From Game Design with Children to Game Development with University Students

What Issues Come Up? *(Preprint)*

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ABSTRACT

This paper reports on the development of game design ideas by children. These were specified in structured informal documents and low-fidelity paper prototypes. University students were challenged to develop children's informal specifications of games into high-fidelity interactive prototypes, and to have these tested with children. What issues did university students encounter in children's informal specifications? This paper answers such questions by explaining the organization of the development process for students in as much details so as to allow for its analysis and replicability in different contexts.

CCS Concepts

•Human-centered computing → Empirical studies in interaction design;

Keywords

Game design; game development; interaction design and children; children as game designers

1. INTRODUCTION

Diverse interaction methods allow designers to create interactive products for and possibly with children, with different levels of involvement and product maturity, according to the adopted techniques [8, 9]. Informant design methods and participatory design methods are typical examples [11]. Those or similar others taking children's ideas directly into design are likely to meet children's interaction design requirements. However such methods are also demanding on all participants, especially when working at school, e.g., [2, 9]. In case of complex products to design, they also requires participants a certain level of commitment to learn, besides rather mature cognitive skills.

Games are the prototypical examples of such products: although they are appealing for children, even their early design can be complex to master—also for design experts. Designing a game means stepping through: the ideation of the so-called high-level concept, demanding designers to think of actions for reaching a goal; in case the game has levels, designers have to establish the chore mechanics for the rules and progression across levels, besides the aesthetics, including the feedback; in case the game requires a storyline (which games tend to have nowadays), designers have to make it consistent with the game mechanics and aesthetics [1].

In brief, designing games requires not only creativity but also several cognitive abilities, ranging from problem solving, logic to working memory, the maturity of which also depends on children's age. Despite that, they have become the design objects of a number of recent design studies with children in the area of participatory design, probably due to their popularity and pervasiveness.

This paper starts from a game design experience with children and posits the following question: can the resulting game design be taken as-is in the hands of game developers? The paper briefly outlines the experience, run in 2014 with primary school children. It then moves to its core matters and explains how the resulting game design documents and prototypes were assessed and used by computer-science university students to develop high-fidelity prototypes of games. Lessons learnt are discussed in the conclusions to the paper.

2. RELATED WORK

Different methods have been devised for designing with children. In participatory methods, intergenerational teams are usually created, with children and adult researchers. The study reported in this paper follows a participatory approach and sees researchers working with children, but it has only one product design expert and one expert of development studies per school class, who acts as observer, like in the studies reported in [13]. Moreover, children and the design expert have different roles in the work hereby reported: the former are realizing design concepts and low-fidelity prototypes in teams, using specific material and tools, whereas the latter scaffolds their work by providing evaluation feedback during and after each design session.

Another interesting work for this paper is reported in [10]: working with participatory design techniques, children and adults "ideated games", which were recorded in captioned videos and then developed "around the world" in game-jam sessions by students or other game developers. In this paper, instead, children developed prototypes and specified them in documents like adult game designers, albeit with material specific for children. Students from computer science were then asked to develop high-fidelity prototypes of games

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starting from such "specifications"—game design documents and prototypes. Therefore the challenge of this paper's work is not investigating children's expectations and getting inspired by children's ideas; rather the challenge is assessing how far those specifications by children can be used as-is by students in order to develop interactive prototypes.

3. DESIGN OF GAMES WITH CHILDREN

A game design activity was run in Spring 2014 in primary schools. The activity involved two classes from two different primary schools in North-Eastern Italy. Children were, in total, 35 (59% females), coming from a variety of socio-economic backgrounds. Classes were of different ages and sizes: the younger class was of $n = 15$ children, in grade 3, with mean age = 8.85 years, SD = .44; the older class was of $n = 20$ children, in grade 4, with mean age = 9.72 years, SD =.47. The design work in each school took a total of five sessions. Each session was organized in a different day of different weeks, and lasted circa two hours and a half. All children participated on a voluntary basis, and their parents authorized their participation through a written consent form. The same game design expert was present in all game design sessions.

