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# Linguistic Critics and Ethics on the Glossary of Modern Dictionaries Patterns and Lexicographic Description

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#### Abstract

**Purpose:** How the lexicons in Korean classical manuscript novels can be lexicon-historically utilized and how often they appears in the Korean classical manuscript novels. The lexicon vocabularies for ethics studies had get ready for the macro-structure, and headwords which complementary elements from micro-structure of texts, technique, sociolinguistic information. Dictionary Information was needed to short and clear, scientific, efficient, dimensional, systematic organization, it is the key to open the global possibility of lexicon studies.

**Method:** That gathering in neologism 405 words, distinguished from 229 words related to covid-19. Comment corpus appeared to frequently were pneumonia, corona, variant of concern, booster shot, revenge spending, vaccination politics, quarantine politics. In order to discover an outstanding speaker, it is necessary to have nuanced understanding on a narrative field. The researcher's questions and requests, the informer talks about the tale, linguistic aspects lexicon geographical map would displayed with political administrative units such as dialect language which show to with the division of administrative system.

**Results:** We arrange to share information which gave to morphology, grammar, semantics interaction setting up that have unity in the process which the manuscript of contemporary Korean linguistics becomes a dictionary and the lexicographic significance of this Manuscript. Results show that comment data prove invaluable for lexicographic description of neologisms, although experts need to decide to what extent the politically incorrectness of commenters' language may be used in dictionaries.

**Conclusion:** Standard words what the map based on the lexical items showed idioms phrases that there were a lot of old forms from which originate with time to time. Yet, another evidences which focusing on the lexical distribution, their poor assets provided them to that this present has been studied text linguistics. Focused with the Dictionaries of Literature Term, This study was conducted to review the problems that compilers realized in the process of arranging and defining literary terms during the Japanese colonial period and attempted to resolve.

Keywords: The Glossary of Modern Lexicon, Lexicographic Description, Social Linguistics , Colloquial Grammar, Neologisms

# **1. Lexicon History**

We should have studied the Spoken and Written in Chosun dynasty about language reformation that process of lexicon history and Encyclopedia of thought of language, it was organized by dictionary of old Korean, Chosun dynasty lexicon dictionaries. Thus, the history of lexicon was influenced on Dictionary of Proverb in 16 century, Modern Korean Dictionaries with a Focus on vocabulary research[1]. The vocabulary list prepared to help learners not only understand subject concepts but also learn subjects[2]. Due to the characteristics of the Korean language, both subject vocabulary and vocabulary related to daily life can be included in the list. However, if the vocabulary for everyday life or learning tool is included in the list, several factors may hinder the understanding of subject concepts such as overlapping vocabulary learned in previous grades[3].

# 2. Korean Dictionaries from the Words Analysis

#### 2.1. Corpus on materials

Korean Morphological Analysis method was lead to Korea University's Research Institute of Korean Studies has recently published one of the biggest Korean dictionaries [4]. 17th Century Korean Dictionary was based on that examples of the Korean Literature on ancient and modern ages would a newspaper article were corpus, the document old materials which had included instances, dictionary of archaic words organization and analyzing, words settlements [5]. Modern Corpus had kept a colloquial lexicon and standard vocabularies all times. Though they researched old classical texts, writing had good readers grammatical data at frequent. Thus, we searched moral ethics in a patterns and grammatical forms, and it was dual language parts from Yidu clauses. Therefore, how the lexicons in Korean classical manuscript novels can be lexiconhistorically utilized and how often they appears in the Korean classical manuscript novels. In especial, in Korean Classical Manuscript Novels aimed to modern language arrangement of large data list[6].

#### 2.2. Social linguistic approach

That regional dialect happened to Dialect Vocabulary study that followed the necessity for a more active social linguistic approach about how, and how much regional dialect vocabulary change as one of the change of Korean which follows the standard language policy. On Concept of dialect contact, types, and the relationship between language policy and standardization of dialects which was formed with modernization, the following is categorization of standardizations confirmed in a survey result about cognition and usage[7].

The thesis sort out newspaper corpus the whole on topic universal, not particular theme. That gathering in neologism 405 words, distinguished from 229 words related to covid-19. After constructing corona news corpus, make up for lexical items of 346. Comment corpus appeared to frequently were pneumonia, corona, variant of concern, booster shot, revenge spending, vaccination politics, quarantine politics. According to web scraping medium in-link from Naver internet news, that investigation built up news document and comments well.

In order to discover to an outstanding good speaker, it is necessary to have nuanced understanding on a narrative field. the researcher's questions and requests, the informer talks about the tale, linguistic aspects lexicon geographical map would displayed with political administrative units such as dialect language which show to with the division of administrative system. Among 155 lexical items on, the clearest distinction is found in the use of language between Daejeong and Jeongui. Of 155, 54(34.8%) lexical items are different between these two areas. Next, 48(30.9%) different between Jeju and Jeongui followed by 17(10.9%) between Jeju and Daejeong. Also, there exists the difference in the use of language in the same area, which represent the psychological importance leading to the cognitive distinction of the dialect. This difference proves that the linguistic change takes places among people in a certain community. 4. There is 50-year difference between Hyun Pyeong-Hyo's works and the present research[8].

# 3. Written Grammar of Dictionary in Modern Korean

# 3.1. Colloquial grammar

Chinese Ancient phrases similar to judgement is mainly made through comparison of commonalities and differences based on words form, but it is insufficient in presenting objective grounds for judgement because it is rather subjective and qualitative. It is required to improve Korean Language Education for Literary Interpretation that can protect Korean Language History and Korean Classical Literature[9].

It is confirmed that the colloquiality of each genre from the documentary expressed as Chinese Proverbs names, origin from the index of words collecting linguistic materials. Lexicographic analyzes were dealt with in the structure of the dialect section of this dictionary is described in detail, and the quantitative analysis results of the dialect section are described [10]. Dialect dictionary published by two Korean researchers, Jeong Tae-Jin and Kim Byeong-Je. This dictionary was published in 1948 for the purpose of collecting dialects for the study of historical comparative linguistics. However, this dictionary has many meanings in that it is the first dialect dictionary published by semantic units selection on.

# 3.2. Grammatical unit of Korean lexicon

First of all, the meaning is the same and the form is different compared to the standard Korean language, it represents the synonymous relation. Next, the meaning of words is different and the form of words is the same, it represents homophonic or polysemous relationship according to the words based on etymological identity or semantic relation[11]. Finally, As a result of discussing about the meaning, part of speech, and grammar unit of '快' and '快要' according to the translation of 『現代漢語詞典』, we realized that '快' is universally used as adjective that means 'the movement or flow of episode is fast in time' in any context it is used in. It is mainly used as a predicate, a complement, or a sentence adverb. It also means 'family name' as a noun.

We also checked that '快' has a contextual meaning of 'will do ~ soon' not only when it is used in front of a verb or an adjective predicate, but also in front of a quantifier predicate. We also found out that '快' is used mainly in front of a quantifier, whereas '快要' is used mainly in front of a verb or an adjective in actual language environment.

|          | Colloquial lexicon | Literary<br>letters | Journal form | Newspaper   | Internet style |
|----------|--------------------|---------------------|--------------|-------------|----------------|
| Learn    | (習)study           | Work                | Research     | Contemplate | See            |
| Lesson   | (功)work hard       | Class               | Listen       | Care        | Think          |
| Try      | (力)strive          | Get                 | Кеер         | Make        | Attempt        |
| Take     | (置)set             | Bring               | Find         | Write       | Have           |
| Put      | (授)give            | Let                 | Bring        | Tell        | Read           |
| Set      | (孫)stuff           | Put                 | Sit          | Stand       | Say            |
| Gather   | (集)collect         | Gain                | Crowd        | Gather in   | Assemble       |
| Raise    | (上)place           | Place               | Grow         | Bring up    | Cause          |
| Clear up | (天)increase        | Amount              | Improve      | Influence   | Populate       |
| Come     | (來)greet           | Welcome             | Mention      | Approach    | Receive        |

 Table 1. Colloquial lexicon example.

