Design of Artificial Intelligence Education Program based on Design-based Research

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Abstract

Recently, the artificial intelligence(AI) is used in various environments in life, and research on this is being actively conducted in education. In this paper, we designed a Design-Based Research(DBR)-based AI programming education program and analyzed the application of the program for the improvement of understanding of AI in elementary school. In the artificial intelligence education program in elementary school, we should consider that it should be used in conjunction with software education through programming activities, rather than creating interest through simple AI experiences. The designed education program reflects the collaborative problem-solving procedures following the DBR process of analysis - design - execution - redesign, allowing the real-world problem-solving activities using AI experiences and block-type programming language. This paper also examined the examples of education programs to improve understanding of AI by using Machine Learning for Kids and to draw implications for developing and operating such a program.

1. Introduction

With the coming of the 4th Industrial Revolution era, the education is also undergoing many changes. The 2015 Revised National Curriculum presents 'cultivation of creative and integrative talent required by future society' as one of visions and in the Practical Course of elementary school, reflecting the vision, software education was introduced and implemented mandatorily [1, 2].

The artificial intelligence(AI) is used in various environments in life recently, and studies on this theme is being actively conducted also in education field [3, 4]. The studies related to AI education may be divided into the areas of applying AI as a technology and the teaching AI technology. In the studies on the former area, the integration of a system managing learners' learning (learning management system; LMS) and AI has been attempted. The studies on the latter area that educates AI technology, however, have just begun [5].

The 'method and cautions of teaching and learning' of Practical Course in the 2015 Revised National Curriculum, in particular, presents the combination of programming education and AI education, stating that 'the computational thinking is not limited to software education but also taught by reflecting in various subjects such as Korean, Social Studies, Mathematics, and Science.' [6]

Various platforms for such AI programming education are attracting attention. These platforms are utilized in connection with software education through programming activities rather than as a merely AI experiences.

The purpose of this paper was, accordingly, to examines the education using Machine Learning for Kids through the case of education program for improving understanding of AI based on the DBR of analysis-design-execution-redesign and provide implications for development and operation of such education program.

This paper is organized as follows: In Chapter 2, related studies are examined. Chapter 3 discuss the design a DBR-based education program for improving understanding of AI and the case of applying the program is presented in Chapter 4. Chapter 5 is the conclusion.

2. Related Works

2.1 DBR

DBR, a research paradigms, is an abbreviation of design-based research. The DBR is a methodology focusing on the how the methods developed to improve teaching and learning interact with various factors related to class situation [7, 8].
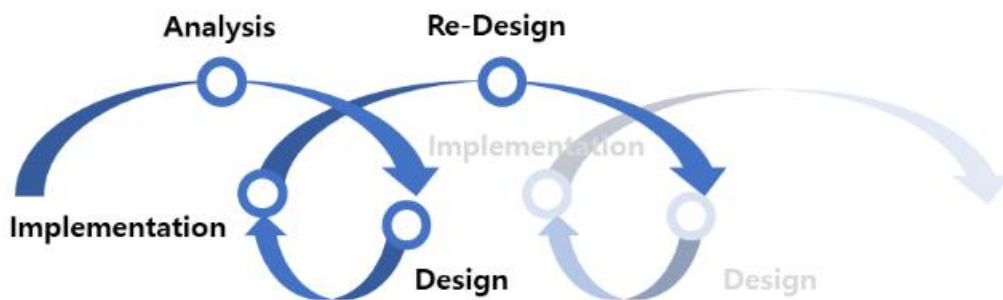
Figure 1. Overview of DBR-based AI understanding program

DBR is conducted through a cyclical process of design - application - effect identification - redesign as shown in Figure 1 in an educational environment where education programs or teaching-learning models are to be actually used. The cycle of this process itself is a research, and the use and improvement of education programs or teaching-learning models. DBR focuses on the context of the cycle, therefore, is a research method that focuses on deriving and optimizing a program in a given environment, rather than on generalizing the

results of the research [8, 9].

2.2. Education Tool to Teach AI

The term, AI was coined and used by John McCarth at Dartmouth Conference in 1956. Tools are being developed to utilize AI in various services[10,11]. the tools for teaching AI include Teachable Machine Learning provided by Google and Machine Learning for kids provided by IBM. Both services are tools to experience simply the principles of machine learning as a web service with various examples and have following differences [11, 12].

The connection of machine learning implemented in Google Teachable Machine Learning with programming activities requires knowledge of Python, a HTML code and textual programming language. On the contrary, IBM Machine Learning for Kids supports, in addition to Python, the Scratch, a block-type programming tool, thus has advantage that allows those unfamiliar with programming to experience programming easily.

