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*Research Article*

# Design of Assessment System of AI Educational Model for Elementary Student

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**Abstract:** In the AI education field, there is an active discussion on the direction of AI education according to the leaner's target. Also, various platforms and programs on experience are being distributed. As a prior study, we propose the AI experience educational model. However, there are insufficient steps to evaluate students' understanding. Therefore, in this paper, we proposed assessment system that can verify the validity of the proposed educational model. The proposal system was designed by constructing an assessment module based on the Item Response Theory for objective student evaluation.

**Keywords:** AI education, Assessment, System, AI literacy, AI Experience education, AI 4K12

## 1. Introduction

Recently, the demand for understanding artificial intelligence(AI) technology has been increasing, and AI education has been introduced worldwide for elementary, middle student(K12) and early learners **(Ministry of Education Korea 2020, 2021)**. However, it is somewhat difficult to understand and implement AI without the background of computer higher education and mathematical theory. Furthermore, AI education should be designed considering the unfamiliarity with computational thinking(CT) and algorithm. Recently, there are various platforms and programs to experience AI. There are various block-based coding platforms such as the Teachable Machine and Entry, ML4kids, App Inventor that can experience AI. And it is applied to the curriculum for K12. According to the Ministry of Education's announcement in Jan 2021, AI education for K-12 subjects will be officially introduced in the regular curriculum form 2025 **(Ministry of Education Korea 2021)**. In this paper, we propose an assessment system for AI experience educational model. As a Prior study, **(Kibbm Lee, Seok-Jae Moon 2020**) proposed an AI educational model. However, there is not enough evaluation steps to understand student's with the AI educational model. In this paper, we designed and implemented an assessment system that can assist students after completing the class by applying AI experience model presented in the prior study. Students can participate repeatedly in the class, and the round of assessment is recorded. The proposed system consists of four modules and was designed based on the item response theory(IRT). AI cognitive factor was designed as an assessment factor for the question, and the assessment method is presented in the form of Quiz. Feedback is designed to have different reports shown to students and teachers. Feedback to students is a report on participating Quiz, and feedback to teachers provides a report on the assessment results according to individual student's assessment element, round of assessment. This paper is consisted as follows: Section1 describes the introduction, Section2 describes the relative theory, Section3 describes proposal system, Section4 describes the implementation, and Section5 describes the conclusion.

## 2.Theory

As a prior study, **(Kibbm Lee, Seok-Jae Moon 2020**) proposed an AI experience play educational model to enhance understanding of AI. Since it is difficult for students to understand the concept of AI, the curriculum of image classification is presented through UA or experience activity. Item response theory(IRT) is a test theory to measure the discrimination of the assessment question by the unique characteristics of each question, not by the test total score **(Hartz, Sarah McConnell 2002)**. The role of learning competency test is not to sort learners' levels according to grades, but to Evaluation for learning or Evaluation as learning. As a result, the use of the cognitive diagnostic model **(Templin, Jonathan, and Robert A. Henson 2010)** is increasing. According to a survey of current practice and teaching of AI, data structure 46%, algorithms 19% as a prerequisite for AI course. In addition, in the survey on difficulties in evaluation, it was found that the basic/main ideas of AI should be included as 77% **(Wollowski, Michael, et 2016)**. The concept of AI literacy is defined as the ability to understand and utilize the techniques and concepts of AI products and services**(Kandlhofer, Martin, et al 2016, Touretzky, David, et al 2019)**. In addition, according to the Ministry of Education, AI Education for K-12 is SW-based. As a new point of AI education, data-driven thinking and the use of models were mentioned **(Ministry of Education Korea 2020, 2021)**. According to a survey on the application of the evaluation system,

the preferred method is Quiz 45.2%. The effect differ when feedback is presented as explanations and as scores by scoring. Therefore, in order to maximize the effect, it should be possible to support learning through immediate feedback **(LEE, Sang-Joon; CHO, Chang-Hee 2010)**.

