I-Wonder-How: A Method for Co-designing with Children in Design Education

UMULU Sıla* and KORKUT Fatma

Middle East Technical University
* Corresponding author e-mail: sila.umulu@metu.edu.tr

This paper explores co-designing with children in the context of undergraduate industrial design education, and investigates the potential of performative and narrative-based design methods in co-designing with children. It addresses the early phases of design process and proposes a co-design method for supporting industrial design students' eliciting children's needs and preferences. The field study conducted involves a co-design session with 51 industrial design students and 24 third grade primary school children, and face to face semi-structured interviews with 24 design students who participated in the co-design session. The findings indicate that the proposed co-design method, I-Wonder-How, is supportive for industrial design students in their eliciting children's needs and preferences. Based on the challenges experienced by design students during the co-design session and the post-session design process, the study draws attention to the importance of the entire co-design experience including pre and post phases. While the pre-session phase entails preparedness of the parties involved, the post-session phase requires design students to focus on reinterpreting and reconstructing design insights.

co-design; co-designing with children; methods for co-designing with children; co-design in industrial design education

1 Introduction

Children as users and designers as adults who design products for children have distinct intellectual advancements as well as different ways of experiencing the world (Melanio & Gennari, 2013). Therefore, inviting children to the design process as partners is critical for developing an understanding about this special user group. Moreover, integrating children into the design process enables designers to broaden their perspective and introduces them into children's creative, imaginative and playful world (Saure Hagen, Mathillas Røsvik, Høiseth & Boks, 2012). Not only professional designers, but also industrial design students as novice designers can benefit from adopting this approach. Co-designing with children can enhance design students' grasp of the design

process, enable them to develop an understanding of children as users, and help them to overcome unique challenges of designing for children. However, the literature lacks specific methods or tools tuned for supporting design students' co-designing with children.

This study focuses on co-designing with children in the context of design education, and argues that developing a co-design method utilizing children's natural tendency for playfulness and role-playing can facilitate design students' getting into children's world, and help them better understand children's needs and preferences. The study aims at developing a co-design method for the early phases of design process to support industrial design students in their eliciting children's needs and preferences, and involves the development of a performative and narrative-based co-design method, its implementation as a co-design session with industrial design students and third grade primary school children, and face to face semi-structured interviews with design students who participated in the co-design session.

The paper consists of six parts. Part 1 introduces the research topic, the aim and scope of the study. Part 2 presents the key terms and the literature review. Part 3 covers the field study and explains the development and implementation of the co-design method in detail; this part concludes with the post-session interviews conducted with the design students who participated in the session. Part 4 presents the results of the analysis of the interviews. Part 5 discusses the conclusions of the study including the strengths and weaknesses of the method. And finally, in Part 6 recommendations are made for the ones who intend to utilize co-designing with children in the early phases of design education projects.

2   Related Literature

The literature review includes participatory design, co-creation and co-design, and the role of children in the design process and children as design partners. This section also covers a review of existing methods and techniques utilized in co-designing with children.

2.1   Participatory Design, Co-creation and Co-design

Participatory design has its roots in Scandinavia in the 70s and was motivated by the workplace democracy movement (Spinuzzi, 2005). This movement emerged as a response to the transformation of the workplaces as a result of the integration of computer systems into them, which caused a dramatic change in the work conditions of workers (Robertson and Simonsen, 2012). The aim of the movement was to give workers a voice in the design development process of those systems (Steen, Kuijt-evers & Klok, 2007). Many leading projects (e.g. Due project in Denmark, Demos project in Sweden, UTOPIA project in Norway) and conferences (e.g. Design Participation in England) conducted in line with this aim planted the seeds of participatory design (Bødker & Pekkola, 2010).

Along with the technological developments, the context of participatory design spread out of the work environment (Mazzone, 2012) and different design fields such as urban planning and architecture have adopted the participatory design approach. Moreover, over many years, participatory design field has developed an extensive collection of methods, tools and techniques, and made an impact on many other research areas as a mindset. From the 1970s up to now, participatory design, as a mindset, has argued that people (users) are "experts of their experiences" and allowed them to take an active role in the design development process (Sleeswijk Visser, Stappers, Van der Lugt & Sanders, 2005).

According to Sanders and Stappers (2012) in the area of participatory design co-creation and co-design have been growing with a motto arguing that "all people are creative." While co-creation refers to "any act of collective creativity", co-design, an instance of co-creation approach, indicates the collective creativity of designers and users working together in the design process (Sanders & Stappers, 2008). Co-design allows the user to take an active role in the design process and to contribute to the design as an equal stakeholder (Slesswijk Visser et al., 2005). Moreover, it allows

designers to access tacit and latent levels of user knowledge by inviting them directly into the design process (Sanders, 2002).

