Child as Protagonist: Expanding the Role of Children in Participatory Design

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ABSTRACT

We suggest that a commitment to political participatory design defines a new role for children in participatory practices—the role of *protagonist*. The objective here transcends the goal of giving children a voice in design, and addresses more broadly how children can be empowered to shape technological development and critically reflect on the role of technology in their practices. This re-accentuation of political participatory design to formulate the protagonist role is important, because it deepens our understanding of how children may be empowered through design. It is also timely in view of current societal challenges pertaining to training children in twenty-first century skills. Based on a case study, we illustrate how the protagonist role, based on political participatory design, can change the objective, process, and outcome measures of the design process.

Author Keywords

Protagonist; participatory design; political participatory design; design competence; twenty-first century skills.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

Children’s role in Participatory Design (PD) remains a topic of great interest in Interaction Design and Children (IDC) research. Landoni et al. [25] ask “How many roles can children play?” emphasizing that children are often invited into the early ideation phases of design, but rarely admitted to other aspects of the design process. Read et al. [31] criticize parts of current IDC research for being “fast and furious” or for being a “reduced PD” in which children are engaged only in isolated, short-term design sessions but are left out of the more important decision-making process. This kind of PD is, according to Read et al. [31], better

referred to as “crowdsourcing of ideas,” as children do not necessarily influence the final outcome here and little emphasis is put on design as a mutual learning process as manifested in PD theory [36]. This concern is further scrutinized by Frauenberger et al. [16], who introduce a methodological framework for critically reflecting on PD projects according to their alignment of values, outcomes, epistemology, and stakeholder participation. They point out that PD involving children needs to be evaluated not just in relation to tangible outcomes, but also in relation to the participants’ learning gains, the values of the projects, and their grounding epistemological perspectives.

In this paper, we offer a novel perspective on children’s role in PD—the role of *protagonist*. Our suggestion builds on the tradition of political PD to emphasize that the objective of design is not only technological products, but for participants to develop new insights, design abilities, and a critical and reflective stance toward technology through their engagement in design work. We position the role of *protagonist* in relation to existing IDC research, involving children as users, testers, informants, co-designers [12, 17] and co-researchers [10]. Through our case study we also illustrate how the role of protagonist differs from previous approaches in *objective*, *process*, and *outcome measures*.

There are at least two related incentives for re-accentuating political PD and introducing the role of protagonist. First, focusing on the intangible outcomes of design—such as new skills, new insights, and a reflective stance toward technology—contributes to the understanding of how children may be empowered through design. Second, in the European context the societal challenge of preparing children for a digitized society has surfaced very prominently in recent years. The notion of twenty-first century skills is currently high on the European political agenda as an attempt to articulate the skills needed to succeed in a highly globalized and digitally mediated society. Some of these skills are closely related to children’s abilities to create with digital materials and also solve complex societal problems [1]. As pointed out by several researchers (e.g. [32]), these competences are not necessarily new. Complex problem-solving has always been a component of human progress. It has also been central in the development of design theory from the beginning, including concerns for digital technology, and has been taught in design schools worldwide for decades

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[32]. Promoting twenty-first century skills is currently being investigated through implicit or explicit adaptations of design theory to education from kindergarten to ninth grade to support children's development of competences [34]. Bekker et al. [4] have introduced a design tool kit to support children's design thinking, while Smith et al. [34] provide a framework for understanding children's design competence in their account of design judgment. Blikstein [6] coins the rapidly extending reach of digital fabrication technologies as a "democratization of innovation" that emphasizes the possibilities for including children in the design of new technologies by introducing those technologies into formal education.

The concept of *design protagonist* suggested in the present paper extends the concern to empower children into developing technology, critically reflecting on it, and acting upon it. It also provides an approach to addressing the challenge of twenty-first-century skills training. In the paper we use the term "protagonist" in a dual sense: first, to articulate the idea that in this approach children are the main agents in the design process as they engage with authentic design problems; and second, to suggest that through their engagement in design, children develop skills in designing and reflecting on technology, and that these skills empower them to make more informed decisions about technology in their lives. Both these ideas derive from the tradition of political PD.

Our inquiry into political PD and the role protagonist is structured as follows. In the two following sections we review literature on PD involving children and the political perspective in PD. We then outline the differing conceptions of children's participation reported in the IDC literature and present our protagonist perspective. Our case study demonstrates how the protagonist perspective may play out in practice. Finally, we discuss potentials of the suggested perspective and outline avenues for future work.

PARTICIPATORY DESIGN WITH CHILDREN

PD has always played a significant role in IDC research, dating back to Druin's seminal work on cooperative inquiry [11,12], Read's work on PD for children [28], and the work by Iversen et al. on the Scandinavian and political aspects of PD with children [21, 22]. In recent years, PD methods and techniques within IDC research have expanded and become increasingly sophisticated, as with the development of a framework describing common PD methods and their use [40] bringing PD to special needs (e.g. [15,26]), facilitating distributed PD work [39,41] in game environments [38], in schools [3,35], and under extreme constraints [14]. The sophistication of existing PD methods is also clear in Mechelen's [27] framework for understanding children's group dynamics and underlying values through PD work. Similarly, Read et al. [31] developed the Rapid Analysis of Design Ideas for integrating ethical and inclusive analysis of large sets of data deriving from a PD project. All these endeavors have

extended the scope of PD work so as to include the analysis of data—something that was not previously considered to be a PD activity.

