

Data Analysis Method for Recognition of AI Education Based on Education Data

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Abstracts: Based on the 4th Industrial Revolution, AI Education, which is closely related to Software Education, has begun to grow up into an important sector for core competencies of the future. Nevertheless, the significance of AI Education does not make up a great portion of diverse academic fields, and even the general public, teachers, and learners do not recognize its weight. Therefore, this study is to analyze reputation and recognition levels based on Unstructured Data mentioned online regarding AI Education and to present a methodology to seek development directions in the AI Education sector in the medium and long term. It is anticipated to contribute to the establishment of effective policies for future education and talent training, based on the general recognition of AI Education, in preparing for the 4th Industrial Revolution.

Keywords: AI Education, Big Data, Data Analysis, Opinion Mining, Education Data.

1. INTRODUCTION

Recently, R&D projects have been propelled constantly in connection with the 4th Industrial Revolution, a global issue. Among them are national big data projects such as ICT, BT, Smart City, which have been applied to various sectors; they have been receiving full and complete support from the government such as the establishment of the relevant organizations and laws. In all, this accelerates utilization of Big Data in various sectors. Still, the domestic education has not achieved outstanding results and the government support is limited to certain ministries [1]. Yet, Big Data-based projects are carried out gradually and systematically in the education sector under cooperation between the ministry of education and other key ministries, powered by outstanding domestic IT infrastructure and manpower [2]. We are getting closer to the stage that connects the large-volume data accumulated for several years and analyzes the resultant big data.

Meanwhile, we see numerous and massive data scattered as each ministry keeps implementing a systematic program to improve their educational spirit and train manpower through creativity, talent, and convergence education; it mainly consists of the education of software, problem-solving skills, computational thinking, machine learning, deep learning, and AI learning [3]. Although the domestic academic field showed quite remarkable achievements in narrowing the gap between education and people by analyzing the overall software education system from the past up to now, there has been no method to specifically quantify and measure the outcomes in fact. The recent rapid growth of online media including social media services, along with the popularity of smartphones and developments in IT technologies, opened another ground for public opinion polls: reputation analysis and recognition analysis. Unlike conventional mass media, social media can provide information using the internet network, and also due to its rapidness and spread power of information, it has become a key tool for reputation analysis of internet news and the general public. Also, as social issues on social media keep transforming from public agendas into policy agendas, public sentiment on online media including social media became an important reference point for the government in policy agenda setting that cannot be neglected.

Thus, this study is to collect Unstructured Data scattered online and, based on such collected data, to analyze opinions, recognition, and reputation of the general public on AI Education, with an aim to analyze AI Education elements that people regard good, bad, or important, and to propose various approaches that promote developments of their applications on domestic AI Education policies in the medium and long term.

2. Related Works

It is to analyze policy directions and curricula for talent training with the current domestic and overseas cases of software and AI Education.

2.1 The Evolution of AI (Artificial Intelligence)

AI has been defined in different viewpoints in accordance with the change of time and developments in the relevant sector. The most representative definition suggested by P. Norvic and S. Russel from a modern approach divides it into four aspects: Human Thinking, Human Behaviors, Rational Thinking, and Rational Behaviors. In sum, periodical approaches of scholars define it as “an algorithm and computing system that assigns human intelligent characteristics to machines by programming.” Although the paradigm of AI study has been mainly classified into either symbolism or connectionism, P. Domingos divides it into six groups: Symbolism based on Regularity and Knowledge; Analogism grounded on Similarity Calculation; Probabilism using Bayesian Conditional Probability; Connectionism with Artificial Neural Networks; Behaviorism using Intensified Learning; and Evolutionism based on Genetic Algorithm [4][5].

Study areas of AI are split into several themes such as Exploration and Problem Solving, Theorem Proving, Knowledge Representation, Inference, Uncertainty, Plan, Machine Learning, Artificial Neural Networks, Genetic Algorithms, and the Development of AI Languages and Tools.