## 3.Proposal System

### 3.1.Proposal system consists

<Fig1> is a system configuration diagram proposed in this paper, and it consists of four modules as follows:

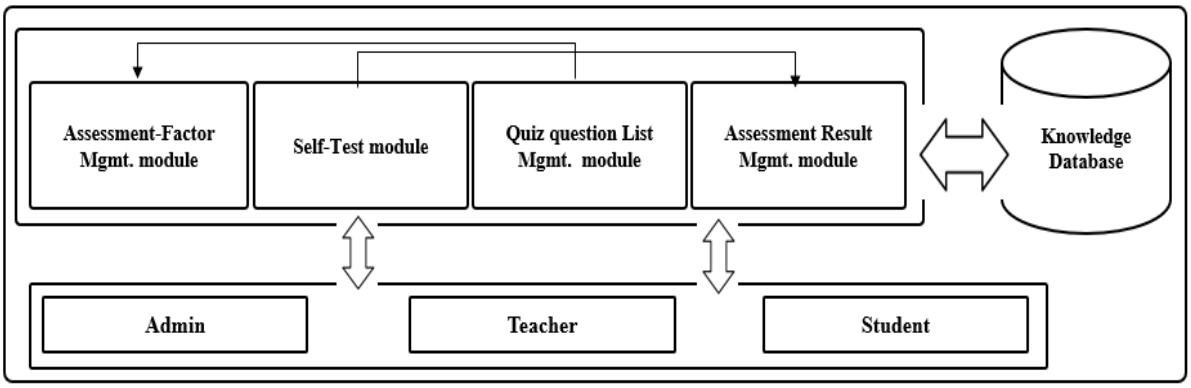



**Figure.1** System configuration diagram

- Assessment-Factor Mgmt. module: It is possible to categorize quiz questions and add or modify assessment elements when there are changes. In this paper, AI cognitive factors is designed as assessment elements for each quiz question.
- Self-Test module: The self-test is conducted by selecting the students after the class to know their understanding
- Quiz question List Mgmt. module: The quiz created by the teacher is managed by matching the assessment elements for each quiz question. To objectively assess the student's level, an assessment system is constructed based on the IRT.
- Assessment Result Mgmt. module: The result of the round of assessment are accumulated and managed by converting the average of each assessment elements and individual scores and ranks.

<Fig2> is the system flow chart of this proposed system. It is described as follows:

