

# Exploring the Possibilities of Dance and Coding Convergence Education

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| I. Introduction                                  | III. Implications and Discussion |
| II. Art and Coding Convergence Research<br>Cases | References<br>Abstract           |

## I. Introduction

The modern society is changing into a convergence technology society centered on software, and the importance of computing thinking is being emphasized to nurture creative convergence talents needed in the era of the 4th industrial revolution. Coding education is attracting attention as a basic education to develop such computational thinking skills (Ahn, 2019, p. 43). This is because coding education can develop logical thinking, problem-solving competency, and creativity through the process of making algorithms and analyzing problems that analyze and categorize problems (Song, 2015).

Coding is possible with a computer program when performing various tasks such as search and conversation with a computer. A set of instructions that writes down the procedure for executing such a computer program is called a code, and the act of entering this code is called coding. Coding can be seen as a language, tool, and means of trying to communicate with a computer. To do this, we need to design a program that the computer can understand and write an algorithm (procedures and processes for solving problems). In other words, coding education refers to learning programming for conversation with a computer. However, coding education goes beyond simply acquiring computer literacy that can only use a computer as a tool. It is meaningful in solving daily life problems with efficient algorithms through logical and procedural thinking by acquiring the basic concepts and principles of computer science (Heo, 2019, p. 587).

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A methodology was needed to make coding education easier to access and to increase public accessibility, and various programs were developed to make fun learning as if playing. The importance of coding education through art creation is also being emphasized as one of these methodologies (Kim, 2021, p. 23). There are various examples of convergence between artistic activities and coding. There are related prior studies, Kim Hye-ran (2021), Ahn Seong-hye (2019), Yang Hye-won (2019), Lee Hye-jeong (2020), Jeon Young-guk, Yoon Ji-hyun (2021), Heo Young-Heo (2019), Cho Gyu-tae, Han Ye-jin, Cho Young-hwan (2022), Lee Hyunmin (2018), Ryu Jihyun, Kim Seungin (2019), Lee Hyunmin (2020) etc. These studies are convergence studies of coding education and art, STEAM, design, music, body games, ecological education, board games.

Regarding the convergence of dance and coding, in foreign countries, computer education experts are first interested in dance, find the interface between dance and coding education and practice it continuously. Whereas in Korea, computer education experts are indifferent to dance, or conversely, even dancers tend to be indifferent to coding education (Hyun-Jung Kim, Ji-Eun Yoon, and Jung Yu-Hwa, 2020). This can be confirmed even with very few related studies. Regarding the convergence study of dance and coding, three studies can be found. Prior studies are ‘Explore dance and computer coding convergence cases (Hyun-Jung Kim, Ji-Eun Yoon, and Jung Yu-Hwa, 2020)’, and ‘a study that explored the meaning of a movement creative education program using coding education software (Jieun Yoon, Ji-Eun Yu, Hyeon-Jeong Kim, 2020)’, ‘a study on the design of a dance-centered integrated art education program based on unplugged coding (Lee Ji-in and Lee Mi-hee, 2021)’.

Despite the results of prior studies that convergence education between artistic activity and coding enhances problem-solving ability and creativity, it is unfortunate that there are few studies on dance. In a survey of interest in coding and computing convergence education in the study of Ji-eun Yoon, Yu-Jeong Yu, and Hyeon-Jung Kim (2020), dance instructors showed high interest and hoped to become creative and professional dance instructors in related fields.

This indicates the need for continuous interest and research on dance, coding, and computing convergence education. Therefore, the purpose of this study is to suggest the possibility of dance and coding and find implications by exploring the case of dance and coding convergence education and exploring the case of convergence research between artistic activities and coding in other fields.

For this purpose, this study used a case analysis research method centered on literature. Books and papers related to dance and coding were explored, and cases of convergence between other artistic activities and coding were examined through books and papers. Each case was limited to domestic research cases, in order to obtain practical implications applicable to the Korean educational environment and to explore its possibilities. Through this, the necessity and possibility of the convergence of dance and coding education are presented, and specific methods are to be presented.

