Journal of Engineering and Applied Sciences 12 (Special Issue 1): 5714-5719, 2017
ISSN: 1816-949X
© Medwell Journals, 2017

A Development on S-STEAM Education Program Utilization of a Machine for Early Childhood in Korea

Hyoung-Jai Kim
Department of Early Childhood Education, U1 University, Seoul 29131, Republic of Korea

Abstract: We aim to develop the program of S-STEAM education that utilizes a machine for early childhood in Korea. An initial basic direction was set to emphasize the necessity of the S-STEAM education for 5 years old by reviewing preceding research and literature regarding science programs, science activities, 3-5 years old Nuri curriculum and S-STEAM education. And we also defined a list of machine and their assessment criteria and then created a list of machine for 5 years old S-STEAM education. Third, we developed the final design of S-STEAM education utilization the machine for 5 years old. First, the program of S-STEAM education utilization the machine will proceed with an order partial appreciation and analysis of S-STEAM for 5 years old, introduction of scientific problem situations, analysis and understanding of the scientific problems, exploring resolutions, creative design and emotional experiencing, creative convergent design, conclusion on scientific problem solving, summarizing, verifying and evaluating S-STEAM. Second, the contents of S-STEAM education program will be based on scientific contents such as the motion of objects, change of state of a substance and environmental science according to every day existing life themes. The machines will provide light, light reflex, heat, electron or motor functions to resolve scientific problem situations regarding S-STEAM education activities and be used to processed creative convergent design. The proposed S-STEAM education program as a new paradigm in science education will facilitate the development and distribution of new convergent teaching methods in the early childhood education.

Key words: STEAM education, S-STEAM, scientific problem, early childhood, machine, development

INTRODUCTION

As science and technology developed, a lot of problems couldn't be solved in a single academic field, so naturally, creative and convergent human resources capable of blending diverse subjects were needed (Kim and Lee, 2016). In modern society, we need human resources to create creative knowledge and information of scientific technology. In other words, it has become an era in which talented people with creative and problem-solving skills are needed through integration and fusion of knowledge, technology and scholarship (Park, 2013a). In recent years, Korea has also applied the convergence education between related disciplines and arts, focusing on science as an effort to cultivate fusion talents. Therefore, research on the integration of science and mathematics (Hong, 2009), science and literature (Han and Lee, 2005), science and society (Jung *et al*., 2008) and science and art (Kim *et al*., 2011) have been carried out. Convergence talent education is the relationship between science, technology, engineering, art and mathematics and is a completely different teaching and learning method than the curriculum education which is separated into a new system of education (Jeoung, 2013).

In the field of early childhood education, there are also studies on the development of various programs that integrate Science and Literature (Kim, 2005), music (Hwa and Jeong, 2003), Art (Kim and Cho, 2012; Hong *et al*., 2016) and Mathematics. Nevertheless, previous researches have been limited to integrating a single domain with science, rather than convergent talent education activities or activities that link different domains with prior activity or extension activities of science (Choi and Seo, 2015).

Education in the post human era must have a convergent thinking ability with scientific and mathematical problem solving with technological and engineering management based on scientific knowledge and with artistic sensibility. It is the STEAM consisted of Science, Technology, Engineering, Arts and Mathematics, that has recently been adapted in the Korean educational system (Lee *et al*., 2013). The STEM education is needed to focus on young childhood the most sensitive stage to develop creative, convergent human resources (Kim *et al*., 2016). Today, early childhood education in Korea is based on constructive school education based on exploring, questioning, subject-based, comprehensive, inclusive, reality-based which is very similar to the direction of

STEAM education (Lee, 2013). Currently, there is a high demand for early childhood teacher's STEAM education programs that include engineering and technology areas that are different from their major. In spite of these demands, early childhood teachers have little experience in engineering and technical education, lack of understanding of teaching and learning methods of steam education and lack of experience in steam education, not enough (Ahn, 2015). Therefore, it is difficult to properly implement the steam education for young children which includes engineering and technology in the field of early childhood education.