2.2 The Role of Children in the Design Process and Children as Design Partners

Druin (2002) states that children can be engaged in four different roles in the design process of technology: as a user, tester, informant and design partner (Figure 1). As users, children are observed, videotaped and tested while they are using an existing technology. In this role, children contribute researchers to gain an understanding of the impact of existing technologies on them and their future needs. In the role of tester, children test initial prototypes of new technologies while researchers observe and ask them for comments on their experiences. As informants, children can be involved in different stages depending on the information researchers need to gain from children. Children can be a user, the tester of initial prototypes or they are asked for input or feedback after the development of a product. Before the 90s, children were considered as passive subjects, as users and/or testers of already developed products. With the participatory mindset, children have taken an active role as partners in the design process.
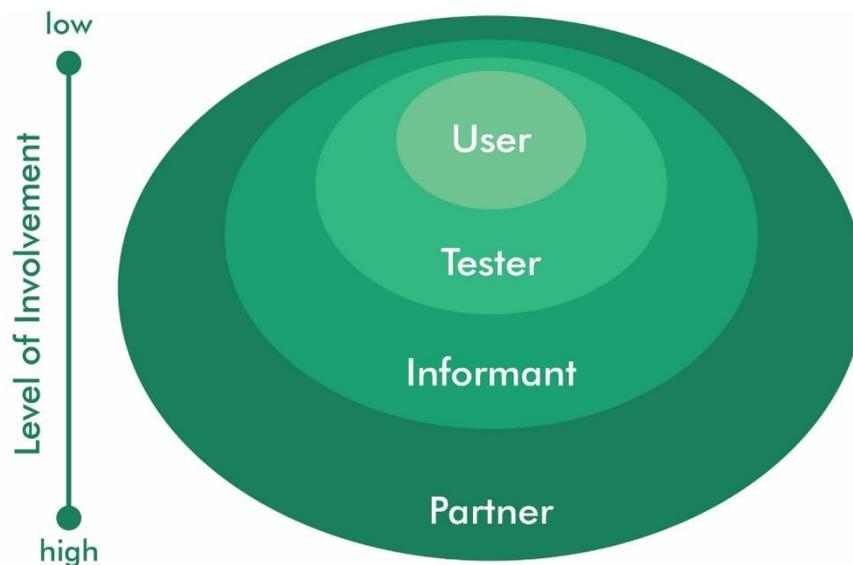

Figure 1 The role of children in the design process (Adapted from Druin, 2002)

2.3 Methods and Techniques for Co-designing with Children

Various methods and techniques have been developed for integrating children into the design process. Based on the ways in which researchers gain information from children, these methods and techniques can be grouped into five as observation-based methods, narrative-based methods, documentation-based methods, art-based methods, and game based methods (Nousiainen, 2008). Observation-based methods aim at gaining an understanding of users' actual work environment and their needs by observing and interviewing them while they are doing everyday activities. Contextual inquiry (Druin, 1999) is the most used and mentioned method in this group. The aim of narrative-based methods is to facilitate expression and verbalization of the views and ideas of children, and they include Embodied Narratives (Giaccardi, Paredes, Diaz & Alvarado, 2012) and Mission from Mars (Dindler et al., 2005). Documentation-based methods aim to discover different aspects of the topic area and to gain information about the context by utilizing documentation techniques, and they include Kid Reporter (Bekker, Beusmans, Keyson & Lloyd, 2003) and Networking News (Nørregaard et al., 2003). Art-based methods intend to enable children to materialize their ideas and generate solutions based on hands-on activities including mock-up and low-tech prototypes; this group includes Comicboarding (Morajevi, Li, Ding, O'Kelly & Woolf, 2007), Mixing Ideas (Guha et al.,

2004) and Layered Elaboration (Walsh et al., 2010) methods, each of which was derived from cooperative inquiry (Druin, 1999).

3 Field Study

The field study comprises two main stages. The first stage is about developing a co-design method for supporting design students' eliciting children's needs and preferences in the early phases of design process; this stage involves the literature review which leads to a matrix of existing methods, and the generation of a co-design method based on the matrix and the design studio project involved. The second stage is about implementing and evaluating the proposed method; this stage explores the theoretical and practical implications of the co-design method, and involves the co-design session, the post-session interviews with design students, and data analysis and findings.

3.1 I-Wonder-How: Developing a Performative and Narrative-based Co-design Method

The proposed co-design method, I-Wonder-How, was developed and conducted in the context of an undergraduate industrial design studio project with the participation of 51 junior year industrial design students and 24 primary school children. The expected outcome of the project was a product family including a washbasin and the accessories related to hand and oral hygiene for primary school bathrooms. The project addressed the primary school bathroom environment in reference to these product categories for building long-lasting hygiene habits, encouraging resource efficiency and product value, and enabling easy cleaning and maintenance. Co-design, in the context of the project, was considered as the most promising approach for eliciting users' needs, preferences and dreams as well as observing their hygiene habits and skills (washing hands and brushing teeth) in the school bathroom context. Therefore, a co-design session which utilized the I-Wonder-How method developed by the researcher was integrated into the fuzzy-front-end of the project with the aim of reframing and reinterpreting the project context by integrating the target users into the design process.

