

Research on Digital Education for Preschooler in Interactive Learning Platform

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Abstract

Educational courses for preschoolers are important in developing their perceptive ability. Recently, many educational programs have been performed under digital environments. It is very innovative compared to traditional educational programs. However, sometimes such new methodology may impede children's emotional exchanges and physical interactions. On the other hand, physical interface through physical senses such as traditional plays may maintain emotional exchanges of a high level. Therefore, children may nurture positive cognitive ability through physical experiences. Accordingly, Preschoolers' education aims for strengthening physical activities and perceptual ability rather than mere obtaining of knowledge. The current digital education environment does not fully satisfy such goals. In order to resolve this, first of all, changes in the interface of digital education are necessary. Educational courses should be formed with a physical interface operated based on children's physical activities. This study intends to present an educational platform appropriate for such a goal.

Keywords: *Edutainment, Interactivity, Digital Education, Learning platform, Preschooler, Educational Contents*

1. Introduction

Multimedia contents are utilized in a digital environment. They are also planned and developed in a digital production environment. Since the emergence of computers, changes in production environment have been gradually intensified. In particular, in the area of education, digitally based services are being expanded. Traditionally, textbooks have been utilized in the form of publication, although recently their frequency has been reduced. On the other hand, educational services using digital devices and platforms are rapidly on the rise.

The advantage of digital educational contents is that subject matters and topics can be more diversified. Digital based learning also has unique attributes that encourage positive participation. In addition, Teachers and students may be provided information very easily and anybody may utilize services with simplicity. It is very innovative compared to traditional education methodology. Moreover, a digital learning environment may efficiently provide children with knowledge. Contents and services also may be easily expanded through networks. As users utilize digital education contents more often, the digital-based education market is growing rapidly. The scope of services is also expanding into different age groups. Therefore discussion and research on digital learning is necessary at this point.

This paper discusses educational contents targeting preschoolers that are provided in a digital learning environment. Chapter 2 examines the traditional interface and digital-based interface for preschoolers. Chapter 3 describes the 'interactive sand screen' of the

haptic user interface suggested in this paper and presents an application case in education field. Chapter 4 reviews the application of interactive education program. Finally, Chapter 5 concludes the study.

2. Preschooler Education

The most important point to consider in educational services for preschool children is the interface. The 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 a metaphor that expresses will, intention, emotion, and perception according to situation [8].

In the case of e-learning and u-learning educations that represent 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 computers, the GUI has been the most intuitive and effective interface method. 'Touch User Interface (TUI)' has also been mainly used in recent days after the emergence of mobile devices composed of touch screens such as smartphones and tablet PCs. These interface methods interact with users in digitized information.

Meanwhile, the sensory organs of human beings interact with information in analog waveform signals such as light, sound, temperature, vibration, and texture that exist in nature. Physical activity that receives information in analog type cannot instantly recognize digitized information without the thinking process. Hence, the sense of physical activity is capable of correct recognition only when it directly receives an analog signal and recognition ability can be finally learned physically only after repeated experience [6]. This is a crucial difference between the digital learning methods.

The process of learning such physical senses itself is the key function of interface for preschoolers. Analogue signals matching the body one to one on a real time basis is a form which is appropriate as such user interface. However, it is difficult for digital-based interface to perform such functions. The reason is that accuracy and efficiency of digital signals act as disadvantages.

2.1. Educational Experience for Preschooler

The traditional user experience, where the user perceives objects and the environment is provided from 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 areas [1]. The haptic experience that is obtained through this playing process plays the role of a catalyst that develops infants' perception ability, emotional intelligence, and body sensation [2].

Preschoolers are in a period of obtaining information about objects and environments based on their physical experience. Preschoolers' physical activity and senses provide and cultivate emotional sympathizing abilities and logical thinking abilities [7]. This process is the first educational experience.

Hence, preschoolers tend to lack experience in obtaining senses and recognizing them, compared to adults who received regular education in schools. Moreover, the connection between their perception of experiences provided by their senses and understanding is not clear yet. Hence, a process of correctly experiencing the senses provided by objects and the environment is very important for preschoolers [5].