2.2 AI Education

In 2019, the South Korean government announced national AI strategies with the statement of vision, “From IT Powerhouse to AI Powerhouse.” It prepared 9 strategies and 100 tasks in the 3 areas using AI, aiming for the world’s top 3 digital competitiveness, generation of up to 455 trillion won of economic effects, and the world’s 10th best life quality of its nationals. This works as a strategic point to improve the national brand power and competitiveness by securing software manpower with interdisciplinary abilities based on the recognition of the importance of the AI sector [6].

In the case of the United States with an abundant AI manpower pool, it keeps making investments and assisting researchers to reserve basic source technologies for brain science and artificial intelligence and proceeds brain initiative policies as government-wide efforts. With such moves, the government provides active support by launching the teacher-led AI4K12 Initiative to establish the standard framework for AI education and apply it to the field. In addition, the Computer Engineering Department of the University of Adelaide in Australia is running free online training for professors to teach digital technologies to k-12 students. This course proposes two AI-related curricula, which consist of background information required to teach and contextualize AI and actual implementation of classroom activities suitable for AI Education [7]. The Chinese government is also raising strong AI-supportive policies and leading the active engagement from companies to propel industrial development and talent training at the same time. Accordingly, its next-generation AI Development Plan announced in 2017 stated to install AI Education in the elementary, middle, and high schools and develop the relevant textbooks; the Ministry of Education in China also has the detailed plan to nurture 500 AI professors and 5,000 AI students by 2023 [8]. Also, the United Kingdom has published AI training policies since 2017, which feature a public-private partnership between the government and industries to propel them [9].

2.3 Software Education

In Korea, it became obligatory in middle and high schools in 2018, emerging as one of the hot issues in education policies. Consequently, many education experts have tabled various educational agendas such as potential problems or side effects due to the obligatory Software Education in symposiums and conferences [10]. One of the most contentious issues was the time assignment of Software Education in the existing curricula. The educational agenda formation plays a crucial role in deciding and executing educational policies and the appropriateness of the agenda setup decides the outcome of educational policies in the future. Thus, we need more

scientific and systematic analysis to draw out education directions.

2.4 Utilization and Implications of Educational Big Data

The studies utilizing large-volume data so far have drawn out utilization methods of Educational Big Data in learning and the frequency of inquiries by analyzing the relationship between various variables. Yet, the analysis model has structural limitations to being a roadmap model in the medium and long term since it focuses on analyzing the outcomes of educational policies only. With the earlier analysis method for domestic educational policies, the related analyses were possible only when the political agendas were revealed beforehand; that is why the political agendas used subjective keywords to improve the set educational policies. Furthermore, while the education system can be useful in determining the importance of the educational policy agenda based on inquiries on Big Data for education, the database that is not specified or inquired only functions as a reference to set or compare educational policy agendas [11].

2.5 Analysis Methods for Unstructured Data

Unstructured Data refers to data such as text, images, and videos that are not processed yet. The analysis methods of Unstructured Data mainly consist of mining techniques for text analysis. Its most representative analysis methods are Text Mining and Opinion Mining [12].

Text Mining is a method to analyze data classification models, keywords, and linkages based on text to extract meaningful information. It draws out information data with significance based on the processing technology of natural languages, examines its connectivity with other information data, and identifies the text category, which brings better results than general information retrieval. The core research areas of Text Mining encompass document summary and characteristic extraction and boast countless applications. The most common application is to extract Structured Information from documents to make it into a database or find out certain rules. Other examples are as follows: assisting document search of web users; generation and analysis of a user profile; identification of natural languages in documents; classification and categorization of documents in large-volume database; reinterpretation of documents using document category information; summary, translation, and exploration of documents, market and risk analysis by acquiring time series information, document index, document filtering and recommendations, extraction of the representative keywords or topics [13].

