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A STUDY ON THE IMPLEMENTATION OF A MAKER EDUCATION TOOL USING THE CONSTELLATION

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ABSTRACT

The Maker Movement is a technological and creative revolution underway around the world. Maker education offers a transformational approach to teaching and learning that attends to the real and relevant needs of learners and humans. In the fourth industrial revolution era, Software, Coding 3d Print, Arduino, IoT are core technologies commonly used in major industrial sectors. Nowadays coding education became mandatory, and it is time to educate the talented students who is necessary for the fourth industrial revolution era. In this paper, we have developed a Maker education tool to educate knowledge on coding, 3D printing, and Arduino by exploring the scientific knowledge of twelve constellations. We have produced starlight education tool and constellation mood lamp which are convergence-type teaching aid that combine maker education, and describe the composition and education contents of these two teaching aid.

KEYWORDS: Maker Education, Constellation, Arduino, 3D printing, Block Coding

1. INTRODUCTION

Maker education [12] closely associated with STEM learning, is an approach to project-based and problem-based learning that relies upon hands-on, often collaborative, learning experiences as a method for solving problems. People who participate in making usually call themselves "makers" of the maker movement and develop their projects in makerspaces, or development studios that emphasize prototyping and the repurposing of found objects in service of creating new inventions or innovations. Culturally, makerspaces, both inside and outside of schools, are associated with collaboration and the free flow of ideas. In schools, maker education stresses the importance of learner-driven experience, interdisciplinary learning, peer-to-peer teaching, iteration, and the notion of "failing forward", or the idea that mistake-based learning is crucial to the learning process and eventual success of a project.

The Ministry of Education, the Ministry of Science and Technology and Ministry of Information and Communication of Korea decided to increase the number of software education leading schools to 191 in 2019. In the fifth and sixth grades of elementary schools, software education is required for more than 17 hours to learn practical subjects and more than 34 hours in middle schools [1]. In Korea, since the craze of coding education produces a lot of expensive private tutoring and illegal private education using parents' vague anxieties, we need to make some urgent solution.

In this paper, we implemented a teaching aid tool to conduct a maker education. The motivation and necessity of the developing starlight teaching aid tool and constellation mood lamp using maker education are as follows.

·We need some creative and convergent teaching aid tool targeting the element and middle school students and seniors.

·We need some active education to make students produce the solutions of problems and help them to derive results.

·We need to reduce private education expenses by making low cost educational tools.

·We need to make some educational items easily accessible by vulnerable social group students.

We developed a starlight teaching aid tool and a constellation mood lamp that are able to satisfy these motivations and improve the quality of creative education and this can reduce private education expenses and can provide the fair educational opportunity for low income families.

2. MATERIALS AND METHODS

Study method and scope

In this paper, we have designed and implemented a teaching aid tool applying the maker education methodology to increase creativeness and educate convergent thinking. Maker education stems from the maker movement that is spreading in the United States under the influence of DIY (Do It Yourself) movement. Ahn Jae-hee and Noh Young-hee's paper defined the maker education as a collective culture that assembles and develops product design with imagination and creativity. People use open source to implement own ideas and applications"[2].

The maker education consists of the following components and it is the education necessary to foster creative and convergent talents in the fourth industrial revolution era.

◉ Open source + idea = new creative things
Example) NeoPixel OSS + Constellation idea = Constellation mood lamp

◉ Open source A + Open source B = New Creative Source
Example) LED light ignition OSS + Remote Control Operation OSS = Creative Constellation light teaching aid
Remote control operation source

◉ Related Knowledge + Open Source or Tool = Creative Sources / Tools
Example) Twelve constellations + moods lamp (tools) = constellations moods lamp
Twelve constellations + led light ignition OSS + Remote control operation source = starlight teaching aid
Subheading should be 10pt Times new Roman, justified.

