Development of STEAM program Math centered for Middle School Students

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Abstract: Now as a society of knowledge and information , it is required the develoment of autonomous and creative human resources that can create new intellectual value using the knowledge and information given by rather than simply memorizing the knowledge. In terms of development of creativity, mathematics is a very important subject. However, many students do not feel the need and the value of mathematics and they just study without any interests. So looking at the buzzword of these days, STEAM . STEAM is the fusion of five fields of studies which are science, technology, engineering, art, mathematics. In the early advanced study it can be seen that using STEAM , education has a positive impact on attitudes and interests . And computer programming enhances students' algorithmic thinking in mathematics. Therefore, this research wants to develop STEAM program centered with mathematics using scratch to improve the mathematical interests of students.

Keywords: STEAM, Scratch , Mathematical interest, Learning program.

Introduction

We are living in an information society away from the industrial economy such that knowledge and information is the driving force of economic development. In such a society, development of autonomous and creative human resources is required because personal and national competitiveness is determined by the value of new intellectual value-added production capacity based on the high level of information processing capabilities. As a seed of invention and discovery, creativity is the most high-level thinking skills and is the most needed ability in a information and knowledge, cutting-edge science and technology era. Thus, creativity is the main goal in all stages of school education[1].

Mathematics has begun with the history of mankind and can be found as a common language of humanity in the worldwide culture and is an essential tool in everyday life .
In particular, mathematics plays a very important role to understand and use a lot of information that is invaluable in a rapidly changing and today's information society.
It is one of the aspects of creativity in the way it makes us to think outside the fixed frame to find the solution[2].

Most students recognize mathematics as an important subject but very few students properly recognize the value of mathematics. Studying for tests, but it's rare for the fun of math, STEAM is an integrated learning approached in the aspects of science, technology, engineering, mathematics, art to one subject. This increases the efficiency of learning and motivation as well as has a positive impact on the development of learners' interest.

In addition, the linkages between various disciplines through STEAM education is consistent with the buzzword "convergence" emerged in the modern world. STEAM is a great way of education is the opinion of experts that are common. In recent years, United

States, Britain, Australia, Canada, and in developed countries have an attracting attention that the core of educational reform is STEAM . In earlier studies conducted, the results that STEAM has a positive effect on improvement of the level of learning attitude in math and science are coming out[3].

According to the principle of learning in NCTM, it emphasizes that students should consist new information actively based on previous experiences and knowledges. It says learnig through understanding is effective. It means when students are in the process where they feel and contemplate by themselves, there they will experience the complete understanding and will have the possibility of creativeness developing [4].

Learning math through real life is very similar in meaning with the concept of STEAM. By utilizing a computer program to solve the problem, students effort to think of the ideas and actually look the mathematics through the implement the program so it would increase the interests in mathematics.

Scratch is a programming language usable in all subjects. The command block works in a way of drag and drop. Compared to the existing engineering tools, it is more visual and dynamic, intuitive and easy to use for school students. Thus, I developed STEAM program centered with mathematics using the Scratch programming language in order to improve their math interests .

1. STEAM

STEM education was introduced in order to improve competitiveness in Science and Technology in the United States in 2003. STEM teaches science, technology, engineering, mathematics in an integrated way. In 2007 George yakman has announced STEAM in addition art to the STEM. [Figure 1] is the STEAM Pyramid. Yakman said by the STEAM education we can increase their relevance to real life and interests[4]. Many education scholars into a unified art in STEM education, said be STEAM.