On the other hand, Opinion Mining is an analysis method to determine preferences such as positivity, negativity, and neutrality on structured and unstructured text collected from online media like social media or portal news [14]. It is applied appropriately to market size predictions, customer response, viral analysis, etc. of a certain service or product. The technology extracts positive and negative lexical information recognizes a sentence representing an opinion on the object, and visualizes the values attained by measuring positive and negative words with graphs and other elements based on the Sentiment Dictionary, the sum of patterns including opinion texts, in the server. It can also draw out more meaningful information data from Unstructured Data comprising opinions from unspecified users. In this regard, Opinion Mining can be called 'Sentiment Analysis.' Furthermore, it can be broadly classified as Text Mining, the technology used for natural language processing and computer linguistics analysis.

3. ANALYSIS PROCESS OF EDUCATION DATA

3.1 Education Data Analysis Platform

The analysis process proposed in this study is part of efforts to draw public opinion and keyword trends of AI Education policies that are revealed in posts and news articles on internet media based on Unstructured Data. Thus, it randomly collected Unstructured Data that contained the word 'AI Education,' focusing on Blog, Twitter, and Portal News. Then, it analyzed keywords to classify the polarity of sentiment words into positivity or negativity and built-up Sentiment Data, which was then used for the perception analysis. The overall system configuration for Sensitivity Dictionary Construction, one of the most important steps in this study, comprises three models: construction of a storage server for data collection, storage, and pre-processing; building a learning model platform

for natural language processing that carries out a morpheme analysis of sentiment words; establishment of a sentiment dictionary for opinion mining analysis.

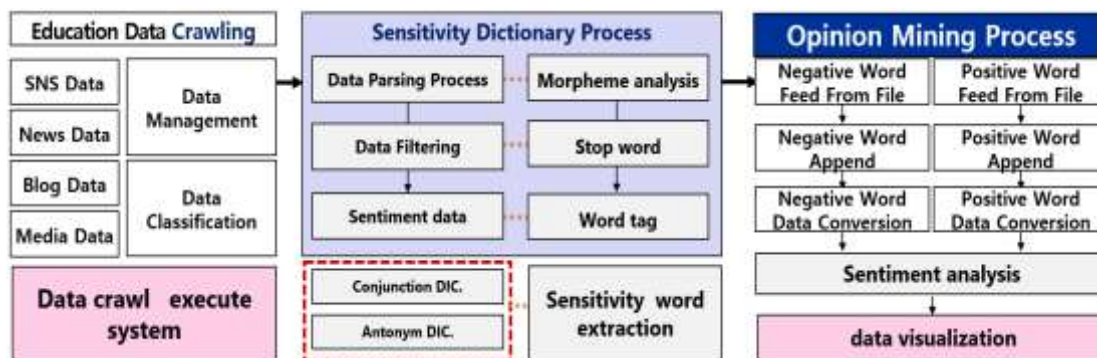


Fig. 1. Platform of Data Collection and Sentiment Dictionary Construction for Education Data Analysis

3.2 Collection Method of Education Data

To collect and extract quantitative and stable data, we need to consider the OS (Operating System) compatibility issue. The Crawling technique used in this study has limitations due to the collection process in Hadoop which requires a Linux environment. Crawling of Scrapy technology is a popular web collection method whose performance is well appreciated and that has high reliability in securing sophisticated data. Currently, many studies are carried out to collect Unstructured Data from the web. What’s more, a new web mining field based on text mining is being proposed. Including the technology that collects SNS replies consisting of 140 characters on Twitter, Facebook, etc., large-volume data on big Portals and Amazon are collected by Web Crawling and Scraping technologies. Web Scraping is also called “Screen Scraping,” which refers to the technology that randomly draws data from random pages on services provided by the web without web browsing of users.

