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Development of an Artificial Intelligence Education Model of Classification Techniques for Non-computer Majors

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***Abstract*—In the near future, as artificial intelligence and computing network technology develop, collaboration with artificial intelligence (AI) will become important. In an AI society, the ability to communicate and collaborate among people is an important element of talent. To do this, it is necessary to understand how artificial intelligence based on computer science works. AI is being rapidly applied across industries and is developing as a core technology to enable a society led by knowledge and information. An AI education focused on problem solving and learning is efficient for computer science education. Thus, the time has come to prepare for AI education along with existing software education so that they can adapt to the social and job changes enabled by AI. In this paper, we explain a classification method for AI machine learning models and propose an AI education model using teachable machines. Non-computer majors can understand the importance of data and the AI model concept based on specific cases using AI education tools to understand and experiment with AI even without the knowledge of mathematics, and use languages such as Python, if necessary. Through the application of the machine learning model, AI can be smoothly utilized in their field of interest. If such an AI education model is activated, it will be possible to suggest the direction of AI education for collaboration with AI experts through the application of AI technology.**

***Keywords*— Artificial intelligence; education model; classification techniques; learning strategy; teachable machine.**

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I. INTRODUCTION

With the advent of the knowledge and information age, the industrial structure and the work culture are rapidly changing in the modern society. Artificial intelligence (AI) is at the core of the 4th industrial revolution, and soon, innovations in social systems will be accelerated based on hyper-connectivity and AI that connects people, objects, and space [1].

In recent years, the government has been leading the development of AI-enabled industries, establishing strategies for cultivating AI talent, and promoting various policies to realize them [2], [3].

AI is developing in conjunction with various industries as it can analyze complex social problems to find causes that are difficult for humans to find and suggest solutions, and can make daily life convenient [4]. AI refers to computers imitating human actions such as thinking and learning. Some representative examples of such AI are IBM's Watson and DeepMind's AlphaGo, Apple's Siri, also known as a smart assistant service, Google's Google Now, Samsung Electronics' Bixby, SKT's NUGU, etc.

AI is growing with the development of technology to analyze a large amount of accumulated data through cloud services [5]. Most of these data-based AI services have algorithms that machines can learn by themselves. An AI service is a formalization of human decision-making processes with various models and algorithms [6].

When a person makes a decision, he extracts information related to a specific problem, learns various related knowledge and cases, and makes a decision based on reasonable judgment. AI can analyze complex social problems to find causes that are difficult for humans to find and suggest solutions, and because it can bring convenience to everyday life, it can develop in connection with various industries [7].

In order to use AI appropriately, it is necessary to understand the principles of AI: how it classifies and processes information. As AI services become active, the importance of AI education is increasing, and educational

programs related to AI are also being developed and applied in various ways [8].

The use of AI is like a software revolution in everyday life, and the importance of software education including AI is becoming increasingly important as everyone can use these technologies conveniently.

In universities, programming education, data-centered education, and AI education are gradually being strengthened for non-computer majors [9]. However, students with non-computer majors lack computer literacy and may also lack the ability to use information. Therefore, when imparting education using AI to such students, it is also necessary to develop their interest and make them understand the usefulness of AI.

In this paper, we derive an AI education model that can be implemented for non-computer majors in universities. Based on the idea of AI education, we propose a case of applying an education model that conducts AI education for non-computer majors using teachable machines and verify its effectiveness.

II. Material and Method

This paper presents the trend in AI education, a classification method of machine learning, and an AI education method as a theoretical background to develop and propose a model to efficiently educate non-computer major classification methods of machine learning.

A. Trend in AI education

AI4K12 says that all students must be appropriately prepared to use AI while working with it, and should have the basic knowledge and understanding necessary to navigate the world around AI [10]. In addition, it presents five big ideas that are sufficient to cover the field of AI and proposes educational content necessary for each K-12 grade [10].

The five big ideas for AI education presented in AI4K12 and the main points covered by each core concept are shown in Table 1 [10].