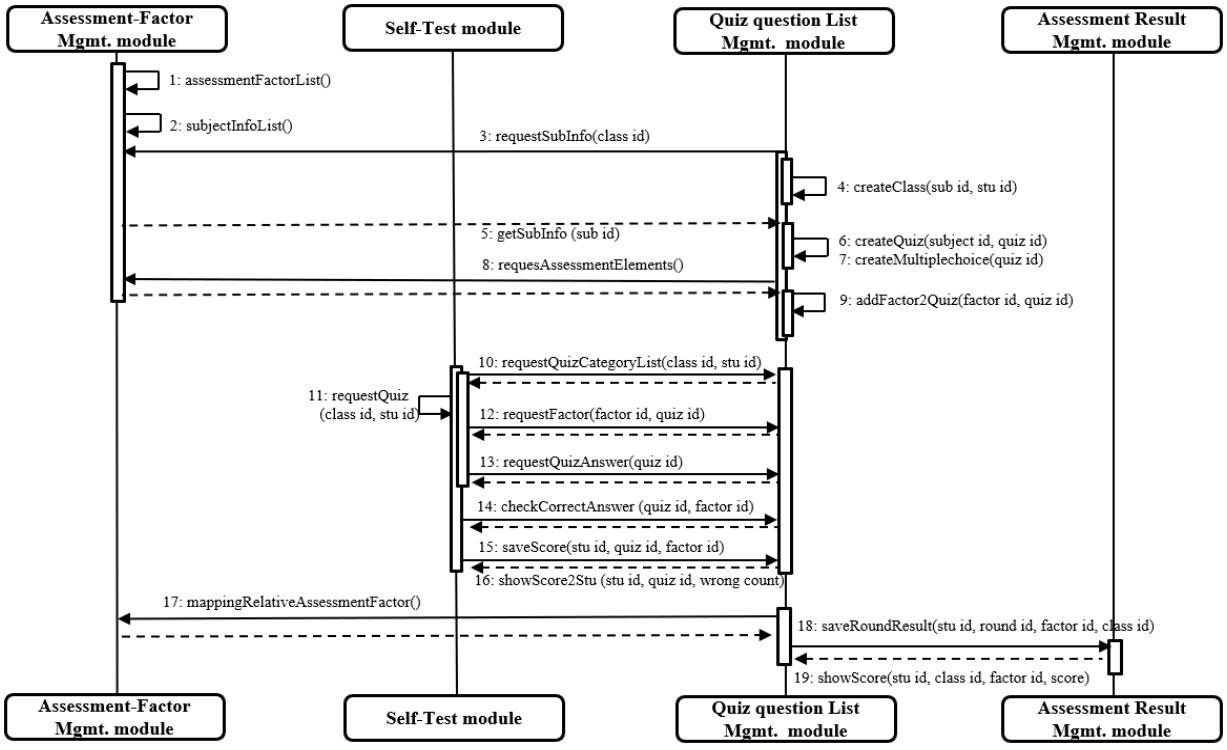



**Figure.2** System flow chart

1: assementFacorList(): Admin can add and modify assessment elements and are saved in the database.
2: subjectInfoList(): Admin can manage the addition, modification, and deletion of the subject name.
3: requestSubInfo(class id): Teacher creates a class and requests the name of the subject.
4: createClass(sub id, stu id): Set the class corresponding to the subject with student list.
5: getSubInfo (sub id): Bring up the subject information
6: createQuiz(subject id, quiz id): Create a quiz corresponding to the subject.
7: createMultiplechoice(quiz id): Create an Multiple choice question corresponding to quiz
8: requesAssessmentElements(): Request a list of assessment elements.
9: addFactor2Quiz(factor id, quiz id): Enter the assessment elements in the create quiz question.
10: requestQuizCategoryList(class id, stu id): Request a list of quizzes for class id and student id.
11: requestQuiz(class id, stu id) : Request a quiz question for the class and student list.
12: requestFactor(factor id, quiz id): Request assessment elements of the quiz question.
13: requestQuizAnswer(quiz id): Request of answers to quiz questions.
14: checkCorrectAnswer (quiz id, factor id): Verify that the answer of the quiz question matches the student's input items.
15: saveScore(stu id, quiz id, factor id): Stores whether the question is answered incorrectly.
16: showScore2Stu(stu id, quiz id, wrong count): show the self-test the error rate and total score per question.
17: mappingRelativeAssessmentFactor(): Map student results to assessment elements.
18: saveRoundResult(stu id, round id, factor id, class id): Search the round of assessment and save it together.
19: showScore(stu id, class id, factor id, score): Provides results related to assessments elements and round of assessments to teachers or administrators who view student outcomes.

### 3.2.AI cognitive factor

The AI cognitive factors selected as assessment elements to be used in the assessment system of this paper are as follows: Recognition of the problem(ROI), Analysis and evaluation of information(AEI), Organization and creation of information(OCI).

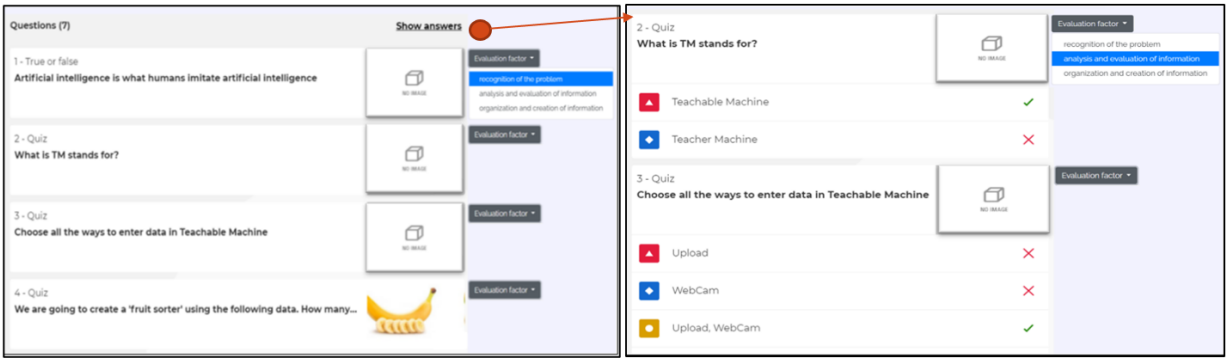
**Table.1.** AI cognitive factor

| AI cognitive factor | description |
|---|---|
| Recognition of the problem (ROP) | Ability to use this module to understand problems and to identify the information needed to solve them. |
| Analysis and evaluation of information (AEI) | Ability to use this module to determine the validity, accuracy, reliability and usefulness of the information needed to solve the problem. |
| Organization and creation of information (OCI) | Ability to create new information by systematically organizing, integrating and devising collected information using this module. |