The research related to the development of the STEAM program for young children is based on a study that examines the effects of arts and science convergent programs for creativity and scientific exploration abilities (Choi and Seo, 2015) and arts and sciences STEAM programs (Park, 2013b; Tu, 2013). Nevertheless, the number of STEAM programs is limited and most developed a convergent program between art and science.

The current education lacks creative thinking and scientific problem solving with technologies and engineering which is regarded as a main purpose of the S-STEAM education program. Therefore, in this study, we apply the machines as instructional media which rigorously represent modern technologies and engineering, in order to design the S-STEAM education program utilization of the machines for early childhood. There have been preceding studies to pave a way toward the S-STEAM education program for early childhood (Kim, 2013; Cho, 2013; Chi, 2015) while studies have lacked in early childhood S-STEAM education program in Korean.

Thus, in this study, we propose to develop the S-STEAM education program utilization of various machines for early childhood that exploit representative features of modern technologies and engineering in order to develop young children's scientific problem solving ability, creativity and convergent thinking ability. Through the S-STEAM education utilization of the machines for 5 years old, it will facilitate applications of the S-STEAM education to early childhood education fields, promote early childhood' scientific problem solving ability, creativity and convergent thinking ability and their accessibility to technologies and engineering. It will enable us to attempt a new educational model as convergent science education in early childhood education:

- What will be model of the S-STEAM education program utilization of the machines for 5 years old?
- What will be contents of the S-STEAM education program utilization of the machines for 5 years old?

MATERIALS AND METHODS

Procedures for designing an S-STEAM education program utilization of the machines: Procedures for designing an S-STEAM education program utilization of the machines for 5 years old are demonstrated in Fig. 1. First, an initial basic direction was set to emphasize the necessity of the S-STEAM education program by reviewing preceding research and literature regarding science programs, science activities, 3-5 years Nuri curriculum and S-STEAM in early childhood. Based on preceding research, we defined a basic concept of

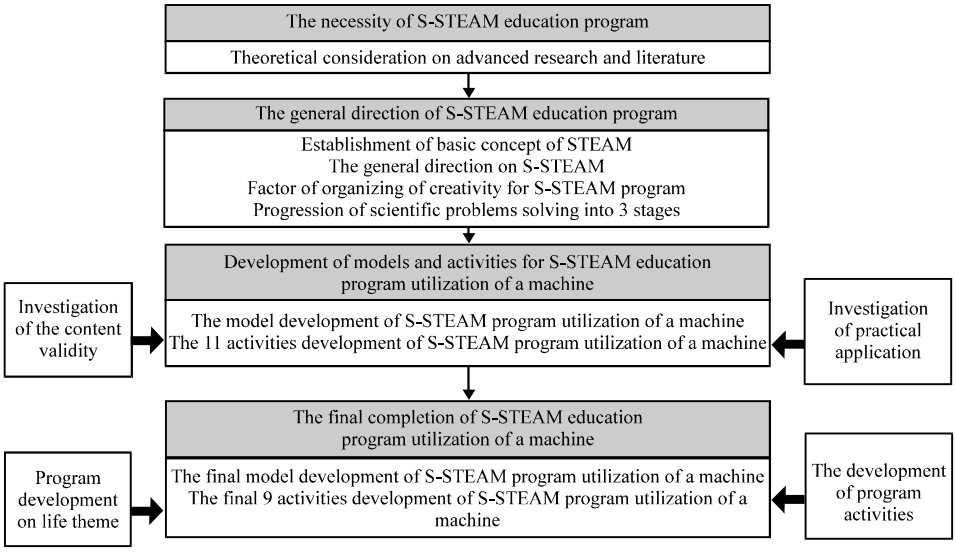

Fig. 1: Procedures for designing an S-STEAM education program utilization of the machines

S-STEAM and a basic direction for early childhood S-STEAM and sub-factor for an early childhood S-STEAM education program. Second, we also defined a list of machine and their assessment criteria and then created a list of machine to provide light, light reflex, heat, electron or motor functions for an early childhood S-STEAM education. Third, we developed the model and 11 activities for an early childhood S-STEAM education program utilization of the machines for 5 years old. Forth, we developed the final model and 9 activities for an early childhood S-STEAM education program utilization of the machines for 5 years old.