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 methods of playing by themselves using haptic interface without special instructions or education programs [4].

The stage of preschoolers is the stage of initiating experiences in educational courses for the first time. They experience different types of activities from plays children have experienced thus far. Therefore, it may be perceived as a very strange and difficult process. Based on this, it is proper to proceed with it in a similar form to plays as maximally as possible. Such form makes children swiftly adapt to educational content. In addition, they come to accept experiences on education pleasantly.

2.2. Purpose of Preschooler Education

As mentioned earlier, preschoolers' experiences in education should provide pleasant feedbacks. This is one of the most important goals. Unlike education for adults, education for preschoolers should be fun. The reason is that it is appropriate to provide an environment in which they think and behave for themselves, and not merely cram educational content in their minds. Resultantly, the best educational courses for preschoolers are to naturally proceed with education through their voluntary participation.

Secondly, education for preschoolers should aim for a clear mastery of their physical senses and cognitive abilities. Through elementary school education, they become very accustomed to such learning processes. However, such a learning process is very difficult for preschoolers. Their experience of physical activities is an essential process for them to perceive and understand their surrounding environment and objects [3]. Based on such accumulation of experience, they are trained in how to communication between themselves and other objects.

Therefore, educational programs for preschoolers need to be operated based on physical interaction. Before a person's thinking and cognitive system is obviously formed, he or she can be provided with reality only when he or she perceives objects and the environment with biological signals. Such reality greatly affects development of senses. Therefore, the process of physical interaction relationships being correctly connected is a crucial goal that education for preschoolers should provide. All these processes should be started from the voluntary participation of children. Otherwise, preschooler education can sometimes produce a negative effect.

3. Interactive Learning Platform 'Sand Screen'

3.1. Haptic Interface and Materials

Education for preschoolers requires a user interface that may perform physical activities. For educational contents for preschoolers, a user interface that can support learning from physical activity is required. To this end, this study developed an interface utilizing sand as a physical material.

In general, sand may easily change overall or partial forms with very small force and provide different tactile senses according to the size of particles. Sand can be transformed through physical force exerted by children. In addition, sand has diverse viscosity according to its degree of moisture. Such physical properties enable children to easily create topographies such as mountains and seas, and structures such as castles and walls using sand.

Such atypical external structure of sand may provide diverse feedbacks in sensory terms. Moreover, sand is a very familiar natural material to children. Because of the physical characteristics of sand, it has been variously utilized in children's playgrounds and as materials for their play.

3.2. Interactive Sand Screen

Interactive Sand Screen composed of real sand is a general analog Playing platform. The interactive sand screens are provided in the form of traditional playing in digital environments.

