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The introduction of IMO, an integrated model for designing for open-ended play ☆

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ABSTRACT

Designing for open-ended play poses specific new challenges to designers. Designing for closed games includes defining rules and goals to balanced the game properly. A design for open-ended play has no predefined rules and goals. The design needs to provide users with more freedom to continually change goals and rules of play, which distinguishes the field from designs of closed games. Gaining knowledge on the design process of creating this freedom is essential. For this purpose, an integrated model for open-ended play is proposed. This model is based on a combination of two existing models: Hunicke's Mechanics Dynamics and Aesthetics (MDA) model and Grünvogel's formal models for game design. Both of the above mentioned existing models are generalized to make them applicable for analyzing open-ended play. In the proposed combined model we distinguish between the perspectives of the design, and the perspective of play. It addresses how to handle changing rules and goals, instead of the assumptions that rules and goals do not change. Furthermore, the model was used to improve our understanding on progression and emergence, two key concepts that are commonly used in game design. The *integrated model for open-ended play* (IMO) was used in a preliminary case study with a digital play application, an interactive environment for open-ended play named the GlowSteps, to evaluate the model and to underline our insights on emergence and progression.

1. Introduction

Mankind has developed designs for play in many forms since play began. When children play freely, they often use attributes, or designs in play. Nowadays modern digital technology has changed the way we play. For example, the introduction of the video game has created a new and immersive category of designs for play. Computer games are often designed to create a fine balance between the player's skills and the challenge the game provides [1], resulting in an immersive flow experience [2]. The challenging nature of computer games makes them very appealing; however, the focus on screens makes children less physically and socially active [3].

Unlike many rule-based computer games, designs for open-ended play aim to provide play materials or toys in which rules and goals are less defined beforehand. The design supports the children in defining their own rules and goals during play [4]. Examples of traditional non-interactive play materials for children aimed at open-ended play are LEGO, wooden building blocks, or a sandbox. The advantage of this approach is that designs for open-ended play create possible ways for children to express creativity [5]. The use of open-ended play in playgrounds might open opportunities for ongoing physical play as well. Many research projects focus on the use of appealing mechanisms of computer games in design for physical play, for example [6–8]. In our research project, we investigate how designs for social-physical play benefit by a more open design approach, to create a longer and more diverse play experience, which we refer to as richness in play [9]. We aim specifically at digital applications for open-ended play.

Game design literature provides game designers with many theories and tools to support the process of developing a game, for example [1,10–12]. In addition, *emergence* and *progression* are two commonly used concepts to characterize the development of game play [10,13]. While progression refers to the development in play, say the logical movement of one moment to the other, emergence describes the property of many games in which new situations arise,

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enabling freedom of players to shape/reshape the game. Game designers tools, methods and models aim to support designers to shape rules and goals in such a way that the game play progression or game flow can be improved. However, existing tools and design methods approach rules and goals as time independent and non-changing during play. When creating designs for open-ended play, this no longer applies, since the rules and goals are flexible and not defined in detail beforehand. Traditional game designer tools thus are no longer fit for purpose. Therefore we need models that support a design approach for open-ended play. Some examples of research in open-ended play are known, for example: Tetteroo et al. [6], who uses a model with 3 interaction design levels to describes a four step design process. To the best of our knowledge no generally usable tools are available, that links *design properties* and *formal description* of interactions, rules and goals, to the resulting development of play. This is why we believe new tools are needed to design and evaluate designs for open-ended play.

In this paper we present an *Integrated Model for designing for Open-ended play* (IMO) that addresses the consideration of a less defined setting of rules and goals. IMO is based on two existing game design models. The first is the Mechanics Dynamics Aesthetics model (MDA) [14] that relates design aspects to user experience. The MDA model provides an analytical view on how aspects of the design, the mechanics (for example: the chess pieces, the game board and game rules) are related to the actual game play, the dynamics (for example: a chess player forms a strategy and strikes on pieces of an opponent player). This relates to the question how a design for open-ended play leads to a specific development in play. The second is Grünvogel's formal model [15] that helps to describe games as systems, relating states, transition rules, and interactions. Grünvogel's model [15] provides us with a formalized descriptive tool to define elements of the game in detail. This can help us to define the properties of the design for open-ended play in a more systematic and detailed way. We argue that the above-mentioned existing models for game design are not sufficient for the design of interactive open-ended play, and generalizations of the MDA model [14] and Grünvogel's formal models [15] are needed. In this paper we propose such generalizations that allows for the description of the open-ended play dynamics.

