiations between the participants and installation. This, have opportunity to explain why in some particular situations there is absence of correspondence between children´s desires and goals and installation´s communication of the message.

7.2 PARTICIPATORY DESIGN IN THE SCIENCE CENTER

Introduction of the PD methodology and the FW, explored how to obtain deeper understanding about the user and his or her use. By applying the methodology I was addressing guiding principles, which have as an aim to embrace democratic practices. Such practices doesn´t occur in abstract places, neither they become externalized without any specific actions (Kensing & Greenbaum, 2013). The designer or the facilitator has to apply some activities and practices, which will address these issues. Through careful planning of the FW I was applying each guiding principle, in order to establish best environment for children´s empowerment. These are: equalizing power relation, democratic practices, situation-based actions, mutual learning and tools and techniques.

Equalizing power relations invites to finding new ways for giving a voice to those who are invisible or unheard in a specific design context. During the original design process of the installation, children were assigned a role of a tester. This role emphasize rather indirect way of communication with the designer, and provides opportunities for only presentation of the likes and dislikes of the young tester (Druin, 2002, p. 7). Such feedback is described as *having a voice* during the design process (Bratteteig et al., 2013). Unfortunately, these kinds of participation doesn´t have direct influence on the prototype, and therefore by assigning the role of an equal design partner we are providing for the young participant the opportunity to *have a say.* By identifying who is marginalized in the process of the installation development – we are able to assign empowering role to those participants, which deserve more attention. In my case the identification of those who were invisible, because of their weaker position in the network was conducted by applying ANT lens on the development process of the installation.

While we are aware of the actors that are under-represented during design process, the next step is to put into play *democratic practices* (Kensing & Greenbaum, 2013). These refer to application of the methods, which support democratic mindset. But, in order to apply the FW, it is important to explain to everybody participating what are the roles of various participants. In case of this particular study, I have explained to the children and adults that everybody who is contributing to redesign ideas is as much valuable as the others. Also, by emphasizing the role as a design partner during the re-design process, was setting a focus on children´s role during the workshop. The role was also establishing a basis for dialog and discussion (Druin, 2002, p. 12), which were absent in the previous design process conducted by the science center.

By conducting the FW at the science center, I was addressing the third guiding principle, *situation-based actions* (Kensing & Greenbaum, 2013). Through application of the method *in* the science center, children were able to imagine how the installation will be working in the existing surroundings. The information about context is important for how children perceive the installation and surroundings. By placing the FW in the right context, we are embracing the

actual situated practices of the young visitors at the science center; and at the same time making it easier to imagine for children how to enhance these practices and knowledge with supporting technology. Also, by applying the FW in the science center we are making the employees more aware about the method and methodology. Such awareness is affecting the pre-established mindset of the employees, making them more conscious about the value of participation (Tzibazi, 2013, p. 166).

Introduction of the FW, and its immanent phases provides opportunity for *mutual learning* of each other's practices (Kensing & Greenbaum, 2013). Through creation of a mind map during the first phase, adults were able to create representations (Robertson & Wagner, 2013, p. 75) of what children are actually thinking about the installation, but also how they reflect upon the content. The role as design partner is also introducing possibility to elaboration (Druin, 2002). While children are reflecting and discussing – they are provided with opportunity to elaborate and unfold their thoughts, instead of just expressing what they like and dislike which isn´t giving any in-depth knowledge for designer, when it comes to e.g. user experience. Simultaneously, the user testing conducted by the science center with the beta product, wasn´t emphasizing installation´s poor feedback, like the FW did with its last phase.

Tools and techniques are referring to the application of various methods, which help participant to express their visions and thoughts (Kensing & Greenbaum, 2013). By applying small activities during different phases of the FW, like creation of mind map, storyboarding and low-fidelity prototypes we are supporting children´s abilities. Introduction of the mind map technique address issues of equal power relations, because by building up children´s knowledge and inviting them to reflect they became more aware and self-confident about their knowledge (Brandt et al., 2012). Their feeling of security has a positive effect on further collaboration with the employees, were they don´t hesitate to express their ideas. Also, through creation of common representations of the prototypes during fantasy phase, the drawing becomes an important non-human actor, which is mediating the communication between the participants (Ehn, 2008). As a result of application of various tools and techniques, which supports

children´s visualization, participants were able to create *alternative visions about technology*, which is the last principle from the set of guidelines.

Through introduction of the PD methodology and methods, the researcher is opening possibility and space for dialog between the museum professionals and young visitors. By introducing opportunity for open and free discussion, participants are able to elaborate on equal terms issues concerning existing design, but also alternative visions, which can support existing community of practices and visitor knowledge.

