International Journal of
Emerging Multidisciplinary Research

ISSN : 2546-1583
Volume 2, Number 4, December 2018
https://doi.org/10.22662/IJEMR.2018.2.4.017

Design and Development of Software Model Textbooks with Novel Engineering for After-Schools

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Abstract

Background/Objectives: In Korea, software education is being strengthened. **Methods/Statistical analysis:** As a result, the polarization in software education is getting worse due to the private education craze. Fortunately, there is room in South Korea to narrow the gap through after-school schools. **Findings:** However, the ability of after-school instructors and the acquisition of information are also important, so this study developed model textbooks. Model textbooks have recently applied Nobel Engineering, which has been gaining attention in South Korea. **Improvements/Applications:** Model textbooks have recently applied Nobel Engineering, which has been gaining attention in South Korea. Through the developed model textbooks, we hope to help with fun software education by applying it to the school site after school

Index Terms

Software Education, Novel Engineering, After-School, Model Textbook, Programming Education

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• Manuscript received November 26, 2018
• Revised December 11, 2018 ; Accepted December 14, 2018.
• Date of publication December 31, 2018.

I. INTRODUCTION

The importance of software education is emphasized all over the world in order to foster the convergence required by rapidly changing modern society [1]. In addition, the revised 2015 curriculum introduced software education to prepare for the Fourth Industrial Revolution and the 21st Century Knowledge and Information Society and to train appropriate personnel [2]. Therefore, various schools are including the Ministry of Education, operate software leading schools and research schools, provide teacher training for each education office, and gradually increase related activities in schools after school [3-6].

However, the existing after-school classes related to software education do not have a systematic curriculum, teaching materials are not unified, and training systems are not in place for new competencies of instructors. In addition, the importance of computing power has recently been emphasized. Regular teachers can be competent through teacher training, but after-school instructors who are alienated from the current system cannot easily get information on computing thinking skills. It is expected to disrupt software-related education in schools after school [7].

In this study, five after-schools in A area were selected to develop software education programs, develop educational model materials, and distribute them to increase interest in software education and enhance software capabilities. To this end, textbooks were developed based on Nobel Engineering.

II. RELATED RESEARCHES

A. After-School

After-school education refers to school education activities other than regular education courses run mainly by the demanders (students and parents). The name and program, which were previously used for after-school classes (primary schools), special skills and aptitude education, and supplementary learning (high schools) by level, have been integrated into the term "after-school" since 2006 [8].

After-school computer classes should be reborn as an innovative education that has been expanded to diversity, autonomy and openness that can enhance students' specialties and aptitude, moving away from knowledge-based standardized education. They should also discover and develop students' aptitude and aptitude so that they can experience more diverse experiences. In addition, it is necessary to develop and enhance individuality and ability by properly providing basic education [9].

B. Model Textbook

Textbooks are used as a primary textbook in schools according to curriculum, and developing textbooks allows the implementation of any single classroom system in the curriculum in textbooks. A classroom system here means a group of components or subcomponents that have an interaction relationship with the aim of changing learners' behavior [10].

Therefore, the development of textbooks should include a course design for the classroom system that the textbooks want to implement. Structural Design is a set of systematic class plans that provide basic constructs of manual systems, ranging from goals, content, methods and evaluations, while properly organizing and integrating components for successful learning [11].

Accordingly, In this study, the development model of a model textbook was established by referring to the study of Kang(2006) for the model textbook development model. The model for developing model textbooks is shown in Table 1 [12].

Table 1. THE DEVELOPMENT MODEL OF SOFTWARE MODEL TEXTBOOK

Level		Contents
Introduction	Motivation	To stimulate learners' experiences before learning by means of a prompt to easily relate them to their learning.
	Aim of Lesson	To present clearly to learners about what to learn based on their experiences of speaking.
Deployment	Contents Relevance	The purpose of this example is to relate to the experience extracted from the 'motivation' phase, so as to provide easy access to and relevance to it. Here the learner's experience and the examples presented are in line with the subject matter and may be linked to the same material.
	Contents Description	Presentation and description of the theoretical content of this learning. It is in line with the examples given in relation to content and may be linked to the same material.
Theorem	Learning Evaluation	To understand this learning, to think about the necessity, and to conduct a formative evaluation based on the learning objectives.
	Learning Theorem	Organise learning and give learners the task to apply learning content.

C. Novel Engineering

Novel Engineering is an engineering education method that combines engineering elements such as robot use and STEAM education in humanities education. Students can actively participate in learning by engaging in engineering activities in traditional liberal arts education and expect their creative thinking [13]. The procedure for working as Nobel Engineering is shown in Fig. 2.