After investigating the existing methods and techniques utilized in co-designing with children, each method or technique was analysed in terms of its main purpose, the activities it included, the age of the participants, the skills required, the design field in which it was utilized, and its pros and cons. This analysis was documented as a matrix of methods. The matrix provided an important reference for developing the method, especially in selecting techniques and developing activities. I-Wonder-How method was developed in four stages: defining the objectives, specifying location and duration, selecting participants and developing activities.

3.1.1 Defining the objectives

In defining the objectives of the co-design method, the project context was taken into consideration. The method was planned to be implemented as a co-design session and was integrated into the project in the initial idea exploration phase with the aim of enabling students to gather user' needs, preferences and dreams. Therefore, the main goal of the method was to enable students to gain insights into the following aspects of the project context:

- The context of design, that is, the school bathroom
- The use of existing products in the school bathroom, that is, washbasin, tap, soap, tissue dispenser, etc.
- Personalization and customization of products of bathroom context and of personal hygiene
- Users' habits and skills concerning hand hygiene and oral hygiene
- Users' ideas about future school bathrooms

3.1.2 Developing activities and selecting techniques

Since the aim of the study included investigating the potential of narrative-based design methods in design students' eliciting children's needs and preferences, firstly, a narrative was generated

through the sessions in which studio tutors and the researcher participated. As a result of the discussions, a narrative inspired by the one used in Mission from Mars technique (Dindler et al., 2005) was decided to be utilized. The narrative was about the Martians who decided to construct a primary school on Mars for children visitors from Earth and contacted industrial design students to help them.

A shared narrative enables children to express their opinions and ideas about the issues which otherwise would be too self-evident to tell through ordinary interviews, and enables researchers to ask even the stupidest questions to children by utilizing a narrative about Martians who want to gain insights into the context of which they do not know anything. Personal hygiene activities, the main focus of the project, are also part of the daily routine and too self-evident. Besides the main aim of facilitating expression, the narrative also made children feel like part of the design team by assigning the children the role of researcher and/or designer consulted by the Martians. To maintain the consistency, all activities were designed considering this narrative.

In designing the activities, path of expression model which Sanders and Stappers mention in their book Convivial Toolbox (2012) was taken as a base. While selecting and staging the techniques, the path of expression enables a pathway.

The first step was concerned with observing the current practices in context; the design teams (children and design students) went to the school bathroom to perform two main hygiene activities, washing hands and brushing teeth. For this step contextual inquiry was selected as a method. Contextual inquiry combines two techniques, observation and interview, by focusing on observing actions performed by users while simultaneously discussing these activities with the user through the interview. Observing children in the field provides design students with insights into children's current practices. Besides, interviewing with them while they perform activities provides design students with the understanding of the reasons behind the way these activities are done. Based on the contextual inquiry, design teams' activities were specified as follows:

- Visiting the school bathroom together
- Children's performing two main hygiene activities
- Design students' conducting interviews with children about these activities

Concerning the documentation technique, both video recording and taking photographs were selected, and two students in each team were responsible for documentation. The children were also asked to take photographs of each other while carrying out activities to be later sent to the Martians. The reason behind giving them the role of the photographer was to make the step engaging for children as well as to make them feel like part of the design team.