## II. Art and Coding Convergence Research Cases

Convergence research cases were searched and classified using RISS (Academic Research Information Service). A total of three studies related to dance and coding convergence were searched. There are a total of 13 studies related to education among arts and coding convergence studies other than dance. Among them, seven studies targeting infants and elementary school students were analyzed. Convergence research subjects with other arts include art, STEAM, design, music, body games, ecological education, and board games.

### 1. Dance and Coding Convergence Research Cases

The convergence study of dance and coding consists of a total of three papers, one for theoretical exploration, for infants, and the other for dance instructors. First, 'Explore dance and computer coding convergence cases (2020)' by Kim Hyeon-jeong, Yoon Ji-eun, and Yu-jeong Yu is the first coding-related study in the field of dance. Focusing on overseas cases of dance and computer coding convergence, it was divided into play, research and education, and performance types, and the characteristics of individual cases were analyzed. First of all, the examples of 'Ozobot Dance' and 'Dance Party', which are fusion games of dance and computer coding, show the characteristic that users can enjoy coding by selecting, combining, and executing various movements of characters in a machine or virtual space. In addition, in the case of convergence research and education of dance and computer coding, computer engineers took the lead and conducted research by linking coding with dance, and furthermore, it is showing that it is gradually developing into joint research in which art educators and dance educators participate. These cases are creating new value through close exchange and collaboration between the computer field and the dance field, and provide implications to the Korean dance field. It emphasized the necessity of convergence education, performance, and research, but pointed out that active and creative convergence practice was insufficient in the dance world.

The second study 'Exploring the meaning of movement creative education program using coding education software (2020)' by Yoon Ji-eun, Yu Yu-Jeong, and Kim Hyeon-Jeong developed a 12-session program that can enhance the convergence capability of dance, coding, and computational thinking for dance instructors. In this study, a survey was conducted on the interest of dance instructors in coding education as a preliminary survey, and more than half of the 108 students showed high interest in coding and computational thinking. It was suggested that most of the dance professors are realizing the craze of coding education in the educational field, and that they recognize the need to use it for dance education. Based on these results, a movement creation program using coding software was developed and education was conducted, and the perception was observed and analyzed. Accordingly, 17 dance instructors participated and participated in 12 educational programs. The 12th

program had time to learn and practice the concepts of coding and computational thinking, the characteristics of art coding, the characteristics of text coding and block coding, Makey Makey, and various functions of Entry.

As a result, it was possible to enhance the ability of dance teachers to practice self-directed convergence education and to strengthen their ability to communicate with students who are accustomed to using digital media. In addition, by expanding dance subjects, educational contents and methods, it is possible to creatively design, practice, and provide dance education, thereby expanding its scope. Along with interest in coding education, reflection about dance education and directions for future movement creative education were suggested.

The third study ‘Dance-centered integrated art education program design based on unplugged coding (2021)’ by Lee Ji-in and Lee Mi-hee developed an unplugged coding and art convergence program that can develop computer thinking, creativity, and problem-solving skills for child. This program is a fusion of dance, music, art, theater and coding in connection with the Nuri course, and consists of the 9th program, which is the stage of understanding, application, and integration. The understanding stage experiences movement using the body and analyzes it to visualize it with patterns and pictures, the application stage moves the core contents of relationships and sequence through the rules of the algorithm. And the integration stage commands movement of space and speed It is divided into stages where you can try coding it by putting it on and arranging it appropriately. Although the program developed in the study was not applied to actual education, it is meaningful in that it designed an integrated art education program in a play-style that is easy for young children to understand.

## 2. Other art and coding Convergence Research Cases

‘A Study on Creative Coding through Art Activities (2021)’ by Kim Hye-ran introduces creative coding focusing on visual arts. In this paper, creative coding is defined as a type of computer programming that aims to create something expressive rather than functional. Creative coding conceptualizes abstract thinking and makes it a visual result through coding, structuring and objectifying everyday problems and subjective thoughts, and fostering logical thinking skills. In

<Table 1> The difference between creative coding and general coding<sup>1)</sup>

General coding	Creative coding
Functional	Expressive
accomplish a given goal	creating something new
Text (Input) → Text (Output)	Text (Input) → visual outcome (Output)
there is only one correct answer	There are different ways of answering for better aesthetically.