Design work at school was organized in line with GaCoCo, a participatory method allowing experts to work on the early design of games with children. GaCoCo was introduced in [5] and incrementally refined as explained in [6]. GaCoCo relies on cooperative learning and gamification for playfully engaging all children in group work; the results of the 2014 game design activity in terms of children's engagement are reported in [7] from a qualitative viewpoint and in [3] from a quantitative viewpoint. In 2014, each design session was organized as a gamified mission with a specific goal, using tangible gamified material for conveying a sense of progression, control and relatedness to children, such as progression maps. In particular, cooperative learning strategies for small heterogeneous groups were set in the GaCoCo protocol for children. Starting from a story read in class and acting as storyline, each group was asked to design their game with ad-hoc material. At the end of each mission (game design day), each group released a part of their overall *game design document* and of the companion low-fidelty paper *prototype*, e.g., see [1].

Moreover, two game design experts conducted a formative evaluation of children's products, released at the end of the daily mission; one was the expert present in classroom during the game design activity. Using game heuristics of [4], they traced how the quality of children's products evolved in time, reporting the encountered issues in a structured manner. Children's game design products released in the last missions and the reported issues are the starting point of the following work.

4. DEVELOPMENT OF GAMES WITH UNIVERSITY STUDENTS

4.1 Introduction

Students from the software engineering course of the second year of the Bachelor program in Applied Computer Science were asked to develop high-fidelity interactive prototypes of games conceived by children, starting from the game design documents and the accompanying low-fidelity prototypes released in the last mission in each primary school—children's game products. Since the course enrolled five groups of students, the aforementioned game design experts and course teacher chose five products to develop, selecting those which minimize the number of issues and satisfy technical constraints of the course, e.g., the technical need to develop 2D games in C^{++}. This section specifies the principles of the approach followed in organizing the course at university, and then the development activity itself.

4.2 Development Approach with Students

Following the guidelines by Oakley et al. [12] and in line with cooperative learning principles used in designing games with children, the course instructors formed heterogeneous groups with members who are diverse in programming skills but have common blocks of time to meet outside class. Each group foresees three different roles: coordinator, recorder and checker. As with children, also roles rotate among students of a group. Instructors assign a game development task to each group.

4.3 Development Activity with Students

4.3.1 Participants

The development team is formed by five groups of students, each of three members. All participating students had already passed courses of advanced programming, data structures and algorithms. Even though they are not seasoned programmers, they were judged to have sufficient expertise to understand, analyze, design and develop a working software solution under the guidance of their course instructors and the two game design experts who had evaluated children's products during the game design activity with children. In particular, the game design expert who had worked with children at school acts as mediator between the game products by children and their development by university students: she collects questions and remarks by these; she answers questions in case children's specifications are unclear and tracks what is unclear.

4.3.2 Activity

For the product development, the resources at hand are a programming Integrated Development Environmnent (IDE), and a collection of pre-furnished graphics elements (e.g., sprites and backgrounds).

Groups of university students had about three months of time to deliver their game interactive prototypes. In developing games, an iterative incremental approach is adopted. Groups submit a weekly brief report, which describes the state of the project and future plans. The report is used as a basis for twelve meetings with instructors. In the kick-off meeting, groups are formed and the structure of the activity is explained by one of the instructors. Then each group decide their own name, read the so-called policies statement provided by instructors, and write their expectations agreement.

In six of such meetings with instructors, students also meet the game design experts. The first time students get to know the game-design project with children. In the second and third meetings students read documents and inspect low-fidelity prototypes by children. In the fourth and fifth meeting, students comment on children's products and, in case needed, ask the game design experts clarification ques-

tions.

In the sixth meeting, held towards the middle of the course, students deliver a presentation in front of the other development groups, instructors and the game design experts. The goals of this presentation are: 1) to share relevant information with other groups concerning similar game design or development issues; 2) to share the progress of their work with the game design experts. At this point, game design experts run an expert review of game prototypes and give students feedback for improving on them.

Results of the expert review are used by students to fix major development issues before their prototypes are evaluated in small-scale studies with children, with game design experts acting as evaluation moderators. Study results are specified in documents by experts and fed back to students, who use these results for improving on their work in the remaining part of the course.

5. GAME DEVELOPMENT ISSUES

5.1 Introduction

In their game development, students reported issues meant for the game design experts and concerning game design products by children. A thematic analysis was conducted on the issues reported by students by the two course instructors and the two game design experts. Instructors and experts first worked separately and then together. Issues for the game development by students were finally categorized as explained below.