Out from the dichotomous thinking such that science of conventional is logical and art is not logical, STEAM is to foster creative human resources by integrating STEM and art. Science provides a methodological tool in the art and art provides creative model in the development of science. Science uses imagination and emotion, thinking that the power of visualization principles of art and art uses scientific discoveries and principles of science[9]
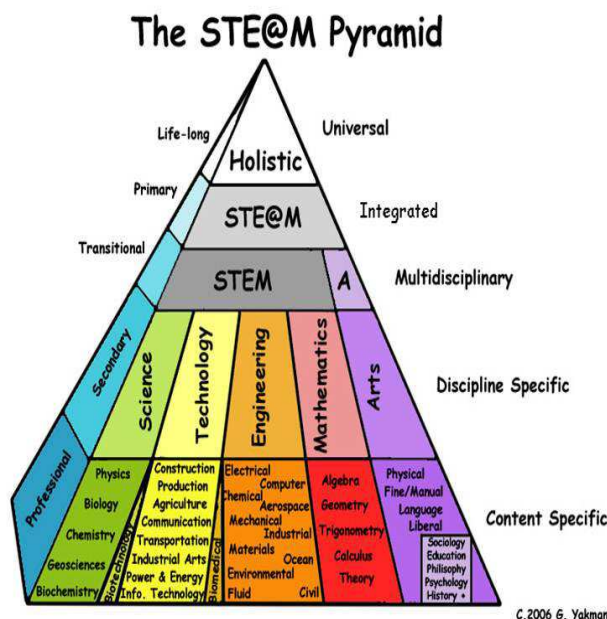
2.   Math based on STEAM

Principles and Standards for School Mathematics argues that mathematics should deal with topics related to the world we live in and it should be related with other fields of subjects. This is proposing mathematics should be integrated with other fields and be explored with real life[10]. Looking for examples of math related with real life, in ji-yeun Lee's paper, she finds the reason why students don't like math and says current math class teaches contents far away from real life. So she proposed contents realted with real life.

When instruct Mathematics, to generate mathematical interest and mathematical thinking and problem-solving kidneys, it is necessary to be away from a common textbook-centered learning methods but to introduce real-world problems associated with real life experience to ensure mathematical affinity[5]. When we see those products or technologies that we often use in everyday life we can see it is integrated with several studies. Thus, when teaching mathematics , it would be more interesting lessons if mathematics is integrated with other subjects and related to real life and based on STEAM .

3.   Math and Computer Programming

In the bottom of Computer programming, it is situated mathematics there. In addition, in a course of mathematics, there is numerical analysis which uses computer to solve math problems and prove the algorithm. Learners improve logical thinking and can look back mathematical concepts such as functions through computer programming . Above all, using a computer. we can solve the problems which is difficult to solve by hand. The programming improves algorithmic thinking, problem-solving, particularly reflective thinking through the process of error correction[6].

Looking at the impact of computer programming on mathematical thinking, computer programming can help to develop individual's intellectual capacity by organizing the information given in a accurate and systematic way and giving the environment to arrange the information to operate logically. In the course of these programming learners are on the a position to build the system of knowledge rather than being audience[8]

4.   SCRATCH

Scratch is an educational programming language made by the MIT Media Lab in 2007 for programming beginners and the teens. Programmers create programming so easily as building several blocks in eight block area. Scratch is so intuitive language that provides almost everything to make computer games, multimedia Presentations, interactive stories, illustrations, and animations [6]. If we list the features of Scratch,
1. It can be used in a variety of ages.
2. It was created based on Squeak.
3. It is programmed using the visual object.
4. It is the programming building blocks like Lego or puzzle pieces.
5. It is possible to parallel execution and stepping.
6. It is possible to utilize a variety of media.
7. Sharing and collaboration is possible.
8. The program is free and open source.
To study math based on STEAM, we need to realize it in some ways. While reviewing scratch, In the process making project using scratch, students learn how to choose and create and manage many objects while choosing many images, animations etc. And scratch

makes students to respond to an unexpected situation with a creative solution. So it increases creative thinking skills [12]. So I think Scratch is a good way to realize it.

5. Methodology of the STEAM program centered with mathematics

5.1 Directivity and select content of Study program

- Choose the theme which learners can see mathematical principles and meet easily in real life
- Choose the theme which includes STEAM elements.
- Consider middle school student's interest, study level, learning ability.

