

A Study on Designing and M-STEAM Class with Smart Devices for Early childhood in Korea

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Abstract

Background/Objectives: Education in the post human era must have creativity with mathematical problem solving, with technological and engineering management based on scientific knowledge, and with artistic sensibility, by guiding students to utilize a major factor of ICT - smart device.

Methods/Statistical analysis: An initial basic direction was set to emphasize the necessity of the M-STEAM class for early childhoods by reviewing preceding research and literature regarding mathematics programs, mathematics activities, Nuri curriculum, and STEAM. And we also

defined a list of smart devices and their assessment criteria, and then created a list of smart devices for an early childhood M-STEAM class. Third, we developed the final design of M-STEAM class for early childhood.

Findings: First, the design of M-STEAM class for early childhood with smart devices will proceed with an order partial appreciation and analysis of STEAM, introduction of problematic situations, analysis and understanding of the problems, exploring resolutions, creative design and emotional experiencing, creative convergent design, conclusion on problem solving, smart devices will be used to provide a wealth of information, information and communication technologies, participation and cooperation, sharing, and interactions. Second, contents of proposed M-STEAM class will be based on mathematical contents such as location, direction, basic measurement, and distance. Smart devices will provide LED lighting, motor, camera functions to resolve problematic situations regarding STEAM activities and be used to proceed creative convergent design.

Improvements/Applications: The proposed M-STEAM class as a new educational paradigm in the post human era will facilitate the development and distribution of new convergent teaching methods in the early childhood education.

Key Words : Class Design, Early Childhood, ICT, M-STEAM, Program, Smart Device.

1 Introduction

Development of information and communication technologies (ICT) and emergence of smart devices have significantly changed approaching methods and educational environments in compulsory education. It has complemented classic textbooks into digital textbooks, and provided copious learning materials by so called, Apps (applications). A steady increase in social network services (SNS) has implemented an approaching method to freely communicate between a person and groups beyond spatio-temporal barriers. In this rapidly changing post-human era, the utilization of ICT in an educational environment is an emerging new educational approach^{1,2}

Education based on ICT employed by the Korean compulsory education system now becomes a trend in early childhood education. Teachers in the early childhood education and administrators in the field³⁻⁶ have concurred to provide children with adequate experiences with computers and smart devices and relevant activities for their development by effectively utilizing ICTs for the 21st century's national competitiveness⁷. In addition, The United Nations Educational, Scientific and Cultural Organization^{8,9} indicates since children in the modern society have already experienced much in ICTs and ICTs become a vital factor for children development, a new, adequate educational method are imperative. In other words, education in the post human era must have a convergent thinking ability with mathematical and logical problem solving, with technological and engineering management based on scientific knowledge, and with artistic sensibility, by guiding students to utilize a major factor of ICT - smart device. It is the STEAM (Science, Technology, Engineering, Arts, and Mathematics) that has recently been adapted in the Korean educational system¹⁰.

2 Literature review

The STEM education is needed to focus on childhood - the most sensitive stage to develop creative, convergent human resources¹¹. While current early childhood education are based on questioning, exploring, subject-oriented, comprehensive, reality-based, and constructive schooling, which is very similar to the direction of the STEAM education¹². The current education lacks creative problem solving with technologies and engineering which is regarded as a main purpose of the STEAM education. Therefore, in this study, we elect smart devices as a teaching medium, which rigorously represent modern technologies and engineering, in order to design the M-STEAM education with smart device for early childhood. Although so far, there have been preceding studies to pave a way toward the STEAM education for early childhood¹³⁻¹⁶, many studies had focused on developing STEAM educational models and programs typically based on science and arts^{11,16} and their corresponding research on class designs were limited to compulsory education^{17,18} while studies have lacked in early childhood educa-

tion. Considering fewer studies have performed in STEAM education emphasizing technologies, engineering, and mathematics than in STEAM education focusing on science and arts¹⁹, the current education systems have limitations in promoting the convergent ability that integrates technology, engineering, and mathematics together^{20,21}. Thus, in this study, we propose to design an M-STEAM education for early childhood with smart devices that exploit representative features of modern technologies and engineering in order to meet the paradigm change in post human era's education. Through the M-STEAM education with smart devices for early childhood, it will facilitate applications of the STEAM education to early childhood education fields, promote early childhood' problem solving and creativity, and their accessibility to information technologies. It will enable us to attempt a new educational model as a new paradigm in the post human era. We established the followings as research issues.

1. How do we design the M-STEAM class with smart devices for early childhood?
2. What will be contents of the M-STEAM class with smart devices for early childhood?