# 4. Morphosyntax of Archaic Words

# 4.1. Vocabulary for the morphosyntax

This paper questions that overcome history of vocabulary for the morphosyntax, and it aims to overview old Korean dictionaries and to suggest ideal directions for the future old Korean dictionaries.

The present study aimed at an extensive examination of this issue, from fundamental questions such as the importance of understanding the orthography and grammar of archaic words for an understanding of classical literary works, to specific methods to promote the effective appreciation of classical literary works through an enhanced understanding of archaic words.

Realization of a Korean Spoken Language Dictionary is a relative concept compared to written language. That was not properly reflect the context of the Korean language, Korean language education should need rethink about system of method have been doing well for correctly use of language in a actual. The Distinction between Orality and literacy reviews that Vocabularies in Literature represents the nature of written language from the old classical Prose Passage Learning[12].

Refined words speech sample that collecting empirical reporting had been made by an iconography which those nouns and figurative words were regional variations, and they had remoted with idioms more and more each other in social outsides by moral educational values, but an ethical perception in school online practicum experiences during the pandemic that required by our elementary writing instruction the future of education. what was on writing development of moral, education, human Nature value. Which with writing ability possible for teacher's guide books on were evaluation that role model instruction of written literary style role on the expressional fictional narrative texts? On summary, the ethical sensitivity influenced on sense of brain, feeling with words reading books, much as items on vocabulary that increased in deeper structure without surface structure, we could have learned spiritual sense and epistemology in an empathy ability on personality in a short time.

# 4.2. Dictionary compilation methodology

This study allowed to 16C Korean dictionary, 18C Korean dictionary, 19C Korean dictionary that based on knowledgebase instead of traditional paper dictionaries. The purpose of analyzing the manuscript of Joseonmal Keun Sajeon, the first Korean unabridged dictionary, and to clarify the lexicographic significance of this manuscript. the context of the composition and revision of this paper was pre-investigated. The changes in the macro-structure and micro-structure were summarized. Based on these discussions, it was examined what kind of search was made in the dictionary compilation methodology before the publication of the dictionary.

# 5. Sociolinguistic Dictionary

# 5.1. Korean ethics studies

The lexicon vocabularies for ethics studies had get ready for the macro-structure, and headwords which complementary elements from micro-structure of texts, technique, Sociolinguistic information. Dictionary Information was needed to short and clear, scientific, efficient, dimensional, systematic organization, it is the key to open the global possibility of lexicon studies. Therefore, we arrange to share information which gave to morphology, grammar, semantics interaction setting up that have unity in the process which the manuscript of contemporary Korean linguistics becomes a dictionary and the lexicographic significance of this Manuscript.

Results show that comment data prove invaluable for lexicographic description of neologisms, although experts need to decide to what extent the politically incorrectness of commenters' language may be used in dictionaries[13].

# 5.2. Reunification and amendment of the dictionary language

The aim of the Karaeeunhae of 17th century is to study the modern national language history on the early seventeen century, being examined the character inscription. This book character reflected the written language, construction of an Efficient Pre-analyzed Dictionary for Korean Morphological Analysis[14].

This study on reunification and amendment of the dictionary language in written and spoken language, it is necessary for us that our folk and the spoken language style narratives on the reflection of the actual language and normalization is universalizability and impartiality in our actual speech community[15].

Also, this paper refer to occurrence frequencies and usage trends of COVID-19 neologisms in journals related to the pandemic in order to demonstrate the differences in neologism usage and evaluation across genre.

We need to concentrated on keeping and collecting dialogue stories what is the politically incorrectness of commenters' language may be used in folktale list set, performing list dictionaries.

Finally, we propose a Pandemic era model for covid-19 neologisms which integrates the findings of the study, taking the neologisms 'Wuhan pneumonia' and 'K-quarantine' as examples.

# 6. The Lexeme Redefined by Lexical Morpheme

# 6.1. Context for neologisms

If the dictionary includes "Insufficiently-analyzed word-phrases", which do not include all the possible analysis of the word-phrase, it may cause the decrease of the analysis accuracy. In this research, we measure the accuracy changes according to the number of word-phrase frequency and the size changes of corpus by Sejong corpus[16]. This old materials contented with various sentential constituents from syntax structures, through achieving dictionary recognition that semantic relation and lexeme redefined by lexical morpheme[17].

The differences in neologism usage and evaluation across genre. In addition to frequency and primary collocate analyses, we carry out secondary collocate and n-gram analyses which provide a better understanding of the use context for neologisms, in a case study of the neologism 'K-quarantine'. Finally, we propose a microstructural model for COVID-19 neologisms which integrates the findings of the study, taking the neologisms 'Wuhan pneumonia' and 'K-quarantine'.

# 6.2. Lexical-semantic information

However, the word formation component of Korean was difficult to analyze morphs in verbal morphology, lexical-semantic information could be aware of the conceptual structure and semantic features. In the history of vocabulary, we had deal with several concepts for describing the change in lexical meanings were examined and 'lexeme' from the perspective of research methodology in lexical research, was applied to studies of history of vocabulary. Lexical education that words basic works were performed to systematically deal with the pattern of meaning changes in Korean vocabulary[18]. Through this, the significance and limitations of this research methodology could be examined. Acquiring meanings of vocabulary Cognitive Development age polysemic sign, homographic sign

Those items vocabulary were that the occurrence of semantic word of origin phoneme such as both signifier and signified, the phrases were polysemic sense or including textbooks sign to ontology, etymology Text Semantics ontology changing of meaning of  $\[\]$ Natukasi $\]$  and synonym.

# 7. Ecolinguistics and Language-Culture Programme

# 7.1. Sociology of language lexicon

Its significance lies in its attempt to try to systematize the content of language-culture education through interdisciplinary research into ecolinguistics and language-culture programme, the results are necessary for the starting period times and region. language-culture intertextuality educational content needs to be refined by the dynamic image of language and multi-cultural society, and Sociology of Language perspectives have to be represent in lexical theory base[19].

Two signs have common origin of iconicity, they can be judged as having the same root. However, in judgment of homographic signs, feed with separate students were the same manuals but different non-manuals. So they can be seen as separate lexemes with different origins. However, the phrases have the definition of ideas or will [20].

To judge 'go' as either polysemic sign or homographic sign, etymology was employed as the standard. If target signs have common origin of iconicity, they can be judged as having the same root. However, in judgment of homographic signs, [GANGHADA] has the same manuals, but different non-manuals[21]. So they can be seen as separate lexemes with different origins. For example, [GANGHADA] should be dealt with at a pragmatic level by revealing the speaker's feelings, and thoughts when expressing [GANGHADA] rather than functioning at the word level. A survey on the vocabulary in communication which have sincere suggestions about creative English education contents in accordance with cognitive development of age[22].

# 7.2. Psychological aspects of lexical meaning

The dictionary of archaic words formed that nominalization of transformation verbal noun word phrase and verb-nominalizing adoption in reflexive sentence as much as many deep-surface converted structure sentences which same morphs part to analyze phrase words sentence. That repetition is defined to reuse, paraphrase tree diagram which should not to be linked with the meaning in utterance of oneself or others[23].

This system headword construction express with sentence parsing words, in extra other an especial position that articles are should be complex words and compound complex. The misused words phrases that blending prevent from sense-meaning what was polysemy, in word with multiple meanings an explanation about a meaning misinterpretation that on etymology melted compound words. Moreover, the blending are meaning in breakfast form and first initial as like acronym represents that mobile internet platforms and a social media that had formulated likely as at lunch all brunch part for version. The new noun-verbal combination that same meaning words different from in analogy back-formation words. On reproduction formal sense are have diverse similarity, in the hybrid words, just like nobleness, beautiful, aimless. Language education that formed information diachronically just likely as such as word formation system in classic materials[24].

