

A study on the Preschooler Education in the Digital Learning Environments - Educational Contents using the ‘Interactive sand screen’

Suk Chon¹, Bokyung Sung², Il Ju Ko³

¹ Rinsoft Co., Ltd., South Korea

² PDK LIMITED Co., South Korea

³ The Global School of Media, Soongsil University, South Korea
tians@maat.kr, bksung@pdklimited.com,
andy@ssu.ac.kr (corresponding author)

Abstract. The preschool childhood is an important period to develop the perceptual ability. In digital learning environment, Educational contents offer diverse experiences. Sometimes digital interface interferes with the emotional interaction. Thus alternative methodology for digital learning is required. Interestingly, the physical interface based in traditional playing can generate highly emotional interaction and positively social relationship with children in learning time. Screen composed of sand is a general analog platform. The interactive sand screens are provided in the form of traditional playing in digital environments. In particular, using the physical interfaces not only develop preschooler’s sensory perception but also improve the educational effect and participation.

Keywords: Edutainment, Haptic User Interface, Digital Learning Environment, Preschooler education, Educational Contents

1 Introduction

Contents production should take account for the digital authoring environment from the planning stage. This trend of changing production process is an inevitable phenomenon that is observed in broad range of fields. In particular, digital-based service is becoming more and more important in education field. Textbooks in publication which have been traditionally used are gradually shrinking. Meanwhile, education contents that use digital device and platform are quickly expanding. Following the increasing use of digital education contents by final users, the digital-based education contents and service market is rapidly growing. Hence, the importance of studying digital learning environments and education contents is ever increasing.

In case of e-learning and u-learning education that represent the digital education, services are operated in conventional user interface provided by computers. ‘Graphic User Interface (GUI)’ is the most common method. After the spread of personal computer, GUI has been the most intuitive and effective interface method. And

'Touch User Interface (TUI)' is mainly used in recent days after the emergence of mobile devices composed of touch screens such as Smartphone and Tablet PC. These interface methods interact with users in digitized information. Meanwhile, the sensory organ of human beings interacts with information in analog waveform signals such as light, sound, temperature, vibration and texture that exist in the nature. Physical activity that receives information in analog type cannot instantly recognize digitized information without thinking process. Hence, physical activity sense is capable of correct recognition only when it directly experiences analog signal and recognition ability can be finally learnt physically only after repetitive experience [6].

Preschoolers are in a period of obtaining information about objects and environments based on the physical experience that physical activity senses provide and cultivating emotional sympathizing ability and logical thinking ability [7]. Hence, preschoolers tend to lack experience of obtaining senses and recognizing them, compared to adults who received regular education in schools. Moreover, their connection between the perception about the experience provided by senses and understanding is not clear yet. Hence, a process of correctly experiencing the senses provided by objects and environment is very important for preschoolers [5].

This paper discusses about the education contents targeting preschoolers that are provided in digital learning environment. Chapter 2 examines the traditional interface and digital-based interface for the preschoolers. Chapter 3 describes 'interactive sand screen' of the haptic user interface suggested in this paper and presents application case in education field. Finally, Chapter 4 concludes.

2 Interfaces for the Preschooler Education

Interface functions as a medium that delivers information within a relationship of user to system, user to user and user to networks. The media is defined as a carrier of information such as text, image, sound, and commands. However, from an aspect of users, the interface also plays a role of information exchange as well as metaphor that expresses will, intention, emotion and perception according to situation [8].

The traditional user experience where the user perceives objects and environment is provided from the nature. Sand, water, tree and earth are the materials for interaction that are first experienced by preschoolers. While playing with these materials, preschoolers experience physical interaction in emotional, logical and social area [1]. The haptic experience that is obtained through this playing process plays a role as a catalyst that develops infants' perception ability, emotional intelligence and body sensation [2].

For example, children quickly adapt themselves to the natural material of sand and water that they can easily experience in the surroundings without a sense of incompatibility. Through the process of physical contact with sand and water, infants realize that they can easily control the unstructured and irregular materials [9]. Through this process, they gradually receive positive feedback rather than negative emotions such as difficulty, tension and anxiety. Moreover, they can find out method of playing by themselves using haptic interface without special instruction or education program [4].