The second step was concerned with recalling and reflecting on children's past experiences. This step aimed at enabling design students to gain insight into needs and preferences of children, and to prepare participants for the next generative session. To do this, interview technique was utilized together with question-driven cards generated by the researcher for this particular step. The first two cards included the first two questions asked by the Martians in which children draw and/or write down their actions performed during each hygiene activity step by step and specify products used to accomplish these actions. The third card includes the third question asked by the Martians. In the process of filling the third card, in order to gain further information about their needs and preferences, a discussion session was integrated into the step in which children reflect on these activities and express their way of making boring activities more engaging.
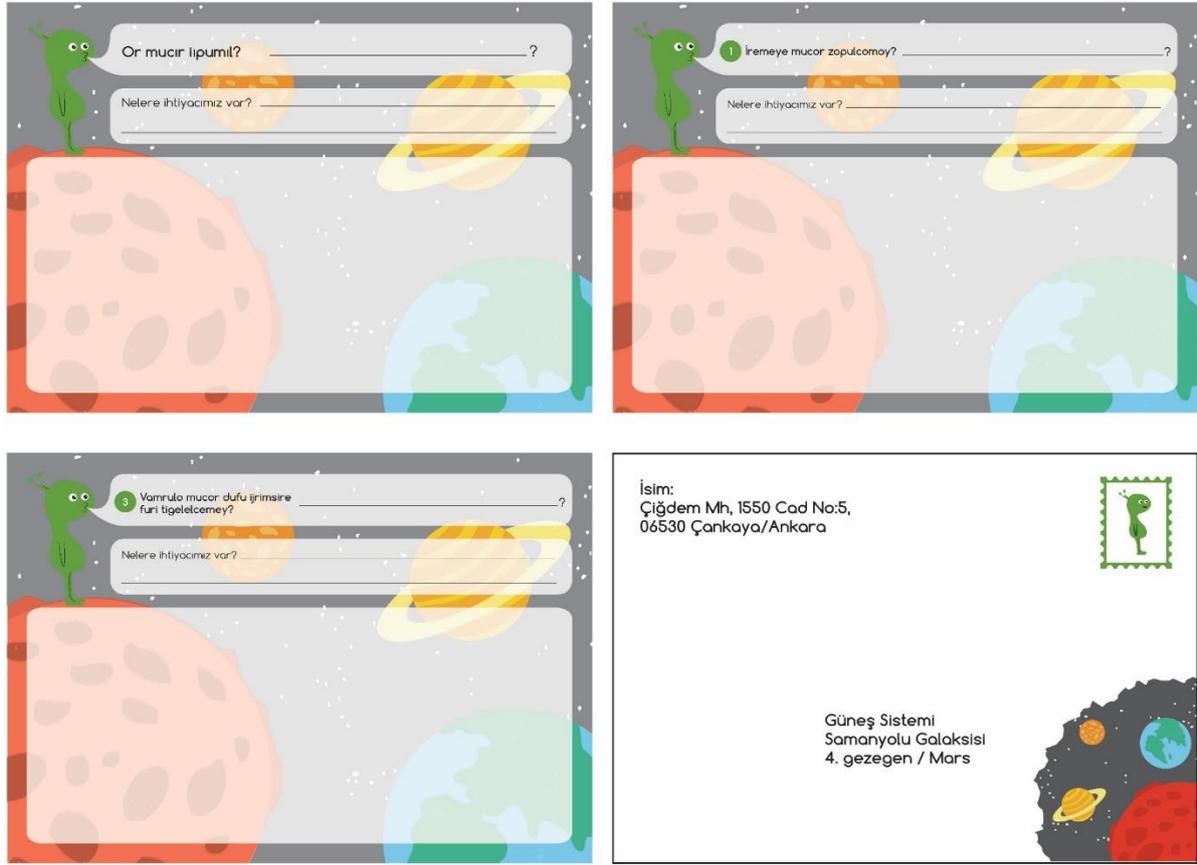
Figure 2 Question-driven cards. Buttom right: Envelope

The third step focused on exploring the future possibilities, in which participants created new ideas and concepts regarding the context. Brainstorming method was considered suitable for this step, as it has been traditionally utilized to generate ideas or requirements, finding solutions to problems and exploring new design spaces (Wilson, 2013). Moreover, using brainstorming method with children in generative sessions has been proved to enable children to generate novel and creative ideas (Thang et al., 2008). Design students are also accustomed to conducting brainstorming sessions in teams.

The fourth and final step involved embodying future ideas and concepts as physical artefacts. Low-tech prototyping technique was considered as the appropriate one for this step since this technique enables children to express their ideas which are difficult to communicate verbally (Druin, 1999), and to generate ideas or solutions which are more relevant and workable (Thang et. al., 2008). Tools and materials for low-tech prototyping included paper, pencils, crayons, glue, scissors, and play dough. In addition to these, design students were allowed to bring materials they considered useful in order to diversify the materials and the ways they expressed themselves (Druin, 1999). Moreover, the students were required to investigate design ideas underlying the artefacts children made because those artefacts could not express themselves (Thang et al., 2008).

3.2   The Co-design Session

3.2.1   Participants and the Spatial Context

As the co-design session was integrated into the third-year design studio project, all registered students, 51 in total, participated in the session. The students were divided into 12 groups, three groups of five and nine groups of three, for the project. The number of children participated in the co-design session was 24. All children were in the third grade (9 years old), and all of them were from the same class. Besides the researcher, the junior year studio team consisting of two studio tutors, three part-time instructors and one teaching assistant also participated in the session as co-

facilitators. The session was conducted in the library of the primary school which the children attended. The library was the main location for most of the activities; during the session children and design students visited the school bathrooms for acting-out and observation. The total duration of the session was two hours, from 2 pm till 4 pm.

3.2.2 Stages of the Co-design Session

Before the session, the design students in each team discussed and distributed the roles among the members; these roles included a photographer, cameraman, note-taker and partner. Each student in the design team also prepared a badge displaying the nickname associated with his/her role and the narrative in order to communicate their roles and facilitate children's engagement into the narrative. Each team also brought a laptop, cameras or smart phones to take videos and photos, and low-tech prototyping materials and tools (paper, pencils, crayons, glue, scissors, and play dough) for idea generation.