What is history of language change reason in origin for back formation those were that sentence is generate word form? On ethic result in an evolutionary perspective, we should apprenticed from the each are those colloquial language kept in rules from common mistakes, error. For that with interchange, a single analogy for that has are lingua evolution theory, a new word re substitution which has recording on word parts classification group with the eight parts of speech. Thus, we learn at language school old linear family and historical language in France[25].

They are the people who educate on transferring all nations, region, cities, and town. Coordination with disharmonic disposition the map of Language in korea, our morality was that Furthermore, we can explain why the speakers select acronyms in terms of psychological reality. First, in lexicon, acronyms are not only connected to original forms but also connected to other acronyms. For example, "emchina" is connected to "emchinttal", "pwuchinnam, thus the following theory is the lexical semantics, taking as the subject of the study generative semantics, neostructuralist semantics and cognitive semantics, while examine to conceptions of development in the social linguistics in the field of Korean philology. This historical approach to lexical semantics, psychological aspects of individual lexical meaning has placed an emphasis on the dynamic qualities. Though Research in this area conducted by Korean linguists flourished in the 1960s and remains incomplete. Second, structural semantics, which began from the 1930s, to 1980s that has took as an autonomous system.

# 8. Conclusion

The material reporters would have used for informants to gather into local person who dialect survey investigation that should have kept variation of lexical items that were based on modern vocabulary devices from the language norm education [26]. Moreover, a standard words what the map based on the lexical items showed idioms phrases that there were a lot of old forms from which originate with time to time [27]. Yet, another evidences which focusing on the lexical distribution, their poor assets provided them to that this present has been studied text linguistics. Researchers should not give to their principles and rules with language "good words are good cheap". The proverbs does not deal with grammatical and phonological aspects of the Jeju dialect [28]. This kind of imbalance should be made up in the future research.

Focused with the Dictionaries of Literature Term, This study was conducted to review the problems that compilers realized in the process of arranging and defining literary terms during the Japanese colonial period and attempted to resolve, based on Dictionary of Important Predicates(1924), New Writer Literature Dictionary(1934), and Modern Literature Dictionary(1939 - 1940). In addition, it was to reconstruct the compilation of the dictionaries by comparing them with two dictionaries, Modern World Literature Dictionary(1954) and World Literature Dictionary(1955) that were published in book form after independence[29]. With the foregoing, this study aimed to identify how literature-related concepts have been redefined before and after independence. The dictionaries of literature terms compiled during the colonial period had one thing in common; they were serialized in magazines.

Narrative stories telling, their backgrounds search what it became more time-centric. The reason is the synchronic time are closely related [30]. However, the method of storytelling education is a means for enjoying the social life of a person within the cultural community. For sharing the communal value and linguistic of evaluation measurement, Conceptual Metaphor expression with story-telling produced with syntactic constructions arrange in alphabetical order. We start with evoking the concept of predicate nouns and support verbs. Then we investigate the syntactic and semantic properties of support verb constructions, through which we define the information types necessary for their lexicographic descriptions [31].

Chinese tends to show higher detail with slightly more sub-metaphors than Korean. In terms of highlighted aspects, the related metaphors generally emphasize on disadvantageous status with related to women in Korean and Chinese proverbs[31]. On relationship with advantage is that Reading Comprehension ability were to be a kind of method which is deeply engaged in concrete life-in order to have a talk and to share an opinion one another[32]. By using this method of storytelling education, we are able to establish more appropriate Christian education in the Korean Christian community[33].

# 9. References

# 9.1. Journal articles

- Lee MS. A Study on the Vocabulary of Elementary School National Language Textbooks for 4th to 6th Graders in Korea and Japan in Use in 2022. *The Korean Journal of Japanese Education*, 58, 77-93 (2022).
- [2] Kim KH. A Way of Reconceptualizing Language-culture Educational Content based on Ecolinguistics. *Korean Language Culture Studies*, 14, 51-73 (2017).
- [3] Mun BY. Change of Meaning and Trends of Historical Research of Vocabulary. *Korean* Semantics, 74, 141-182 (2021).
- [4] Hong SM. Suggestions about Creative English Education Contents in Accordance with Cognitive Development of Age. *English for Specific Purposes Review*, 3(1), 51-66 (2021).
- [5] Ji RL. Historical Trends and Characteristics of Lexical Semantics. *Korean Language Research*, 31, 195-227 (2012).

- [6] Lee YJ. A Study for Acronymization in Korean: Focusing on a Case of Syntactic Construction to Acronym. *Korean Linguistics*, 69, 165-198 (2015).
- [7] Jeong HD. Covid-19 and Speech Community. *Language and Literature*, 88, 93-128 (2021).
- [8] Yi JH. A Study on the Reflection of the Actual Language and Normalization to Initial System and Rhyme Table in Unhae. *Kugyol Studies*, 46, 267-315 (2021).
- [9] Kim HJ. Problems with and Improvement Measures for Tales Categorization in 'The Comprehensive Collection of Korean Folklore Literature'. *Folk Customs Study*, 28, 261-298 (2014).
- [10] Choi JD & Kim SH. Lexicographic Analysis of Joseongoeobangeon-sajeon -Focusing on the Quantitative Analysis of Dialect Section-. *Korean Dictionary Studies*, 37, 52-91 (2021).
- [11] Kim YJ & Cho SY. Analysis of the Speech Pattern of the Government's Message to the Public in the Face of the Covid-19 National Crisis. *Culture Exchange and Multiple Cultures Education*, 11, 443-476 (2022).
- [12] Jeong HC & Park DG. The Theory and Realization of the Compilation of a Korean Spoken Language Dictionary. *Journal of Bangyo Language and Literature*, 32, 145-171 (2012).
- [13] Kim TG. The Values of Ecological Linguistics and Dialect -On SiJo by Yun Geum-cho-. *Korean Language and Literature in International Context*, 80, 241-272 (2019).
- [14] Kim HY & Kim KH. Korean Language History Education Prospectives in Ecolinguistics. *The Korean Language and Literature*, 68, 115-140 (2016).
- [15] Kim GH. Big Idea of Korean Subject based on Ecolinguistics for Convergence Education. *Education Course Evaluation*, 18(3), 29-54 (2015).
- [16] Kim SH & Kim JH. Material Research Data Structure and Construction of Sentiment Lexicon. *Trends in Metals & Materials Engineering*, 35(1), 67-79 (2022).
- [17] Kang SS & Won HJ & Lee MH. Analyzing Vocabulary Characteristics of Colloquial Style Corpus and Automatic Construction of Sentiment Lexicon. *Smart Media Journal*, 9(4), 144-151 (2020).
- [18] Kim BG & Lee JS. Automatic Construction of Korean Two-level Lexicon Using Lexical and Morphological Information. *KIPS Transactions on Software and Data Engineering*, 2(12), 865-872 (2013).
- [19] Cho JH & Jung HK & Kim YS. A Development of the Automatic Predicate-argument Analyzer for Construction of Semantically Tagged Korean Corpus. *KIPS Transactions on Software and Data Engineering*, 19(1), 43-52 (2012).
- [20] Kim H. Suggestions on Teaching and Learning AI Ethics using Cooperative Learning Method in Elementary and Secondary Education. *Robotics & AI Ethics*, 7(1), 65-75 (2022). [Read More]
- [21] Yi L & Jo SG & Park GY. Moral Teacher and Immoral School: A Case of Chinese School. *Robotics & Al Ethics*, 4(2), 1-5 (2019). [Read More]
- [22] Kim BJ & Park GY. Concern-based Acceptance Model for Character Education and Some Implications to AI Ethics. *Robotics & AI Ethics*, 5(1), 8-15 (2020). [Read More]
- [23] Lim Y & Lee M. Implications of Emotional Coaching and Integrated Art Therapy Teaching Method on Leadership Education in the AI Era. *Robotics & AI Ethics*, 5(2), 42-49 (2020). [Read More]
- [24] Kim J. A Study on Confucius' Dialogue in the Analects and Application to Coaching 5 Steps Models: Exploring Vale-oriented Coaching Learning. *International Journal of Human & Disaster*, 7(1), 77-87 (2022). [Read More]
- [25] Bae G & Park S & Jin Y & Yoon M. Study on the Mediating Effect of Self Focused Attention and Depression in the Relationship of Effect between the Human's Self Esteem and Inter Personal Problems. *International Journal of Human & Disaster*, 6(4), 1-16 (2021). [Read More]
- [26] Choi J & Nam GI. The Construction of the East Asian Wooden Tablet Database: Current Status and Issues. *The Eastern and Western Humanities*, 18, 237-263 (2022).
- [27] Yun YM. A Study on Modern Korean and Japanese Vocabulary Research Methods focusing on the Utilization of Dictionary Search Program. *The Korea Journal Japanese Education*, 35, 167-184 (2016).
- [28] Ha SY. The Dialect Orthography Korean Dialect Textbook. *The Journal of the Humanities*, 76, 1-20 (2016).