First, an initial basic direction was set to emphasize the necessity of the S-STEAM education program for 5 years old by reviewing preceding research and literature regarding science programs, science activities, Nuri curriculum and S-STEAM. Based on preceding research, we defined a basic concept of S-STEAM and a basic direction for early childhood S-STEAM and sub-factors for 5 years old S-STEAM education configuration. Second, we also defined a list of machine as instructional media and their assessment criteria and then created a list of machine for early childhood S-STEAM education configuration. Third, we developed the final design for 5 years old S-STEAM education program.

Features of machine used in an S-STEAM education program: The machine employed in this study utilizes the light, light reflex, heat, electron or motor functions, whose contents are listed in as shown in Fig. 2.

Findings

A model of the S-STEAM education program utilization of the machines: S-STEAM is a convergent science education that expands scientific factors in infrastructures built by machine, to integrate contents of science, technologies, engineering, mathematics and arts. A design model of the early childhood S-STEAM education program utilization of the machines is demonstrated as shown in Fig. 3.

Contents of the S-STEAM education program utilization of the machines: Contents of the S-STEAM education program utilization of the machines for 5 years old such as light, light reflex, heat, electron or motor functions and convergent thinking factors are demonstrated shown in Table 1.

As the pre-activity for designing a model of the S-STEAM education program utilization of the machines for 5 years old, various functions by machine applications

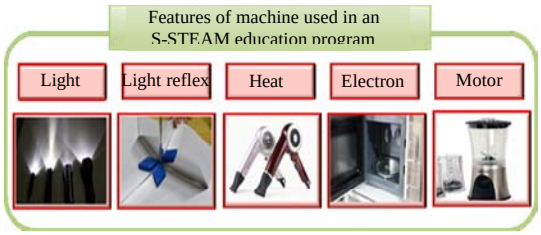

Fig. 2: Features of the machines of the S-STEAM education program

Table 1: Contents of the S-STEAM education program utilization of the machines

Life theme	Activity name	Activity contents	Factors of STEAM	Activity picture
Animals and plants and nature	My own garden made of shadows of plants	Shining the light of a flashlight in a dark place on various plants, creating a 'shadow garden' thought of as a shadow of a plant	S: Navigation of light and shadow T: Making light and shadow E: Variety of plant material A: Using various plants to express M: Various shapes	
Our village	Our neighborhood is changing at will	Take a picture of our neighborhood and check out our neighborhood which is illuminated with various mirrors such as concave and convex mirrors	S: Exploring the properties of the mirror T: Building design A: Building a building using various materials M: Arrangement of the size according to the position of the mirror	
Health and safety	I make healthy drinks	Change the colors of various fruits into a blender and taste senses the mixing of colors and the taste of various materials	S: Navigation of color mixing principle T: Knowing electric and electronic goods E: Variety of fruit ingredients A: Mixing of various colors M: Percentage of fruit and water	
Living tools	My painting finished with cleaner	Drawing on a sheet of paper using a vacuum suction force with a variety of lightweight objects in various colors	S: suction principle of machine T: Knowing electric and electronic goods E: Know the movement of the vacuum A: Decorating with various colors suction M: Various shapes	