The co-design session consisted of five stages and included three missions to be accomplished:

1. Establishing the narrative
2. Mission one: Decoding signals from Martians
3. Mission two: Exploring the school bathroom
4. Mission three: Proposing a dream school bathroom
5. Presenting children with "Interplanetary Design Champion" badges

In the first stage, the narrative and the roles of the students and the children were introduced. The role of the children, as the members of the design team, was to help the Martians to find solutions to their problem. After they were presented the narrative, the design students introduced themselves as mediators and facilitators with specific roles and nicknames written on their badges. Duration of this stage was ten minutes and conducted in the library. After the introduction, the first mission was given.

In the second stage, the children were shown three videos including signals sent by the Martians in Mars language. Then, the design students wanted children to help them translate these signals into the local language individually. The signals addressed the three questions listed below:

1. How do you wash your hands?
2. How do you brush your teeth?
3. How do you make these activities enjoyable and fun?

In order to guide the translation process, each child was given a decoding sheet which included a table to match letters of Mars language with the local language. With the help of the table, each team went over the questions one by one, and briefly discussed alternative answers. After the decoding phase, the design students proposed the children to pay a visit to the school bathroom to make an exploration together.

Figure 3 Decoding session

The third stage was divided into two parts. In the first part, the children and design students made an exploration in the school bathroom. In the bathroom, the children performed two main hygiene activities which the Martians expected to learn about: washing hands and brushing teeth. Each child was given the role of taking the photos of the other child while s/he was carrying out these activities. Throughout the stage, the student teams made discussions with children regarding the two activities during children's performing, and they documented the session by photos, videos and notes. In the second part, the student teams returned back to the library and the children were given three cards. Each card addressed one of the three questions which the Martians asked through the signals. In the first two cards, children wrote down or drew the stages of each hygiene activity together with the materials and products utilized for these activities. In the third card, the children expressed the low points of the activities together with their reasons and described how they made them more engaging. After being filled in, the cards were put into a special envelope to be sent to the Martians by the design students. The total duration of the third stage was 45 minutes. After this stage, the children were given the third mission.

Figure 4 Exploring the school bathroom. Top: Children performing activities. Bottom: Children filling in the question-driven cards.

In the fourth stage, each team conducted a short brainstorming session with the children and then embodied their ideas into artefacts. In the brainstorming session, the children generated ideas regarding the future products utilized in hygiene activities by using sticky papers to write down and/or draw ideas. Then, the student team provided the children with low-tech prototyping materials so that they could describe, drew and/or model their ideas. When they were ready, each child took a photograph of his/her work to be sent to the Martians by the design students. The duration of this stage was 45 minutes. After the generative session ended, the children were given the artefacts they made. In the final stage, each child was given a "Interplanetary Design Champion" badge sent by the Martians to thank them for their help.

Figure 5 Low-tech prototyping session

3.3 Post-session Interviews

In order to understand the implications of the proposed method from the students' perspective, semi-structured interviews were conducted with the design students who participated in the session. At the beginning of each interview, the participant was given a consent form which informed the participant regarding the context of the study. The interviewer started by asking a general question about the topic of the study, and gradually continued with more specific questions. During the interviews, the order of the questions was changed, and some additional questions were asked according to the interviewees' answers without digressing from the topic. The interviews were conducted at the Industrial Design Department's graduate design studio. The interviews lasted between 10 to 30 minutes and were audio-recorded.

3.3.1 Participants

Out of 51, 24 industrial design students (15 female and 9 male students) participated in the post-session interviews individually. There were two students from each design team. The participants were selected based on their roles in the co-design session as there were an equal number of students in each role. The foreign students were excluded from the interviews; since the students communicated with children in the local language during the co-design session, foreign students were not able to provide detailed information concerning the session.

3.3.2 Interview Schedule

In order to structure the interview, an interview schedule including the questions and the possible probes was prepared. Before the questions took their final form, two pilot studies were conducted, and after each study, the questions were revisited and revised. In its final form, the interview schedule consisted of 17 questions and divided into five parts:

- Insights gained from the co-design session
- Comparison of the user observation phase with the co-design session
- Evaluation of the co-design session stages
- Evaluation of collaboration during the co-design session
- Suggestions

3.3.3 Analysis of Interviews

In the analysis of the interviews, thematic analysis method was adopted (Auerbach and Silverstein, 2003). Firstly, 24 audio-recorded interviews were transcribed verbatim into MS Word. Transcription process provided the researcher with the overview of, and familiarity with the data. After transcribing, the data was read all over again in detail. During the second reading, some initial themes started to emerge. Later, the transcribed interview data were studied in the light of initial themes. The raw data were divided into chunks, that is, relevant texts (Auerbach & Silverstein, 2003), and codes were assigned for each chunk considering the initial themes. Lastly, all data were

copied to MS Excel to easily arrange or cluster the data, and themes were divided into sub-themes and categories.