7.3 BENEFITS FOR SCIENCE CENTER

By gaining deeper knowledge about what children expect from the installation, but also about what knowledge they have – we are able to design more suitable installation. The existing installation is fun and engaging because children are underlining this notion (see section 6.6.1). But, the introduction of the PD approach and the FW is building up an in-depth knowledge about what children already can and what they think is difficult or poorly explained. During the interview, the NFS representative was describing that while they were having user testing children said that it was fun to play with the installation. Because of that, the science center made only some changes to the history, which was narrated, in the beginning of the playing session. If they had conducted e.g. a FW together with the PD guidelines – they would be able to reveal other flaws of the installation.

Aspects that were uncovered through children participation in the FW shed light on the installations feedback. Generally, simple questions, which expects yes – no or like – dislike answers are not suited to discover flaws in various design principles (Sharp et al., 2009, p. 31). In order to address such issues one have to ask the right questions. Because of that, during user testing conducted by the science center, the team was unable to discover flaws in feedback. But the problem occurs, when the testing team isn´t aware of the problems tied up to specific design principle – and in result never confronts the issue with their questions. In order to address this concern, the solution can be introduction of the users as a design partners during development process

(Druin, 2002), so that the designer or the researcher creates open space for dialog. In turn, there will be opportunity for discussion and elaboration of different issues tied up to design and use.

The application of PD in general supports more suitable design for the particular user, and contributes to better understanding of the user and his or her use. The science center is dependent on its visitors in order to sustain their functionality as a place for science inquiry in a direct manner (Allen, 2004). By inviting accountable end users to the participatory design process, the science center is creating opportunities for mutual learning, central to PD (Kensing & Greenbaum, 2013) where they can learn more about the user and vice versa. The knowledge they obtain during such activities is in-depth and creates arena for discussion with the visitor, whom can elaborate on their opinions. Simultaneously, by creating circumstances friendly for the user participation and role such as design partner during the design process – the visitors becomes important contributors of science center´s *communities-of-practice* (Ehn, 2008, p. 94).

On the other hand, user participation is time consuming. This isn´t anything new (Druin, 2002; Kujala & Mäntylä, 2000), but as Druin (2002) argues any participation is good participation. Regardless of which role we choose to give the user during the design process it is good for the user experience. Whether the participant will be assigned the role of a user, tester, informant or design partner (Druin, 2002) – it will have some influence on the product.

Although, economical issues were not my primary area of interest, ANT allows for uncovering of such factors. The economical issues can also be assumed to play vital role while inviting the users in such institutions like science center. The PD approach is representing with its self values which are addressing common good, where democratic practices and ethical motivation is a core of the methodology (Robertson & Wagner, 2013, p. 65). In case of my study, I am also addressing issues concerning children empowerment in a general matter (Unicef, 1989). Where through application of methods, we are engaging children, but also supporting children´s rights to participation in cultural

activities, which have in turn influence on children´s personal development. So, can costs of participation outweigh children´s rights in the science center?

Thorough inclusion of young visitors into the design process, the science center contributes to *visitor-designer dialog*, and as result the threshold for open discussion is lower. When there is space for dialog between the young visitors and the museum professionals, there is also opportunity for mutual learning and in turn better understanding of the design, user and use.

8 CONCLUDING REMARKS

During this study, I have applied ANT perspective and PD methods in order to establish deeper understanding of the design process carried out by the NFS and science center in Oslo. The ANT lens supported identification of the heterogeneous actants contributing to development of the BioEnergiPinBall installation. Based on that information I was able to identify the actor, which was marginalized in the network; despite the theoretical framework has Machiavellian characteristics. The application of PD approaches and methods supported the empowerment of the barely represented actor during the design process. Through introduction of the FW as a design intervention method, I created an opportunity for young participants to get a new role as design partner and be included on equal terms in the design process.

By applying the PD methodology and democratic practices, I found that when children are given opportunity to be heard, they can discuss and elaborate about the issue, especially when they are given enough of time. Also, the possibility of being considered as an equal design partner provided children the feeling of being valued and important, as much as the adults during the design process. On the other hand, the possibility to participate in the PD activities encourage young people to reflect on the issue of design process, but also on the domain of photosynthesis. As a result by inviting young people to the participation we are supporting their personal development, but as well learning.

For future research I would suggest to introduce an extra mutual session for museum professionals and children concerning the role as design partner. Where the adults and children can discuss together the role of being a design partners, and what does that involve when it comes to mutual learning. During my research, there were significant differences between the adult participation in the individual groups, which can imply that, the understanding about their role during the workshop wasn´t good enough.

