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Additional Information

KINDERTIVITY: Using Interactive Surfaces to Foster Creativity in Pre-kindergarten Children.

Vicente Nacher, Javier Jaen

ISSI Group, Dpto. Sistemas Informáticos y Computación, Universitat Politècnica de València.

{vnacher, fjaen}@dsic.upv.es

ABSTRACT

Taking into account the existent educative and pedagogical techniques, which have proved its effectiveness to foster the innovation and creativity, this thesis poses to develop, experiment and evaluate a new technological framework based on interactive surfaces to be applied in the context of preschool education. The goal is to facilitate the three factors required for creative learning: knowledge, creative thinking and motivation but taking into account the cognitive and interaction limitations of these very young users.

Categories and Subject Descriptors

H.5.2. [**Information interfaces and presentation**]: User Interfaces - Evaluation/methodology, Interaction Styles

General Terms

Design, Experimentation, Human Factors, Standardization

Keywords

Pre-kindergarten, Touch interaction, Education.

1. INTRODUCTION

The European Union recognizes creativity as a key factor for the economic development, hence, "Increase the creativity and the innovation, including the entrepreneurship spirit, in all levels of the education and training" is the 4th goal of the strategic framework for the European cooperation in the field of education and training and it is one of the constituent elements of the new R&D strategy in the 2020 Horizon [3]. This is a necessary strategy because, as Cropley points out [5], the traditional education systems tend to frequently assume the existence of one valid answer (or, at least, a preferred one) for any type of problem. This fact prevents the generation of new ideas and innovation processes. According to this, a creative student, or with a different cultural basis, can be considered as a distortion source or distraction in the knowledge acquisition process imparted by the teacher. However, while the individual ability to obey exactly the given orders with discipline were in line with necessities of an industrial society and massive production systems, the ability to be part of collaborative processes and direct the divergent thinking as the motor of creativity and innovation are essentials nowadays in the *information society*.

Fostering creativity must be addressed from a very early age, even in the preschool phase, since the main cognitive processes associated to creativity have their sources in this phase of the individual development [6]. Moreover, the technological support to be used when developing creative characteristics in pre-kindergarten children is critical since the choice of the underlying supporting technology has a great impact on the nature of the pedagogical activities to be performed in a creative learning context.

The initial hypothesis for this thesis is that it is possible to trigger in a more effective way creative collective constructivist processes in pre-kindergarten children through the participation of multiple users in physical spaces of shared games based on interactive surfaces. Therefore, we pretend to study the use of these surfaces in the early phase of the cognitive development and its suitability for the creation of educational tools.

2. RELATED WORK

Multi-touch technology has evolved quickly in recent years, from the adoption of graphical user interfaces to its wide acceptance nowadays [1]. This technology offers new sophisticated input and processing mechanisms that enable users to interact in a more natural and intuitive way [19]. These characteristics have triggered a new approach to developing applications for even very young children. Supporting this evidence, the Horizon report [10] identifies mobile devices (smartphones and tablets) as one of the two emerging technologies suitable for children under two years old and Rideout pointed out that children between zero and eight years old are frequent users of digital media and they meet with touch technology often before they can even speak [4].

This inherent ability of touch systems to engage children's attention is being widely exploited to promote learning activities from pre-kindergarteners to adolescents [12, 18, 11]. Moreover, some studies have demonstrated that the technology can also be used to promote collaboration between peers [16, 17, 7] and to foster creativity [8, 2].

However, the increasing interest in multi-touch technology has not as yet given rise to studies on the design of multi-touch systems for the youngest age range (2-3 years old) [9].

Taking into account the previous works, we believe our proposal is a step forward because of the following reasons: (1) the suitability of the interactive surfaces to support social learning since several subjects share the same physical space and, as it happens in traditional technology-free games, the communication during the creation process, experimentation and reflection is direct and no mediated by a computer. (2) The collaborative nature of the technologic infrastructure, in which users can carry out different tasks in parallel and on the same table; and (3) the creative nature of the infrastructure in which users select the game elements and the reactive behavior that its offer. This allows educators to have a direct feedback about the evolution of children's creative mental models. These models are internalized in a collective way since the activity itself is based on reflection, creation and experimentation processes. The goal is that also educators have a tool on which they can measure in an effective way the level of knowledge development, in depth and breadth, of

the divergent/convergent thinking processes and the motivation of users in the activity.

3. CONTRIBUTION

In order to assess the actual skills of pre-kindergarten children with interactive surfaces, we have performed an evaluation of a set of basic multi-touch gestures [14]. The results showed that although only the tap and drag gestures are used in commercial applications targeted to pre-kindergarten children, there are additional multi-touch gestures that can be performed by them (one finger rotation, scale up and scale down). In addition, this study provides a set of design guidelines to define and improve the interactions of these particular users. The application of several of these design guidelines [15] showed that more problematic gestures, such as double tap and long press, can be suitable for pre-kindergarten children too.

On the other hand, we have carried out another study addressing communicability of multi-touch gestures [13] and the results proved that the use of animated languages to communicate gestures to pre-kindergarten children is possible. This opens a new opportunity to new studies with training sessions in order to evaluate the acquisition ability of this type of languages with these young users.

These preliminary results have been published in international forums and allow tackling with a lot of motivation the important milestones that this thesis poses. To sum up, the main milestones of the thesis are the following:

-**Contextualization**: the evaluation of the types of interaction that can be performed by pre-kindergarten children in multi-touch surfaces.

-**Assistance**: the definition of assistive techniques of interaction that allow the increase of effectiveness of pre-kindergarten actions with interactive surfaces.

-**Communicability**: the definition of effective mechanisms to communicate which actions are expected from the user through animated languages that allow children to be autonomous when using the multi-touch technology without the continuous supervision of adults.

-**Adaptability**: the definition of strategies that allow the adaptation of the Assistance and Communicability mechanisms to the specific skills of each user.

-**Creativity**: the construction and validation of environments that foster creativity and allow collaboration between users (pre-kindergarten children) to obtain in the future more adequate educational tools for these users.

4. ACKNOWLEDGMENTS

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