4 Results of the Analysis of the Post-session Interviews

4.1 Contribution of the Method to Co-designing with Children

There were several aspects of the co-design session which supported design students in co-designing with children. One of the most stated aspects was that the session was fun both for children and students, but especially for children. This feature facilitated children's creativity and their integration into the design process. Moreover, it made children express their ideas and collaborate with students willingly and in a fun way. Taking photos, prototyping, and the narrative itself were the activities stated by the design students as engaging.

In addition to being engaging and fun, each activity supported design students' co-designing with children in terms of various aspects. According to the design students, the shared narrative made children more comfortable and free to share their ideas and thoughts. It also created a common ground for children and students by making all members of the team a part of a shared mission. Activity of taking photos enabled the children who were shy to come out of their shell and to fully integrate into the design session. Low tech prototyping also empowered children to express the ideas which were difficult to communicate verbally; furthermore, it enabled children to create more concrete and detailed ideas as well as to create connections between the spatial context and the product.

4.2 Contribution of the Method to the Early Phases of Design Process

There were several aspects of the session which supported design students in the early phases of the design process. One of those aspects, and the most mentioned one, was that the session enabled design students to observe children in context. Exploring the school bathroom phase was considered as the most fruitful one among others in terms of data collection. Design students gained several insights in this stage in terms of user characteristics, hygiene habits, usability and resource efficiency and most of them integrated those insights into their final design solutions. For example, one group investigated the potential of washing hands together for developing sustainable hygiene habits by observing children's communication with each other while they were in the school bathroom together. Based on this insight they designed a station with three washbasins which enabled children to communicate with each other during performing hygiene activities. The second most mentioned aspect was that the design session enabled the design students to develop a deep understanding of the user group. According to the design students, this was facilitated by the brainstorming and prototyping phases during which the students gained insights into children's preferences and dreams.

In addition to the benefits of the session for the design process, the students also stated that the session contributed to their developing design research skills as a long-term benefit. It is important to note that the students who participated in the session did not have any previous experience in co-designing with children. Thanks to this session, the students gained experience in communicating and designing with children as design partners. Some students mentioned that the session altered their thoughts about children in a positive way.

4.3 Challenges Faced by the Students during the Session

There were some challenges faced by the students during the co-design session in terms of data collection, management, communication and location. Firstly, the challenges regarding data collection were experienced during the school bathroom exploration, reflection and evaluation, and brain storming phases. During the exploration phase, the children altered the way they performed the hygiene activities because the design students were observing them. This situation created doubts about the reliability of observations. Furthermore, some students mentioned that the children felt hesitated and embarrassed to brush their teeth in front of others. During the reflection

and evaluation phase, the children got confused about how to use the question-driven cards they were provided with, and they oscillated between drawing and writing. The cards remained insufficient in facilitating the children to think about activities in detail. According to the design students, this situation resulted from the fact that the paper size was too big and there were no guidelines or restrictions regarding the use of cards. This caused children's spending more time with deciding on what to do than completing the task itself. Furthermore, some students mentioned that the children competed against each other because there was one card for two children, so both wanted to be the one who wrote the most. During the brainstorming and prototyping phase, the students had difficulties in guiding the children because they digressed from the topic and generated extreme ideas which could not be utilized as design solutions. According to the students, besides children's nature, this situation might also result from the fact that the children perceived the prototyping phase as play because of the materials provided.

Secondly, one of the major problems the students experienced during the session was time management. Most of the students stated that the duration of the session was not enough to accomplish all the tasks and some of them failed to finish decoding and filling in the question-driven cards. Moreover, managing the flow of the session was also considered as challenging by some students; according to them, the reason behind this could be insufficient preparation.

Thirdly, communication with children was one of the important issues indicated by design students. The most stated challenge was that the children refrained from the students. According to the students, this might be caused by the inefficiency of the warm-up phase, children's being in the school environment, or the narrative. Due to the limited time allocated by the school, the warm-up session could not be done efficiently. This situation affected the whole process in some teams. Also, being in the school environment caused some children to perceive the design students as authority, and they hesitated to communicate with the students and/or to express their ideas.

Lastly, all teams being located in one room, the school library, caused some problems. According to the students, the space was crowded and noisy, which was distracting both for the children and the students.

5   Conclusion

This paper reported a study which aimed at investigating the potential of performative and narrative-based methods in co-designing with children in the context of undergraduate industrial design education. In order to fulfil the aim, firstly, a co-design method was developed and implemented as a co-design session in the context of a design studio project. Then semi-structured interviews were conducted with the design students who participated in the co-design session. The findings addressed the strengths and weaknesses of the method called I-Wonder-How. Moreover, the results drew attention to the issues which required further development.