The interactive experience by physical activity that preschoolers experience is an essential process for recognizing and understanding the surrounding environments and subjects, based on which they communicate with the surroundings [3]. Hence, user interface of the contents targeting preschoolers should be based on the haptic interaction. A process of recognizing materials and environment through sensitive experience provides sense of presence to the subject. Hence, correctly connecting the interactive relationship is a very important purpose that the interface of preschool education should deliver.

3 The haptic user interface ‘Interactive sand screen’

For education contents for preschoolers, user interface that can support learning from physical activity is required. An interactive sand screen is a haptic user interface that makes use of sand as physical materials.

In general, sand can be partially or totally transformed with only a small amount of strength and it can possess diverse viscosity according to the moisture condition. Thanks to these attributes, children can easily create landscape such as mountains and oceans or structures such as castle and walls using sand. Moreover, it can sensitively provide diverse feedback since the texture differs according to the size of sand particles. Due to its physical characteristics, sand has been used in playground and diversely used as play materials for children for a long time.

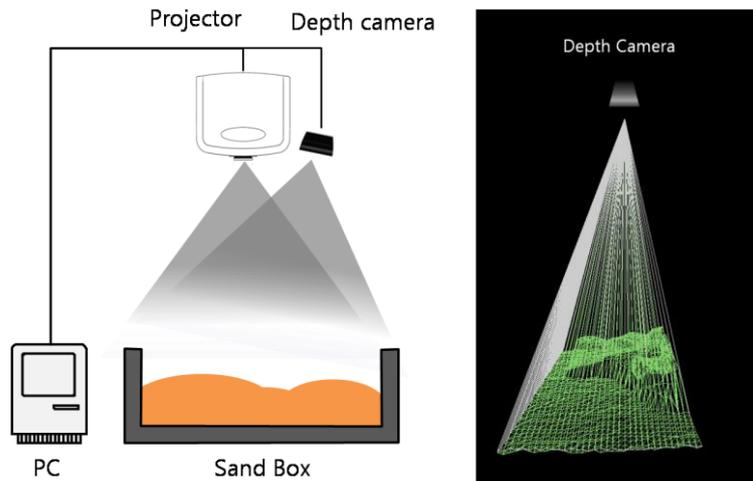


Fig. 1. Structure of interactive sand screen

Figure 1 describes the structure of the interactive sand screen suggested in this paper. Images are shot using the beam projector installed above the sand box and the depth camera installed at the same location recognizes changing information of the sand surface in real time. The ‘interactive sand screen’ plays a role of a display that simultaneously provides the interface for haptic feedback of education contents.

The depth camera installed alongside the beam projector can recognize the changing sand height for as small as 1 millimeter. The depth layer of sand consists of a total of seven levels with a 50mm of height difference as standard unit. The educatees can freely touch and play with sand within the range of sand screen generated by the beam projector.



Fig. 2. Education program using interactive sand screen

As is shown in Figure 2, the shape and form of the display change in real-time by the real-time action of users in the relevant interface. The educatees (preschoolers) should directly touch sand in order to create landscape in the screen. During this process, they can feel the texture and temperature provided by sand. The education program begins with flat condition where the height of the sand is at level 3. As the educatee builds sand high, the level of the relevant area increases, while the level of sand decreases as sands are being dug up.

The level of sand was set at the depth of sea where the lowest level 1 becomes deep sea, followed by middle seas, near seas, and finally by beach and island. Creatures living in the ocean in each of the region are displayed in computer animation on the interactive sand screen.

In this process, the educatees are simultaneously provided with visual experience with the haptic experience as a medium. Different from the previous education programs, educatees proceed on the education program through their own physical activity. The educator's role is to support this process. As a result, high immersion into the education program is possible. Interestingly, the children played while learning.

The relevant experience education program was implemented in Seoul National Science Museum. It was provided for the preschoolers over two summer vacations. During this period, more than ten thousand paid users participated, with higher interest and participation compared to the previous education programs. It was a very successful result despite the fact that it was a rather challenging experience education program.

4 Conclusion

User interface provided by digital technology environment has an advantage of enabling running of diverse multimedia contents. Moreover, it provides interesting user experience through an augmented platform by connecting the actual space and virtual space. However, the interface of education contents that are provided to preschoolers should be differentiated from the user interface targeting students in regular school curriculum or ordinary adults.

This paper developed a haptic user interface of ‘interactive sand screen’ to address this problem and confirmed its usability as a new interface by implementing an experience education program on preschoolers.

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