Exploring the Role of Children as Co-Designers – Using a Participatory Design Study for the Construction of a User Experience Questionnaire

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***Abstract*—The evaluation of interactive products and systems based on hedonistic and pragmatic qualities is an important part of user-centered design. Human-Computer Interaction (HCI) research provides many validated and standardized questionnaires for usability and user experience assessment. However, these questionnaires are not suitable for children as younger users of digital products, as these surveys are developed and evaluated by usability professionals for adult users. Problems may arise due to the length, rating scales and difficulties to understand the content of user experience (UX) questionnaires. This paper focuses on the involvement of children in UX research as co-designers and describes the development of a semantic differential scale for measuring the user experience of children and teenagers (up to age 14). In order to involve children as users in UX studies, little attention has been paid to participatory research as a useful and innovative approach to do user experience research with children. Consequently, the usefulness of the implementation of a workshop with 6 children to develop and design a user experience questionnaire for an interactive learning app for children is discussed. It aims to get a better understanding of the effects of doing research with young teenagers. The results of the workshop show a UX questionnaire measuring UX on pragmatic as well as hedonistic qualities for a specific product. A first evaluation study demonstrates a high internal consistency of the scales.**

Keywords - participatory design; workshop; UX evaluation; semantic differential scale; pupils; user experience.

I. INTRODUCTION

Questionnaires can measure user experience quickly and in a simple way while covering a wide-ranging impression of a product. They are commonly used tools for user-centered evaluation of software and digital products. An important definition of user experience is introduced by the ISO 9241-210 and outlines user experience as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" [1]. It highlights emotional, hedonic, affective and aesthetic components and is typically characterized as fun, pleasure or negative feelings when interacting with a product [8]. Quantitative data about the user's perceptions of a product can be a helpful addition to other methods to assess the strengths and weaknesses of interactive products [7]. In particular, the research field of Child Computer Interaction has focused not only on how to design and evaluate products with and for children, but also on the modification and adaption of suitable survey methods for children and young adults [2][10]. Results show that user experience is not measurable with younger participants without modifications of already established (quantitative) methods [5][16]. Therefore, researchers need to work closely with the target group to identify useful approaches that encourage their perspectives and opinions. Methods need to be adjusted to children and young people´s strength, context and also culture. Therefore, this paper investigates the use of a participatory design study to construct a suitable and understandable UX semantic differential scale questionnaire for children up to 14 years based on the creation of common UX questionnaires [7]. The research question under consideration is whether young teenagers are able to participate in the construction of a questionnaire for a specific product. The development process involves the selection of semantic differential pairs, categories for item pairs, the overall length and a rating scale.

The rest of the paper is structured as follows. Section II describes related work. In Section III, the used method and challenges are illustrated in more detail, whereas Section IV presents findings and results. Section V summarizes the conclusion and future work.

II. RELATED WORK

The following section gives an overview of the related work regarding models of participatory design with children as well as the construction process of user experience questionnaires. Based on these approaches, this study combines the idea of children as co-designers in the construction process of one user experience questionnaire. Afterward, the questionnaire was applied in a user test study to evaluate its reliability.

A. Participatory research with children

The Child Computer Interaction community highlights the advantages of children as active participants in design as well as evaluation studies. The motive arises out of different needs, beliefs and contexts of uses of digital products of experts, adults and children [10][11]. Participatory research with children can mean many things. Normally, it takes the theoretical viewpoint that children are experts and having competencies in specific settings. The level of involvement varies. Listening to children's opinions, supporting them to reflect on their opinion and include their views into research processes is one approach to perform participatory research

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with children [13]. Different stages of participation can also mean that children as researchers identify and develop research questions, choose appreciate research methods, overtake the role of a researcher and are also included in the interpretation and evaluation of collected data [6]. The approach includes the design and development of a UX questionnaire in the context of a UX-workshop with 6 pupils from one class from a comprehensive school (grade 7, age between 12 and 13, m=3, f=3) in Germany. The pupils act as co-designers and are put in charge of the questionnaire creation. This approach is based on the construction process of many standardized UX questionnaires [3].