2.3. Machine Learning for Kids

Machine Learning for Kids is a web service developed by IBM in UK to provide a simple experience of machine learning in AI [12]. Because it is provided to teachers free of charge and supports Korean, it is easy to experience even for learners with poor English ability. All you need is an account that generates the code, making it easy to learn and train the AI you want. The simple learning and training about AI requires only an account that generates code.

Furthermore, since the development of AI programs using block-type programming such as Scratch as shown in Figure 2, AI training in conjunction with block-type programming covered in software education is allowed.

Figure 2. Scene of AI Programming

Following is an examination of a case of DBR-based class using Machine Learning for Kids.

3. Design of DBR-based Education Program

This education aims to make students not only simply experience AI but also allow them to develop an AI program through the process of analysis - design - execution - redesign for them to feel interesting and fun, and to improve creative and integrative thinking and problem solving. Ana this program, through this, aimed to develop the competencies required for students who are to become talents of future society.

3.1. Designing Education Program to improve Understanding of AI

This program was designed, with the theme of solving problem using AI programming, to allow students to solve problems based on the process of analysis - design - execution - redesign of DBR in each activity. In addition, the activities were designed to allow students to develop AI program step by step using a block-type programming language in software education.

In this paper, the program utilizing Machine Learning for Kids, among the platforms for AI education, is examined.

The subject and the contents of each sessions are shown in Table 1.

Table 1. Learning Contents of Each Session

Session	Subject	Contents
1	Experience of A.I	Familiarization with A.I
2	Block-type Programming	Development of one's own animaion using block-type programming
3	A.I Programming	Development of responsive animation using A.I
4	Debugging	Presentation & Share

DBR-based activities were mainly performed in the 1, 2, and 3 sessions among a total of 4 sessions. Students were induced to collaboratively solved a problem on a given subject, to perform DBR-based activities of analysis - design - execution - redesign, and to repeat this process until the problem was solved after redesign, so that the debugging and self-feedback were achieved.

The 1st session, a step of experience, was designed to make students to be familiarized with AI. Through the process of finding and practicing the AI in real life and meaning of AI. These were reconfigured based on DBR and designed as shown in Table 2.

Table 2. Organization of 1st Session

Criteria	Contents
Analysis	Analyzing Machine Learning for Kids
Design	Theme Selection & Designing Program with learning and training
Execution	Executing A.I chatbot using programming

Redesign	Redesign by share repeated execution

The 2nd session, a step of experiencing programming, was designed, contrary to existing program where only a simple experiences was allowed through block-type programming, to draw various outcomes from students by four step class reconfigured based on DBR as shown in Table 3.

Table 3. Organization of 2nd Session

Criteria	Contents
Analysis	Analyzing story scene to be represented by animation
Design	Designing animation using block-type programming
Execution	Executing completed animation program
Redesign	Redesigning animation program by share and repeated execution

The 3rd session, a step of programming AI, may seem to be similar to 2nd session, however, has character of designing points of story divergence to apply machine learning and developing AI learning model as shown in Table 4.

Table 4. Organization of 3rd Session

Criteria	Contents
Analysis	Analyzing story scene to create animation
Design	Designing points of story divergence according to machine learning model
Execution	Executing animation by creating AI learning and model
Redesign	Checking execution of animation and redesign

In the 4th session, a step of presentation and share, the algorithm and products developed in previous sessions are presented and shared for mutual assessment and redesign.

4. Case Study: Application to Class

In the 1st session as shown in Figure 3, the tasks of examining the meaning of AI that is attracting attention recently and experiencing the learning and training of machine learning through Machine Learning for Kids were provided. In this course, the program was designed, after analyzing Machine Learning for Kids, to design program through a learning and training according to themes such as interviewing historical figures and introducing own family. A chatbot was developed and executed by using the designed model as programming and was redesigned through repeated execution and share. For the basis of subsequent sessions, students went through a group discussion to design algorithms for implementing them rather than simple experience and

reflect them on the task.