Fig. 1. The Whole Process of Novel Engineering

III. Design of Model Textbook for Novel Engineering

Table 2. Curriculum of Entry Block Coding Classes

No.	Contents	Details
1	Entry Start	Orientation
2	Start Block	Event, Object, Scene
3	Move Block	Loop, If, Clone
4	Flow Block	Move, Rotate,
5	Looks Block	Show, Hide, Change, remove, Flip
6	Brush Block	Brush, Color, Stamp
7	Sound Block	Chord, Volume
8	Decision Block	Mouse Event, Related Operator, Logical Operator
9	Calculate Block	Number, Arithmetic Operator, Timer, Random
10	Variable Block	Global Variable, Local Variable
11	Function Block	Add Function
12	Extention Block	Add Extention Block
13	Hardware Block	Connected Hardware

Table 3. Curriculum of Robot(Ex: Hamster Robot)

No.	Contents	Details
1	Coding Start	Orientation, Input Devices, Output Devices
2	Application Start	Roboid Application, Bluetooth Mode
3	Cording Stack	Start, Basic Coding
4	Sentences	Sequence, Loop, Conditional
5	Problem Solving	Hamster's Sensor, Smartphone's Sensor, Speech Recognizer, Auto Driaving
6	Extention Board	Input/Output Devices, Extention Board Connect,
7	Dash Board	Making, Coding
8	Hamster Projects	Parking
9	Hamster Projects	Track Counter
10	Hamster Projects	Line Tracer
11	Hamster Projects	Avoider
12	Hamster Projects	Racer

This study was conducted to apply for five after-school in area A. They were all operating classes teaching entry and classes teaching robots, as shown in Table 2 and Table 3. Based on this, it will produce model textbooks.

IV. Development of Model Textbook for Novel Engineering

Based on the design principles and development models presented in this study, model textbooks were developed as follows. In this study, a unit of entry coding is given as an example.

A. Reading Book and Identify Problems

In this study, we read a fairy tale book(Fig. 2) called 'The Magic Pot' and try to organize it into an entry block. To do this, read the fairy tale and find out what is required problems for entry coding. The reason for the selection of "The Magic Pot" was that it was easy to focus on the activities of becoming a character in the play and understand the perspectives of other characters.

Fig. 2. Fairy Tale 'The Magic Pot'.

B. Design Solution

The solution was designed to be designed directly before programming into Entry. It also provided space to draw pictures and to write descriptions so as not to be simple graffiti. The parts required for the Design Solution are shown in Fig. 3.

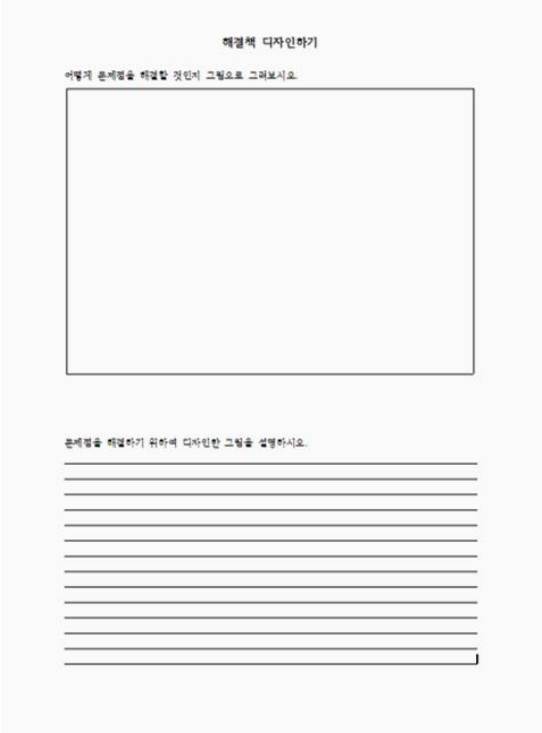

Fig. 3. Design Solution.

C. *Entry Block Coding Tool*

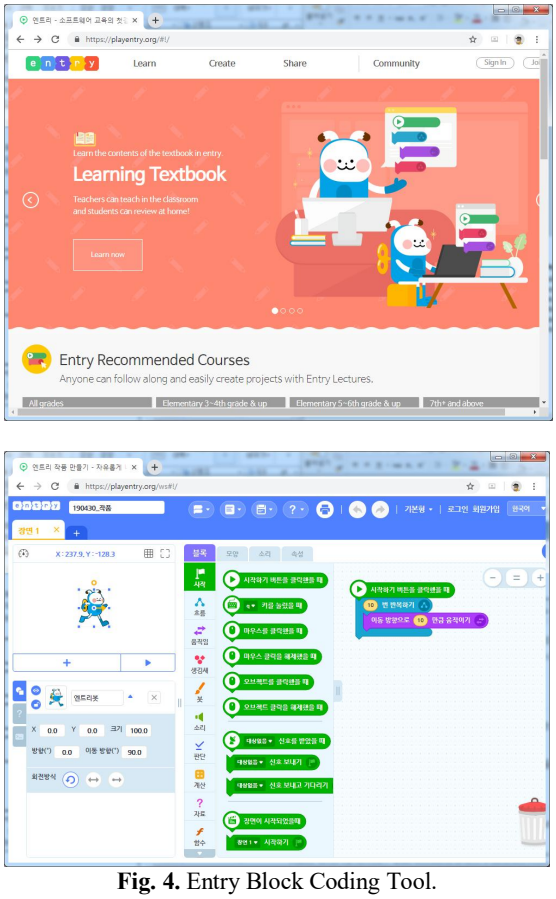

Fig. 4. Entry Block Coding Tool.