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APPENDIX A

(Ble sendt til Trond Lohre på forhånd, før intervju)

Hoveddel

Bakgrunnsinformasjon om installasjonen

- Fortelle om bakgrunnen for dette prosjektet
- Hvem var initiativtaker for installasjonen? Hvorfor?
- Hva ville dere oppnå med denne installasjonen? Mål for prosjektet
- Hva ville dere lære bort? Hvorfor ville dere lære bort akkurat det?
- Hvilken målgruppe har dere tenkt for installasjonen? Hva visste dere fra før om målgruppen for installasjonen?
- Hvordan ble dette trukket videre i utformingen?
- Hvorfor vitensentre –og ikke museer? Evt. Andre plasseringer?
- Dere jobber med mange formidlingsprosjekter –hvilke tanker har dere om dette i forhold til de?

Direkte på designprosess med installasjonen:

- Hva ville dere si gjennom BioEnergiPinBall?
- Hvilken rolle spilte læreplanen i skolen i design prosessen?
- Kan du fortelle om prosessen rundt utforming av kravspesifikasjon? Hva baserte den seg på/Hvem andre kunne påvirke kravspesifikasjonen?
- Hvilke konsepter den baserer på?
- Hvorfor disse konsepter? Hva var det så viktig med disse?
- Hvorfor flipper-spillet som medium? Hvorfor denne type teknologi?
- Flipper-spill litt tilfeldig hvor ballen ruller – hvorfor dette valget?
- Hvorfor ikke noe digitalt – dere jobber jo med det i andre formidlingsprosjekter?

- Hvem rådet dere med? Var designvalg selvstendig eller var det noen andre som var involvert i design utforming?

- Måtte dere gå på noen kompromisser for å utforme installasjonen? Noen spesielle aktører dere måtte ta hensyn til?

- Hvilke tanker hadde dere rundt brukeropplevelse, når dere opprettet krav for installasjonen?
- Var det vanskelig å balansere brukeropplevelse mot læring?

Avluttning:

- Er den slik dere har forventet dere?
- Hvordan følger Skogselskapet opp denne installasjonen?
- Synes du den møter behov til brukeren/teknisk museum?
- Er det noe dere ville ha gjort annerledes i dag; f.eks basert på erfaringer/bruken av denne?

APPENDIX B

Samtykkeerklæring for bruk av lydopptak i forskningsprosjekt UtVite

Forskningsprogrammet UtVite – Utforsk Vitensentre ble initiert av INSPIRIA Vitensenter, i samarbeid med Norges Miljø- og biovitenskapelige universitet (NMBU) seksjon for læring og lærerutdanning (SLL), Naturfagssenteret ved Universitetet i Oslo (UiO) i 2012 med støtte fra STATOIL. Norges Forskningsråd er tilknyttet som observatør. Bakgrunnen for UtVite er to evalueringer av vitensenter programmet som viser behovet for mer kunnskap om vitensentrenes betydning for læring av realfag og effekten av vitensentre som rekrutteringsarena til vitenskapelige karrierer.

UtVite-programmet har tre fokusområder som bygger på disse behovene; 1) utvikling av vitensentre som læringsarena, 2) kartlegging av vitensentrenes betydning for realfagssatsningen, 3) tiltak for kompetanseutvikling på vitensentre. Disse tre fokusområdene danner grunnlaget for 8 prosjekter som er planlagt iterativt og vil informere hverandre underveis i forskningsprosessen. Forskningen i UtVite er basert på samarbeid der ansatte ved vitensentre, skoleklasser med lærere og elever samt studenter ved ulike relevante fagretninger involveres i forskningen på ulike vis. Våren 2014 vil masterstudenter i realfagsdidaktikk ved Norges Miljø- og biovitenskapelige Universitet og ved Institutt for informatikk ved Universitetet i Oslo gjøre studier i utstillingen.

UtVite vil benytte lydopptak til intervjuer. Det innsamlede materialet vil være grunnlag for forskningen vi gjør i UtVite, hvor mastergradsarbeidene er et steg på veien. Det er frivillig å delta som del av forskningsmaterialet, og intervjuobjektet kan når som helst trekke seg fra deltakelsen uten å begrunne dette nærmere. Vår rolle som forskere innebærer at vi er underlagt strenge etiske regler for hvordan lyd, foto og videomaterialet kan brukes. Materialet er meldt inn for Norsk Samfunnsvitenskapelig Datainnsamling og vil bli makulert ved prosjektets slutt.

Den nødvendige tillatelse gis ved å undertegne og returnere svararket (side 2) til kontaktperson på vitensenteret, eller til forskeren som vil gjøre observasjoner. For nærmere spørsmål kan jeg kontaktes på tlf: 99728156 eller dagny.stuedahl@nmbu.no

Med hilsen

Prof. Dagny Stuedahl Norges miljø- og biovitenskapelige universitet Institutt for matematiske realfag og teknologi, seksjon for læring og lærerutdanning

Samtykkeerklæring

Jeg har lest informasjonen om UtVite-prosjektet ved Inspiria og Norges miljø- og biovitenskapelige universitet. Jeg er kjent med at den frivillige deltakelsen i forskningsprosjektet innebærer dokumentasjon ved hjelp av lydopptak.