As PD is now considered mainstream—and, arguably, has almost become a trademark of IDC research—many different interpretations of this particular design approach coexist. Guha et al. [17] emphasize the intergenerational *co-design* aspects of PD in their revisiting of cooperative inquiry, whereas Yip et al. [42] describe PD as a "method" of enhancing technology for children by designing with children. Citing [13], Read et al. [31] consider PD to be a "philosophy" in which end-users actively engage with designers and developers to collaboratively explore future design solutions. Iivari and Kinnula [19] discuss the challenge of creating "genuine participation." Iversen and Dindler [23] describe participatory "epistemology" in which they point to the intangible outcomes of PD processes, such as "emancipation" through design with and for children. As stressed by [16], the field of PD has expanded and diversified and a broad spectrum of approaches and methodologies have emerged to support the design of children's technology. Despite the diversity of understandings of PD, the ethos at the heart of PD (as suggested by Read et al. [28]) is active engagement of children in the design of new technology in order to both develop better technologies and give children a voice in the design process. This particular interpretation of PD resonates well with Simonsen and Robertson's [36] notion of *pragmatic* PD. Pragmatic PD stresses the need for users and developers to learn together about possible and useful technological solutions ([36], p. 6). Empowerment is obtained by providing participants legitimate access to the entire design process, from project definition to evaluation of the design outcomes.

POLITICAL PARTICIPATORY DESIGN

Historically, PD has always had a strong political component [9, 24]. From a political standpoint, PD has been a struggle for democracy. The overarching goal was to create an emancipatory practice in which users, through their own commitment to the design of new technologies, could become capable of influencing their practice. While tangible technological products were an important part of the early political PD, many of the activities in the projects were aimed at providing practitioners with skills related to IT and creating organizational arrangements that would support local development and influence. As stated by Bansler [2], user organizations such as trade unions "... must carry out their own investigations, independently of management, and raise their own demands regarding the use of new technology in order to establish a basis for negotiations with management" ([2], p.16). The core PD objective was the education and encouragement of users to actively participate in the design of technology through a mutual learning process. Accordingly, much of the material produced during the early PD projects (such as DEMOS, DUE, UTOPIA) was in the form of educational material

and reports that documented local experiences with democratizing the introduction of technology (see [5]). The tangible outcome of the process was an IT product, but a more important outcome was the new-won insights, skills, visions, and democratic awareness among users that had been attained through their engagement. To achieve this objective, the design *process* was constructed around making future users and stakeholders active participants in the process. The process aspect of PD is arguably its best-known aspect, and has since been adopted within a range of communities related to technology design, including IDC. The agenda of providing people with the skills needed to shape their own practice and engage in relevant political negotiations continues to play a role in the PD community, but it has arguably been overshadowed by research that focuses on tools and techniques for user–designer cooperation and experiences with involving various user groups in design. Much less documented is the extent to which the ambitions of political PD have actually been achieved. Formal evaluation and *outcome measures* are rarely reported in the PD literature [7]. These have surfaced recently in retrospective studies assessing what people gain from PD projects [7,8] and in frameworks suggesting how such outcomes might be evaluated [16]. But in IDC research, the political agenda now appears all but absent except for a few cases in recent work [18,20,21,22,31] tracing back the underlying political roots of PD in Child–Computer Interaction research.

In this paper we suggest that the focus of political PD—providing people with opportunity and means to shape their own technology and practices—resonates well with IDC’s ambition of enhancing children’s ability to critically understand, reflect on, and take action in a digitally mediated society through the tools, technology, and dialog provided in the PD process. In order to examine political PD in the context of IDC, we review the various roles played by children in participatory IDC practices and discuss these in terms of *objective*, *process*, and *outcome measure*. We illustrate how political PD differs within each of these categories defining the role of *protagonist*. Through a case, we show how this role may be instantiated in terms of objective, process, and outcome measures.

CHILDREN’S ROLE IN PD

Druin [12] developed a highly influential framework for understanding children’s role in PD, known as “the onion model.” The model distinguishes between roles in PD processes that engage children as users, testers, informants, and co-designers. Children can be studied as *users* of technology, yielding insight into their practices and the significance of technology. They can also be engaged as *testers* of a new system, and thus engaged in the design process to determine the importance of features and the usability of the system. More proactively, and at an earlier stage in the design process, children can be encouraged to generate ideas for a new system as *informants* in the design process. Here, children act as information providers in

relation to expert designers or researchers. Finally, Druin [12] introduces the role of *design partner* to give children a voice throughout the design process by articulating their expertise and real-life experiences. Guha et al. [17] elaborate on this conceptual understanding by stressing the different dimensions of roles in the design process and by specifying how those roles are brought into play in PD projects in relation to the developers, the technology, and the goal of the inquiry. Doorn [10] recently expanded the understanding of children’s role in PD by studying how children can act as co-researchers in design by gathering, sharing, and enriching contextual data.