Accordingly, this study used the Scrapy technology, set up AI Education as a keyword, and selected target websites; through the repetitive collections, it classified the relevant data and for some websites that did not allow Scrapy, it went through manual labor to obtain Education Data in real-time.

3.3 Korean Grammar-based Pre-processing Process for Education Data Analysis

In Korean grammar, adopting pre-processing design for appropriate words and grammar rules must precede designing the Opinion Mining Analysis Model since one word has a different and abundant meaning which cannot be expressed in English grammar. Thus, when analyzing Korean grammar, we must apply new patterns and rules beforehand to enhance the reliability and accuracy of the analysis.

For the stable Opinion Mining Analysis, this study expanded the Sentiment Dictionary set by earlier studies. Also, it carried out data pre-processing to extract word candidates to be included in the dictionary for Education Data Analysis. Since this study performed pre-processing based on the collected Unstructured Data, any outlier or abnormality was not found in data items. It also performed filtering work to draw important words that had significance in a sentence or can be sentiment words. In the United States, it may use SWN (SentiWordNet) for easy pre-processing when extracting sentiment words in English grammar [15][16]. Here, SWN refers to a dictionary containing sentiment information by applying English grammar; it is a vocabulary dictionary that allocated sentiment index to words such as positivity and negativity with significance for sentiment classification and opinion mining analysis, now being used by over 300 study groups in the world. As a vocabulary dictionary of synonyms based on 147,278 English words including nouns, verbs, adjectives, and adverbs, SWN features the normalization that the sum of all sentiment values such as positivity, negativity, and neutrality makes one (1) in total [17].

That is, although SWN has strong advantages in extracting sentiments from English sentences with its

structure of the grammar algorithm, it faces difficulties in extracting the same from Korean sentences, which lowers the accuracy of predictions. Therefore, this study excluded SWN and adopted the following rules to perform word filtering centering on the Unstructured Data that was collected to effectively draw sentiment words from the Korean grammar. First, it filtered out all special letters, English, and stop words. The noun extraction-based filtering was to remove the words that have no meaning as morphemes in the Korean grammar. Second, it eliminated all meaningless words and one-letter texts. Next, it classified identical words in a conjunctive form and distinguished the fundamental meaning of sentiment words. Also, it made distinction between homonyms and synonyms and reflected it into the API of one Sentiment Dictionary. Lastly, it took away abbreviations and newly-coined words but included the words registered in Wikipedia and Korean dictionaries during the filtering work.

Moreover, to enhance the precision of Opinion Mining Analysis, popular loanwords that are frequently used by the general public were included in the sentiment data as well. For instance, there is the word 'Condition' which describes the health or physical status of a person; this word can be written as '컨디션[kændɪʃn]' or '콘디션[kondɪʃn]' in Korean notation. As such elements are increasingly incorporated into Korean when notation for loanwords is not clear, they were also reflected as sentiment words in this study. In addition, the word 'content' in English is written as [kontents] in Korean. Although it is an incorrect notation, it was registered as the standard to refer to the overall content in 1999 in Korea, and many people have accepted and utilized it since then. Considering the issue, the Sentiment Dictionary applied both 'Content' and 'Contents.' Also, although it sorted out meaningless numbers from sentiment words, some cases had numbers with huge significance as 'the 4th Industrial Revolution' or 'the 5th Generation mobile communication.' Such were incorporated in the dictionary as well.

Table 1. Data Filtering Rules for Education Data Analysis

1. Remove special letters and stop words.
2. Remove English letters and meaningless one-letter texts.
3. Remove meaningless numbers but include important words with certain numbers (e.g. the 4th Industrial Revolution, 5G, etc.).
4. Remove articles, conjunctions, words with high neutrality.
5. Remove Chinese characters and foreign languages.
6. Include newly-coined words registered in the official Korean dictionary.
7. For abbreviations, apply a popular notation but remove those not frequently used.
8. Remove half-structured data based on HTML/XML syntax.
9. Remove strong swearing words and slangs.