- [29] Kim H. Suggestions on Teaching and Learning AI Ethics using Cooperative Learning Method in Elementary and Secondary Education. *Robotics & AI Ethics*, 7(1), 65-75 (2022). [Read More]
- [30] Lim Y & Lee M. Implications of Emotional Coaching and Integrated Art Therapy Teaching Method on Leadership Education in the AI Era. *Robotics & AI Ethics*, 5(2), 42-49 (2020). [Read More]

# 9.2. Thesis degree

- [31] Jung HS. A Study on the Adaptive Vocabulary of Korean as a Subject for KSL Elementary School Learners. Chonnam University, Doctoral Thesis (2022).
- [32] Song JS. A Study on the Aspects of Textbook Realization in Media Transformation Literature using Erasure Methodology of Ecolinguistics. Dongguk University, Master's Thesis (2017).
- [33] Kim SH. A Study on Adolescents' Sentence Concluding Style in Computer Communication Language: Focusing on Twitter Users. Korea National University of Education, Master's Thesis (2013).

# **10. Appendix**

# 10.1. Author's contribution

| -Set of concents  |        | Initial<br>name | Contribution   |
|---|--------|-----------------|--|
| -Set of concepts ₪<br>-Design ☑<br>-Getting results ☑<br>-Analysis ☑<br>-Make a significant contribution to collection ☑<br>-Final approval of the paper ☑<br>-Corresponding ☑<br>-Play a decisive role in modification ☑<br>-Significant contributions to concepts, designs,<br>practices, analysis and interpretation of data ☑<br>-Participants in Drafting and Revising Papers ☑<br>-Someone who can explain all aspects of the paper | Author | КН              | <ul> <li>-Set of concepts ☑</li> <li>-Design ☑</li> <li>-Getting results ☑</li> <li>-Analysis ☑</li> <li>-Make a significant contribution to collection ☑</li> <li>-Final approval of the paper ☑</li> <li>-Corresponding ☑</li> <li>-Play a decisive role in modification ☑</li> <li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data ☑</li> <li>-Participants in Drafting and Revising Papers ☑</li> <li>-Someone who can explain all aspects of the paper ☑</li> </ul> |

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# Nursing Ethical Considerations in the Al-Based Technologies

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#### Abstract

**Purpose:** As artificial intelligence(AI) has currently used in many ways related to nurses, there is an ultimate need to consider the ethical values of AI in healthcare. Thus, the present study first investigates several types of AI-based technologies and robotics applied to nursing, such as supportive, cooperative, and collaborative robots. Moreover, several ethical guidelines and requirements for AI, ethical issues and concerns of AI, especially nursing ethical considerations, are explored based on the principles of biomedical ethics and the nursing code of ethics.

**Method:** We searched for existing scientific literature using the keywords "AI or Robot or Nurses", "AI or Robot and Ethics" in PubMed until March 2022. Next, we reviewed the articles related to ethical issues and considerations in AI-based technologies, especially in the field of healthcare. In addition, a web-based search about robotics in nursing was conducted to find out their specific roles.

**Results:** The direction of ethical discussion of AI has changed from Roboethics, which emphasizes robot's behavior and the responsibility of robots, to ethics for humans, such as developers and users. There are many ways AI is helping to overcome health care challenges, such as diagnosis, precision medicine, and prediction models. For the safety of human-robot interaction, ethics of caring need to be discussed in close proximity for nurses, patients, or both. Therefore, AI needs to consider patient safety first, do no harm and aggravate the patient's condition, sufficiently provide to treat diseases and improve patients' health conditions, and the service needs to be distributed equally without prejudice and discrimination regardless of medical problems.

**Conclusion:** As AI has incredible potential to empower people and widely benefit current and future generations, AI ethics needs to be further discussed in a direction in harmony with the development of related industries. Nurses should understand AI applications and their implications for nursing research and practice to improve patient care and clinical outcome. In addition, careful ethical considerations and engagement with nurses in implementing and evaluating AI-based technologies in healthcare are critical to the best clinical decisions and developing reliable innovations.

#### Keywords: Artificial Intelligence(AI), Roboethics, Biomedical Ethics, Morality, Nursing Codes of Ethics

# **1. Introduction**

Artificial Intelligence(AI) has recently made tremendous progress in many areas; healthcare, including medicine and biomedical research, might receive significant benefits from AI-based technologies[1]. In fact, AI in healthcare isn't new; it's progressively used in various ways involving nurses. Moreover, the unpredicted challenges for healthcare caused by the Coronavirus Disease 2019(COVID-19) pandemic have made that AI moves to rapid advances and has changed the way of our life with numerous benefits, including healthcare landscapes[2][3][4][5][6][7][8]. Today, AI tools and technologies play critical roles in managing every stage of the COVID-19 crisis, including detection, prevention, responses and recovery[9]. Under these conditions,

there is an ultimate need to consider AI's ethical values, and it is essential, not optional. Thus, ethics has been discussed side by side with the technical development of robots or AI. Therefore, the present study described the ethical issues of AI in the recent hyper-connected era, especially nursing ethical considerations.

As the number of industrial robots and AI systems continues to increase over the last 10 years, the ethical principle and regulations of robotics and AI have become priority issues world-wide[10]. Generally, the ethics of robotics is considered the first prescriptive approach in AI-based technologies. Since robot ethics(roboethics) was coined by Gianmarco Verugio[11], AI ethics have been widely discussed with an increasing number of related publications[12][13]. The direction of AI ethics initially emphasizes the responsibility of the robot itself, and then it has changed from machine ethics to ethics for humans such as developers and users. In fact, we need to consider the relationship between humans and robots in more depth rather than impose responsibilities on robots by simply thinking of robot ethics as human-centered.