The various different categories of children’s roles can be represented by objective, process, and outcome measures (Table 1). Engaging with children as users involves studying children’s practice and use of technology with the objective of gaining insights that may aid in designing technology. The outcome measure relates to the amount, validity, and quality of the knowledge obtained. Involving children as testers points to the objective of developing new technology or adjusting new designs so as to better fit children’s behavior. In this mode of involvement, the objective is to gain insights into a particular design or prototype by having children try out the proposed design. The outcome is tightly connected to the quality of the new design: outcome measures relate to issues such as usability, utility, and the experiential qualities of the design. While the objective of informant design parallels the “child as tester” perspective, the process in which the objectives are met and the outcomes gained differs significantly. According to Guha et al. [17] and Scaife and Rogers [33], informant design advocates working with children at those specific points during the design process when their input is considered to be most valuable or most needed. The “child as design partner” perspective has its objective in common with informant design, though it emphasizes empowerment by giving children access to the design process [12]. Also, design partnering is often based on a long-term commitment between children and designers, emphasizing a co-design perspective with shared responsibilities and concerns. As stated by Guha et al. [17], informant design is a process of providing feedback to adults. The goal of design partnering, by contrast, is the elaboration and negotiation of all perspectives on design. For a thorough review of these differences, see [33]. Finally, Doorn [10] introduces the co-researcher perspective, which differs significantly from existing roles. In this perspective, children are engaged in the knowledge production that can eventually lead to the design of new artifacts. The objective is to generate context-sensitive and situated knowledge, by allowing children to gather, share, and enrich contextual data from their environment. This process sometimes becomes detached from design work, since the emphasis here is on knowledge production. The outcome of this process is a strong conceptual understanding of children’s praxis that can be used to design better products.

These categorizations of children's role in design are of course archetypical, and they draw on some of the same methods and techniques for collaboration. The categorizations could also be criticized for being one-dimensional in relation to the complex matter of child participation. Mechelen [27] argues that children's role is not exclusively determined by the relationship to designers and the design process, but also to group dynamics among the children. Nevertheless, the archetypical roles offer broad categorizations for understanding how, why, and when children are engaged in design.

The contribution of this paper is to offer a sixth category based on principles drawn from political PD, stressing the training and prompting of participants to develop skills to shape technology themselves and accordingly to critically reflect on the role of technology in their practice. We term this sixth category "child as protagonist." While a few IDC authors have touched on ideas closely related to political PD [18,21,22,29], we find the perspective is underdeveloped. This category shares certain traits with "child as design partner" and "child as co-researcher," but we argue that it is distinct, in particular in its objective and

its outcome measures. The objective of the "child as protagonist" category is to develop a critical and reflective stance toward technology and to develop skills for designing technology. In terms of process, we suggest that this objective is realized by children engaging in processes through which they develop design competence. This has some similarities in common with, for example, the "child as design partner" approach, in which children also participate in design work. The difference with the "child as protagonist" is that here the process is arranged primarily to help children develop their design competence and ability to reflect on the role of technology, rather than with the primary aim of developing good products. In terms of outcome measures, the "child as protagonist" category will look at the extent to which children have developed insights into the nature of digital technology as well as enhancing their design competence and their ability to reflect on the role of technology in their lives. In the section that follows we illustrate, through a case study, how this category may be used in participatory practices, and we highlight how the objective, process, and outcome measures may be materialized.

	Objective of participation	Participatory process	Outcome measures from participation
Child as user	Researchers test a general concept that may help inform future technology or provide better understanding of the process of learning which may contribute to future educational practices.	Children are observed, video-taped or tested before and/or after technology use.	Knowledge about children's technology use and learning.
Child as tester	Researchers gain insights into children's use of a particular technology and eventually improve that technology based on these insights.	Children test prototypes of a particular technology.	Knowledge about the usability, utility, and experiential qualities of the proposed technology.
Child as informant	Researchers gain insights to inform the design at various stages of the design process by eliciting and including children's expert knowledge.	Children may be observed with existing technologies, or they may be asked for input throughout the entire design process.	Knowledge provided by children that relates directly to the technology being designed.
Child as design partner	Researchers give children a voice in the design process. Children and researchers co-design new and meaningful technologies by means of partnership.	Children and researchers engage in various design sessions with a shared goal of designing new technology.	Empowerment of children by giving them a voice in design. Development of meaningful technologies.
Child as co-researcher	Researchers and children gain contextual knowledge by jointly studying children's practices.	Children contribute to design by sharing, gathering, and analyzing data from their own use practice.	Knowledge about the design context and the possibility of incorporating this knowledge into new technology.
Child as protagonist	Researchers encourage children to be the main agents in driving the design process and thereby to develop skills to design and reflect on technology and its role in their life.	Children carry out a complete design process in which process and product reflection is a central component.	Children's new insights into design and digital technology and reflective stance toward technology in their life.

Table 1: An overview of children's different roles in the design process adapted from Druin [12], Guha et al. [17] and Doorn [10] and extended by a perspective on child as protagonist.

METHOD

Our case study derives from a research project conducted in Danish public schools (folkeskoler) for children aged six to sixteen. Based on the insights gained over three months of participant observations [37, 34] in design and crafts teaching, the research team developed a research-through-design experiment [43] to examine how we could invite children into design in a protagonist role. The experiment was carried out in collaboration with three seventh-grade classes at N. J. Fjordsgades School in Aarhus, Western Denmark, between October and December 2014. A design researcher acted as the main facilitator of the project, in collaboration with a local teacher, while three design researchers documented the process using video and field notes. The experiment was conducted in the school's makerspace, and the activities were continuously developed, evaluated, and refined by the team in three iterations. In total, 69 students (aged 13–14) were engaged in the research experiment, which ran over the course of six weeks and amounted to two to four lessons per week. The researchers followed selected groups of students throughout the process. They also conducted semi-structured interviews (20 to 30 minutes in duration) with 14 pairs of students about their experiences of and reflections on the design process.