Table 1: Continue

Life theme	Activity name	Activity contents	Factors of STEAM	Activity picture
Transportation facilities	Fly aircraft	Make an airplane that can fly away along the runway with a fan	S: Exploring the nature and principles of objects (airplanes) T: Designing an airplane E: Variety of materials A: Designing an airplane M: Plane development	
Our country	Observe the melted popcorn tower	Popcorn is used to build up the tower without using glue, to make it solid with heat and to make a nice tower with paints and recyclables	S: Search for object characteristics, principle of change of objects using water and heat T: Top making design E: Variety of materials, recycled materials A: Designing the top decorating M: Change over time	
Many countries in the world	Yogurt bottle diet	Create a miniature yogurt that changes with the heat of a microwave oven by drawing the image of people from all over the world in an empty yogurt bottle	S: Exploring the change of matter by heat T: Making miniature yogurt bottles of different sizes E: Change of object using electric appliances A: Various material design M: Various shapes	
Winter	Bloom on the syrup	Use the senses to search for the characteristics of water, oil, starch syrup, draw pictures using syrup on paints and put the artwork in the freezer	S: Exploring the properties of water, oil and starch syrup T: Drawing various pictures using the change of syrup A: Decorate with various colors M: Change over time	
Environment and living things	Humidifier with colored breath	Put the water mixed with the water in the humidifier, draw the picture by putting the painted wood on the humidifier inlet	S: Explore the principle of humidifier T: Method and means change, featured design E: Variety of tools A: Using various tools to express M: Percentage of water and paint in the humidifier	

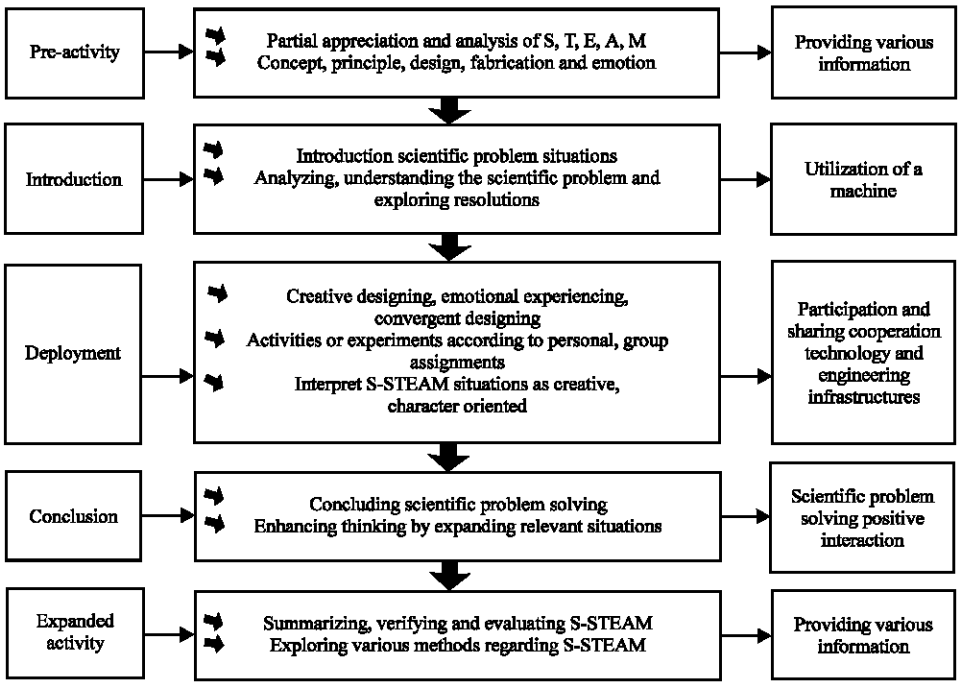

Fig. 3: A design model of the S-STEAM education program utilization of the machines

to analyze and appreciate the concept, principle, design, fabrication and emotion for the individual factors of STEAM; S, T, E, A and M is provided. In the introduction, a scientific problem situation will be suggested to analyze, understand and explore the origin of the problem. The machines will be applied to utilize technologies and engineering. In the deployment, participation, cooperation, sharing and technological and engineering infrastructure of machines will be made to enable creative designing, emotional experiencin and creative convergent designing. In the conclusion, concluding on scientific problem solving, enhancing creative thinking ability by expanding relevant situations, creativity, creatively solving problems and interacting machines with various functions will be made. The last expanding S-STEAM education activities will summarize, confirm and evaluate the S-STEAM education program to explore various ways.