In Nobel Engineering, coding is carried out following the design solution phase. In this study, we have to code into the program Entry. Entries are block-coding tools similar to scratches and allow easy and fun learning of the principles of programming. It can also be coded online and learned offline. An example of an entry coded is shown in Fig. 4.

D. *Feedback*

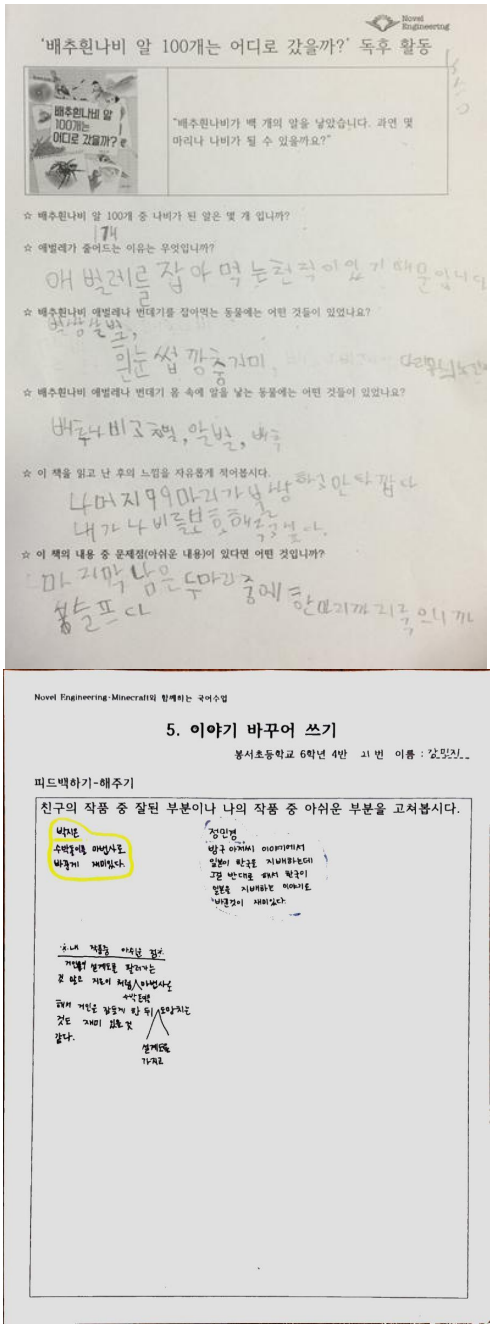

Fig. 5. Cases of Feedback

In Nobel Engineering, there is a feedback phase in which after coding, one takes time to exchange opinions with colleagues. Through this process, they may take time to modify their coding results. Fig. 5 shows a case of sharing feedback with friends in another study [14, 15].

E. Improve Design and Reconstruction Stories

Model textbooks developed in this study may lead to re-examination and modification of the results and outputs that have been carried out. Through the activities of presenting solutions to problems and imagining stories behind them, students can actually experience the same realism as being the main character. Thus, when reconstructing a story, characters, backgrounds, and events are presented in various ways. New faces can appear, move to new settings, or create new events to solve problems. Through Novell Engineering, it was possible to observe students' imaginative and open-minded attitudes in the areas of creative thinking, such as their obsession with task, compared to the existing writing activities [16]. These activities can be implemented by adding objects or backgrounds, depending on the characteristics of the entry, when implemented with entry coding. Model textbooks can be developed by taking advantage of the features of this Novel Engineering class model and entry block coding tool.

V. CONCLUSION AND SUGGESTION

In this study, we developed a Nobel Engineering model textbook for after-school classrooms. Among the steps of Nobel engineering, model textbooks were developed in the procedures of Reading Book - Problem Identify - Design Solution – Coding – Feedback - Improve Design - Reconstrution Stories, etc. Through this process, the company was able to develop the habit of reading, not just function-oriented Entry block coding tool, but also to develop a convergence education content that can actually be viewed through programming.

First, the principles and concepts of the convergence education process have been developed so that they can learn from learners' motivation, evaluation, and theorem, away from the existing function-oriented coding, and an understanding of the direction of revision of the software curriculum should be preceded.

Second, after-school textbooks that reflect the characteristics of the unit of the software class should be designed and developed.

Third, when developing model textbooks, information textbooks should be developed based on design principles and development models based on development procedures.

Fourth, the on-site application of model textbooks that were not carried out in this study will have to be carried out in a later study to develop a teaching-learning course and reported to actual classes, and to observe classes, to see if there is anything to be modified or supplemented.

The limitation of the study is that it fell short of analyzing the application cases because it is in the process of developing model textbooks.

Future research projects include a variety of applications and generalizations for after-school schools in other areas.

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