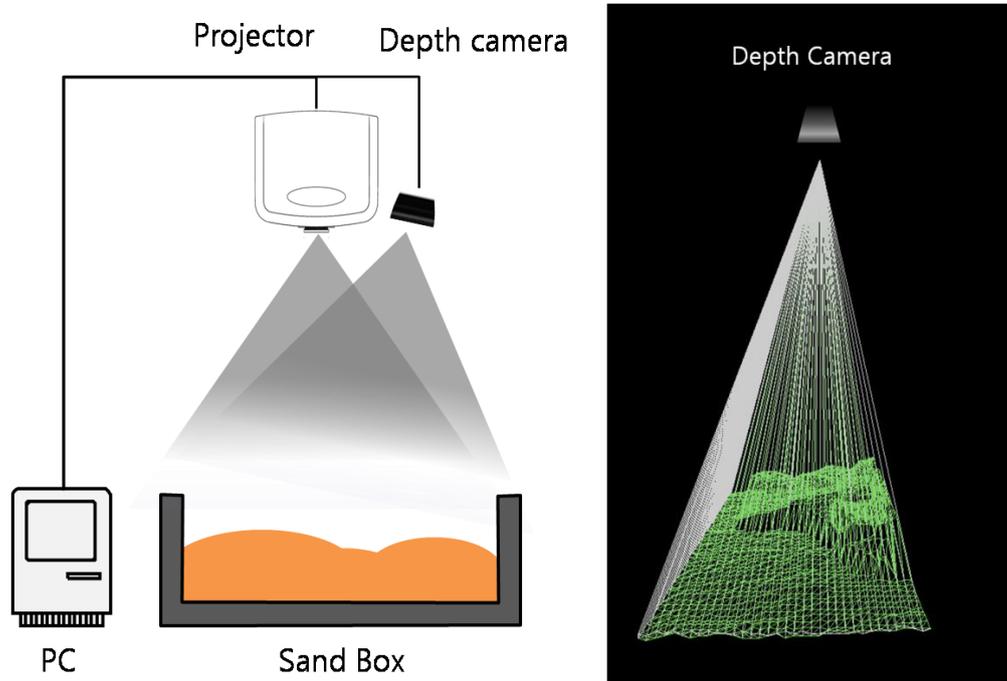


Figure 1. Structure of Interactive Sand Screen

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 the changing information of the sand surface in real time. The 'interactive sand screen' becomes a display that simultaneously provides the interface for a haptic feedback of education contents.

Major characteristics of the interactive sand screen are as follows:

- 1) Sand is used as a user interface itself.
- 2) Response is made on a real time basis for the user's motions
- 3) The functions of input and output devices are performed at the same time.

The depth camera installed alongside the beam projector can recognize changing sand height for as small as 1 millimeter. The depth layer of sand consists of a total of six levels, with a 30~50mm of height difference as standard unit. The participants can freely touch and play with sand within the range of the sand screen generated by the beam projector.

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



Figure 2. Physical user Interface 'Interactive Sand Screen'

The level of sand was set at the depth of the 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 regions are displayed in computer animation on the interactive sand screen. This system provides interactive education service.

This physical user interface based on traditional playing can generate highly emotional interaction and positively social relationships in learning time. Consequentially, using the interactive sand screen not only develops the preschooler's sensory perception, it also improves participation and educational effects. [11].

3.3. Development of Interactive Education Program

Children first come to see animation of crabs and clams on the seashore through the main screen when the educational program is initiated. Then they create castles on the sand screen and look at movements of living things. In the next step, they perform a game where organisms from tropical seas such as crown fish, sea anemone, blue tangs, and corals emerge in coastal waters. In intermediate waters, they come to encounter middle to large sea organisms such as sharks, dolphins, and sea turtles. Lastly, they observe unique marine creatures living in the deep sea.

In actuality, children cannot interact with sea creatures in the deep sea or intermediate waters. The general educational method is for children to observe or watch their pictures or photos. In this process, text or oral explanation is provided. However, while looking at fish emerging according to the height of sand they created themselves, they come to understand the depth of sea. Moreover, this method enables them to think of the appearances of diverse ocean organisms according to the ecological environments. This starts from intuitive understanding of the sand topography that they created themselves.