Previous Research

Computational making has been increasingly introduced into formal learning settings for the learning of computer science. The use of the Arduino controller in a high school computer science class for the learning and application of computing concepts in a real world project where students had to display their artifact to other schools and the community. Through the analysis of video data, interviews, and other documents, the study traces the design process of students and their perceptions towards this engineering-oriented making process. Findings indicated that although students persisted through design iterations, advanced coding, and electronics, they also experienced frustration and discouragement. Besides practical suggestions for computational making in schools, the study suggests deeper investigations into inculcating the playful, growth-oriented, failure positive, and collaborative maker culture into these formal settings. It is an educational application of a constellation called 'the place where the stars stay'. This application has applied augmented reality and made it possible to feel the relative distance of the modeled stars. They added a game with constellation learning and story here, which increased user's interest and engagement. This research case has the side effects of augmented reality through small monitors. The symptoms of eye strain and dizziness can be seen and there is a limit to the use of this tool as a tool to acquire knowledge of the learner's constant constellation [3].

Secondly, there is an advantage that the learning stage is systemized and the amount of learning is large in the maker education field of the science gifted. However, since the teaching paradigm is composed of the maker of the finished product, the range of the learning field is narrow and the purchase of the teaching aid is not economical [4]. In the third field of early childhood science education it applies the maker education to the subject of inquiry experiment on the questions that arise in the problem solving process rather than acquiring the concept of principle. Currently, there are a lot of teachers who are able to teach by incorporating maker education into Nurie course, which is an early childhood education course [5].

Examples of research from a technical point of view are 3D printers, Arduino, and block coding. Lee Jae Jung, Choi Ji Jin and Cho Sang Tae taught the modeling of farm equipment and pollen directly for agriculture based on the principles of 3D printer and knowledge of agriculture. The project proved the positive effects of learning by increasing creativity, ideas and confidence for students [6]. Seth S. Horowitz and Peter H. Schultz of paper, a low cost system that can convert 3D shape and terrain elevation models to real models is presented, using data from topographic maps, radar data, high digital terrain models and providing learning materials for space [7]. Cha Jae-Gwan mentioned the necessity of coding education using Arduino as an educational program to improve the creativity of adolescents. It also explains the need for a teaching aid that can be taught based on the low cost of materials and the wide use of open source [8]. Won Eunjin, Seo Jin-Ha, and Kwon Ki-hwa, in paper 'Development of Indoor Environment Measurement Education Contents Using Coding', selected the items that affect the environment with the theme of fine dust and then they developed a program that can visualize contamination values on the tablet screen using block-type coding programs and various measurement sensors

of Arduino [9]. Ahn Chang Ho, Lee Ki Ji, Mun Suk Jae, presented a learning model using block-based coding entries. Entry coding accounts for much higher levels of understanding of key concepts of storytelling, project understanding, and problem solving than text coding Self-efficacy, self-directed learning, and interest have been proven to improve learners [10]. Dincer Ozorana, Nergiz Ercil Cagiltayb, Damla Topallia presented a learning model using block-based coding Scratch. "Scratch makes programming more enjoyable, visual Scratch helps learning algorithm, programming concepts like functions and loops Additionally, there is also some evidence showing that when the course content is supported with Scratch environment. Failure rate of the students decreased Grades of the students increased in the second midterm and final exam Attendance rate of the students is increased" [11].

In this paper, we introduce star light teaching aid and constellation mood lamp, which is a maker paradigm that can help learners to identify problems and solve them, and to make students realize their own results. There is no physical fatigue or side effects in the curriculum and the subject of education can be trained as a learner and for all students who are not a specific subject. It is also a teaching aid to educate the silver class. With Arduino parts that are easy to buy, you can create a teaching aid without any financial burden. This teaching aid can practice the limitations of the scope of the training of the monolingual program, the block coding and the Arduino in the precedent research case up to the block coding, the 3D printer modeling and the Arduino education course. It is a teaching aid that helps students to learn self-directed learning as well as creative convergence education because there is no difficulty in learning without the mentor and educator needed for learning.

Implementation Tools
Entry version 1.6.14 (based on 2018.11.20) was used. At this stage, we used objects to learn the shape of the constellation, and we implemented the coding for sequential statements, loop statements, conditional statements, signal understanding, and scene
 In the real modeling & 3D printing stage, we implemented the modeling using Fusion360 program provided by AutoDesk, and output the modeled .stl files using Cubicreator 3.1 version of G-code conversion that 3d print can output.
In the Audino stage, we implemented the tinkercad program in AutoDesk and implemented the Arduino part if the error does not occur theoretically.