In the case of text data collected from the web, it includes XML syntax in part. Thus, it carried out filtering during data collection. Also, text documents prepared by normal users show high occurrence frequency of personal preference to context and swearing words, slang, and coined words, which brings a need for the Sentiment Dictionary specialized for its detailed analysis. With this in mind, it included all stable contexts written by editors and columnists into candidate words for the Sentiment Dictionary when collecting Education Data scattered online but filtered some strong swearing words and slang from documents written by non-experts and clients; some words with soundness in the context such as 'Daebak' were incorporated into sentiment words due to its high popularity.

3.4 Definition of Classification Model of Homonyms and Synonyms in Korean Grammar

In Korean grammar, we need to first understand words for efficient Opinion Mining Analysis. Some words called 'homonyms' sound the same but hold different meanings. We need a classification model when two or more words have the same pronunciation but completely different meanings. Following are the examples of homonyms and synonyms.

Table 2. Examples of Homonyms and Synonyms [18]

Form	Word	Meaning
Homonym	부치다[Buchida]	<ul style="list-style-type: none"> - It is beyond my power. - Send a letter. - Cultivate a farmland. - A piece of writing mailed on Arbor Day. - Submit the agenda to a conference. - The manuscript put to stamp.
	붙이다[Buchida]	<ul style="list-style-type: none"> - Attach a postage stamp. - Kindle a flame. - Put a watchman. - Append conditions. - Give a nickname.
Synonym	Smart Phone	<ul style="list-style-type: none"> - Cell phone - Portable telephone - Hand Phone - Mobile phone
	Ship	<ul style="list-style-type: none"> - Boat

The above grammar consists of words subject to Opinion Mining Analysis. It must implement table classification and store them into a database. That is, although ‘부치다([beɪ], boat)’ has the meaning of a ‘Ship’ moving across the water, it also refers to ‘Pear’ and ‘Stomach.’ In this education data analysis, the term ‘*Daebak*’ previously applied for the filtering is one of homonyms. Among the data samples mainly collected, it appears in sentences like “AI subject is *daebak* easy” or “AI class is *daebak*.” These can be translated as “AI subject is so easy.” or “I love AI class.” According to the Korean dictionary, ‘*Daebak*’ also refers to a large ship on sea or a big item as a metaphor. However, young generations use the word to refer something successful. Then, its antonym is ‘*Jokbak*,’ which describes something goes terribly wrong. Like this, Korean letters can vary their forms and interpretations through time and generation and these requisites must be all included in the sentiment words to get precise results.

3.5 Application Model for Antonyms in Korean Grammar

Reputation analysis unpacks reputation as positivity and negativity in a sentence by putting together the number of positive and negative words in a sentence on average. However, some antonyms that have conclusive words are hidden behind positive words. It was analyzed that although the overall context seemed positive, the last word changed the tone, pointing to a negative prediction. Generally, in deriving the Sensitivity Dictionary, positive words are applied as they are without consideration for irony with their following words in the sentence. This study regarded positive words as they were but filtered out some that were likely to convert to negative and set up a separate data dictionary. Lastly, it made a group of associated words that connected sentences. In determining the sentiment of opinions, the occurrence frequency cannot function as the precise standard. Hence, it reorganized the Sentiment Dictionary by applying association rules of words under the presumption that even when positive words are weighted high in a sentence, the sentence may mean negative in the overall context like in an irony.

4. ANALYSIS RESULTS

4.1 AI Education Analysis Items

It stored and accumulated large-volume data and carried out pre-processing to analyze the recognition of the general public on AI Education. Also, it applied design techniques of Korean grammar and various pre-processing rules to improve the accuracy of the analysis and performed parsing of antonym correspondence, homonyms, synonyms rule classification, and association words. It developed two analyses. First, it drew out and analyzed which words most frequently appear when applying the keyword ‘AI Education’ based on educational data collected from the Web. Although the keyword was ‘AI Education,’ it could have been expressed like ‘AI Education,’ ‘AI Schooling,’ etc. Thus, it adopted various expressions with the same meaning for the keyword analysis, increasing the precision and credibility of data analysis. Second, it developed the Sentiment Dictionary Platform with 180,000

sentiment words to conduct the Opinion Mining Analysis to identify public recognition.