RESULTS AND DISCUSSION

Currently in Korea, there are active researches on integrating mathematics, science, art and music but there is not much interest in the technical and engineering aspects of education. Therefore, this study emphasized the importance and necessity of STEAM and aimed to develop S-STEAM education program for 5 years old who applied various machines as a teaching medium. The program developed in this study will contribute to linkage of early childhood education with elementary education and to solve true S-STEAM education in early childhood education.

First, class design for S-STEAM education program that utilizes various machines for early childhood will proceed with an order partial appreciation and analysis of S-STEAM for 5 years old, introduction of scientific problem situations, analysis and understanding of the scientific problems, exploring resolutions, creative design and emotional experiencing, creative convergent design, conclusion on scientific problem solving, summarizing, verifying and evaluating S-STEAM. Here, machines are used to provide rich information and communication technologies and engineering, seamless convergence, sharing and interaction throughout light, light reflex, heat, electron or motor functions. Second, the contents of proposed S-STEAM education program that utilizes various machines will be based on scientific contents such as the motion of objects, change of state of a substance and environmental science according to everyday existing life themes. The machines will provide light, light reflex, heat, electron or motor functions to resolve scientific problem situations regarding S-STEAM education activities and be used to processed creative convergent design.

The S-STEAM education program that utilizes various machines is a creative activity that solves a wide range of subject-oriented problems and consists of activities to build closer relationships between activities, such as science, mathematics, art, music and so on, ranging from science-based activities to technology and engineering. This S-STEAM education program that utilizes various machines can bring synergy effect to classes if it is used as an extension activity in connection with activities such as science, art, music and mathematics centered on existing life themes. In addition, this S-STEAM education program that utilizes various machines will enable young children to experience creative and convergent experiences such as bringing interest and bringing educational effect. In particular, considering that the characteristic of early childhood curriculum is integrated education and early childhood education programs should utilizes various machines will contribute to the development of early childhood science education as a convergent curriculum. In addition, it is expected that this will contribute not only to effectiveness in education but also to fostering future convergence talents that can contribute to Korea's creative economy. According to, based on the S-STEAM program that utilizes various machines developed in this study, it is necessary to apply convergence education programs such as mathematics-centered which are highly utilized in early childhood education.

CONCLUSION

The results of the science-related studies, Yu and Choi (2013), Cho and Kim (2013) and Kim and Lee (2011) which are considered to be closest to the contents of technology and engineering education are relatively low compared to the existing direction of early childhood education. This study is of great significance in that it aims to solve problems in real life by producing products more heavily in 'solving real life problems centered on technology and engineering' that have not been treated so much.

SUGGESTIONS

The followings are suggested as follows. First of all, it is necessary to develop a teacher education training program to disseminate convergence education such as S-STEAM education program that utilizes various machines to early childhood education field and to develop a convergence type curriculum for the application of convergence education subject to teacher training institute. In particular, in order to provide a more systematic convergence education in the field of early childhood education, field-oriented program development and active field research should be carried out because

most early childhood teachers lack scientific knowledge as well as technology and engineering. Second, in the subsequent study, there is a study on the effects of creativity, scientific problem solving ability and convergent thinking ability as subordinate variables including qualitative analysis including analysis of active places calculated through the S-STEAM education program that utilizes various machines and qualitative analysis of children's questions and responses need.

REFERENCES

Ahn, H.H., 2015. Kindergarten teachers perceptions and demands on STEAM education. Master Thesis, Kyungsung University, Busan, South Korea.

Chi, S.A., 2015. A study on development and effects of the art teaching-learning model integrated with science for young children. Early Childhood Educ. Res. Rev., 19: 337-369.