B. Construction of UX questionnaires

Good user experience is important for the success of interactive products. There is a large number of standardized UX questionnaires for measuring user's subjective perception and opinions of products and different components of UX. The AttrakDiff [3], as well as the User Experience Questionnaire (UEQ) [7], apply a semantic differential scale to measure UX, whereas the Modular Valuation of Key Components of User Experience (meCUE) [9] and the Visual Aesthetics of Websites Inventory (VisAWI) [14] consist of statements with a 7-point Likert scale. They have in common to quickly measure user experience, but are not suitable for the needs of children and teenagers. In general, UX questionnaires are developed within a workshop of usability professionals and validated in several user studies [12]. In the case of the German User Experience Questionnaire, the authors describe user experience based on aspects of pragmatic and hedonistic qualities. A set of 229 items were brainstormed and reduced in several studies to 80 items. 6 scales, as well as 26 items, were extracted by factor analysis. The scales include attractiveness, perspicuity, efficiency, dependability, stimulation and novelty [7]. In the research area of Child Computer Interaction, Hanna et al. [2] recommend the use of pairwise comparisons for the evaluation of interactive products with children. Zaman [16] introduced a pairwise comparison scale for the evaluation of UX with preschoolers. The author suggests that a pairwise comparison scale with 5 items leads to reliable answers from preschoolers in terms of system preferences, but the multidimensional of UX is not quantitatively measurable.

III. METHOD

The next sections report on the construction process of a UX questionnaire within a creative workshop by using participatory design. The workshop is divided into two parts. The first phase aims to give the pupils detailed and adapted information about the concept of user experience and UX questionnaires and the need to evaluate interactive systems within a user-centered design. Moreover, the UEQ [7] and its elements (number and order of items and scales) are explained and serve as an example for a UX questionnaire. This phase also includes a 30-minute testing time of an app under consideration on two mobile devices. After creating a profile and choosing one subject, the participants can play and use the different functions of the learning app [4]. The app itself consists of five different subjects. The user has to complete lessons to earn points. The collected rewards can be redeemed in several games. With this approach, the pupils get a better impression and understanding of the system. After this introduction follows the construction phase of the questionnaire. The task is to develop and design a questionnaire that includes all the necessary elements and items that are needed to evaluate the app. The pupils work together to find and discuss useful contrasting words and phrases for the evaluation of the learning app. In the beginning, the participants had difficulties to get started, as they cannot find words to describe the app. Therefore, the researcher asked the children again about their feelings and emotions when interacting with the app. It presented a starting point for further suggestions from the children. Figure 1 shows a translated version of the constructed UX Kids questionnaire.

Questionnaire for the Anton-App: Please give your opinion.

1. Learning development

		1	2	3	4	5	
1	easy	☆	☆	☆	☆	☆	difficult
2	suitable for learning	☆	☆	☆	☆	☆	Not suitable for learning
3	achieved study goals	☆	☆	☆	☆	☆	Not achieved study goals
4	Sufficiently for learning	☆	☆	☆	☆	☆	Not sufficiently for learning
5	It motivates to learn	☆	☆	☆	☆	☆	It does not motivates for learning
6	progress	☆	☆	☆	☆	☆	no progress

2. Overall impression of the app

7	exciting	☆	☆	☆	☆	☆	boring
8	It works well	☆	☆	☆	☆	☆	bad
9	It works fast	☆	☆	☆	☆	☆	slow
10	Fun	☆	☆	☆	☆	☆	serious
11	entertaining	☆	☆	☆	☆	☆	not entertaining

3. Design and appearance

12	well structured	☆	☆	☆	☆	☆	Not well structured
13	friendly	☆	☆	☆	☆	☆	Not friendly
14	joyful	☆	☆	☆	☆	☆	sad
15	colorful	☆	☆	☆	☆	☆	simple
16	tidy	☆	☆	☆	☆	☆	untidy

4. Are you satisfied with the Anton App?

Yes ☐ No ☐

5. Please explain why you are satisfied or not satisfied with the app.

Figure 1. The created UX questionnaire (translated version)

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In the beginning, the brainstorming session is based on an oral discussion, whereas later the pupils use a whiteboard to write down randomized words and phrases. In the end, the pupils decide to organize antonyms in categories. The workshop took place during school time and lasted 2 hours with the absence of teachers. During the workshop, the researcher provided a passive role and did not participate in the discussion. To avoid further influence through the researcher, the shown presentation excludes judgmental statements about the app. In case of a possible failure of the workshop process, several slides with potential words and synonyms were prepared for discussion and selection with the participants. Observation, as well as writing notes, are used to document the development process by the researcher. Cronbach´s Alpha as an index for scale reliability is used to assess the questionnaire [15]. Regarding the selection and participation of children, teachers were given an introduction to the research topic. Written consent by parents or legal guardians was essential to participate in this study. Moreover, all children gave oral consent for each activity.

Examining the construction process and the interactions of the pupils, some challenges and effects appeared that need to be addressed. The workshop format illustrates that the role of the researcher is to be a contact person for questions or problems that might arrive during the construction process. It seems as the pupils are hesitant in the beginning and not sure how to start the brainstorming session. To support the discussion session, the researcher asked about their feelings and impressions of the app while interacting with it. In the following hour, the workshop is being maintained by word suggestions and discussion of opposing words or phrases, item pair by item pair by all children. For example, there is a long debate about the opposite of the word “fun”. In the end, the pupils decide on the word “serious”. The pupils decided on an approach to collect as many words as possible to evaluate the app and debate the usefulness of the words.