TABLE I
FIVE BIG IDEAS PRESENTED BY AI4K12

Core concept	Explanation	Key concepts
Perception	Computer recognizes the world using sensors	-Human sensor vs. computer sensor -Process from sensing to recognition -Recognition type and recognition method -Limitations of computer recognition, etc.
Representation & Reasoning	Agents are used to maintain and express reasoning about the world	-Type of expression -Inference algorithm type -Limitations of general reasoning algorithms
Learning	Computer can learn from data	-What is learning? -Access to machine learning -Learning algorithm type -Principles and types of neural networks
Natural Interaction	Intelligent agents require many types of knowledge to interact naturally with humans	-Understanding natural language -Natural interaction application -Human-robot interaction -AI limitations for natural interaction
Social Impact	AI affects society in positive and negative ways	-Changing the business, health, education and governance of AI technology -Numerous technical and ethical decisions required when developing AI applications -AI technology has various effects on the community and people.

First, it deals with perception, the concept where computers use various sensors to recognize the world. The second is expression and reasoning, which are related to expressing knowledge and inference to solve problems. Third, learning is an area where you can directly experience machine learning and neural networks that lead to the development of AI technology using various programming techniques and tools. Fourth, it relates to natural interactions on how robots and humans can interact. Finally, social impact deals with AI ethics and the effects of AI technology on society.

B. AI Education Method

Machine learning is a field of AI, which refers to the development of algorithms and technologies that enable computers to learn [11], [12]. The essence of machine learning lies in the representation of data evaluation and generalization, referring to the processing of data that is still unknown.

Machine learning includes supervised learning that leads to a certain output after inputting user-generated data, unsupervised learning that include model patterns only with input without output, and feedback generated after learning a large amount of data by the computer itself [13], [14].

Reinforcement learning is a method of relearning to generate an algorithm. Supervised learning has the characteristic of producing a reliable output value as the amount of data increases because of an increase in its accuracy with an increase in input data. Unsupervised learning is a method in which a computer learns by itself and then applies it to derive a desired output value. This requires a high level of computational power and is currently used in most data mining techniques [15].

Simply put, if the task is discriminating objects in pictures, the pictures are called learning data. Labels are objects in a picture that are predefined, such as motorcycles, bicycles, people, and cars. Because the label is defined by a person looking at the picture, reading the labeled picture from the computer's point of view is called supervised learning because it is learned by receiving guidance. If there is no label, it is called unsupervised learning.

For AI technology innovation, it is important to secure the data necessary for AI training. However, some companies, such as Google, are paying attention to a transfer learning technology that achieves the desired goal by retraining only

part of the data with a pre-trained AI model, even if the amount of data is insufficient [16].

Transfer learning is the application of AI algorithms created in a specific environment to other similar fields [17]. A representative example of the transfer learning model is the "teaching machine" that Google has invested in for years [17], [18]. This technology is the easiest tool to learn and implement AI. This method creates a pre-training model with a large amount of training data using MobileNet (an algorithm that focuses on power efficiency) and modifies only the last part of the model for transfer learning [17], [18].

C. Classification techniques in machine learning

Consequent to reviewing AI education policies and industry trends, strengthening basic AI education should induce basic literacy and interest in AI from the elementary and secondary education stages, and education on AI ethics should also be imparted in addition to nurturing and securing advanced AI talent [19]. It is necessary to improve AI acceptance by expanding universal education so that ordinary people can use AI as easily as they use smartphones.

At a related research on the development of education on AI, there is a lot of interest in how to teach students about AI and how AI can be used in education. As a topic of recent research [20], [21], the methods of using AI for education can be summarized as follows:

First, customized learning to suit the student's level.

Second, AI judges the areas that students do not understand well and informs them that they need to be supplemented.

Third, a change in the direction of learning itself is an act of searching for learning information rather than remembering knowledge.

Fourth, a learner can get the necessary help anytime, anywhere.

Fifth, it helps students find the next level of learning, information, departments, and schools based on large amounts of data.

In this paper, after explaining the classification technology of supervised learning, we try to understand the elements of machine learning by executing a model implemented with Python and Tensorflow, and train the model based on the data collected and refined by the teachable machine. In this case, we try to understand the advantages and disadvantages of classification technology by applying it.

III. Results and Discussion

The purpose of this paper is to analyze the trends related to AI education and introduce cases of developing and applying AI education models related to classification techniques that can be applied to non-computer majors.

A. AI education model

The analysis procedure for presenting an appropriate educational model while conducting software education in university liberal arts subjects is shown in fig. 1.