## 4.Implements and Comparison analysis

### 4.1.User Interface

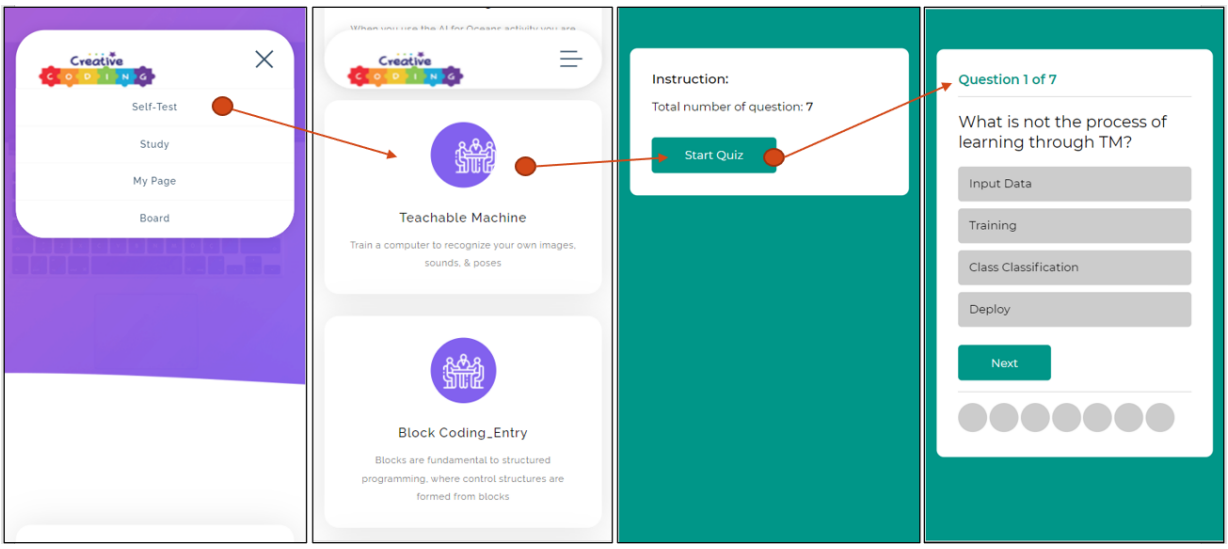
In this paper, we design an assessment system to quantitatively evaluate student's AI comprehension and coding performance levels after class with AI experience educational model. It consists of four modules, and users of the system are divided into students, teachers, and administrators. Students can choose self-test, teachers can create Quiz, and admin can modify the assessment elements. Teachers and admin have access to the results reports of students by assessment elements and round of assessment. Quiz format is multiple choice, the number of questions should not exceed five for each assessment element so that they can participate in a short period of time.