The field notes and video material from the observational studies and the research experiments were logged and analyzed, with a particular focus on the groups of students we followed most closely. This is described in Smith et al. [34] with a focus on the case study and the comparison between actions and experiences in the design process and the students' retrospective reflections. In the present paper, this case study serves to illustrate how the protagonist perspective might be realized in the context of a concrete design experiment. To meet the ethical concerns that arise in PD research involving children [29,30], informed consent for conducting the research was gained from the school principal, teachers, parents, and the students themselves. All 69 students chose to participate for the entire duration of the study. We did refrain from engaging children in the process of framing the design brief and activities, and analyzing the data. This could potentially have strengthened the study and the depth of the children's involvement, but it would have demanded more than the available resources.

The design experiment was conducted as part of the Aarhus University FabLab research project: an ongoing interdisciplinary research project studying how digital fabrication technologies in combination with design thinking can be introduced into formal education. In Smith et al. [34], we presented a thorough account of the design experiment and described how the interventions enhanced the design competence among the participating students. In the present paper, we use the design experiment to illustrate how a political PD perspective supports children's protagonistic role in design. We demonstrate in the

following three sections how political PD fundamentally affects and changes the objective, process, and outcome measures compared with more established PD approaches as discussed in the preceding section.

OBJECTIVE: ENCOURAGING CHILDREN TO BECOME PROTAGONISTS

The objective of the research project was to encourage children to be the main actors in driving the design process and in so doing to improve their skills to design and reflect on technology and its role in their everyday life. These aims were articulated throughout the process activities, but perhaps most explicitly in the opening design brief (Table 2).

In accordance with its status as EU Capital of Culture 2017, Aarhus Municipality has received funding from the European Union's Re-designing Urban Spaces Program to redesign Aarhus's city hall park. Frederiks Allé (a local street) will be led through a tunnel under the park so as to open up a whole new park area between the city's concert hall and city hall. Aarhus's vision for the new city park is to create an innovative and engaging public space especially for young people. The city council has therefore asked three school classes to develop a number of design proposals for the Capital of Culture 2017 campaign.

Table 2: The design brief

The design brief challenged the students to redesign a public park in accordance with the city council's aim of developing a more recreational space in the area for everyday leisure and social activities. It was intended to direct the students' attention away from their own personal (arbitrary) ideas and rather toward the opportunities provided by the brief so as to develop relevant concepts for a specific context. The brief contained two important components to engage the children as protagonists in the design process, namely authenticity and closeness. The design brief was developed from an *authentic* challenge in that Aarhus had just been elected European Capital of Culture in 2017, an honor that had been hyped in the local news as something potentially affecting the cultural identity of the city. It was hoped that the authenticity of the design brief would give the children an intrinsic motivation to engage in the design work. Further, the municipality's involvement as project sponsor allowed the children to feel that they were part of a broad network of professionals exploring future urban environments. The design brief also situated the design challenge in the students' own neighborhood. The *closeness* of the brief was an important aspect of allowing the students to identify with the challenge, while openness of the concrete framing was maintained so as to allow the students to develop their ideas freely. The children were thus faced with a challenge that was complex but within which they could potentially affect a public decision-making process, and, more importantly, change their own physical surroundings for the better.

The design brief and its requirements were regularly revisited through the students' work. As researchers and facilitators of the process, we created the role of design expert. This was intended to distance us from being "teachers" who have predefined answers to the outcome of the process and to support our roles as facilitators who were to guide the students and groups in their own work. After we had introduced the design brief, the urban context, and the planned activities for the students' field studies, the students worked to frame and reframe their unique challenge and plan the execution of their process. Our roles were to support activities and collaboration in the groups and to scaffold the students' sense of ownership and legitimacy in the process.

Rather than developing specific technological artifacts, the design brief emphasized an exploratory process, working with technology as a flexible and creative means. The role of the technology was downplayed in the initial activities and introduced during the ideation phase as students were able to work with and integrate relevant technologies into their projects. The availability of different technologies as flexible tools and materials to be integrated into the process shifted the students' perceptions of technology from something involving fixed objects to something involving digital means for creating their own alternative opportunities and solutions. This strategy was chosen to support the students in developing their own reflective stance toward technology.

PROCESS: SCAFFOLDING AN ITERATIVE AND REFLECTIVE PROCESS

To support the process of children engaging as protagonists, we employed a process model that could support this particular stance throughout the entire design process. The model was based on six main activities. The circular model illustrates design as an iterative process, since all design outcomes eventually lead to new research questions and new problem framings. Moreover, iterations occur within and between each of the activities and with increasing experience, eventually crisscrossing effects are created that use the model as a framework for navigating through one's own design project. The model contains six main design activities, each including several sub-activities: (1) the design brief, for framing a complex challenge and planning the design process; (2) field studies, to explore and research the context and users; (3) ideation, for the creative development of ideas using various techniques and materials; (4) fabrication, for mock-up and prototyping of concepts using digital technologies; (5) argumentation, for testing a design concept or product and reflecting on the design moves and arguments of the process; and (6) reflection, for reflecting on the learning outcome—or design competence—developed through the entire design process (see Fig. 1). For a description of the process model, see Smith et al. [34].

Figure 1: The six main design activities illustrated in an iterative design process model.