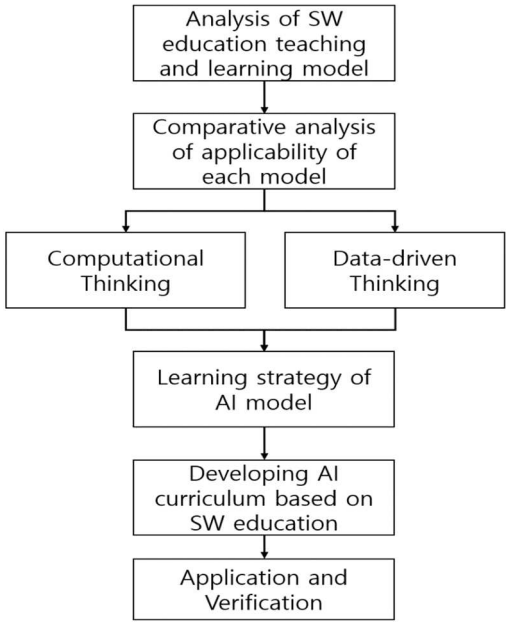


Fig. 1 Analysis procedure for software educational model

Following the analysis of the models and application cases suggested in the existing software education related teaching and learning model development studies, the most important considerations were observed to be computing thinking ability and data-oriented thinking [22], [23].

It is important for the AI education model to understand the concept of machine learning based on this computational thinking ability, and to search for a suitable model through data-driven thinking, as opposed to conventional programming. Rather than focusing on finding results from the given data, it focuses on finding a regularity from the given data [24], [25].

The process of finding a regularity from the given data is called AI training, and if it is found through learning, then the correct answer or predicted value is based on the regularity found in the new data that comes in. By letting go, you can solve the problem. The proposed learning strategy according to the software education model development procedure is shown in fig. 2.

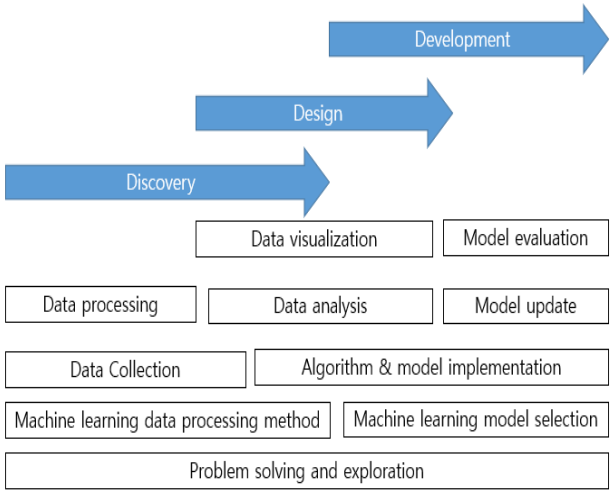


Fig. 2 Learning strategy of AI education model

We can define problems that can be solved with AI in their field of interest and express a structured search process to solve these problems. This expresses the rules and information for solving problems as knowledge, and creates new facts learned by organizing the reasoning process. It can understand the data appropriate for solving the problem and collect the necessary data to extract and process key attributes.

It is necessary to understand the concept of machine learning and select a suitable model for solving problems while exploring the application fields of machine learning. It can process data that can be used in models, visualize the data according to their purpose, and analyze the visualized data in various forms to organize it.

Machine learning is a process of automatically generating a model from data to solve a problem and understanding the principles of analysis and visualization of data used in machine learning to select a model necessary for problem solving.

The model is trained by implementing it as an algorithm, and is evaluated using test data. The model is modified according to the performance evaluation results, and the evaluation results of the model are summarized and presented together with the final visualized result.