**(a) Quiz list and matching Assessment-Factor (b) Quiz list and multiple choice, correct answer**

**Figure.4 UI of Assessment-Factor Mgmt. module**

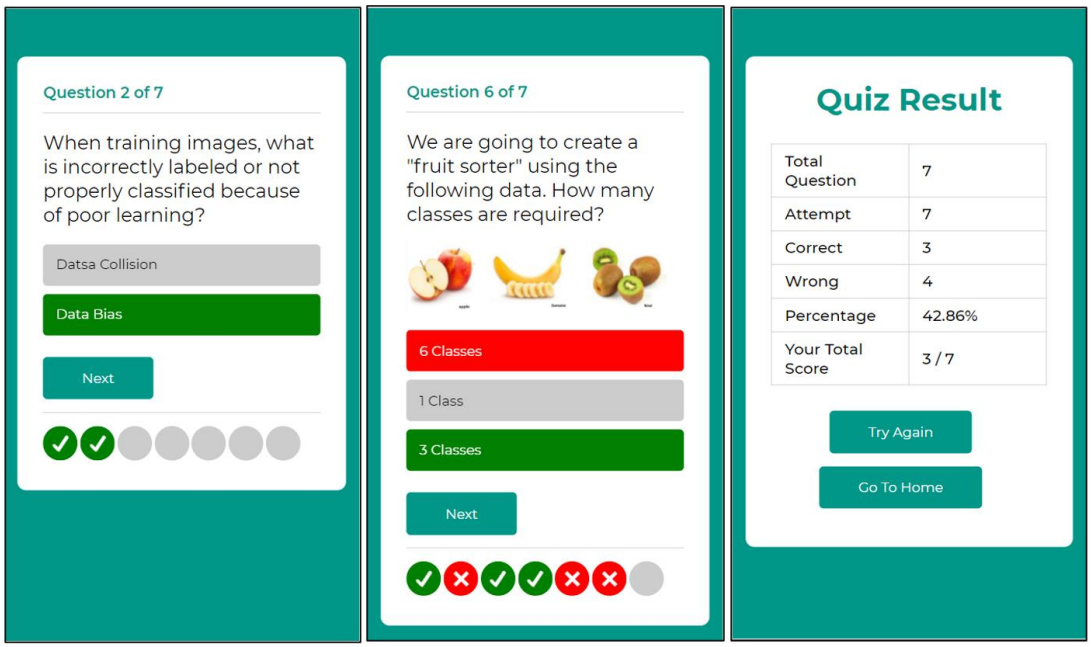
<Fig4> is UI of Assessment-Factor Management module. Teacher can create a quiz for the subject corresponding to the assigned class. <Fig4(a)> is a UI that can be checked with the uploaded image after creating the quiz question and before being shown to the student. In addition, assessment elements for each question can be selected and modified. As shown in <Fig4(b)>, a Quiz list and multiple choices are shown, and the correct answer can be checked again.




(a) (b) (c) (d)

**Figure.5 UI of Self-Test Module**

<Fig5> is UI of the Self-Test module. When a student logs in and selects self-test as shown in <Fig5(a)>, and selects a class as shown in <Fig5(b)>, quiz starts. When the quiz starts, the total number of question is displayed as shown in <Fig5(c)>. When the start quiz button is pressed, the first question is shown as shown in <Fig5(d)>. In the case of student UI, in consideration of convenient accessibility, it is implemented in the form of a responsive web app so that there are no restrictions on devices such as PC, tablet, and mobile.




(a) (b) (c)

**Figure.6** UI of Quiz question List Mgmt. module

<Fig 6> is the Quiz question list Management module shown on the student's screen. During the quiz, the correct answers of the corresponding questions are compared in real time and feedback is made at the same time. When clicking the correct answer in multiple choices, the selected choice turns green as shown in <Fig6(a)>. If a student clicks on an incorrect answer, the selected choice turns red as shown in <Fig6(b)>. The circles that match the number of questions at the bottom are marked in green or red. By exposing the correct answer, you can check the correct answer through immediate feedback, so it is designed to be able to learn at the same time while doing a self-test. The number of red and green circles at the bottom is displayed according to the total number of questions. The sign at the bottom is fixed even if the question changes, so students can predict their own scores until they finish the quiz. The feedback for each question is designed to be easy to understand immediately by students using colors and symbols. <Fig6(c)> shows the total question, attempt, correct, wrong, percentage, and total score as feedback provided to the student.

### 4.2.Comparison Analysis

The strengths and weaknesses were compared by selecting the assessment system used during classes in 2020~2021. In general, Kahoot is widely used, assessment elements cannot be set separately, and student records are not accumulated, so they must be analyzed for each quiz.