The strengths of the method lie in its being performative and narrative-based as well as its involving hands-on techniques. The method combines exploratory and generative research techniques utilized in the early phases of the design process, and gathers and structures these different techniques under the roof of a shared narrative. The shared narrative about the Martians which spans the whole session creates a common ground for the children and the design students by assigning them all the role of a researcher. This helps design students' overcoming the challenges of integrating users into the design process as partners. Even if most of the children do not believe in the narrative, they consider the session as a game, embrace the process and go through the tasks willingly and joyfully. The narrative also enables design students to go beyond the boundaries of existing social and cultural context while designing for future experiences. The performative character of the narrative -which can be seen in the school bathroom exploration phase- facilitates the children's integration into the process as well as providing the design students with a rich source of data regarding the context and the users' habits and skills. The children's taking an active role in documenting the exploration phase makes them feel comfortable and integrated into the design

team. The whole process preceding the brainstorming and prototyping phase including the performing and reflecting on their current practices and past experiences raises children's awareness about the topic and helps them recall their experiences. This facilitates children's expressing their thoughts and ideas in the brainstorming and prototyping phase. Low-tech prototyping tools utilized in this phase also enable children's expressing their ideas and provide the students with a rich source of knowledge which can be transformed into design insights and ideas.

Besides the strengths there are weaknesses concerning the method and the entire co-design process. First of all, the method was implemented, and the session was conducted by novice designers with no previous experience in participating in or facilitating co-design sessions with children. Therefore, they did not know much about how to gather data during the co-design session with children, how to probe children, how to properly document a session, and how to communicate with children effectively. Moreover, as they did not have experience in generative sessions with children, the outcomes of the brainstorming and prototyping phase fell short of their expectations. The students expected a direct contribution from the children in the form of design ideas which can be applied to the problem area readily, rather than reinterpreting and reconstructing the ideas generated by the children as design insights. Therefore, most of the students considered brainstorming and prototyping phase unfruitful.

There were some other aspects which resulted in challenges during the session. One of them revealed itself in decoding, and reflecting and evaluating phases. The children had difficulties in understanding the intended use of the cards in these two sessions and thus, in fulfilling the tasks. Moreover, these activities caused some children's competing against each other regarding "who finishes first" and "who writes most". Another aspect was that the time for warm-up was too short. In some cases, this caused children's refraining from students and in some groups this situation affected the whole process and caused difficulties in gathering data.

6   Recommendations

The main insight gained through the study is that the co-design process should be taken as a whole and include the pre-session and post-session processes as well. In order to achieve the intended aim of the method and the co-design session, it is necessary to specify the roles and responsibilities of all the actors and stakeholders involved for all the phases. Therefore, the following sections discuss the recommendations for the ones who intend to utilize co-designing with children in the early phases of design education projects.

6.1   Pre-session Process

As mentioned above, as students did not have previous experience in generative sessions with children, they experienced challenges in terms of managing the process and collecting data during the session. In order to fulfill the aim of the co-design session and to minimize those challenges, the students should be informed prior to the session regarding the following issues:

- how to gather data during a co-design session with children, how to prop children, how to properly document a session, and how to communicate with children effectively
- the order and aim of the activities, and the ways of conducting these activities
- the expected and possible outcomes of the session

Another issue revealed by the field study was that the children had difficulties in terms of using the cards utilized in decoding, and reflection and evaluation phases. It would be beneficial to conduct pilot studies to test the effectiveness of such material, and to consult primary school teachers in terms of evaluating the suitability of the tasks for children's skills.

6.2   Post-session Process

According to the results of the study, most of the design students had difficulty in analysing the data gathered in the co-design session as well as integrating their insights into their design solutions. Providing the students with a guideline or directions for the post-session analysis would benefit the process. The students can also be provided with a platform or can be encouraged to conduct discussion sessions for sharing their insights and experiences with each other. Post-session discussions and presentation of analyses can provide diverse insights for design students.

7   References

Auerbach, C. F., & Silverstein, L. B. (2003). *Qualitative Data: An Introduction to Coding and Analysis (Qualitative Studies in Psychology).* NYU Press.

Bekker, M., Beusmans, J., Keyson, D., & Lloyd, P. (2003). KidReporter: A user requirements gathering technique for designing with children. *Interacting with Computers, 15*(2), 187–202. doi.org/10.1016/S0953-5438(03)00007-9

Bødker, S., & Pekkola, S. (2010). A short review to the past and present of participatory design- introduction to debate section. *Scandinavian Journal of Information Systems*, *22*(1), 45–48.

