Chapter 80
Development and Application of Art Based STEAM Education Program Using Educational Robot

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ABSTRACT

This article aims at developing an art-based STEAM educational program that would help elementary school students to develop their abilities to solve scientific problems and artistic sensibilities by using an educational robot. In addition, this article investigates whether the program could be applied in the field. In order to achieve the purpose of this article, 'mobile' and 'abstraction' were selected as the subjects of the activities and the STEAM educational program which allowed students to learn knowledge regarding science, technology and mathematics in a comprehensive manner through the course in order to experience and create works of art. Also, the level of satisfaction and effectiveness were confirmed by applying the program to the class targeting students in the 4th and 6th grades.

INTRODUCTION

The Fourth Industrial Revolution, characterized by ubiquitous, mobile Internet, cheap but highly powerful sensors, artificial intelligence and machine learning, is changing the concepts of knowledge, time and space based on the evolution of digital technology (Lom, Pribyl, & Svitek, 2016; Schwab, 2016). In the era of the 4th industrial revolution, the boundaries between the fields of study that were subdivided previously have become blurred and the integration of knowledge and fields of study is being accelerated

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in the process to implement new and innovative ideas (Tolentino & Park, 2010; Zhang, 2016). Therefore, our society demands people of talent who can think comprehensively and creatively across various fields of study (Goldberg, 2015; Ko, An, & Park, 2012).

To address these trends, the Korean government has adopted 'STEAM' education for learning that integrates the fields of Science, Technology, Engineering, Arts and Mathematics, with the objective of building creative capacity with both creative imagination and artistic sensitivity (Kim, 2007, 2012). The concept of STEAM education originated from STEM education, which was proposed by Sanders (2009) as an integrated education combining science, technology, engineering, and mathematics. Later, Yakman (2008) proposed STEAM education, which incorporates A (arts) into STEM education, suggesting the possibility of education for the whole person. STEAM education aims to induce students' interest about science and technology and to develop their creative problem-solving abilities, in order to provide an effective education to those who will lead the future of science and technology development. In Korea, Kim (2007) introduced STEM education in an academic journal in 2007 for the first time, and the Korean government has adopted STEAM education as a national education policy and is currently promoting this educational approach to develop integrated thinking and problem-solving abilities based on scientific technologies (MEST, 2010). Since STEAM education started being propagated in schools from 2011, the development of the STEAM program for school education and the distribution of class materials have been carried out through various educational researches (Bae, 2011; Kim, Lee, & Kim, 2013; Lee, Kim, & Kim, 2015; Shim, Kim, & Kim, 2016).

However, many STEAM educational programs are developed based on science and mathematics, and the role of art is merely limited to the function of a tool for science and technology (Eun, 2015). Kim (2012) suggested that creative convergence talents can be fostered through the mutual promotion of science and technology and art capacities. With this, he presented cases of convergence education that used videos, image science and computer software as examples of the convergence of science and technology and arts. In addition, various cases of convergence education using robots in STEAM education have been introduced with the development of robotics technology, and it has been confirmed that education using educational robots is effective in enhancing students' creative expression and higher-order thinking skills (Cross, 2014; DeSimone, 2014). Robotics technology is increasingly being considered as a learning tool that integrates mechanical, computer science, technology, engineering, math and science. However, there are only a few cases regarding the use of educational robots in art based STEAM programs. The objective of this research is to develop and apply a STEAM educational program that includes courses where the making of fine artworks is combined in a convergent manner with the use of educational robots and programming tools. The STEAM educational program suggested in this research is expected to provide teaching-learning materials to increase STEAM literacy, scientific efficacy and creativity through integration of robotics and arts.

THEORETICAL FRAMEWORK

Educational Robots for STEAM Education

With regard to educational robots, there can be three categories of education depending on the purpose of the use of robots: learning about robots, learning from robots and learning with robots (Shin & Kim, 2007). In STEAM education, it has been confirmed through various studies that robots can be used as