4.2 AI Education Keyword Analysis

It drew out the top 10 keywords associated with the keyword 'AI Education' where 'AI' ranked at the top of the list. However, since it generally refers to Artificial Intelligence in English, it was excluded from the rank. When determining the ranks again based on the pure recognition level, the first place belonged to 'the 4th industrial revolution.' It seems attributed to the trend that technologies based on national strategies are closely related to the 4th industrial revolution as the significance of Big Data, Cloud Computing, Robot Techniques, Artificial Intelligence, IoT, and Wearable Technology are emerging amid the software revolution around the 4th industry. In other words, it seems to be perceived as a part of domestic future education to prepare quaternary industries.

Meanwhile, 'Software Education' held second place. In South Korea, some recognize AI Education as a curriculum under Software Education; more and more people are putting AI Education into the framework of Software and Coding Education in their minds. However, since domestic Software Education mainly focuses on improving computational thinking through coding training and problem-solving skills, AI and Software Education may have different curricula. Also, AI Education focuses more on Data Learning, Machine Learning, and Deep Learning in the software aspect. What's more, liberal arts majors run education on AI ethics and philosophical concepts of AI, etc. It means the general public has quite a narrow recognition of AI Education.

Table 3. AI Education Keyword Analysis Based on Domestic Portals

Rank	AI Education Keyword
1	The 4 th industrial revolution
2	Software Education
3	Coding
4	Coding Education
5	Certificates
6	Curriculum
7	Learning
8	Machine Learning
9	Future Education
10	Deep Learning

Also, 'Coding' and 'Coding Education' held advanced positions, which reveals that most people look at AI from the software perspective only. 'Certificates' were another higher factor. It shows that AI-related certificates are gaining popularity on the web since the big issues of the 4th Industrial Revolution include AI Education. In other words, it implies that many learners feel uncertainty about the future and the burden of employment and have a high interest in certificates on-trend. Besides, 'Curriculum,' 'Learning,' 'Machine Learning,' 'Future Education,' and 'Deep Learning' were detected. In the overall analysis, it was found that while curricula widely adopt AI Education in the software and humanities sectors, many people occasionally think that it is just a part of Software Education.

Currently, domestic universities are reforming the curricula of liberal arts and humanities. Accordingly, many sciences are emerging in AI Education, including the Introduction to AI, AI Applications, AI Practices, and AI Ethics. It is time to make people recognize the wide range of AI Education and the various curricula. Through these efforts, people may understand that AI Education can be expanded and applied to other majors. In the medium to long term, it will lead to the enlargement of AI-converged talent training.

4.3 Reputation Analysis of AI Education

Based on the data collected regarding AI Education, this study performed the Opinion Mining Analysis. It drew out top 10 positive words and top 10 negative ones for the analysis.