Dindler, C., Eriksson, E., Sejer, O., Lykke-olesen, A., Ludvigsen, M., Spaces, I., & Katrinebjerg, I. (2005). Mission from Mars - A Method for Exploring User Requirements for Children in a Narrative Space. *Proceedings of the 2005 Conference on Interaction Design and Children- IDC '05* (pp. 40–47). doi.org/10.1145/1109540.1109546

Druin, A. (1999). Cooperative inquiry: Developing new technologies for children with children. *Human Factors in Computing Systems (CHI)*, *14*(99), 592–599. doi.org/10.1145/302979.303166

Druin, A. (2002). The role of children in the design of new technology. *Behaviour and Information Technology*, *21*(1), 1-25.

Giaccardi, E., Paredes, P., Díaz, P., Alvarado, D. (2012). Embodied Narratives: A Performative Co- Design Technique. *Proceedings of the Designing Interactive Systems Conference* (pp. 1-10). doi.org/10.1145/2317956.2317958

Guha, M. L., Druin, A., Chipman, G., Fails, J. A., Simms, S., & Farber, A. (2004). Mixing ideas: A new technique for working with children as design partners. *Proceedings of the 2004 Conference on Interaction Design and Children Building a Community - IDC '04* (pp. 35–42). doi.org/10.1145/1017833.1017838

Mazzone, E. (2012) *Designing with Children: Reflections on Effective Involvement of Children in the Interaction Design Process* (Doctoral dissertation). Retrieved from http://clok.uclan.ac.uk/6661/

Melonio, A., & Gennari, R. (2013). *Co-Design with children: the State of the Art*. *KRDB Research Centre Technical Report* (pp. 1–29). Retrieved from http://www.inf.unibz.it/krdb/.

Moraveji, N., Li, J., Ding, J., O'Kelley, P., & Woolf, S. (2007). Comicboarding: using comics as proxies for participatory design with children. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1371–1374). doi.org/10.1145/1240624.1240832

Nørregaard, P., Andersen, J., Dindler, C., Frich, J., Iversen, O.S. & Nielsen, C. (2003). Networking News—a method for engaging children actively in design. *Proceedings of the 26th Information Systems Research Seminar in Scandinavia (IRIS 26)*.

Nousiainen, T. (2008). *Children's involvement in the design of game-based learning environments* (Doctoral dissertation). Retrieved from Jyväskylä University Digital Archive. (Order No. 978- 951-39-3449-1)

Sanders, E. B. N. (2003). From user-centered to participatory design approaches. In J. Frascara (Ed.), *Design and Social Sciences: Making Connections* (pp. 1–8). New York: CRC Press. doi.org/10.1201/9780203301302.ch1

Sanders, E. B.-N., and Stappers, P. J. (2012). *Convivial Toolbox: Generative Research for the Front End of Design*. Amsterdam: BIS.

Sanders, E., Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign: International Journal of CoCreation in Design and the Arts*, *4*(1), 5-18.

Saure Hagen, E., Mathillas Røsvik, S., Høiseth, M., & Boks, C. (2012). Co-Designing with children: Collecting and structuring methods. *Proceedings of the 9th Norddesign Conference* (pp. 27-28).

Simonsen, J., & Robertson, T. (2013). Participatory Design: An introduction. In J. Simonsen & T. Robertson (Eds.), *Routledge International Handbook of Participatory Design* (pp. 1–17). New York: Routledge.

Sleeswijk Visser, F., Stappers, P. J., Van der Lugt, R., & Sanders, E. B.-N. (2005). Contextmapping: experiences form practice. *CoDesign: International Journal of COCreation in Design and the Arts, 1*(2), 119–149. Retrieved from http://www.tandfonline.com/doi/abs/10.1080/15710880500135987

Spinuzzi, C. (2005). The Methodology of Participatory Design. *Technical Communication, 52*(2), 163– 174. doi.org/10.1016/j.infsof.2008.09.005

Steen, M., Kuijt-evers, L., & Klok, J. (2007). Early user involvement in research and design projects – A review of methods and practices. *Proceedings of the 23rd EGOS Colloquium* (pp. 5–7).

Thang, B., Sluis-Thiescheffer, W., Bekker, T., Eggen, B., Vermeeren, A., & de Ridder, H. (2008). Comparing the creativity of children's design solutions based on expert assessment. *Proceedings of the 7th International Conference on Interaction Design and Children - IDC '08* (pp. 266–273). doi.org/10.1145/1463689.146376

Walsh, G., Druin, A., Guha, M., Foss, E., Golub, E., Hatley, L., Bonsignore, E., Franckel, S. (2010). Layered elaboration: a new technique for co-design with children. *Proceedings of the Conference on Human Factors in Computing Systems* (pp.1237–1240). doi.org/10.1145/1753326.1753512

Wilson, C. (2013). Brainstorming. *Brainstorming and Beyond*. Oxford: Elsevier.