The most well-known roboethics principle is the Three Laws of Robotics <Table 1>, introduced by Isaac Asimov in 1942 and designed to prevent the possibility of being used by humans in a way that harms humans [14]. Asimov added a 'Zeroth Law' in 1985, implicating that humanity is placed over the fate of one individual. Later, the alternative Asimov's laws have proposed on accountability, responsiveness, and control to emphasize the responsibility for robot behavior lies on humans<sup>[15]</sup>. As the application of robots has become diversified in various fields and the frequency of human-robot contact has increased in the mid-2000, the human-robot relationship became highly interested [16]. As a result, the World Robot Declaration was announced in Fukuoka, which focused on the co-existence of robots and human beings [17]. Besides the technological development of the robot itself, the management and ethics for the benefit of human beings have developed into the discussion. Since the declaration, there have been various discussions on robot ethics, with the main content being the peaceful co-existence of human beings and robots. Especially the 'Robotics Research Roadmap' suggested by the European Robotics Research Network(EURON) in 2007, emphasized the ethics of robot designers, manufacturers, and users, preparing legal and institutional devices to protect humans from robots [18]. As ethical discussions on the development of the intelligent robot become highly necessary, guidelines for AI development have been announced by international organizations and major countries. In Japan, the Draft AI R&D Guidelines were published concerning the principles of collaboration, transparency, controllability, safety, security, privacy, ethics, user assistance, and accountability. In addition, OECD reported the Digital Economy Outlook 2017, providing an overview of converging trends, policy and regulation developments, data on the digital economy, and the effect of digital transformation on economies and societies<sup>[9]</sup>. The OECD AI principles adopted in May 2019 are innovative and trustworthy and respect human rights and democratic values. With the growing worldwide movement to establish an AI ethical, legal system, several ethical principles are summarized in <Table 1>.

| First law  | A robot may not injure a human being or, through inaction, allow a human being to come to harm                   |
|------------|--|
| Second law | A robot must obey the orders given it by human beings except where such orders would conflict with the first law |
| Third law  | A robot must protect its own existence as long as such protection does not conflict with the first or second law |
| Zeroth law | A robot may not harm humanity or, by inaction, allow humanity to come to harm                                    |

# Asimov's laws of robotics[14]

#### Fukuoka world robot declaration - expectations for next-generation robots(2004)[17]

Next-generation robots will be partners that coexist with human beings

Next-generation robots will assist human beings both physically and psychologically

Next-generation robots will contribute to the realization of a safe and peaceful society

#### The EURON robotics roadmap(2007)[18]

| Human dignity and human rights               | Autonomy and individual responsibility |                            |  |
|--|--|----------------------------|--|
| Equality, justice and equity                 | Informed consent                       | Privacy                    |  |
| Benefit and harm                             | Confidentiality                        | Solidarity and cooperation |  |
| Respect for cultural diversity and pluralism | Social responsibility                  | Sharing of benefits        |  |
| Non-discrimination and non-stigmatization    | Responsibility towards the biosphere   |                            |  |

OECD draft council recommendation on AI(2019)[9]

#### Section 1: principles for responsible stewardship of trustworthy AI

1.1 Inclusive growth, sustainable development and well-being

1.2 Human-centered values and fairness

1.3 Transparency and explainability

1.4 Robustness, security and safety

1.5 Accountability

Section 2: national policies and international cooperation for trustworthy AI

2.1 Investing in AI research and development

2.2 Fostering a digital ecosystem for AI

2.3 Shaping an enabling policy environment for AI

2.4 Building human capacity and preparing for labour marker transformation

2.5 International cooperation for trustworthy AI

In the ethics of the industrial field, global IT companies began to emphasize the principles and ethics in AI development after the early AI chatbot 'Tay' revealed the Dangers and discarded it due to racist remarks. In 2016, IEEE published the Asilomar AI principles, the 23 guidelines for R&D of AI development which are subdivided into three categories: Research, Ethics and Values, and Longer-Term Issues[19]. In addition, Google has established seven principles with the goal of bringing the benefits of AI to people and society[20]: be socially beneficial, avoid creating or reinforcing unfair bias, be built and tested for safety, be accountable to people, incorporate

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privacy design principles, uphold high standards of scientific excellence, and be made available for uses that accord with these principles. For the review process, any team, such as new products, research, and partnerships, can request formal AI principles review to check if they confirm the AI principles.

Taken together, the direction of ethical discussion of AI has changed from Roboethics(machine ethics), which emphasizes robot's behavior and the responsibility of robots, to ethics for humans, such as developers and users. As AI has incredible potential to empower people and widely benefit current and future generations, AI ethics needs to be further discussed in a direction in harmony with the development of related industries.

# 2. AI-based Technologies and Robotics applied to Nursing

# 2.1. Types of robots used in healthcare

Caring is an essential quality in building trust with each other and is central to nursing. Nurses are responsible for patient care, collecting data, making nursing care plans with critical and clinical decision-making skills, etc. There are many ways AI is helping to overcome health care challenges, such as diagnosis, precision medicine, and prediction models. AI-based robotics can be divided into medical and assistive robotics(more relevant to nursing). Assistive robots/devices constitute mobile and body assistants, patient transfer, and monitoring patients[21]. Recently, semi-autonomous AI robots and drones were deployed for immediate response in hospitals to deliver food and medication, clean and sterilize, and add healthcare workers. In addition, there are companion robots and medical facility logistics robots, and it has been actively commercialized and used in various fields in the last 10 years. Some examples of AI-based robots applied to nursing were summarized in <Table 2> and <Table 3>. Although AI-based robots in this paper were applied to nursing, other healthcare professionals, such as physicians, were also users of these technologies.

One of the earliest nurse robotics was a social robot named 'Pearl' in 2002, which had two primary functions; remind about routine activities and guide through the environment [22]. According to ISO8373, a nursing robot has a certain degree of autonomy to assist clinical staff with performing tasks[23]. A recent review paper identified 133 robotic systems in nursing care and classified them according to the technical and data-derived hierarchical classifications of the use care[24]. First, the technical classifications for human-robot interaction were divided into 7 classes: Supportive, Cooperative, Collaborative, Wearable robotics, Responsive, Cobotic and intelligent auxiliary devices, and Teleoperated devices. The three main categories(Supportive, Cooperative, and Collaborative) covered almost 80% of the projects[24], and the examples of each category were listed in <Table 2>. Supportive robots can assist in the performance of the task to held nurses and patients, like TUG, BUDDY, and AuRoRoll[25][26][27]. Cooperative robot systems share the control between the human and the robot, and examples are Care Robot Yurina, ROBERT, and Kasper[28][29][30]. In the category of Collaborative(human and robot perform the part that better suits them), Kinova Jaco and Liocan were classified[31][32].

| Robot             | Function and role  |      |
|-------------------|--|------|
| TUG               | Autonomous mobile robot to transport carts and compartments within hospitals                         | [25] |
| BUDDY             | Emotional robot has multiple functionalities at home(monitoring and reminding)                       | [26] |
| AuRoRoll          | Wheelchair capable of navigating autonomously with camera-based sensor module                        | [27] |
| Care robot Yurina | Care robot to effectively help life, carry and transfer patients, and used as an electric wheelchair | [28] |

**Table 2.** Examples of AI care robots of the technical classification in nursing.

| ROBERT      | Efficient rehabilitation and early mobilization of patients | [29] |
|-------------|---|------|
| Kasper      | Humanoid social robot to help children with autism          | [30] |
| Kinova Jaco | Assistive robotic arm that can be mounted on a wheelchair   | [31] |
| Lio         | Personal assistant robot with a multifunctional are         | [32] |

In addition, robotic systems can be classified according to the fields of application, or use cases, which indicates the most desirable way [24]. There are 12 classes in the use case classification: Companion robot, Logistics, Therapy, Personal aids and assisting devices, Mobility support, Rehabilitation, Telepresence, Transfer robot, Toy robot, Teaching robot, Telediagnosis, and Cleaning. They were mapped and deduced into the four categories: Peripheral activities of nursing, Systems which increase autonomy of the patient, Systems that closely involve both patient and nurse, and Tele applications. In the first category of 'Peripheral activities of Nursing', the robotic projects support the nurses away from patients to focus on more essential tasks. Three classes(Logistics, transport of patients/transfer robot, and cleaning) belonged to this category. Logistic robots perform logistics chores, like HOSPI, MOXI, and Care-O-Bot[33][34][35]. Transport of patients/transfer robots can be used to lift and transport patients, and cleaning robots perform cleaning chores. The second category of 'Systems which Increase Autonomy of the Patient' is designed to assist the patient without the involvement of the caregivers. It covers the highest percentage of 54% in the use case classification, belonging companion robots, therapy support, personal ads and assisting devices, mobility support, and toy robots. Like Mario and Maggie, the companion robot is a robot to build real or apparent companionship with patients by reducing feelings of isolation and loneliness[36][37]. The well-known robots Paro and Milo are used in the therapy session [38] [39]. Personal aids and assisting devices can provide help with an activity of daily life care, mobility support help patient to move, including standing up and walking, and toy robots entertain the users. The third category is 'Systems which Closely Involve both Patient and Nurse' with two classes of rehabilitation and teaching robots. 'Tele Applications' is the last category, including telepresence using remotely controlled robots and diagnostic systems/telediagnosis for remote diagnosis. One-third of classes belong to three use cases: Companion robots, Logistics, and Therapy support<sup>[24]</sup>, and the selected examples of robot systems are listed in <Table 3>. As some robots can be used for many functions at other use cases, a single robot system may support and help more than one use care.