**Table 2. Comparison Analysis with other Quiz App**

| | **Kahoot** | **Plickers** | **Aiedu App** |
|---|---|---|---|
| For self-paced learning | support | Not support | support |
| Quiz format | Multiple choice | Multiple choice | Multiple choice |
| Limit of multiple choice questions | Variable within 1~4 choice | Variable within 1~4 choice | Variable within 1~N choice |
| Image upload | support | Support | Support |
| Management of assessment elements | Not support | Not support | Support |
| Management of assessment round | Not support | Not support | Support |

| | | | |
|---|---|---|---|
| Realtime feedback for student | Support | Not support | Support |
| Instance feedback for teacher | Incorrect answer and total score for each question | Incorrect answer and total score for each question | Incorrect answer and total score by question, cumulative comparison |

### 4.3 Apply System

Students who participated in the self-test of this assessment system consisted of grades 5-6. Participating students selected subject of image learning that applying the AI experience educational model, and conducted a self-test after class. As a results of this study, students' understanding increased as they learned more than once or twice, but there was no trend that the assessment score continued to increase as they learned more. Even after learning 10 times, there were cases where the assessment score was low. Considering that there is a difference level according to students, the average round of assessment was analyzed. The same tool was used, the achievement was steadily increased when the image classification was learned five times by executing various projects. Furthermore, it is relatively difficult to build an efficient AI training model even through the repeat round is increased for the pose recognition than image classification.

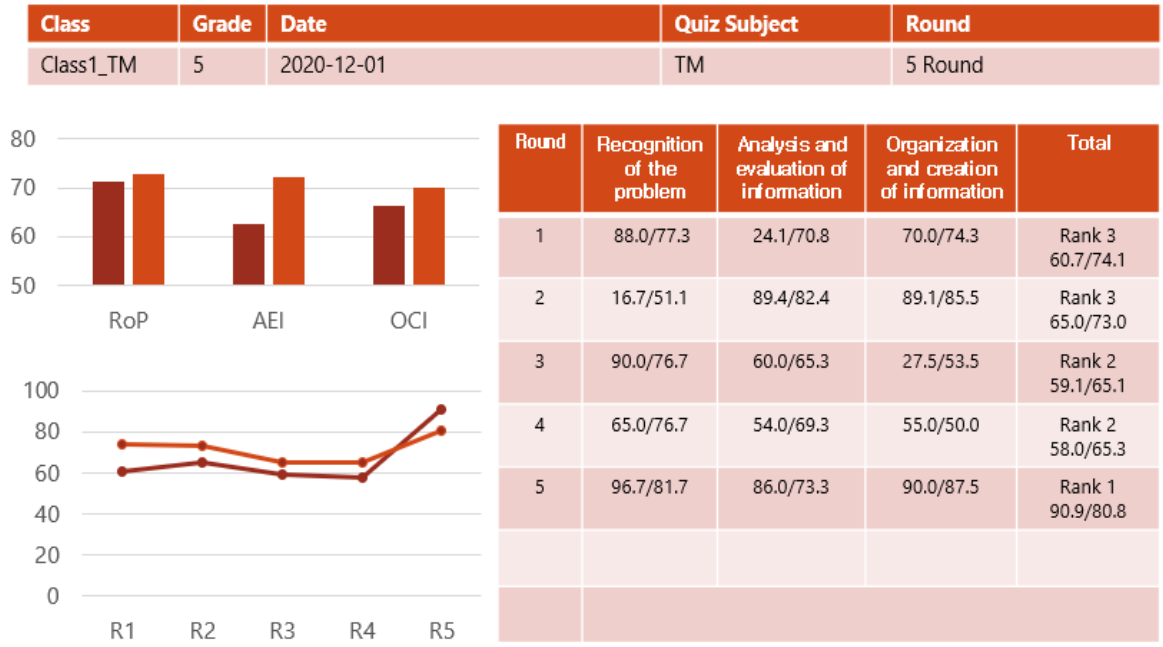



**Figure.8 student's result by system**

## 5. CONCLUSION

This paper focuses on environmental conditions fir implementing AI educational model development, rather than developing a valid and reliable tool for students' AI literacy level. The student could self-test through the assessment system, the teacher could search the student's assessment result, and it could be helpful to adjust the learning difficulty in the curriculum design applying the educational model in the future. It is significant to evaluate the appropriateness of the educational model by developing an assessment model including cognitive factors. Through this, it will be possible to develop a learning module that combines other fields other than image classification of AI and expand them to apply achievement evaluation.

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