It appears that overall not more than 20 antonyms are being reviewed. Regarding the scale, the pupils discussed several options and decide on a 5-point Likert scale with stars, as they argue that it might be easier to understand and looks more aesthetic than points. To create greater comprehensibility of the questionnaire, the children consider adding words like good, medium and bad on top of the answer categories. They notice that giving an answer and competing the questionnaire, based on the contrasting items, already shows a tendency towards a word and therefore decide against this idea. As a result, it is questionable if the pupils fully understand the concept of a rating scale. Simplicity is also one reason to order pairs into positive (left side) and negative (right side) on the questionnaire. To provide extensive feedback, two additional questions were added. It consists of one closed question and one free text field for written responses. The workshop ends with the organization of words into categories, which is initiated by one pupil. It is questionable whether the concept of the workshop design is fully understood by the children, as finding words to evaluate the app seemed to be a difficult task. Nonetheless, the participants understood the need to design and adapt a questionnaire based on children's competences, as the understandability for younger pupils was taken into account during the brainstorming session and discussion of useful words.

IV. FINDINGS & DISCUSSION

The following section presents the findings of the study for the workshop results and the newly developed user experience questionnaire designed by children.

A. Comparison to the User Experience Questionnaire (UEQ)

All in all, the UX Kids questionnaire contains 16 antonyms in 3 categories. It includes “learning development”, which deals with the quality of the content, if the system motivates or if it is adequate for learning. The category “overall impression of the app” contains item pairs for functionality, efficiency, fun and entertainment. The third category is called “design and appearance” and contains 5 items of color design and purpose. Additionally, an overall evaluation with one closed question: “Are you satisfied with the app?” and one free-text field for further explanations was added. Interestingly, not only the word selection but also an appealing design of the questionnaire seemed to be important. In comparison to the UEQ [7], many differences can be identified: The UX questionnaires differ in length, the number of items, rating scale and the number of scales. The UX Kids questionnaire also includes an overall evaluation question as well as a qualitative free-text field option to give a detailed review of the learning app. Interestingly, both questionnaires evaluate UX based on pragmatic as well as hedonistic qualities of an interactive product. Therefore, children view not only design and aesthetics as important factors for evaluating a learning app, but also the quality of content, usability and functionality. In particular, the content of a system is typically not part of UX instruments.

The comparison shows that children can take the role of an “expert” to do user experience research. It shows that a participatory approach can support children as co-designers to conduct user-centered studies, as the result consists of similar assumptions of the concept of user experience.

B. Evaluation of the UX Kids Questionnaire

To analyze the performance of the newly developed UX instrument, it is applied in a user test study to evaluate the UX of the learning app with 230 pupils from grades 6 and 7 of a comprehensive school in Germany. During a playtime of 20 minutes, the pupils explored the app on mobile devices in groups of three or four children. Afterward, the participants were asked to fill out the questionnaire in order to evaluate the app. 207 children completed the questionnaire and gave useful feedback about their opinion and possible improvements. Table 1 shows the Cronbach´s Alpha values for the full questionnaire and all three scales. The statistical analysis demonstrates a Cronbach’s Alpha of 0.88 for the newly developed questionnaire, which proves the high internal consistency of the scales [15].

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TABLE I. CRONBACH´S ALPHA PER SCALE

Scale	*α*
Overall	0.88
Learning development	0.75
Overall impression of the app	0.80
Design and appearance	0.71

V. CONCLUSION AND FUTURE WORK

This paper investigated the use of participatory design to construct a UX questionnaire for and with children and teenagers based on participatory design and early user involvement. The workshop approach shows that with an appropriate introduction to the topic of UX and evaluation, participatory design is a valuable method to do user experience research with children. Due to children's different perceptions, abilities and use context of interactive products, methods need to be adapted to their needs. Within a collaborative brainstorming session, the target group is able to do identify words and item pairs to evaluate the learning app and discuss them. Based on this research, it can be concluded that quantifying the user experience of younger users is possible within a participatory design study. The questionnaire is suitable to be used with qualitative methods to measure the multidimensional construct of UX of a specific product.

Further research involves the evaluation of the UX Kids questionnaire in user studies with pupils from a comprehensive school in Germany to verify the reliability and validity of the questionnaire with a statistical analysis and also with different learning applications. More research into suitable methods for measuring children's user experience is needed, as the participatory design study revealed some difficulties in regard to UX research with children. In particular, quantitative UX methods for younger children aged between 12 old and younger need to be explored and validated. Further research should also go more deeply into other possibilities to measure UX quantitative or in mixed methods approaches.

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