Vennligst kryss av:

Lydopptak der mine utsagn forekommer kan brukes til forskningsformål som beskrevet i informasjonsbrevet:

❑ Ja, jeg samtykker

Dokumentasjonsmateriale der mine utsagn forekommer kan også brukes som illustrasjoner i fagartikler, foredrag og presentasjoner på web og via andre mediekanaler knyttet til formidling av forskningsprosjektet UtVite:

❑ Ja, jeg samtykker

Navn:_____

Sted: _____

Dato: _____

På forhånd takk!

APPENDIX C

Tid	Aktivitet
15:30 –16:00	Forberede rommet og utstyr til workshopen
16:00-16:30	Forklare deltakere målet med workshopen, og hvordan formen på workshopen kommer til å være. Ta en kikk på installasjonen, slik at alle barn blir kjent med den. (trene på det)
16:30-16:45 **KRITISK** **Brainstorming**	**Vi er her for å finne ut, om hvis man engasjerer fremtidige brukere som dere i tidlig utviklingsfase – vil det gi gode resultater for de som kommer til å bruke denne installasjonen i fremtiden – andre barn som dere.* **Og **dere** er perfekte for denne oppgaven fordi dere har nettopp lært om fotosyntesen på skolen, og fordi spillet er laget for barn mellom 11-12-13 år.* **Vi skal gjøre veldig mange ulike aktiviteter i dag, slik at selv om dere hadde en lang dag – så vil dere forhåpentligvis ikke kjede dere her. Vi skal ha ulik type gruppearbeid…* **Vi skal gjennom tre ulike faser hvor den første handler om å ta et kritisk blikk på installasjonen. Hva er det som ikke funker med denne. Neste er fantasi fasen, hvor vi skal prøve å finne ut hvordan man kunne forbedre noen hvis man ville levd i en perfekt verden, uten noen grenser akkurat som våre drømmer. Og helt til slutt skal vi prøve å finne ut hvordan man kan finjustere vår drømmer til den virkelige verden vi lever – slik at vi kan forbedre spillet for andre barn – akkurat som dere.* Men før vi setter i gang med dette, la oss se på hva installasjonen egentlig handler om? Idemyldring, barn for seg selv og ansatte.
16:45-17:00 **KRITISK** **Kort**	Når skjer XX begrep når man spiller spillet? **Fange, Large, Produsere energi, Lage bygningsmateriale, ren luft.** Dele ut sett med begreper til hver av gruppene.
17:00-17:10 **KRITISK** **Prioritering**	Velge ut begrepet som kommer minst frem. Sortere de fra de som kommer mest til de som kommer minst.

Tegneserie

17:10-17:30 **FANTASI**	*Dere skal tenke dere at, vi er i en verden som har ingen grenser, alt er mulig, drømmene, fantasiene deres kan skje – bruk de for å komme på en annen måte , som kan lære bort andre barna på en bedre måte det begrepet som har kommet nederst på lista deres. Tegn en liten tegneserie, hvor dere viser hvordan installasjonen skal se ut og hvordan barna spiller med denne.* Hvordan kan installasjonen lære bedre begrepet som fikk dårligst resultat på liste (den som er nederst på lista)? Tegn en liten historie, hvordan installasjonen skal **se ut** og **fungere** når den er i bruk. (fortelle konseptet storyboarding)
17:30-17:40 **FANTASI**	Skriv ned egenskaper som må til for å lage en forbedring.
17:40-17:55 **REALISERING**	Presentasjon i plenum av alle 3 ideene. *Nå skal vi se på alle ideene, fortell oss hvordan denne skal se ut og hvordan dere har tenkt at andre barna skal bruke den.* (ca. 5 min per gruppe).
17:55-18:05 **REALISERING**	Diskusjon i plenum. *La oss se hvilke forslag som kan gjøres i virkeligheten. Tenk dere hvilken av de som kan brukes med minst mulig endringer – slik at denne fungerer også i virkeligheten ikke bare i fantasi verden.*
18:05-18:30 **REALISERING**	*La oss tegne på nytt en liten tegneserie av installasjonen, etter at den er tilpasset til vår virkelighet. Prøv igjen å vise hvordan denne skal se ut og hvordan skal den brukes av de andre.* *Skriv på siden hvilke krav som dere mener burde stilles den nye installasjonen. F.eks. skal den være større, skal den begynne et annet sted, skal den slutte annerledes?* Takk for innsatsen dele ut kinobilletter??

Presentasjon i plenum

Tegneserie