1) Kim, H.(2021). A Study on Creative Coding through Art Activities, *Journal of Korean Society of Media & Arts*, 19(4), p. 26.

addition, by carrying out productive activities of creative thinking and self-expression, education that develops qualitative thinking skills based on experience becomes possible. This study presents the difference between creative coding and general coding as follows.

Ahn Seong-hye, in ‘Curriculum Design for Coding Art Education for child (2019)’, proposed a project-oriented coding art education model linking computational thinking and logic, math, science, and art activities as STEAM convergence education for infants and lower grades of elementary school. To this end, she composed the learning contents of 25 items to develop the concept of computer science, computational thinking ability, and design thinking ability. And she organized the curriculum into conceptual understanding activities using board games and art activities to create project-based creative works by applying them. In this study, ‘the design thinking process’ was presented as a concept corresponding to computational thinking for coding education, such as problem discovery - problem analysis - problem definition - problem solving strategy - idea generation - design - prototype - demonstration and evaluation.

In addition this study introduces the step-by-step curriculum of kindergarten and elementary school in Korea’s coding education curriculum (revision curriculum in 2015). It is desirable for kindergarteners aged 5-7 years to understand computational thinking through manipulation and play in an unplugged form, while elementary school students in 1st and 2nd grades experience programming in unplugged and block forms, and 3-6 year olds experience programming in blocks (Seonghye Ahn, 2019, p. 51).

Yang Hye-won’s ‘Music Coding Education Case Study: Focusing on the Sonic Pie Course of the British Code Club (2019)’ presented the Sonic Pie music coding education program as an educational case, saying that the convergence attempt between music and computer coding is insufficient. Music coding here is to create music by designing an algorithm with specific rules and functions using a computer programming language. In this way, by writing musical ideas into computer codes, it is possible to perform abstraction and automation procedures, thereby nurturing computational thinking skills. It can increase the understanding of music, and it can be performed at the same time as composing, increasing the real music experience (Yang Hye-won, 2019, p. 60).

Lee Hye-jeong’s ‘Development and application of body game programs using coding (2020)’ explored the effect on children’s creative thinking ability and basic motor skills by developing a body game program using coding and applying it to the field. Here, the body games are activities using game tools, such as parachute, squirrel roll, pea sack, and stalking. As a result, it was possible to confirm the positive research results in terms of creative thinking ability and basic motor ability.

Jeon Young-guk and Yoon Ji-hyeon’s ‘Case of Operation of an IT-based Convergence Program for Elementary School Students: Focusing on Suncheon Bay Ecology Exploration and Creative Expression Activities (2021)’ is a theme fusion type dealing with the ecology of Suncheon Bay for

elementary school students at S University’s Crane Science and Art Center. It dealt with cases of programs that developed and applied contents. 18 students in grades 3-5 from elementary schools near Suncheon Bay participated in the coding and ecology convergence camp program with the theme of Suncheon Bay’s ecology for 6 weeks. The students came up with a story related to Suncheon Bay, made a sketch, and then carried out a project to create an animation with Scratch. In addition, after coding practice to design, assemble, and control LEDs using an Arduino board, a creative presentation was held. In this study, the model of IT convergence education was applied in the research program design, and the contents are as follows.

<Table 2> A 6-week program applying the IT convergence model<sup>2)</sup>

Stage	Period	IT Convergence education model	Program content
Stage 1	Camp 1 week	<b>Situation presentation</b>	An introduction to the life of a crane flying from Siberia to Suncheon Bay, making an art book
Stage 2	Camp 2-3 week	<b>Creative design &amp; implementation</b>	Implementation of flying cranes with sketches, scratches, and lighting with Arduino
Stage 3	Camp 3-6 week	<b>Emotional experience</b>	Exhibition and crane wing performance using scratch animation and Arduino lights

In the first stage, the situation presentation stage, real-life problems are presented so that students can be interested and immersed. The second stage, the creative design stage, should include activities that students can consider and cooperate with each other so that students’ ideas can be reflected in learning activities and various student-centered outputs can be produced. In the third stage, the emotional experience stage, it is necessary to provide opportunities for students to experience interest or immersion, the value of success or failure, and the spirit of challenge in the learning process (p. 54).