| Robot      | Function and role  | Reference |
|------------|--|-----------|
| HOSPI      | Autonomous mobility vehicle robot to help provide medical support inside the hospital                    | [33]      |
| MOXI       | Diligent robotics to assist hospital staff with routine activities                                       | [34]      |
| Care-O-Bot | Mobile robot to help people in the home  | [35]      |
| Mario      | Caring service robot for loneliness, isolation, and dementia in older persons                            | [36]      |
| Maggie     | Personal social robot to talk to users, entertain and train cognitive functions                          | [37]      |
| Paro       | Interactive therapeutic robot to stimulate patients with dementia and other complex cognitive disorders. | [38]      |
| Milo       | Humanoid robot for the education of children with autism at home   | [39]      |

 Table 3. Examples of AI care robots of the use case classification in nursing.

In the recent report regarding robotic systems for nursing care, they analyzed and classified 133 robotic systems based on a technical point(expanded from Haddadin S & Croft E [40]) and a

use case classification[24]. Proximity and autonomy were considered for the interaction of robotics with the patient or caregiver and the degree of independent robot action, respectively. One of the primary roles of the nurse in care is to assist the patient. In triangular interaction among patients, nurses, and robots, active collaboration is required and needs to be developed for future prospects. In addition, the issue of care needs to be addressed broadly because of the increase in the elderly population with the nursing shortage. Although robotic systems in nursing care are of great interest to overcome the future challenges, the safety of human-robot interaction and ethics of caring need to be discussed in close proximity for nurses, patients, or both.

# 3. Nursing Ethical Considerations in AI and Robotics

# 3.1. Roboethics and levels of morality

With new technological developments and increases in robotic and AI capabilities, several organizations have been inspired to develop new principles and manifests<sup>[41]</sup>. In addition, Frank Pasquale has proposed four New Laws of Robotics in 2020, expanding the influential Asimov's laws<sup>[42]</sup>.

- Robotic systems and AI should complement professionals, not replace them.
- Robotic systems and AI should not counterfeit humanity.
- Robotic systems and AI should not intensity zero-sum arms races.
- Robotic systems and AI should always indicate the identity of their creator(s), controllers(s), and owners(s).

The book reflects current implementation trends today, such as shattering privacy rights by centralized control of governments, undermining workplace protections, and ignoring diversity, which considers the morality of human actors[42]. The morality of robotics is distinguished into three levels[17][43].

- **Operational morality**: the moral significance and responsibility lie totally in the robot designer and user.
- Functional morality: an ethical robot has the ability to make moral judgments without direct top-down instructions from humans, and the designers can no longer predict the robot's actions and their consequences.
- Full morality: the robot is so intelligent that is fully autonomously selecting its actions, and it is fully responsible for them.

As autonomy and ethical sensitivity are embedded in a robot, the more autonomy required, the more morality(ethical sensitivity) to increase the robot's level of morality[44].

# 3.2. Principles of biomedical ethics and nursing code of ethics

According to Gallup, nurses are consistently rated highest in honesty and ethics [45]. Since Florence Nightingale founded the 'Nightingale Pledge' having a reputable and ethical profession, the ethical principles in nursing guide contemporary nursing. As a modification of the Hippocratic Oath, there are four main principles of ethics, which ultimately optimize daily nursing practice, patient care, and outcome.

- Autonomy: The patients have the right to make self-determination and decision-making.
- Beneficence: Kindness and charity require for the benefit and welfare of others.
- Justice: An element of fairness in all medical and nursing decisions and care considered regardless of the individual's economic status, ethnicity, gender, etc.
- Non-maleficence: Nurses must do not harm intentionally, ensure the safety of the patients, avoid risk or negligent care, and minimize them.

These ethical principles are fundamental in nursing, given their roles as caregivers. Revised by the most significant change in 2015, the nurse's code of ethics currently contains 9 provisions(interpretative statements), which can provide more specific guidance of nursing practice, consisting of the fundamental values and commitments(provisions 1-3), boundaries of duty and loyalty(provisions 4-6), and extended duties beyond patient interaction(provisions 7-9)[46]. As they demonstrate the respect of dignity, diversity, and rights of individuals, nurses learn the importance of morality and ethical behavior in nursing practice, continuing the knowledge throughout their careers.

The 4 principles of biomedical ethics have some limitations for solving complex ethical concerns related to AI; they need to be discussed and systematized before they become mature, focusing on the triangular relationship among AI, nurses, and patients. Based on the principle of autonomy, AI provides sufficient information to patients and obtains consent from them, and proper communication with healthcare workers is necessary. AI needs to consider patient safety first and do not harm and aggravate the patient's condition. In addition, AI sufficiently provides to treat diseases and improve patients' health conditions, and the service needs to be distributed equally without prejudice and discrimination regardless of medical problems.

# 3.3. Ethics guidelines for trustworthy AI

In 2018, the European Commission set out the vision for AI to support 'ethical, secure and cutting-edge AI mad in Europe', with the aim of promoting Trustworthy AI[47]. AI systems need to be human-centered to improve human welfare and freedom. Therefore, the resolution focuses on the aspects of the roboethical framework, such as human-centered and embedded values in technology, decision-making, transparency and explainability of algorithms(the European Parliament(2019)). To maximize the benefits and prevent/minimize the risks of AI systems in a rapid technological change, trustworthy AI is the foundational ambition of the European Commission. There are three components of Trustworthy AI.

- Lawful: it should be lawful, complying with all applicable laws and regulations.
- Ethical: it should be ethical, ensuring adherence to ethical principles and values.
- **Robust**: it should be robust, both from a technical and social perspective, since, even with good intentions, AI systems can cause unintentional harm.

All three components are necessary to achieve and secure Trustworthy AI, ideally working them in harmony and overlapping in their operation. Fundamental human rights are the basis for ethical principles, and ethical reflection can help understand the development and use of AI systems. As a basis for Trustworthy AI, fundamental rights are 'Respect of Human dignity, Freedom of the individual, Respect for democracy, justice and the rule of law, Equality, non-discrimination and solidarity, and Citizen's rights', which are legally obligatory in Europe. Four ethical principles, based on fundamental rights, are 'Respect for human autonomy, Prevention of harm, Fairness, and Explicability' specified as ethical imperatives. Therefore, to achieve Trustworthy AI, the principles must be translated into concrete requirements, and seven requirements of Trustworthy AI are summarized in <Table 4>. All of these requirements are equally important with mutual relationships and are applicable throughout the AI system's life cycle to developers, deployers and end-users, and the broader society.

| Human agency and oversight      | Including fundamental rights, human agency and human oversight  |
|---------------------------------|---|
| Technical robustness and safety | Including resilience to attack and security, fall back plan and general safety, accuracy, reliability and reproducibility |
| Privacy and data governance     | Including respect for privacy, quality and integrity of data, and access to data  |

 Table 4. Seven requirements of trustworthy AI[47].