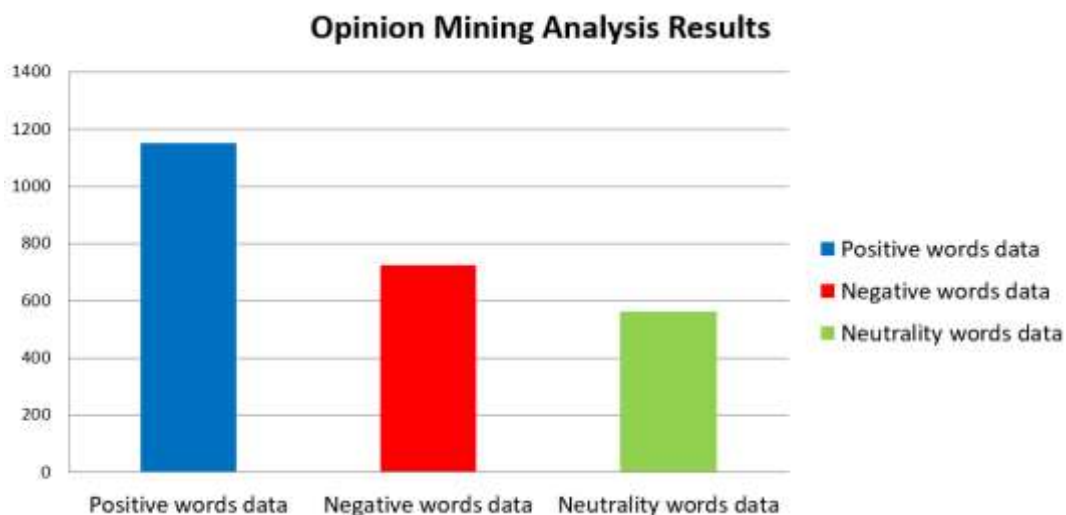


Fig. 2. Opinion Mining Analysis Results

Positive words included 'Fun,' 'Effective,' 'Helpful,' 'Creative,' and 'Freedom.' They may have various implications. For example, 'Fun' means that the learner experienced joy and interest in AI Education but at the same time suggests the necessity that AI Education must be fun and joyful like Software Education. In addition, 'Effective' can be interpreted that the current domestic AI Education in the curriculum is effective. Besides, 'Helpful,' 'Creative,' and 'Freedom' show the public awareness of AI Education as a science that helps the future education or promotes creativity.

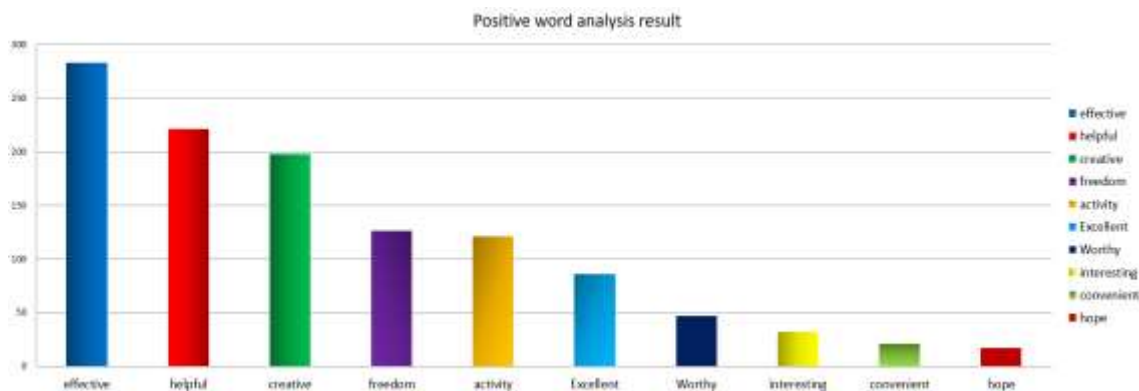


Fig. 3. Positive Data Analysis Results

On the contrary, negative words were 'Difficult,' 'Lacking,' 'Nervous,' 'Inefficient,' etc. It implies that many people think AI Education is a demanding course. 'Difficult' was the most commonly used word, and this reflects the recognition of learners who have yet to receive AI Education and that of previous learners. Domestic universities have incorporated AI-related studies into their curricula of various subjects for non-majors. Moreover, it is mandatory for elementary, middle, high school, and education college students to learn AI. Now we need an approach to alleviate the difficulties by developing easier curricula of AI Education for non-majors of software science. In addition, while the word 'Lacking' cannot derive an accurate analysis, it can be interpreted as failings of the current AI Education or learners.