Heo Young’s ‘Program Development for Unplugged Coding Education in Elementary School (2019)’ proposed the problem of the difficult situation of elementary school coding education. Coding education in elementary schools in Korea is mainly conducted at leading schools and research schools, and it is difficult for reasons such as the manpower pool, lack of basic equipment, and lack of programs. To solve this problem, a project-based program for coding and creating a new board game was presented. ‘Understanding coding principles and making board games’ for elementary school coding education is a program to learn and apply the basic principles of coding education. In this study, the following three types of coding education contents were presented.

The first is an unplugged activity that learns the principles and algorithms of computer science

2) Jeon, Y. & Yoon, J.(2021), Case of Operation of an IT-based Convergence Program for Elementary School Students: Focusing on Suncheon Bay Ecology Exploration and Creative Expression Activities, *The Journal of Computer Education*, 24(4), p. 55.

without a computer. It uses the learner's body, study papers, and teaching aids, and the representative content is a board game. The second is an educational programming language, which is a block-type software developed so that students can easily create software. Scratch and Entry are representative. The third method is physical computing, which refers to interacting with computer programs and various objects in the real world. Here, various objects refer to tools that connect to computer programs, and include Arduino, MakeyMakey, etc. (Heo, 2019, p. 589).

'Development of Design Principles for the Improvement of Creative Digital Competencies (2022)' by Gyu-Tae Cho, Ye-Jin Han, and Young-Hwan Cho developed nine design principles and detailed guidelines for the improvement of creative digital competencies of elementary school students. This creative digital competency is the ability to create new solutions and ideas by creatively using digital devices to solve practical problems. The learning design principles developed in this study are as follows (pp. 169-171).

The first is a practical problem-oriented principle. A practical problem is an open problem that can come up with a variety of solutions while a specific situational context is presented. After understanding the problem in depth, it is necessary to clearly define the given problem. The second is the principle of learning through making. Activities that focus on product production rather than professional knowledge and skills on coding and physical computing tools should be conducted. The third is the principle of reflective thinking. Students write a reflection journal about their overall process and share it with their friends. The fourth is the principle of repetitive making. It can help improve students' competencies by suggesting activities to revise ideas and re-create products. Fifth is the convergence principle with design thinking. This design is a convergence content with coding, and it is necessary to allocate a lot of time to the idea formation activity so that you can fully explore the problem and focus on the idea formation process in the convergence field. The sixth is the principle of idea generation through sharing and remixing. In the coding environment, collaboration takes place in the form of remix, in which existing creations are modified and developed into one's own work, and in this process, a work reflecting the ideas of various people is created. Sharing opinions among students helps to complement their own ideas. The seventh principle is the principle of promoting creative idea formation. You can sketch your own ideas first and use a variety of divergent and convergent thinking facilitation techniques. Eighth is the principle of support by student level. It is necessary to classify the students' levels using the competency level diagnostic tool, and provide different activities or support for each level. It is necessary to provide different complexity of the problem according to the level of competence of the students. The last is the principle of adaptive feedback and guidance. This is to provide timely feedback to students according to the learning environment and situation context.

### III. Implications and Discussion

In order to explore the possibility of dance and coding convergence education, this study looked at the convergence studies of dance and other art activities and coding education. There are a total of three dance-related convergence studies, one for theoretical exploration, the other for infants, and the other for dance instructors. In this study, research on coding convergence with other arts was explored for the papers for infants and elementary school students. There are total of 7 studies convergence studies between coding and art such as visual art, STEAM, design, music, body games, eco-education, and board games. Considering that the related studies were published between 2018 and 2021, the importance and necessity of convergence research with coding can be inferred. Several implications were obtained through the exploration of these prior studies.