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| Transparency                               | Including traceability, explainability and communication  |
|--|---|
| Diversity, non-discrimination and fairness | Including the avoidance of unfair bias, accessibility and universal design, and stakeholder participation |
| Societal and environmental wellbeing       | Including sustainability and environmental friendliness, social impact, society and democracy             |
| Accountability                             | Including auditability, minimization and reporting of negative impact, trade-offs and redress             |

# 3.4. Ethical concerns and embedded ethics in healthcare

Rapid development and evolution of AI and robotics in healthcare certainly have the potential to help nurses improve the efficiency and quality of care [48] [49] [50]. Even though AI-based technology promises a number of positive benefits, the new ethical issues and challenges have been identified, which are rooted in inherent inefficiency and unpredictability, creating unintentional harmful behaviors[51][52]. The issue of risk has previously been considered, and it distinguishes three key types associated with evolution, multiplication risk(uncontrolled population growth due to high reproduction rates), maladaptation risk(unwanted harmful features of behaviors), and domination risk([51]. As these risks of harm result from the control problem of semi/autonomous robotic systems, meaningful human control is necessary to mitigate and avoid safety risks. Thus, the risk of harm needs to be evaluated, and the precautionary measures are required to include: Centralized, externalized reproduction, Advanced prediction system, and Value loading[53][54]. To maintain control, mitigate risks, and take precautions, careful ethical and methodological guidelines, as well as the relevant form of responsibility, need to be fully established for maximizing the benefits of AI. The ethical concerns surrounding AI and robotics have resulted in the explosive establishment of ethical principles by various public and private organizations worldwide[52][55]. Ethical considerations in AI developers are particularly important in the development of AI-based healthcare settings, which interact with patients directly or indirectly. A recent paper proposed an 'embedded ethics' approach, referring to the ongoing practice of integration of ethics into the entire AI development process [52]. This approach aims to anticipate and address any ethical and significant issues by collaboratively working and integrating ethics into development. Through the integration modes, practices, requisite expertise and training, embedded ethics will help to understand the ethical, social, and political dimensions of AI technologies.

# 4. Discussion

This paper summarized the recent development of AI-based technologies and robotics specially applied to nursing, and the following ethical requirement proposed by several organizations. As AI and robotics continue to mature, nurses and other healthcare workers need to participate in the development and evaluation process. Thus, they have a responsibility to ensure the safety of technology in order to be used safely, ethically, and positively affect healthcare. In a recent scoping literature review paper regarding AI-based technologies in nursing, none of the articles addressed the AI implementation or AI operational phase concerning the specific ethical research consideration, apart from stating an IRB approval in two-thirds of articles[8]. In addition, they stated the lack of comprehensive evaluation of clinical nursing. To meet the ethical standards and promote ethical integrity, the core values of nursing need to be supported in AI-based technology. Although AI-based robotics performance is adequate, it might introduce unpredicted problems; thus, nurses need to play a vital role in guidelines on the safe adoption of the innovation and actively engage in using new technologies.

Since the COVID-19 pandemic, nurses have interacted remotely to deliver care, and AI is transforming the nurse's roles in care delivery [56][57][58][59]; AI can support non-nursing tasks

and reduce the burden on nurses to spend more time with patient's care. In healthcare, AI is typically defined as tools, such as machine learning, deep learning, neural networks, and natural language processing that transforms clinical data into knowledge autonomously. Therefore, nurses should possess an understanding of AI applications and their implications for nursing research and practice to improve patient care and clinical outcome. Nurses play an essential role in collecting data and must understand the relationship between data and AI technology or AI tools[60]. In addition, for the best clinical decisions using AI-based technologies in healthcare, careful ethical considerations and engagement with nurses in its implementation and evaluation are critical in developing reliable innovations. Nurses' contribution and active participation in all stages of AI development are crucial in maximizing potential benefits and minimizing its risks in terms of nursing and patient outcomes. Therefore, including these efforts and the use of AI technologies in healthcare, further research should be conducted to reinforce nursing professionalism and improve patient outcomes for the qulity of nursing.

# **5. References**

# 5.1. Journal articles

- [1] Kourou K & Exarchos KP & Papaloukas C & Sakaloglou P & Exarchos T & Fotiadis DI. Applied Machine Learning in Cancer Research: A Systematic Review for Patient Diagnosis, Classification and Prognosis. *Computational and Structural Biotechnology Journal*, 19, 5546-5555 (2021).
- [2] Lee A. The Effect of Artificial Intelligence Literacy Education on University Student's Ethical Consciousness of Artificial Intelligence. *Robotics & AI Ethics*, 6(3), 52-61 (2021). [Read More]
- [3] Li Y & Park G. AI Ethics and Privacy Right. *Robotics & AI Ethics*, 5(2), 27-33 (2020). [Read More]
- [4] Park G & Kim H & Li Y. Virtue for Post Covid-19 and AI Technology. *Robotics & AI Ethics*, 5(2), 8-18 (2020). [Read More]
- [5] Li Y & Cho H & Park G. The Advent of AI and Its Some Implications to Military Affairs. International Journal of Military Affairs, 5(1), 38-47 (2020). [Read More]
- [6] Kim T & Park G & Seo E. IR4.0 and Ethical Tasks of AI. Robotics & AI Ethics, 4(2), 6-13 (2019). [Read More]
- [7] Stokes F & Pamer A. Artificial Intelligence and Robotics in Nursing: Ethics of Caring as a Guide to Dividing Tasks Between AI and Humans. *Nursing Philosophy*, 4, 212306 (2020).
- [8] Gerich H & Moen H & Block LJ & Chu CH & DeForest H & Hobensack M & Michalowski M & Mitchell J & Nibber R & Olalia MA & Pruinelli L & Ronquillo CE & Topaz M & Peltonen L-M. Artificial Intelligence-based Technologies in Nursing: A Scoping Literature Review of the Evidence. International Journal of Nursing Studies, 127, 104153 (2022).
- [10] Langman S & Capicotto N & Maddahi Y & Zareinia K. Roboethics Principles and Policies in Europe and North America. *SN Applied Sciences*, 3, 857-857 (2021).
- [13] Moon A & Rismani S & Van der Loos HFM. Ethics of Corporeal, Co-present Robots as Agents of Influence: A Review. *Current Robotics Reports*, 2, 223-229 (2021).
- [15] Murphy R & Woods DD. Beyond Asimov: The Three Laws of Responsible Robotics. *IEEE Intelligent Systems*, 24(4), 14-20 (2009).
- [16] Lee WH & Park JW & Kim WH & Lee HS & Chung MJ. Robot's Motivational Emotion Model with Value Effectiveness for Social Human and Robot Interaction. *Journal of Institute of Control, Robotics and Systems,* 20(5), 503-512 (2014).
- [17] Tzafestas SG. Roboethics: Fundamental Concepts and Future Prospects. *Information*, 9(6), 148-148 (2018).
- [24] Agraz CN & Pfingsthorn M & Gliesche P & Eichelberg M & Hein A. A Survey of Robotic Systems for Nursing Care. *Frontiers in Robotics and AI*, 9(832248), 503-512 (2014).
- [25] Zhang T & Zhu B & Lee L & Kaber D. Service Robot Anthropomorphism and Interface Design for Emotion in Human-robot Interaction. *IEEE Xplore*, n10221214, 674-679 (2008).