5.2 Design the model for teaching

Table 1. The model for STEAM and content [7]

STEAM	content
Introduction	- Introducton Project based Learning program Motivation
Deciding Subject and planning	- Decide topic - Decide subtopic and make teams -Secure study sources.
Becoming one with project	-Investigate and research, sharing datas, Meeting and collaboration sharing and expanding thinkings - Express subject with art elements.
Presentation of the results	- Represent the results -Compare own results with others through representation
finish and evaluation	- Evaluate various methods - Finish and reconstruct

5.3 Instructional design of STEAM program centered with math.

Table 2. Example of Math Program <Making a Clock>

Table of content	Contents
Unit	Of the shape, Proportional expression
Learning goals	We can make the clock using proportional expression and the angle.
STEAM	S: The difference between analog and digital T: The development of technologies of watch E: Advanced clock A: Clock Design M: The concept of angle in geometry, proportional
Detailed activities	·Time can be displayed using the angle and proportional expression ·Understand the difference between analog and digital, and should design the clock with the advantage of this.

Table 3. Example of Math Program   < Create geometric patterns >

Table of content	Contents
Unit	Function
Learning goals	Understands the graph of function and utilize

	Putting it into the props to create their own patterns.
STEAM	S: The principle of fabric dyeing T: The Development of dyeing technique E: The process of fabric dyeing A: design M: function and graph
Detailed activities	·Understand the function and can draw the graph ·Think about the principle of fabric dyeing and program it with scratch to create their own patterns and we can relate with real life.

6. Conclusion and Future Work

In this study, I developed STEAM program centered with mathematics using scratch to improve mathematical interests for middle school students. This program could increase learning interest. In the learning process, programming will help learner's mathematical thinking. To inspect the effects of this program, we have to apply this method to real class. Developed STEAM program will be taught to students in class and we'll observe the student's learning activities and analyze outcomes of learning.

STEAM-related learning programs have not been developed a lot. Learning programs based on STEAM should be developed a lot for school teachers field to utilize them. We need to discipline teachers to teach the program well and train many teachers. From now on, there should be many attempts of STEAM education. As the concept of STEAM, many teachers from various fields get together and share their knowledge to make better program.

References

[1] Dong-Hee Lee. (2009). The Effect of Climbing Learning Method on Mathematical Creativity and Inclination for Mathematical Creativity. Master Thesis. Busan national University.
[2] Byeng-Jo Kim. (2002). The Study on the effectiveness of the creativity training program by DESK model. Master thesis. Kyung Hee University.
[3] Hyo- nyung Lee. (2011). Investigation of STEM education of USA for the start of STEAM. Journal science creation .
[4] Woo- Jin Kim. (2012). STEAM Program Development and Application for Improving Creativity of the Gifted Elementary Student about Math Focused on 4D-Frame Teaching Aid Activity. . Master thesis. Korea National University of Education
[5] Ho-Soon Kim. (2002). The Effects of Problem Centered Learning based on Real Life Problems in Mathematical Beleifs and Attitudes. Master thesis. Korea National University of Education.
[6] Yun -A Kim. (2012). A study on the Function of first grade Middle School Using an Educatioal Programming Language "Scratch". Master thesis. Korea National University of Education.
[7] Soon- Beom Kwon. (2012). The Effects of Convergence Education based STEAM on Elementary School Students' Creative Personality. Master thesis. Korea National University of Education
[8] Byung-duk Ahn. (2004). Elementary computer science curriculum which based on Visual Basic programming in order to improve mathematical problem solving skills. Master thesis. Yonsei University.
[9] hyung-ju Park.(2012). A Study on analysis of Mathematical textbook based on STEAM Education. Master thesis. Ewha Womans University.
[10] Shin-deuk Lee. (2006). Development and application of ICT teaching and learning Materials driven real life and the changes of students' recognition after mathematics instruction. . Master thesis. Korea university.
[11] Ji-Yeon,Lee. (2011). Mathematics in (Real) Life. Master thesis. Chung nam National University.
[12] Natalie Rusk, Mitchel Resnick,& John Maloney. (2010) Learning with Scratch. http://info.scratch.mit.edu/sites/infoscratch.media.mit.edu/docs/scratch-21centuryskills.pdf