We recognize that our process model is one among several suitable design models to illustrate iterative design processes. However, this particular model was designed to embed certain characteristics that support children as protagonists throughout the design process. First, the design model supported an ongoing interplay between divergent and convergent thinking and doing. Divergence and convergence notoriously compel the children to open up their design process and take in new perspectives and subsequently deselect (potentially important) aspects in their efforts to reach a meaningful design solution. The interplay between divergence and convergence demands a high level of commitment, agency, and determination. These in turn sustain the children's role as protagonists in the process. Second, the design model incorporates argumentation and reflection as the closing activities of each iteration. By positioning reflection as the outcome of the design activity, the design process closely ties its aim to the objective of developing a reflecting stance toward technology and design, as described in the "child as protagonist" perspective. Third, the design model does not prescribe either specific actions or project measures. It merely indicates how the design process develops. This is to encourage the children to be mindful about their process, their collaboration, and their choices during the process, rather than focusing solely on the tangible outcome. There are no formal instructions in the model, indicating that there is no correct way for children to proceed through the stages of project framing, research, ideation, and fabrication to the final stages of argumentation and reflection. This lack of authority in the model transfers a high level of self-efficacy and agency to the children. They have to stay in charge of the design process while they gradually explore the design brief and activities provided by the design experts.

In the case study, the process model was carefully introduced and monitored by the design team. An important task for the researchers was to support the alternation between divergent and convergent thinking and thus to keep the process going. The purpose was not to harvest ideas

from the students, but to scaffold their process in order to develop their design abilities. Each activity was supported by the general framing, but the real challenge was the leap between the activities. Moving from field studies to ideation, or from ideation to fabrication, demanded the transformation of diverse data, ideas, and materials into a new activity, while at the same time interweaving the design challenge and the constraints posed by analog and digital materials. In order to develop the students' design abilities, we were careful of how we assisted and supported their forward progression. Sometimes the students sought direct instructions, but we emphasized our roles as facilitators of their process and mostly provided new questions rather than solutions. They were not instructed in, for example, how to integrate the Arduino software and hardware with their concept, but were pointed toward ways of finding out what they needed to know. In this way, self-motivation, collaboration, and trial and error rather than predetermined learning goals were the drivers in making decisions.

OUTCOME MEASURES: EVALUATING THE OUTCOME OF A POLITICAL PD PROCESS

Both the evaluation process and the outcome measures were aligned with the political PD agenda. A strong emphasis was put on children's new insights into design and digital technology and their reflective stance toward technology in their everyday life. Consequently, the evaluation targeted not only the intellectual outcomes directly related to the design process, but also the outcomes in terms of student insights and their general perception of technology. The reflection activity and the argumentation activity of the process model were a critical component in ensuring that students gained insights into the nature of the design process and of technology more generally. The students gave a presentation of their design argument to the class as a coherent presentation of their research findings, ideas, and prototype, inviting representatives from the municipality and from the university. Each group made video scenarios of their design idea, as well as oral presentations of their functioning prototypes. Feedback from the panel was given in relation both to the design brief and to the design decisions taken by the group during the process. In addition, the researchers, the teacher and the students had a shared discussion about the learning outcome of the entire design process, reflecting on the activities, the iterative connections between them, and their applicability in other complex issues in which design and technology were relevant. These collaborative assessments of the outcome and of learning from the process were conducted in order to give the students shared experiences of designing—as well as a language and reflections about the quality of design—to strengthen their (collective and individual) design competence. The activities may resemble those of other design processes in which participants collaboratively debrief, except that in this case the reflection activities were positioned as the end goal of the design process.

To further pursue outcome measures related to political PD and the role of protagonist, we also examined the children's personal gains emerging from the process participation. To do this, we inquired into the children learning gains – not only in relation to the specific design outcome, but in relation to the children's general perception of technology and design. To a large extent, the questions we posed resemble the evaluation taxonomy proposed by Bossen et al. [8]. Although the interviews were informal and dialogue-based, they centered around nine fundamental questions. The nine questions (*italic*) and their relation to the taxonomy (**bold**) provided by Bossen et al. [8] are listed in Table 3. The interviews were conducted after the design process. In this project, 14 students were interviewed in rounds of two-and-two. The reason for interviewing the students in pairs was to engage them in conversation around the questions and their prototypes, supporting each other in reflecting on insights from the design process.

It is important to note that engaging children with these nine abstract questions demands a certain expertise: sometimes the questions needed to be simplified and converted into concrete examples and communicated in everyday dialog. Nevertheless, the questions provide a way of learning about what children gain from the design process, as well as how they may transfer knowledge gained in the process to their everyday lives.

Influence on the project and product

How did your personal engagement influence the design process and the design outcome?

Most satisfying and most frustrating experiences

What were the most important experiences and challenges you remember from the design process?

Personal gain from participation

Thinking back on the process, what was the most valuable personal insight you gained?

Extent of new outlook on technology or personal practices

How did your relationship to digital technology develop during the design process (and after the process)?

New quality of work, new possibilities discovered, or more influence on own work conditions

How would you consider your experiences in relation to other types of school work?

New areas of competence acquired

Which new competences (research, programming, ideation, reflection) have you gained from the design process?

Subsequent shifts in career or future training path owing to the project

(How) did your participation change your relation to education and future career plans?

Overall assessment of participation in project

How would you describe your participation in the process?

Newly emerged opportunities in general

(How) did your project participation make you consider new opportunities in relation to design of digital technology?