3 Proposed Work

3.1 Procedures for designing an M-STEAM class with smart device for early childhood

Procedures for designing an M-STEAM class with smart device for early childhood are demonstrated in (Figure 1) First, an initial basic direction was set to emphasize the necessity of the M-STEAM class for early childhood by reviewing preceding research and literature regarding mathematics programs, mathematics activities, Nuri curriculum, and STEAM. Based on preceding research, we defined a basic concept of STEAM and a basic direction for early childhood M-STEAM, and sub-factor for an early childhood M-STEAM a class configuration. Second, we also defined a list of smart devices and their assessment criteria, and then created a list of smart devices for an early childhood M-STEAM class. Third, we developed the final design for an early childhood M-STEAM class.

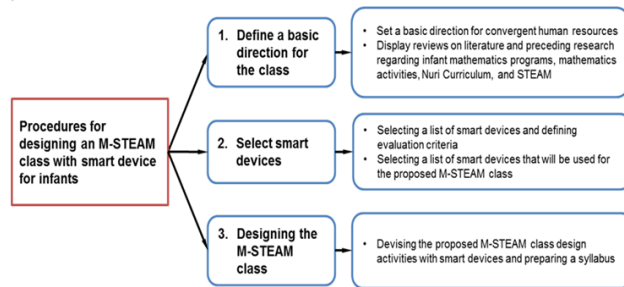






Figure 1: Procedures for designing an M-STEAM class with smart device for early childhood

First, an initial basic direction was set to emphasize the necessity of the M-STEAM class for infants by reviewing preceding research and literature regarding mathematics programs, mathematics activities, Nuri curriculum, and STEAM. Based on preceding research, we defined a basic concept of STEAM and a basic direction for infant M-STEAM, and sub-factors for an infant M-STEAM a class configuration. Second, we also defined a list of smart devices and their assessment criteria, and then created a list of smart devices for an infant M-STEAM class. Third, we developed the final design for an infant M-STEAM class.

3.2 Features of smart devices systems used in an M-STEAM class for early childhood

The smart device system employed in this study utilizes the sound, microphone, light-emitting-diode lighting, motor and camera functions, whose contents are listed in as shown in table1.

Table 1: Smart Device System Classification and Contents

Classification	Contents	Classification	Contents
 Sound Microphone	<ul style="list-style-type: none"> The sound function will be determined whether it will use a an exterior module or process internally. Preferably, functions embedded in the processor such as ADC and DAC or sound's codes will be used. If an external sound chip is used, we will develop a function to play an WAV, WMA as well as MP3 file based on the VS1003 chip by VLSI. Since former developed technologies already existed, we will reflect this. 	 Motor	<ul style="list-style-type: none"> A motor control module that can be integrated in a moving object such as a car. Precise control possible by using a stepping motor. Front / rear / left / right control available.
 Light Emitting Diode (LED)	<ul style="list-style-type: none"> LEDs embedded in a semi-transparent tube provide a lighting effect. An LED module whose brightness and color can be controlled by an Android device or iPad/iPhone is embedded. 	 Camera	<ul style="list-style-type: none"> In conjunction with smart devices, movie recording and picture taking are available. Once connected with a communication module, it can be controlled and monitored remotely. The camera module has a high resolution (more or equal than 1280*720, high definition). Through this camera module, children can record and verify the interior and exterior of their products.

3.3 A model of the M-STEAM class with smart devices for early childhood

M-STEAM is a convergent education method that expands mathematical factors in infrastructures built by smart devices, to integrate contents of mathematics, science, engineering, technologies, and arts. A design model of the early childhood M-STEAM class with smart devices is demonstrated in (Figure 2)

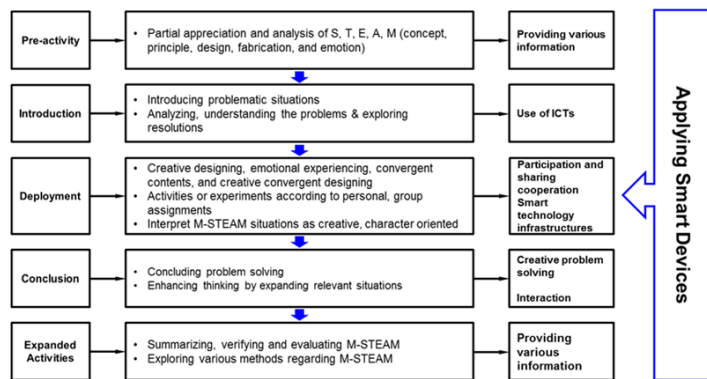






Figure 2: A design model of the M-STEAM class with smart devices for early childhood

3.4 Contents of the M-STEAM class with smart devices for early childhood

Contents of the M-STEAM class with smart devices for early childhood such as sound systems, microphones, LED lighting systems, motors, and camera functions and convergent thinking factors are demonstrated shown in table2.