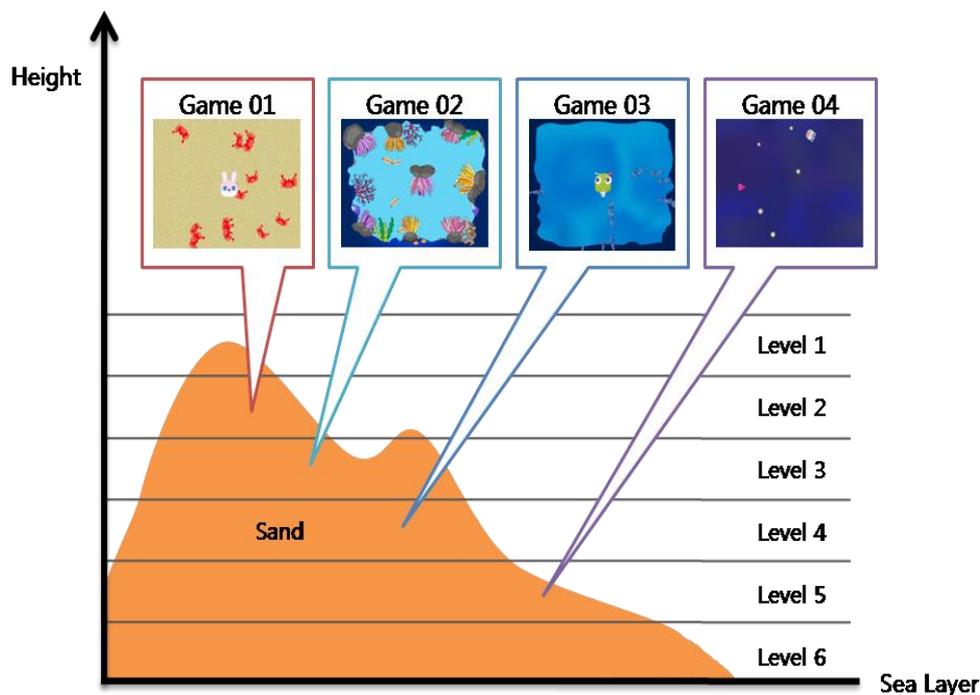


Figure 3. Development of Interactive Education Program

In the process of education, the participants are provided with both tactile experiences and audiovisual experiences. Unlike existing educational programs, the learners proceed with the educational program themselves through physical activities. The educator's role is limited to supporting such processes. Self-directed education provides pleasant experience like a play. Therefore, the educational program induces active participation from children and provides a high level of immersion.

4. Practical Application of 'Interactive Sand Screen'

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 educational experience.

The original purpose of this study was to examine the accessibility and familiarity of the tactile interface for preschoolers. However, while providing practical educational service through developing systems and contents, a new topic emerged.

The additional topic is a new possibility to complement the weaknesses of traditional education and overcome the limitations of digital education.

A weakness of traditional education is that the extension or change is difficult. These are operated for a long time with a fixed platform. For example, most of the materials are still blocks or cards or stickers. These are limited to the publication platform. The limitation of digital education is that contents are locked in a two-dimensional screen. Children also may hear and see, and also touch the content. However, real objects provide a variety of physical sensations associated with emotions.



Figure 4. Education Contents of Interactive Learning Platform

Children generally think and behave creatively in the process of a play. For example, Figure 4 is the appearance of the children participating in the interactive learning platform. As is shown in Figure 4, children determine a new play rule using existing plays or toys, or establish new conditions or goals. As a result, the same play is differentiated according to areas and gradually becomes complex over time.

However, children's natural active participation in educational courses is not easy. In general, in educational courses, children do not exert all their creativity. Relatively, educational courses fail to induce participation from interested children like a play. Nonetheless, in the new educational environment, children created a new story that programs did not provide.

For example, they established the goal of a huge island after discussion and created their own topology and imagined their story themselves. Or, they created a new game among themselves and proceeded with it. Such active participation was performed without any educator's direction. Conclusively, the interactive learning platform confirmed its usability as a new methodology by implementing an educational experience for preschoolers.

5. Conclusion

The user interface provided by the digital environment grants an advantage of operating diverse multimedia. In addition, it can connect actual space and virtual space and may provide interesting user experiences through an augmented platform. However, it is difficult to provide sensory feedbacks that the analog method has. Therefore, educational services provided to preschoolers should be differentiated in all parts from the user interface operated for students in regular educational courses or ordinary adults to content planning.

This study developed "sand screen", a tactile user interface, as an alternative measure to resolve such problems. This study also developed an educational program through a form of play with diverse physical activities based on physical senses. Finally, this study derived high utilization measures as a new educational platform based on the process of educational program services with preschoolers as the subjects. In addition, this study also identified diverse uses and possibilities of new digital educational environment.

Based on such interesting phenomena, this study intends to propose an appropriate direction of participation type educational platform based on preschoolers' voluntary participation. In conclusion, the appropriate direction of preschoolers' education starts from the intersection between play and education. To this end, technical environment and content planning, which may induce voluntary participation from children, should back such education without failure. Based on

such previous studies, research on education in interactive environments should be continuously performed.

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