Table 3: Interview guide for evaluating children's gains.

The questions point to great variation among student gains. Some students do not necessarily internalize knowledge

from this kind of participation [34]. In our design experiment, however, some students followed an almost vertical learning curve in terms of their ability not only to participate in design process but also in their understanding of digital technology. As an illustrative example of the interview process and the outcome measures of a political PD process, two girls reflected on the question “Which new competences (research, programming, ideation, reflection) did you gain from the design process?” as follows:

Sarah: *Well, you can design everything. It's not closed. It's completely open, for everything. I really didn't expect to have this result now [looking at her prototype].*

Agnes: *No, I really hadn't expected that either. It seemed hopeless at one point. [...] You just have to keep on and on and on, and then you will succeed.*

Researcher: *What did you think design was?*

Sarah: *I thought it was something like...*

Agnes: *Clothes, or something...*

Sarah: *Yes, clothes! That's what you think of when you hear the word design.*

Researcher: *So what do you think design is now?*

Agnes: *I think it's something new; your own imagination that you can think aloud with! You can design many things, like this wall for example [touching the wall].*

Sarah: *Before this, I hadn't even thought about such things. I didn't think, Okay, how can I improve an urban space. But I do now, because we've learned about it here, and you've taught us how to think in this way. [...] You begin to think differently, How could I do this, and What if I did it this way. It's a creative way of thinking.*

As this example illustrates, the students managed not only to create coherent products in response to the design challenge. Through their participation, they also managed to develop a design language and a sense of direction that enabled them to engage dynamically in the complex process of using a range of analog and digital materials in iterative movements of reflection and action. Finally, the interview sessions suggested that the process had implications for their general perception of digital technology and design.

The design case study illustrates how the protagonist approach to PD is explicitly embedded in our outcome measures. A protagonist approach includes questions related to the children's new insights both into design and digital technology and into the reflective stance toward technology in their everyday life.

DISCUSSION

As the case study illustrates, a political PD process has many similarities with more conventional PD approaches such as cooperative inquiry [12, 17] in which children are engaged as design partners. Political PD will draw from the

same toolbox of methods and techniques [40], and the process will seek empowerment by giving children a voice in the design process. However, adopting the perspective of political PD and framing children as protagonists has both epistemological and practical consequences. In terms of epistemology, it frames the objective of participatory work not as the design or testing of a particular product, but the insights, skills, and reflective stance that children develop through the process. This, in turn, serves the purpose of empowering children to take an active role in developing technology and in making decisions about technology in their lives.

In terms of how this is practiced, our case study exemplifies how the process of participation is reshaped by the protagonist perspective. At first glance, the protagonist role looks similar to that of design partner, since both roles imply that children take an active part in designing. However, there are key differences reflected in the way that objective, process, and outcome measures were realized in our case. As described, an important part of supporting the children in taking on the role of protagonist was to create legitimacy and ownership in the process. We deliberately chose a design challenge connected to the children's everyday life in order to motivate them to take on an active role. Additionally, the open-ended design model was used to invite students to employ their own ideas and reasoning in the process. The process itself reflects that the objective was not to conduct co-design or to elicit ideas and requirements from the children, as typically in design partnering, but to support them in developing their own skills.

In terms of outcome measures, the questions and categories listed in Table 2 differ very distinctly from conventional PD approaches in IDC research. While learning from the process certainly takes place in the design partnering, for example, it is not the explicit objective there, nor will it typically be the measure of evaluation. The nine questions (Table 2) proposed for measuring outcomes resonate well with Fraunberger et al. [16], who argue that PD must display an “internal rigor” by critically reflecting how PD processes and outcomes correspond with its epistemological ground.

The overview in Table 1 portrays the protagonist role as separate from other roles. It is important to stress however that in practice children will likely move between these roles during any given process. This point is also made by Druin [11,12]. Moreover, as the “onion model” suggests, any layer of the model will incorporate the preceding one. Hence in any given process the question may be the extent to which children play a given role rather than having one particular role throughout.

Since the protagonist role in general as well as the example provided in our case study emphasize the skills and competence children acquire through participation, it may be argued that this approach bridges the divide between a

design approach and a learning approach. A recent study has looked precisely at the intersection between PD and education [3]. Recognizing this work, we do however see a difference between setting learning goals for design activities and engaging children as protagonists in open-ended inquiries through participatory design.

CONCLUSION

We suggest that political PD provides a new role for children in PD practices—the role of *protagonist*. A protagonist perspective positions the children at the center of the design process as they engage with real-world design problems. The objective is to support their own development of skills in terms of designing and reflecting on technology. Our argument is that these skills empower children to make more informed decisions about technology in their lives. We have illustrated how a political PD epistemology and the understanding of children as protagonists significantly change the objectives, process, and outcome measures of the design process.