First, the modern society is changing into a convergence technology society centered on software, and the importance of computing thinking is being emphasized to foster creative convergence talents needed in the era of the 4th industrial revolution, and the necessity of coding education is being emphasized. Moreover, creative coding through the convergence of art and coding is being emphasized more in terms of development of computational thinking, creativity, and problem-solving ability. However, the convergence research of dance and coding is a very insufficient, with one dance instructor subject, one infant subject, and one theoretical study, that's why related research is needed.

Second, the values and significance of art and coding convergence education suggested in previous studies are summarized as follows. First of all, the convergence of art field and coding is a program equipped with art and computer education elements. Each different subject can be studied complementary to each other, and two integrated thinking is possible. This can be used as an interdisciplinary convergence subject and can be performed as an activity-oriented experiential education. It can also cultivate core competencies required by modern society (Yang, 2019, p. 78). Through the process of making art creations with computer coding, it is possible to develop creative convergence thinking skills by enabling new ways of thinking that combine artistic imagination and scientific creativity. In addition, we can experience self-expression through creative coding activities and feel a sense of accomplishment by applying new ideas and project implementations. In the field of art, it is possible to break away from the existing subjective art creation, to look at works of art with an objective structure and form, and to think about new art creation methods (Kim Hye-ran, 2021, p. 32).

Third, this creative convergence of art and coding takes the form of project-based education. Ahn Seong-hye's study (2019) defines STEAM convergence coding education as art-oriented project-based coding education, defining it as 'coding art education' and suggesting its importance. Also, Wang, Huang, & Hwang (2014) proved that project-oriented education is effective in improving students' problem-solving ability by conducting a scratch education study using a problem-solving



project-based learning method (Ahn, 2019, pp. 53-54, cited again). In fact, it can be seen that most of the prior art and coding convergence studies were conducted in a project-based format. Therefore, it would be appropriate for the dance and coding convergence education for elementary school students to be designed as a dance-centered project-based education.

Fourth, coding education content types include methods such as unplugged activity, block type, and physical computing. In the case of research targeting elementary school students and young children, it is appropriate to apply block type contents. Scratch and Entry are representative block-type contents. In fact, even in previous studies, research targeting infants or elementary school students was an unplugged activity, and studies targeting elementary school students and above used block-type contents such as scratch or entry.

Fifth, in the convergence education of art and coding, it goes through the stages of presenting situation -creative design and implementation-emotional experience. This is the stage where the IT convergence model is applied, and the following learning design goals are applied. It aims at making activities based on constructivist principles, promoting creative idea formation, and adaptive support of student activities.

Sixth, dance and coding convergence education is to develop creative digital competency. Creative digital adversity is the ability to create new solutions and ideas by creatively using digital devices to solve practical problems. To this end, the dance and coding convergence class design principle focuses on the principle of learning through making, the principle of reflective thinking, the principle of idea generation through sharing and remixing, the promotion of creative idea formation, support for each student level, and adaptive feedback and principles of guidance.

In this study, it can be meaningful in exploring the necessity and meaning of dance and coding convergence education and suggesting its possibility. Through this, more active and creative convergence methods could be explored and conceptualized. Based on this, research that can realize the goal of dance and coding convergence education should be continuously conducted by developing practical programs suitable for the subject and applying them to the field.

However, since the subject of this study was limited to domestic research cases, future research will need to expand its scope to various foreign cases. This can be a comparative study of convergence research between Korea and foreign countries, and through this, implications for various methods of convergence research can be obtained.

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## Exploring the Possibilities of Dance and Coding Convergence Education

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This study examined the convergence research between dance and other fields of artistic activities and coding education in order to explore the possibility of dance and coding convergence education. Creative coding through the convergence of arts and coding is being emphasized more in terms of development of computational thinking, creativity, and problem-solving ability. The creative convergence of art and coding takes the form of project-based education. In addition, dance and coding convergence education is to develop creative digital competency, and this is the ability to create new solutions and ideas by creatively using digital devices to solve practical problems. For this purpose, the dance and coding convergence education design focuses on practical problems, the principle of learning through making, the principle of reflective thinking, the promotion of creative idea formation, support for each student level and adaptive feedback.

**Keywords:** Coding(코딩), Convergence(융합), Digital competency(디지털 역량) Project-based(프로젝트 기반), Making education(메이킹 교육)