3.   RESULTS AND DISCUSSION
Star light teaching aid
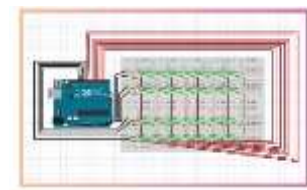
Figure 1. *Block Coding/ Entry*   **Figure** 2. *Modeling & 3d Printing*   **Figure** 3. Arduino *Sample*

Step 1 Block Coding (Entry)
Be familiar with the scientific knowledge of astrology, and then Each of the constellations is represented in the form of a sequence, repetition, and conditional coded training is given.

Step 2 Modeling & 3d Printing
Modeling the necessary shelves for the Starlight paradigm through the Fusion 360 program, creating g-code for direct output

Step 3 Arduino
Educate students to use Arduino to express the necessary circuit diagrams for Star light teaching aid.

Figure 4. *Implementation Model of Star Light teaching aid*
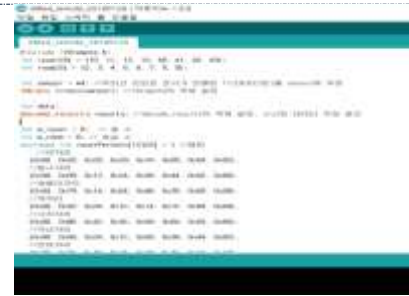

Figure 5. *Arduino Code*

64 LEDs constituted of 8 * 8 arrays are given respective position values in hexadecimal and then we sent it by remote control and made it possible to express constellation from January to December

Constellation mood lamp

Figure 6. *Block Coding/ Entry*
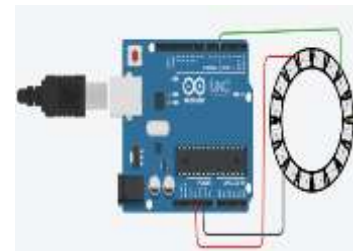

Figure 7. *Modeling &3d Printing*

Figure 8. Arduino Samples

Step 1 Block Coding (Entry)
Be familiar with the scientific knowledge of astrology, and then each of the constellations is represented in the form of a sequence, repetition, and conditional coded training is given. (Same as Star-light teaching aid)

Step 2 Modeling & 3d Printing
Constellation mood and other moods needed to insert 12 constellation images into the column, try to model the bottom part, g-code to produce the output directly.

Step 3 Arduino
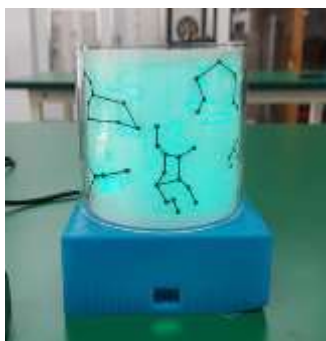We use Arduino to train the circuit diagram necessary for constellation mood lamp.

Figure 9. *Constellation moods lamp*

Figure 10. *Arduino Code*

Using the strandtest / simple file provided by NeoPixel, learners can learn about ignition and light color change

in easy way.

4. CONCLUSION

In this study, the precincts such as the star light and the constellation mood lamp are composed of a maker teaching aid for elementary and middle school students and the elderly. Convergence education can be carried out by combining scientific knowledge of constellation with technologies such as coding, 3D Print, and Arduino education. By allowing learners to create parishes directly, they can improve their understanding of constellations, coding, 3D Printing, and Arduino and it is possible to solve the problem by themselves and to draw out the result. Such education can strengthen knowledge of information processing capacity and creative thinking capacity. With simple Arduino parts, constellation, coding, 3D print, and Arduino training can be done together; we can save private education expenses. It is an educational system that allows easy access to low-income families due to low education costs. It will become a teaching material for fostering creative talents that are needed for the 4th Industrial Revolution era.

Some suggestions for the spread of constellation maker parish and subsequent research are as follows. First, surveys and statistical data showing the interest of learners, improvement of creativity, learning self - efficacy about constellation maker parish are needed. Second, basic learning materials are needed to improve understanding of the second constellation maker teaching aid. For example, different materials are needed when teaching for elementary and middle school students and for seniors. Third, it is necessary to make easy access to education of constellation maker's teaching aid by creating an animation-related program *YouTube* for this teaching aid and creating an environment to learn regardless of physical distance.

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