With the development of IMO we expect to provide a framework to investigate what processes influence the development of open-ended play, and how rules and goals emerge, based on the design for play. Furthermore, one of our aims is to develop IMO as a tool to be able to better define emergence and progression in open-ended play. Subsequently, we aim to support designers and design researchers in creating and evaluating interactive environments for open-ended play with IMO. The presented model may provide design researchers with a structure for analyzing the design for open-ended play. The different layers of IMO can help to evaluate how design choices influence the development of play, and how the design might be improved. Thereby we expect such a model might be able to provide designers with better tools to create effective designs for open-ended play.

In this paper we will show how IMO can helps us to understand how the interactions opportunities of the system can be improved, which is the first step in working towards more immersive play experiences. We will underline this approach with reflecting on observations from a pilot study. In this reflection we will show IMO provided us with a structure in which we could pinpoint how designed properties of the design influenced play. The formalized approach made clear how rules and goals developed in the different play sessions. This led us to new insights on emergence and progression in open-ended play.

This paper is structured as follows: the context of this work is sketched in Section 2, where an overview of related work and our own research project is given, including a motivation for the presented work. In Section 3 we briefly review the theoretical background of the models we use and discuss the principles of progression and emergence in more detail. In Section 4, we propose generalizations of MDA and Grünvogel's formal models to make them applicable to open-ended play. This is where we introduce IMO. Next, we describe our new insights concerning progression and emergence that IMO provided us. In Section 5, we describe an initial evaluation of a design for open-ended play, based on a pilot study. We discuss the applicability of IMO and we link our insights on progression and emergence to the pilot study. However, providing full proof of concept is not the aim of this paper, but the presented evaluation does underline our initial insights. Finally, we discuss the potential of IMO for future research.

2. Related work

2.1. Related projects

With respect to our work, we describe several related existing designs for physical play. Several examples of play installation use interactive elements to enrich playgrounds, and trigger physical play. *Icon* [16] and *Yalp* [17] are interactive outdoor playgrounds that use interactive elements, such as sound and light, to enrich an outdoor playground. These examples trigger physical play, yet they have predefined games, which players can select with help of some kind of interface. *Head-up games* (HUGs) [18] are handheld devices that provide an interactive addition to most existing outdoor games like Tag. The games developed with HUGs are rule based; yet the design does provide more freedom in play of children. The *Play-ware technology project* [8] investigates how a modular system of play tiles can be arranged and programmed to support play for children. In this project an artificial intelligent software platform drives the interactions and adapts those interaction to the situation on the playground.

Examples of interactive designs for open-ended play are *ColorFlares* [4], *Krul* [19], *Morels* [20] and *MagicBuns* [21]. All of these examples are interactive tangible objects that provide opportunities for play, without providing rules and goals for the actual game-play. *ColorFlares* [4] provides simple local interactions, where an object has a colored light. Users can influence the colors of objects by specific actions. *Krul* [19] provides different abstracted sounds depending on how the orientation of the object. Children can use the object and the sounds to enrich their play. For example: in one of the observations with 'Krul' a child pretended he was fueling a car holding 'Krul' diagonal by using an abstract water like sound [19]. Afterwards the child held 'Krul' horizontal, and used a machine like sound of 'Krul' to act out he was driving the car [19]. *Morels* [20] are soft interactive objects, which can be thrown, kicked or squeezed. Two morels in each other's vicinity provide sound feedback. Furthermore squeezing it can charge a Morel, which will eventually results in launches the other Morels. The variety of opportunities to interact with morels, create option for players to define different games. *MagicBuns* [21] exists of five interactive O-shaped objects that can light up in various colors. Users who play with *MagicBuns* [21] have to explore the interaction opportunities, assign meaning to them, and are free to use them in play, in any way. For example: players might define rules for active games like interactive tag by use of the MagicBuns design. In the examples above the designs support open-ended play, yet the interactions programmed in the objects are not adaptive. In our project we aim to enrich the play experience by providing different interaction opportunities in different play situations.

Many of the examples above include multiple interactive objects. Collections of objects are combined together, which form