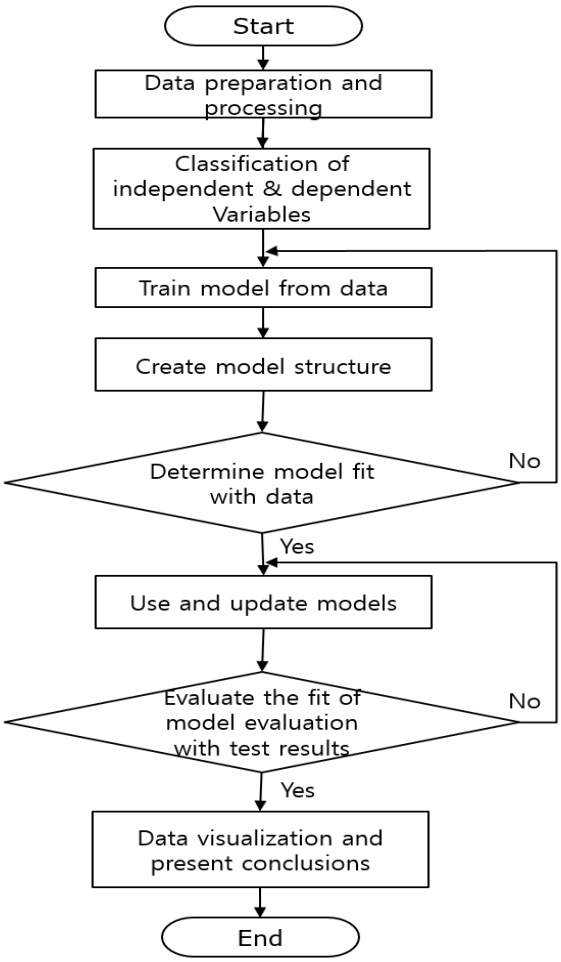


Fig. 3 AI educational model flowchart

The process of applying the actual AI training model is shown in fig. 3. After understanding the principles of presenting various problem situations and predicting the unknown, we apply a linear regression model and a k-nearest neighbor (kNN) model [26], [27]. These models are actually based on the subject of interest, such as meteorological data analysis, wine quality prediction, prediction of the survival rate of patients with lung cancer, and other topics such as diabetes prediction.

To solve this problem, the independent and dependent variables are determined after collecting and processing public data. Appropriate machine learning models are selected, the data is appropriately classified as training data or test data, and then the model is trained. The model's suitability is judged with the test data, and the model is modified if necessary to draw an appropriate conclusion [27].

The kNN model used here is one of the most intuitive and simple supervised machine learning models. The kNN model does not perform a training in advance but defers it and performs a generalization (classification) upon the arrival of a new data test request.

The basic concept of the kNN model is finding the group to which the training data closest to the new data belongs for classifying which group it belongs to. First, the characteristics of the labeled learning data are quantified and expressed in a coordinate space [27].

When the initial data is found while expanding the virtual circle around the new data, the group (label) to which the data belongs becomes the new data group. In other words, when n pieces of data are given, the problem is selecting the most similar among n pieces of data in response to a certain request. In this case, the data is expressed as a point in space, and the most similar point usually refers to the point where the Euclidean distance is minimum. It is also the point where a specific objective function is minimized in some cases.

The formula for calculating the distance value in the kNN model is as follows.

$$\hat{f}(q)=\underset{v\in V}{\operatorname{argmax}}\sum_{i=1}^{k} w_i\delta(v,f(x_i)) \quad (1)$$

$$\hat{f}(q)=\frac{\sum_{i=1}^{k} w_i f(x_i)}{\sum_{i=1}^{k} w_i} \quad (2)$$

This model is programmed to calculate the distance value *f(x)* using the Euclidean distance and is compared with the data of the given training set to determine the closest neighbor. The new data is classified based on k records at this time, it is understood that underfitting is a case in which the error rate is high in both learning and testing and verification, and the overfitting problem is the result of learning and recognizing all noise and outlier data as normal.

In order to understand the relationship between the training error and the error rate during verification, and to increase the efficiency of classification, we apply a new method for discriminating data: changing the k value or adding other features.

B. Case of AI education using teachable machine

In order to provide AI education with data science education that can also be learned by non-computer majors, it is necessary to understand the concept of data-driven thinking. In addition, it is necessary to understand the basic concepts of AI, learn techniques for expressing knowledge, and learn techniques to properly handle and analyze data based on statistical thinking.

To do this, we introduce AI and machine learning using a teachable machine among the AI education tools that can be easily used, understand the basic concepts, and then learn the basics based on sources such as audio clips, photos, and videos on the Internet. We need to create a model and learn the concept of data processing accordingly. An example of training a class-based model is shown in fig. 4.