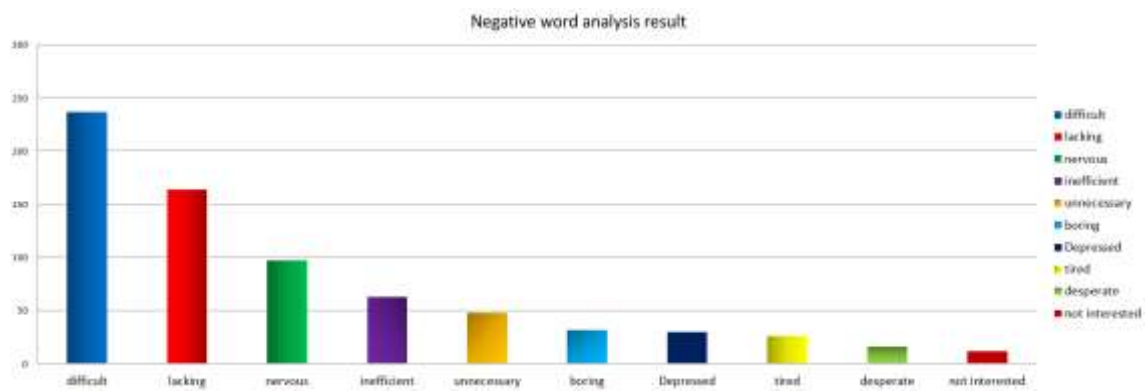


Fig. 4. Negative Data Analysis Results

Neutrality words included 'Software Education,' 'Coding,' 'Challenge,' 'Korean SAT,' 'Curriculum,' 'Problem,' 'the 4th Industrial Revolution,' and 'Private Education.' Since they are not classified as sentiment words but only show a high occurrence rate regarding AI Education, they may be interpreted as the general recognition of 'AI Education.' Enhancing the effectiveness of domestic AI Education in the medium and longer term based on the general analysis results requires progressive improvements. First, we must let people know about the diversity of AI Education. Although approaches from the Software Education perspective are meaningful, people should aware of various fields in AI Education such as philosophical factors, problem-solving skills, the learning process of AI, and the importance of AI ethics in humanities, thereby establishing the identity of AI Education. Next, we must develop the AI Learning Model that is fun. It must reflect the strengthened AI education platform, political factors, and an education system where non-majors can learn without difficulties. Third, the current curricula must be customized according to difficulties individuals encounter in AI Education. Most people think of AI Education as a requisite for the 4th Industrial Revolution or a practical tool for the future. Thus, we need a learning methodology that explains the necessity of AI Education to promote a clear understanding and easier applications.

CONCLUSION

The earlier utilization of Educational Big Data only drew some suggestions such as how to use them in learning through analyzing the relationship between different variables such as related data inquiry and frequency. However, this uniform analysis model has limitations in analyzing performance factors of educational policies and suggesting guidelines for a roadmap in the medium and longer term. So far, analytical techniques of domestic educational policies have been possible only when political agendas were given beforehand, which led to the progress of educational policies with subjective keywords. In this regard, the analysis technique presented in this study enables the management and analysis of massive and numerous Unstructured Data and minimizes the error range of Big Data analysis results with expected improvements in accuracy and credibility.

It analyzed the recognition and reputation of the general public on AI Education by using texts as Unstructured Data. It suggested the Filtering Process and Sentiment Dictionary Development Process based on educational data and identified the public awareness of AI Education through the analytical process and results. Many people were found not appreciating the importance of AI Education and reducing its meaning merely in connection with Software Education. Thus, it proposed development directions in the medium and longer-term to secure AI talent training in the future with the analysis results. It is expected to propose a model for improvements in domestic AI Education and learners in the future and bring a chance to raise awareness of AI Education Program build-up and creative and converged talent training: a must for welcoming the 4th Industrial Revolution area with national competitiveness.

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