5.2 Results

Issues that students found in developing games were clustered into five main categories: gameplay and mechanics inconsistencies or unclear functionalities; gameplay and mechanics incompleteness; development; audience; game design understanding. The first two categories are the same used by game design experts to classify issues found in children's products. The other categories are novel. All are explained in details in the following.

5.2.1 Gameplay and mechanics inconsistencies or unclear functionalities

Students sometimes noticed issues concerning inconsistencies or unclear functionalities in gameplay or mechanics. Students remarked them or advanced proposals to solve them. Issues in this category include what follows.

1. What are powers for?

2. What is the function of objects? They are only mentioned without giving further details.

5.2.2 Gameplay and mechanics incompleteness

Students advanced solutions concerning gameplay and mechanics, missing in children's game design. Issues in this category include what follows.

1. How long is the game expected to last?

2. Should we also create an introduction video to the game?

5.2.3 Development

Students sometimes asked instructors questions concerning implementation details. Issues in this category include what follows.

1. Where do we get graphics elements and sound?

2. For which platform should we implement the game?

5.2.4 Audience

Students sometimes wondered about specific requirements of the intended players wrt games. Issues in this category include what follows.

1. Our idea was to provide children a very nice, easy to understand game. By considering also the current trend, is it possible to implement a 2D game?

2. Which should be the official language of our game? English? Or the native language of children?

5.2.5 Game design understanding

Students sometimes asked the game design experts questions concerning design choices already specified in documents or in prototypes. Issues in this category include what follows.

1. Is it ok if we interpret slaps to guards as scored questions that have to be answered by the player? (This is inconsistent with the game design document).

2. How do you complete the first level? (This was specified in the game design document).

5.2.6 Analysis

A total of 39 issues were recorded, distributed among the aforementioned 5 categories. One third of issues (33%) are concerned with game design understanding questions, whereas 23% are concerned with development issues. A qualitative analysis of issues concerning game design understanding reveals that they are mainly related to animatable objects or interaction elements that are present in prototypes but are not fully specified in game design documents.

Finally, students reported issues pertaining to inconsistency, incompleteness and unclear functionalities of gameplay and mechanics in the children's game products. Some of these were the same found by game design experts at the end of the design activity with children; other issues were found by students, e.g., the need of tutorial videos for delivering instructions concerning gameplay.

6. DISCUSSION OF RESULTS AND LESSONS FOR THE FUTURE

According to the above analysis, issues concerning gameplay and mechanics, left by game design experts as requirements of children, were also detected as issues by students. The incompleteness of gameplay and mechanics in children's products was detected, and students proposed design solutions, e.g., tutorial video for the gameplay. Other issues pertaining to unclear functionalities of elements for gameplay and mechanics, which were not classified as issues by game design experts, were generally related to powers and roles of characters. According to the explanation given to students by the game design expert working with children, children had specific functionalities in mind for powers and

roles of characters, but were unable to realize them properly in paper-based prototypes or to specify their functionalities clearly in documents.

Game design understanding issues were also high in number. According to their qualitative analysis, these issues are related to the interaction and animation, which are not rendered in low-fidelity prototypes nor always fully explained in game design documents.

All such results can be useful to game designers willing to work with or for children. For instance, limitations in children's products reported in this work could be due also to the choice of design material: paper-based prototypes cannot convey interaction and game design documents by children, alone, were not sufficient in that respect as specifications for university students. Such specifications could be complemented with recordings of children's play-testing of their games, like in [10].

Alternatively or additionally, children's game design documents could be completed by adult game designers before being handed over to developers, so as to fix remaining issues concerning unclear functionalities and incompleteness of gameplay and mechanics elements. The expert game designer, sitting in class with children, seems a promising candidate for completing game design documents before passing them on to developers, in an act of collaborative design across generations of learners.

7. CONCLUSIONS

This paper reported a game design experience with primary school children, and how it evolved into a game development experience with university students.

More specifically, the paper starts tracing how game products released by children were evaluated using game heuristics by two game design experts, and treated as products "by adults". Specific albeit few issues were remaining in products released by children, also after the experts' feedback. University students from computer science were then challenged to develop children's products into high-fidelity prototypes of games, starting from products released by children. Issues that students found in developing games were also tracked and categorized. According to the conducted analyses, children's products were in general clear but not sufficient as specifications for university students, in particular due to incompleteness or unclear functionalities of gameplay and mechanics elements.

The paper concludes discussing the available results and drafting first lessons for future editions of game design activities with children.

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