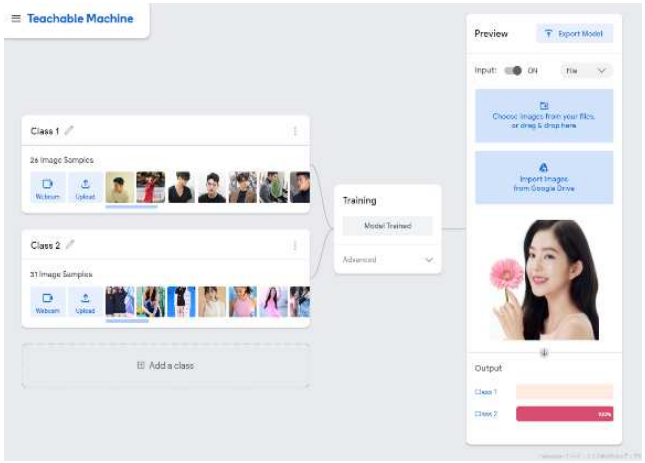


Fig. 4 Examples of a generated image classification model

In order to understand the concept of important data in AI education, organize the data on the model you think of and include the appropriate data in Class1. Class2 thinks of a model different from Class1 and organizes the data accordingly. When the class is ready, machine learning is performed to train the model you thought of [28]. Moreover in order to examine the judgment result according to the trained model, a new picture or audio clip is prepared and tested to find whether it matches the previously trained class. An example of testing a class-based model is shown in fig. 5.

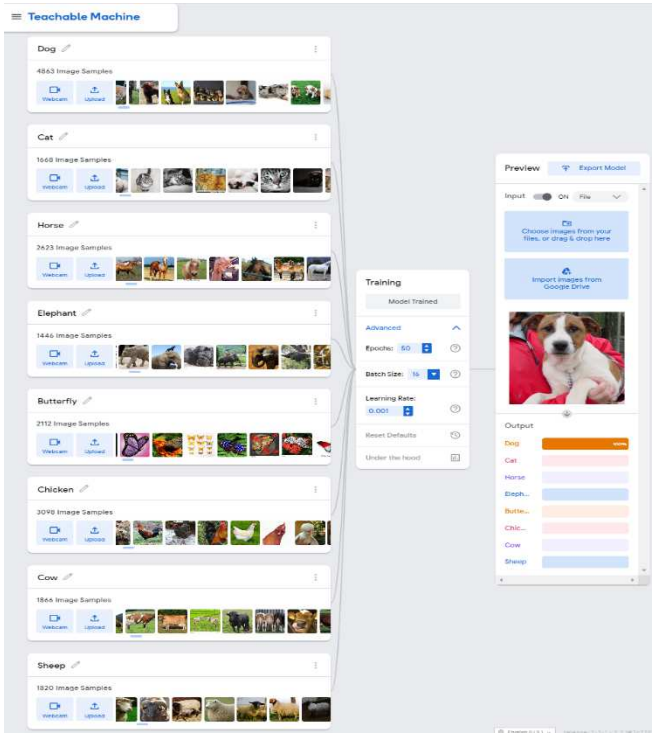
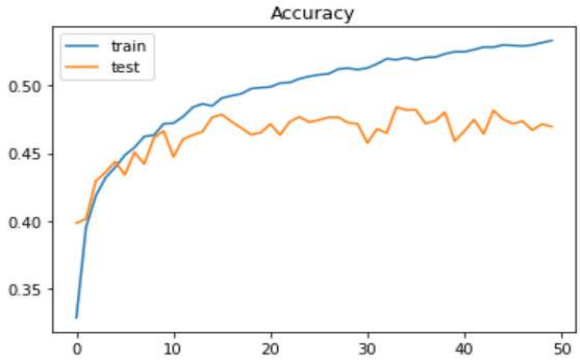
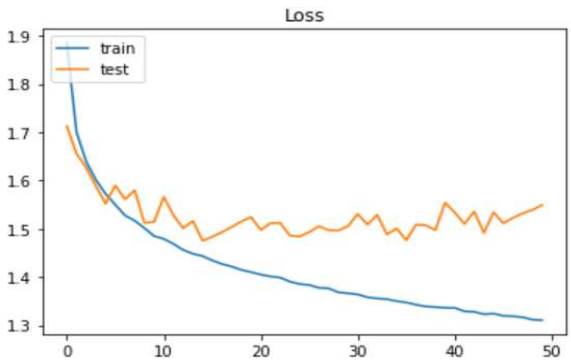
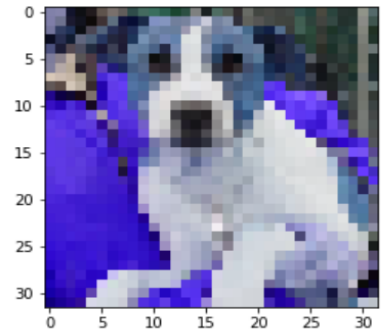


Fig. 5 Examples of image classification model behavior test

Using this process, students can understand the concept of data, the concept of a model consisting of data, and the concept of performing a classification based on the principle of machine learning [29], [30]. Students of non-computer majors will be able to understand the concept of machine learning along with the concept of AI and will be able to gradually understand the principles of AI and improve their ability to apply them to their own fields while creating and learning their own models. Fig. 6 shows an example of fitting and evaluating the tested model.








```
1/1 [==============================] - 0s 17ms/step
airplane = 25
automobile = 0
bird = 6
cat = 47
deer = 0
dog = 13
frog = 4
horse = 0
ship = 2
truck = 0
---
Predicted result= cat
```

Fig. 6 Complete students' own project

The image classification model completed this way can be combined with previously learned items, and the results can

be confirmed through actual tests using a google colaboratory. This process can improve students' confidence and satisfaction through project completion and is an important criterion for evaluating the performance of the models created and trained by them.