Cho, H.S., 2013. A direction of the infant STEAM education to develop convergent human resources. Proc. Korean Soc. Early Childhood Educ., 2013: 9-18.

Cho, S.S. and J.S. Kim, 2013. The influence of life invention activities on young children's creativity, scientific problem solving ability and scientific attitude. Early Childhood Educ. Res., 33: 401-422.

Choi, J. and S. Seo, 2015. The effects of a convergent arts and science program on young children's creativity and scientific inquiry. Family Environ. Res., 53: 67-80.

Han, Y.W. and W.K. Lee, 2005. An effect of integrated science inquiry learning method through literature materials on the elementary science learning. Korean Soc. Elemen. Sci. Educ., 24: 9-20.

Hong, S.O., E.J. Jung and S.Y. Lee, 2016. Development of the a-STEAM type technological models with creative and characteristic contents for infants based on smart devices. Indian J. Sci. Technol., 9: 1-8.

Hong, Y.K., 2009. Designing the integrated mathematics and science program and its effectiveness. J. Curriculum Integr., 3: 42-66.

Hwa, L.J. and B.S. Jeong, 2003. The effects of literature-based science activities on children science inquiry ability and attitude. J. Future Early Childhood, 10: 61-83.

Jeoung, Y.Y., 2013. The study of the effect to the child's creativity through the formative activity based on convergence human resource education: Formative activity focused on moving. Master Thesis, Myongji University, Seoul, South Korea.

Jung, M.J., K.S. Yoon and D.K. Kwon, 2008. A meta-analysis on the application effects of STS teaching and learning model. J. Sci. Educ., 32: 55-70.

Kim, H., 2013. A method of STEAM educational activities for 5-year old infants creative convergent education based on role playing. Proc. Korean Soc. Early Childhood Educ., 2013: 89-104.

Kim, H.J., M.S. Song and S.O. Hong, 2016. The effects of science education STEAM program on young children creativity and scientific problem-solving ability. J. Korea Open Assoc. Early Childhood Educ., 21: 613-640.

Kim, J.H. and H.J. Lee, 2011. The influence of scientific activities through creative experiments on children's scientific problem solving ability and scientific attitude. Korean Educ. Prob. Res., 29: 83-108.

Kim, M.S., 2005. The effects of the science integrated activities using picture books on young children's scientific process skill and problem-solving ability. Master Thesis, Chonnam National University, Gwangju, South Korea.

Kim, N.Y. and H.S. Cho, 2012. Development of an integrated art with science education program for young children and its effectiveness. Early Childhood Educ. Res. Rev., 16: 73-102.

Kim, S.S., H.R. Yang and B.Y. Lim, 2011. A study on the development of in-service teacher education program for improvement of early childhood teacher's lesson building aapacity. Early Childhood Educ. J., 15: 311-335.

Kim, S.W. and Y. Lee, 2016. The analysis on research trends in programming based STEAM education in Korea. Indian J. Sci. Technol., 9: 1-10.

Lee, S., J. Baek and J. Lee, 2013. The development and the effects of educational program applied on STEAM for the mathematical prodigy. Educ. Primary Sch. Math., 16: 35-55.

Lee, Y.S., 2013. The direction of STEAM education in nuri-curriculum. J. Early Childhood Educ., 34: 327-341.

Park, E.S., 2013a. Effects of art and science convergence education STEAM program on children creativity development. Master Thesis, Myongji University, Seoul, South Korea.

Park, E.S., 2013b. Effects of infant creativity in the development of art-science STEAM educational programs. Master Thesis, Myongji University, Seoul, South Korea.

Tu, Y.J., 2013. The study of the effect to the child's creativity though the formative activity based on convergence human resource education. Master Thesis, Myongji University, Seoul, South Korea.

Yu, G.J. and S.Y. Choi, 2013. The effects of QR code use in science activities on young children's scientific attitude and problem solving ability. Children Lit. Educ. Res., 14: 220-228.