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REFERENCES

1. Katerina Ananiadou and Magdalena Claro. 2009. 21st century skills and competences for new millennium learners in OECD countries. Paris: Organization for Economic Cooperation and Development.
2. Jørgen Bansler. 1989. System Development Research in Scandinavia: Three Theoretical Schools,” in *Scandinavian Journal of Information Systems*: Vol.1(1), 1.
3. Wolmet Barendregt, Tilde M. Bekker, Peter Börjesson, Eva Eriksson, and Olof Torgersson. 2016. Legitimate Participation in the Classroom Context: Adding Learning Goals to Participatory Design. In *Proceedings of the 15th International Conference on Interaction Design and Children (IDC '16)*. ACM, New York, NY, USA, 167–174.
4. Tilde Bekker, Saskia Bakker, Iris Douma, Janneke van der Poel, Koen Scheltenaar. 2015 Teaching children digital literacy through design-based learning with digital toolkits in schools, In *International Journal of Child-Computer Interaction* Volume 5, 29–38.
5. Gro Bjerknes, Pelle Ehn, Morten Kyng, Kristen Nygaard. 1987. Computers and democracy: a Scandinavian challenge, Avebury.
6. Paulo Blikstein. 2013. Digital Fabrication and “Making” in Education: The Democratization of Invention. In J. Walter-Herrmann & C. Büching (Eds.), *FabLabs: Of Machines, Makers and Inventors*. Bielefeld: Transcript Publishers.
7. Claus Bossen, Christian Dindler, Ole Sejer Iversen. 2016. Evaluation in participatory design: a literature survey. In *Proceedings of the 14th Participatory Design Conference: Full papers—Volume 1 (PDC '16)*, Vol. 1. ACM, New York, NY, USA, 151–160. DOI: <http://dx.doi.org/10.1145/2940299.2940303>
8. Claus Bossen, Christian Dindler, Ole Sejer Iversen. 2010. User gains and PD aims: assessment from a participatory design project. In *Proceedings of the 11th Biennial Participatory Design Conference (PDC '10)*. ACM, New York, NY, USA, 141–150. DOI=<http://dx.doi.org/10.1145/1900441.1900461>
9. Susanne Bødker. 2003. A for alternatives. *Scandinavian Journal of Information Systems*. 15(1), 87–89.
10. Fenne Van Doorn. 2016. Children as co-researchers in design: Enabling users to gather, share and enrich contextual data, Doctoral thesis from T/U Delft, NL.
11. Allison Druin. 1998. The design of children’s technology, Morgan Kaufmann Publishers Inc., San Francisco, CA.
12. Allison Druin. 2002. The Role of Children in the Design of New Technology. In *Behaviour and Information Technology*, Vol. 21(1), 1–25.
13. Pelle Ehn. 1990. Work-Oriented Design of Computer Artifacts. L. Erlbaum Assoc. Inc., Hillsdale, NJ, USA.
14. Karen E. Fisher, Katya Yefimova, and Eiad Yafi. 2016. Future’s Butterflies: Co-Designing ICT Wayfaring Technology with Refugee Syrian Youth. In *Proceedings of the 15th International Conference on Interaction Design and Children (IDC '16)*. ACM, New York, NY, USA, 25–36. DOI: <https://doi.org/10.1145/2930674.2930701>
15. Christopher Frauenberger, Judith Good, Alyssa Alcorn. 2012. Challenges, opportunities and future perspectives in including children with disabilities in the design of interactive technology. In *Proceedings of the 11th International Conference on Interaction Design and Children (IDC '12)*. ACM, New York, NY, USA, 367–370. DOI=<http://dx.doi.org/10.1145/2307096.2307171>
16. Christopher Frauenberger, Judith Good, Geraldine Fitzpatrick, Ole Sejer Iversen. 2015. In pursuit of rigour and accountability in participatory design. *International Journal of Human-Computer Studies*, 74(0), 93–106.
17. Mona Leigh Guha, Allison Druin, Jerry Alan Fails. 2013 Cooperative Inquiry revisited: Reflections of the past and guidelines for the future of intergenerational co-design, *International Journal of Child-Computer Interaction*, Vol. 1(1), 14–23.
18. Juan Pablo Hourcade. 2008. Interaction Design and Children. In *Foundations and Trends in Human-Computer Interaction*, Vol. 1(4), 277–392.