Table 2: Contents of the M-STEAM class and convergent thinking factors for early childhood

Life theme	Activities	Factors for Convergent Thinking	Smart Device Application	Activity Pictures
	Title: Our local map of public agencies			
Our Hometown	Searching by locations and directions of public agencies with a map that can be used in day and night. (location and direction)	S: Searching towns on the map (observation, classification), light T: Cartography according to day and night E: Design with light A: Drawing towns M: Counting buildings, location, direction	Designing a map with LED lighting to make it visible at night	

	Title : My story of home that I made ³⁾			
Life tools ⁴⁾	A ruler shaped bug measures and compares objects. (Measurement –basic measurement and measurements on surrounding objects) ⁵⁾	S: Various lighting, blending lights. T: House Blueprint, 3D representation. E: SCAMPER technique (Magnification, reduction, rotation). A: charring picture books, playing and recording songs. ⁶⁾ M: Measuring house, window fenestration ⁷⁾		
	Title: Interesting Perspective Photos ³⁾			
Many countries around the world ⁴⁾	Taking an interesting perspective photo of famous architectures in many countries around the world. (Distance, direction) ⁵⁾	S: Principle of Perspective ⁶⁾ T: Taking perspective photos ⁷⁾ E: Utilizing various special lenses ⁸⁾ A: Appreciating the sophistication and beauty of world architectures ⁹⁾ M: Comparison of object's size depending on its distance ¹⁰⁾		

As the pre-activity for designing a model of the M-STEAM class with smart devices for early childhood, various information by smart device applications 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 problematic situation will be suggested to analyze, understand, and explore the origin of the problem. Smart devices will be applied to utilize information and communication technologies. In the deployment, participation, cooperation, sharing, and technological infrastructure of smart devices will be made to enable creative designing, emotional experiencing, information fusing, and creative convergent designing. In the conclusion, concluding on problem solving, enhancing thinking ability by expanding relevant situations, creativity, creatively solving problems, and interacting with smart devices will be made. The last expanding class activities will summarize, confirm, and evaluate the M-STEAM class to explore various ways. It will employ smart devices that provides various information.

4 Conclusion

It also requires an ability to adequately choose relevant knowledge as well as an innate intellectual ability. Accordingly, ever since 2010, while studies on integrating mathematics, science, arts, and music together have been actively performed, technology and engineering parts in the education have not received much attention.

As the early childhood education has emphasized the importance and necessity of STEAM, we aimed to develop M-STEAM class design for early childhood and its corresponding contents with smart devices as a means of a convergent teaching method. It will lead to link between the early childhood education and the elementary education and also contribute to settle a true STEAM class in the early childhood education.

Our conclusion based on the results demonstrated are as follows: First, class design for M-STEAM class with smart devices for early childhood will proceed with an order partial appreciation and analysis of STEAM, introduction of problematic situations, analysis and understanding of the problems, exploring resolutions, creative design and emotional experiencing, creative convergent design, conclusion on problem solving, summarizing, verifying and evaluating M-STEAM. Here, smart devices will be used to provide a wealth of information, information and communication technologies, participation and cooperation, sharing, and interactions.

Second, contents of proposed M-STEAM class will be based on mathematical contents such as location, direction, basic measurement, and distance. Smart devices will provide LED lighting, motor, camera functions to resolve problematic situations regarding STEAM activities and be used to proceed creative convergent design.

This study provides academic and educational background materials for the early childhood education by developing the proposed M-STEAM class design. In order words, the proposed M-STEAM class as a new educational paradigm in the post human era will facilitate the development and distribution of new convergent teaching methods in the early childhood education. Specifically, the proposed M-STEAM class will maximize early childhood' self-directed learning, voluntary participation, as well as positive interactions with machine, since early childhood in free activity times on an educational field voluntarily select smart devices, express their own thoughts and opinions, and creatively create their own results. In particular, the contents of the proposed M-STEAM class will facilitate a mood of convergent education by overcoming educational difficulties in a kindergarten which requires educational experts to implement new technologies in convergent educational media. As well as, when a teacher prepares for a class in a kindergarten, he or she

can deteriorate from his/her center of activities by actively utilizing smart device teaching media. In this process, we are expecting that it creates a classroom atmosphere with creative thinking capability, and with smart quality. Our proposed class simultaneously satisfies 'STEAM literacy'^{14,22}, which has served as a STEAM education purpose in South Korea and provide an adequate STEAM educational model in the fields of the early childhood education. In addition, our proposed education that agrees with Sanders²³, who claimed an increased value when integrating classes together such as science and arts, will play an important role in the early childhood education since it implements a true STEAM education with smart devices representing technologies and engineering for early childhood.

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