Figure 3. Scene of Class of Familiarization with AI

In the 2nd session as shown in Figure 4, the programming activity using Scratch, a block-type programming tool was conducted. In order to connect with the theme of the 3rd session, an animation was designed and produced using block-type programming tool by combining with producing one's own animation. An algorithms to express the flow of the story was designed and, in this course, students executed and experienced naturally the program structures such as sequence, selection, and repetition. In the problem solving course of analysis - design - execution - redesign while redesigning program, students were induced to solve problems collectively through DBR.
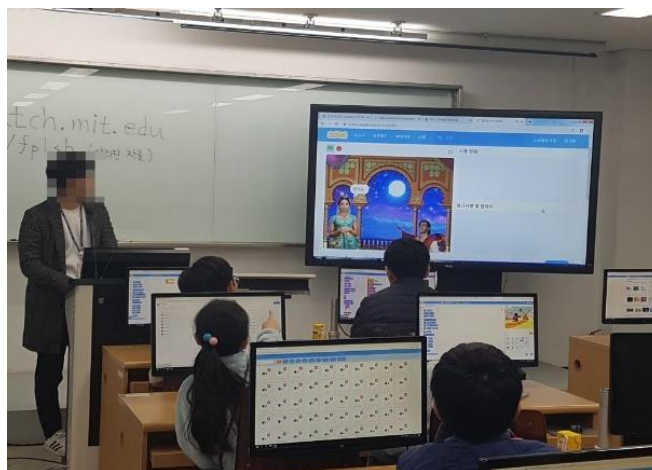
Figure 4. Scene of Producing One's own Animation by Activities using Block-type Programming

In the 3rd session as shown in Figure 5, based on the solved tasks in the previous session, a task of AI programming was presented. A response animation using AI was produced by loading the model learned and trained using Machine Learning for Kids to Scratch, a block-type programming tool. The accuracy of AI program was improved by analyzing the story for producing animation, learning the expected answers, and executing and redesigning the scene learned during the programming process.

Figure 5. Scene of Producing Responsive Animation using AI

In the 4th session, the algorithms and products created in previous sessions were presented and shared for mutual assessment and redesign of group products.

5. Conclusion

In this paper, we designed a DBR-based AI education program for the improvement in understanding of AI and applied the program to the elementary school class. In this course, several suggestions were derived.

First, The students were instructed to utilize computational thinking around the problematic situation in real life mentioned in 'method and cautions of teaching and learning' of 2015 Revised National Curriculum by learner-oriented problem solving programming utilizing learning and training of machine learning and block-type programming tool. Second, by instructing the programming activities by combining them with AI, rather than limiting to only software education, the improvement of creative problem solving emphasized in 2015 Revised National Curriculum was sought. Third, the previously produced programs were debugged and more collaborative problem solving was allowed in each activity by going through DBR process of analysis - design - execution - redesign.

The future studies need to empirically verify the impact of the DBR-based program to improve understanding of AI on the learner's development of computational thinking, and to redesign and improve the program through connection with subsequent educations.

References

[1] Ministry of Education, Guide for Software Education Operation, 2015

[2] Woo Yeol Kim, "Design of STEAM Education Process applying 3D Printer for Computational Thinking," International Journal of Internet, Broadcasting and Communication Vol.10 No.1, pp.23-30, 2018. https://doi.org/10.7236/IJIBC.2018.10.1.4

[3] Kim gapsu, "Development and Application of Teaching-Learning Model for AI Education in Elementary School," Korean Association Of Information Education, Vol.21, No.1, pp.137-147, 2017

[4] Jangmook Kang, Sangwon Lee, Algorithm Design to Judge Fake News based on Bigdata and Artificial Intelligence, International Journal of Internet, Broadcasting and Communication Vol.11, No.2, pp. 50-58, 2019 http://dx.doi.org/10.7236/IJIBC.2019.11.2.50

[5] Lee young-ho, "An analysis of the Effects of Block-type Programming Language-based AI Education on the Attitudes of Students toward AI technology," Korean Association Of Information Education, Vol.23, No.2, pp.189-196., 2019

[6] Kim jeongrang, "An Analysis of Textbook Contents according to Achievement Standard in Revised Elementary School Software Education," Korean Association Of Information Education, Vol. 23, No. 1, pp. 9-18, 2015.

[7] The DBR Collective, Design-based Research: An Emerging Paradigm for Educational Inquiry. Educational Researcher, 32(1), 5-8., 2013

[8] Kang jeongchan, "Design-based Research (DBR) as a Methodology for Field Research to improve Class," Korean Association for Educational Methodology Studies, Vol.23, No. 2, pp. 323-354, 2011

[9] Kim minjeong, "Development of Teaching-Learning Strategy to aid Flip-Learning Pre-video Self-Directed preparation through DBR," Korean Association for Educational Information and Media, Vol.23, No. 4, pp. 789-814, 2017

[10] Lee seonjin, Development and Application of AI Education Program based on Recommendation System for Elementary Students . Graduate School of Education, Cheju University, Thesis for Master's Degree, 2018

[11] Google Teachable Machine Learning. Retrieved from https://teachablemachine.withgoogle.com

[12] Machine Learning for Kids. Retrieved from https://machinelearningforkids.co.uk