19. Netta Iivari and Marianne Kinnula. 2016. Inclusive or Inflexible: a Critical Analysis of the School Context in Supporting Children's Genuine Participation. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction* (NordiCHI '16). ACM, New York, NY, USA, Article 63, 10 pages. DOI: <https://doi.org/10.1145/2971485.2971531>
20. Ole Sejer Iversen and Rachel Charlotte Smith. 2012. Scandinavian participatory design: dialogic curation with teenagers. In *Proceedings of the 11th International Conference on Interaction Design and Children* (IDC '12). ACM, New York, NY, USA, 106–115. DOI=<http://dx.doi.org/10.1145/2307096.2307109>
21. Ole Sejer Iversen, Anne Marie Kanstrup, and Marianne Graves Petersen. 2004. A visit to the “new Utopia”: revitalizing democracy, emancipation and quality in co-operative design. In *Proceedings of the Third Nordic Conference on Human-Computer Interaction* (NordiCHI '04). ACM, New York, NY, USA, 171–179. DOI: <https://doi.org/10.1145/1028014.1028040>
22. Ole Sejer Iversen and Christina Brodersen. 2008. Building a BRIDGE between children and users: a socio-cultural approach to child-computer interaction. *Cognition, Technology & Work* 10(2), 83–93. DOI=<http://dx.doi.org/10.1007/s10111-007-0064-1>
23. Ole Sejer Iversen and Christian Dindler. 2013. A Utopian agenda in child-computer interaction, In *International Journal of Child-Computer Interaction*, Volume 1(1), 24–29.
24. Finn Kensig and Jeanette Blomberg. 1998. Participatory Design: Issues and Concerns. *Computer Supported Cooperative Work* 7, 3–4, 167–185. DOI=<http://dx.doi.org/10.1023/A:1008689307411>
25. Monica Landoni, Elisa Rubegni, Emma Nicol, and Janet Read. 2016. How Many Roles Can Children Play?. In *Proceedings of the 15th International Conference on Interaction Design and Children* (IDC '16). ACM, New York, NY, USA, 720–725. DOI: <http://dx.doi.org/10.1145/2930674.2932222>
26. Julia Makhaeva, Christopher Frauenberger, and Katharina Spiel. 2016. Creating creative spaces for co-designing with autistic children: the concept of a “Handlungsspielraum.” In *Proceedings of the 14th Participatory Design Conference: Full papers—Volume 1 (PDC '16)*, Vol. 1. ACM, New York, NY, USA, 51–60. DOI: <http://dx.doi.org/10.1145/2940299.2940306>
27. Maarten Van Mechelen, M. (2016). Designing technologies for and with children: Theoretical reflections and a practical inquiry towards a co-design toolkit. Doctoral thesis defended in June 2016, UHasselt—KU Leuven.
28. Janet C. Read, Peggy Gregory, Steward MacFarlane, B. McManus, P. Gray and R. Patel. 2002. An Investigation of Participatory Design with Children: Informant, Balanced and Facilitated Design. Interaction Design and Children, Eindhoven, Shaker Publishing.
29. Janet C. Read, Matthew Horton, Gavin Sim, Peggy Gregory, Daniel Fitton, and Brendan Cassidy. 2013. CHECK: a tool to inform and encourage ethical practice in participatory design with children. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (CHI EA '13). ACM, New York, NY, USA, 187–192. DOI: <http://dx.doi.org/10.1145/2468356.2468391>
30. Janet Read. 2015. Children as participants in design and evaluation. *Interactions* 22, 2 (February 2015), pp. 64–66. DOI=<http://dx.doi.org/10.1145/2735710>
31. Janet C. Read, Daniel Fitton, Gavin Sim, and Matt Horton. 2016. How Ideas make it through to Designs: Process and Practice. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction* (NordiCHI '16). ACM, New York, NY, USA, Article 16, 10 pages. DOI: <https://doi.org/10.1145/2971485.2971560>
32. Andrew J. Rotherham and David.T. Willingham. 2009. 21st century skills: the challenges ahead. In *Educational Leadership*, 67(1), 17–20.
33. Mikec Scaife and Yvonne Rogers, Y. 1998. Kids as informants: telling us what we didn't know or confirming what we knew already? In A. Druin (ed.) *The Design of Children's Technology: How We Design, What We Design, and Why*. Morgan Kaufman.
34. Rachel C. Smith, Ole S. Iversen, Mikkel Hjorth. 2015. Design thinking for digital fabrication in education. In *International Journal of Child-Computer Interaction* Volume 5, September 2015, 20–28.
35. Rachel C. Smith, Ole S. Iversen, Thomas Hjermitsev, and Aviaja B. Lynggaard. 2013. Towards an ecological inquiry in child-computer interaction. In *Proceedings of the 12th International Conference on Interaction Design and Children* (IDC '13). ACM, New York, NY, USA, 183–192. DOI=10.1145/2485760.2485780 <http://doi.acm.org/10.1145/2485760.2485780>
36. Jesper Simonsen and Tony Robertson. 2013. Routledge International Handbook of Participatory Design. New York: Routledge.
37. James Spradley. 1980. Participant Observation. Holt, Rinehart and Winston, New York.
38. Greg Walsh, Craig Donahue, and Zachary Pease. 2016. Inclusive Co-Design within a Three-Dimensional Game Environment. In *Proceedings of the 15th International Conference on Interaction Design and Children* (IDC '16). ACM, New York, NY, USA, 1–10. DOI: <http://dx.doi.org/10.1145/2930674.2930721>
39. Greg Walsh and Elizabeth Foss. 2015. A case for intergenerational distributed co-design: the online kidsteam example. In *Proceedings of the 14th*

- International Conference on Interaction Design and Children* (IDC '15). ACM, New York, NY, USA, 99–108. DOI=<http://dx.doi.org/10.1145/2771839.2771850>
40. Greg Walsh, Elizabeth Foss, Jason Yip, and Allison Druin. 2013. FACIT PD: a framework for analysis and creation of intergenerational techniques for participatory design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '13). ACM, New York, NY, USA, 2893–2902. DOI: <http://dx.doi.org/10.1145/2470654.2481400>
41. Greg Walsh, Craig Donahue, and Zachary Pease. 2016. Inclusive Co-Design within a Three-Dimensional Game Environment. In *Proceedings of the 15th International Conference on Interaction Design and Children* (IDC '16). ACM, New York, NY, USA, 1–10. DOI: <http://dx.doi.org/10.1145/2930674.2930721>
42. Jason Yip, Tamara Clegg, Elizabeth Bonsignore, Helene Gelderblom, Emily Rhodes, and Allison Druin. 2013. Brownies or bags-of-stuff?: domain expertise in cooperative inquiry with children. In *Proceedings of the 12th International Conference on Interaction Design and Children* (IDC '13). ACM, New York, NY, USA, 201–210.
43. John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through design as a method for interaction design research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '07). ACM, New York, NY, USA, 493–502. DOI=<http://dx.doi.org/10.1145/1240624.1240704>