C. AI education effect analysis

In order to analyze the effect of AI education, a questionnaire survey on the perception of AI was conducted with 11 participating students before and after education. The recognition questionnaire for AI was evaluated a 5-point Likert scale. The questions are shown in Table 2.

TABLE II
QUESTIONNAIRE ON AI RECOGNITION

Item Number	Survey content
No. 1	I understand the concept of AI.
No. 2	I have applied AI to everyday life.
No. 3	I think AI will help us in our daily life.
No. 4	It is fun to use AI.
No. 5	To use AI, you are nervous or worried.

In order to test the understanding of AI education, questions were presented to the students to measure their understanding of the AI contents. The questions in each questionnaire are shown in Table 3.

TABLE III
AI COMPREHENSION TEST

Item Number	Survey content
No. 1	Python basic grammar questions
No. 2	Python data processing questions
No. 3	Correlation questions
No. 4	Bayesian Reasoning questions
No. 5	kNN model questions
No. 6	Decision tree questions
No. 7	Clustering question
No. 8	Association rules question
No. 9	Regression question

After understanding AI education, the results of the correlation analysis are shown in Table 4.

TABLE IV
CORRELATION ANALYSIS BETWEEN THINKING AND UNDERSTANDING OF AI

Item	Perception	Understanding	Satisfaction
Perception	1		
Understanding	.119	1	
Satisfaction	.701*	.485*	1

Following the correlation analysis, the result between the average value of AI thinking test and AI education satisfaction was found to be 0.701 ($p<0.05$). The result of measuring the degree of understanding of AI education and the analysis result of satisfaction with AI education was 0.485 ($p<0.05$). From the result of AI education, it was found that both perception and understanding of AI were correlated with education satisfaction. However, the correlation between thinking and understanding was 0.119, indicating no correlation.

TABLE V
INDEPENDENT SAMPLE TEST RESULT

Elements		N	Avg	Std.	*t*	*p*
Perception	Pre	11	3.35	.401	-3.131	.007
	Post	11	3.90	.201		
Understanding	Pre	11	6.72	1.79	-.892	.386
	Post	11	7.50	1.52		

Table 5 shows the results of analyzing the group average of the pre- and post-results for each group while conducting education on thinking and understanding of AI. When comparing the pre-average score of 3.35 (Std. 0.401) and the post-average score of 3.09 (Std. 0.201) for thinking about the results of AI education, the average score is high and the deviation is small, indicating that an effective learning has been achieved. There was a significant difference with 95% confidence ($t=-3.131$, $p<0.01$). That is, there is a difference in thinking between the pre-diagnosis and post-diagnosis results.

However, no significant difference was observed when analyzing the results of understanding the contents of AI ($t=-.892$, $p<0.5$). It can be seen that the concept of AI was understood, but was not fully understood by a short one-week study. It was also observed that the degree of understanding should be increased through long-term education of more than one semester.

IV. CONCLUSION

Currently, AI is technically applied in many fields, but specific methods and research on AI education are still in its infancy. Spreading this developing technology across the society is necessary, and this can be matured through education."

In this paper, we analyzed the trends related to AI and explored AI education. In order to discuss the perspectives of teaching AI to computer non-majors in universities, an education model was proposed, and education on classification techniques was conducted using an actual kNN model and a linear regression model. A meaningful result was found upon analyzing the correlation between perception and understanding of AI, and a meaningful recognition result was also derived when comparing the pre-post average of AI education.

Therefore, the model and teaching method of AI education are suitable. AI education should be systematically carried out at elementary, junior high, and high schools along with universities by looking at the context of an organic connection. Since it is difficult to cultivate AI personnel in a short period of time, efficient AI education can be achieved by cultivating AI literacy and technology education at universities while

developing computing and thinking skills along with data science from an early stage of education.

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