- [35] Graf B & Reiser U & Hagele M & Mauz K & Klein P. Robotic Home Assistant Care-o-bot 3 -Product Vision and Innovation Platform-. *IEEE Xplore*, n11558311 (2009).
- [41] Winfield AFT & Jirotka M. Ethical Governance is Essential to Building Trust in Robotics and Artificial Intelligence Systems. *Philosophical Transactions of the Royal Society a Mathematical Physical and Engineering Sciences*, 376, 2133-2133 (2018).
- [48] Robert N. How Artificial Intelligence is Changing Nursing. *Nursing Management*, 50(9), 30-39 (2019).
- [49] Celi LA & Fine B & Stone DJ. An Awakening in Medicine: The Partnership of Humanity and Intelligent Machines. *The Lancet Digital Health,* 1(6), 255-257 (2019).
- [50] Togni GD & Erikainen S & Chan S & Cunningham-Burley S. What Makes AI 'Intelligent' and 'Caring'? Exploring Affect and Relationality Across Tree Sites of Intelligence and Care. Social Science & Medicine, 277, n113874 (2021).
- [51] Eiben AE & Ellers J & Meyne G & Nyholm S. Robot Evolution: Ethical Concerns. *Frontiers in Robotics and AI*, 8, n744590 (2021).
- [52] McLennan S & Fiske A & Tigard D & Mulle R & Haddadin S & Buyx A. Embedded Ethics: A Proposal for Integrating Ethics into the Development of Medical AI. *BMC Medical Ethics*, 23, n6 (2022).
- [53] Eiben AE & Bredeche N & Hoogendoorn M & Stradner J. The Triangle of Life: Evolving Robots in Real-time and Real-space. *Bioinspired Robotics*, 2013, 1056-1063 (2013).
- [55] Varkey B. Principles of Clinical Ethics and Their Application to Practice. *Medical Principles and Practice,* 30(1), 17-28 (2021).
- [56] Maddahi Y & Klvandi M & Langman S & Capicotto N & Zareinia K. Roboethics in Covid-19: A Case Study in Dentistry. *Frontiers in Robotics and Al,* 8, 612740 (2021).
- [57] Sarker S & Jamal L & Ahmed SF & Irtisam N. Robotics and Artificial Intelligence in Healthcare during Covid-19 Pandemic: A Systematic Review. *Robotics and Autonomous Systems*, 146, n103902 (2021).
- [58] Mowbray M. Moral Status for Malware! The Difficulty of Defining Advanced Artificial Intelligence. *Cabridge Quarterly of Healthcare Ethics*, 30(3), 517-528 (2021).
- [59] Pirni A & Balisteri M & Capasso M & Umbrello S & Merenda F. Robo Care Ethics between Autonomy and Vulnerabiity: Coupling Principles and Practices in Autonomous Systems for Care. *Frontiers in Robotics and AI*, 6, n654298 (2021).
- [60] Ronquillo CE & Peltonen L-M & Pruinelli L & Chu CH & Bakken S & Beduschi A & Cato K & Hardiker N & Junger A & Michalowski M & Nyrup R & Rahimi S & Reed DN & Salakoski T & Salantera S & Walton N & Weber P & Wiegand T & Topaz M. Artificial Intelligence in Nursing: Priorities and Opportunities from an International Invitational Think-tank of the Nursing and Artificial Intelligence Leadership Collaborative. *Journal of Advanced Nursing*, 77(9), 3707-3717 (2021).

# 5.2. Books

[14] Asimov I. Runaround. Street & Smith (1950).

- [40] Haddadin S & Croft E. Physical Human-robot Interaction. Springer Handbook of Robotics (2016).
- [42] Pasquale F. New Laws of Robotics: Defending Human Expertise in the Age of Al. Belknap (2020).
- [43] Tzafestas SG. Roboethics: A Navigating Overview. Springer (2015).
- [54] Bostrom N. Superintelligence: Paths, Dangers, Strategies. Oxford University (2014).

# 5.3. Additional references

- [9] https://www.oecd.org/ (2020).
- [11] https://en.wikipedia.org/ (2020).
- [12] Veruggio G. The Birth of Roboethics. IEEE International Conference on Roboethics and Automation. Workshop on Roboethics (2005).
- [18] htttps://www.roboethics.org/ (2006).
- [19] https://standards.ieee.org/ (2016).

[20] https://ai.google/responsibilities/ (2016).

[21] Human Assistant Robotics in Japan. Minerva Fellowship Programme Report (2016).

[22] Pearl: A mobile Robotic Assistant for the Elderly. AAAI Technical Report WS-02-02 (2002).

[23] https://www.iso.org/ (2022).

[26] https://buddytherobot.com/ (2020).

[27] https://www.interaktive-technogine.de/ (2017).

[28] https://www.roboticstoday.com/ (2009).

[29] https://www.lifescience-robotics.com/ (2020).

[30] https://assistive.kinovarobotics.com/ (2020).

[31] https://assistive.kinovarobotics.com/ (2020).

[32] https://www.fp-robotics.com/en/ (2020).

[33] https://new.panasonic.com/ (2019).

[34] https://wwwdiligentrobots.com/ (2020).

[36] https://www.mario-project.eu/ (2021).

[37] https://roboticslab.uc3m.es/ (2014).

[38] https://www.parobots.com/ (2014).

[39] https://robokind.com/ (2020).

[44] https://wonderfulengineering.com/ (2014).

[45] https://new.gallup.com/ (2020).

[46] https://nursingworld.org/ (2015).

[47] https://ec.europa.eu/ (2018).

# 6. Appendix

# 6.1. Authors contribution

|               | Initial<br>name | Contribution   |
|---------------|-----------------|--|
|               |                 | -Set of concepts 🔽   |
|               | МК              | -Design 🗹  |
| Lead          |                 | -Getting results 🔽   |
| Author        |                 | -Analysis 🗹  |
|               |                 | -Make a significant contribution to collection $\ igsidemindexideminatioxia.$ |
|               |                 | -Final approval of the paper <i></i>   |
|               | ВН              | -Corresponding 🔽   |
|               |                 | -Play a decisive role in modification $\ oxdot$  |
| Corresponding |                 | -Significant contributions to concepts, designs,   |
| Author*       |                 | practices, analysis and interpretation of data $\ igside Q$  |
|               |                 | -Participants in Drafting and Revising Papers 🛛  |
|               |                 | -Someone who can explain all aspects of the paper $\ igsidentum{arsigma}$  |

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# The Effect of Learners' Characteristics on Learning Performance in Non-Face-To-Face Liberal Arts Coding Class

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#### Abstract

**Purpose:** In this study, we investigate the characteristics of learners in the liberal arts coding class and study the relationship between learners' characteristics and learning outcomes to find methods to enhance learning performance. Through this study, we intend to provide the basic data to be used by the schools and educators operating coding education in the real world to establish the teaching strategy for coding education according to the characteristics of the learners.

**Method:** The collected data was analyzed using SPSS 23, as follows. The reliability of the measurement tools on self-efficacy, learning interest, learning motivation, digital literacy, and learning satisfaction were calculated and verified. Through a survey, data on self-efficacy, learning motivation, digital device efficacy, learning satisfaction, and academic achievement were collected and descriptive statistical analysis was performed to identify trends. We performed multiple regression analyses with self-efficacy, learning motivation, and digital device efficacy as independent variables, whereas learning satisfaction and academic achievement as dependent variables. Before the regression analysis, a Pearson correlation analysis was performed between self-efficacy, learning motivation, digital device efficacy, learning satisfaction, and academic achievement to confirm the significance of the relationship between the measurement variables.

**Results:** The significance test results of the regression model showed that self-efficacy and digital device efficacy had a positive effect on learning satisfaction and learning motivation and digital device efficacy also had a positive effect on academic achievement. In other words, we evaluated that higher self-efficacy and digital device efficacy lead to higher learning satisfaction whereas higher learning motivation and digital device efficacy lead to higher learning satisfaction.

**Conclusion:** Through this study, we confirmed that learners' characteristics have a high influence on both learning satisfaction and academic achievement. In the future study, we plan to add multiple factors of learners' characteristics that affect learning performance and studies on educators' characteristics to obtain various and meaningful results.

# Keywords: Learners' Characteristics, Coding Classes, Learning Performance, Online Education, Programming Education

# 1. Introduction

Nowadays, as ICT(Information and Communications Technology) develops in various ways, the diversity of ideas generation for technology development is important. Therefore, the interest in teaching imagination and communication skills to the students majoring in fields such as humanities and social sciences by applying converged IT(Information Technology) is increasing[1][2]. Recently, universities are providing basic coding education to all students, including non-major students, by opening software-related subjects and introducing curricula to nurture the manpower in adapting to the changing era. In particular, since university freshmen who do not major in IT lack the opportunities to experience coding, coding education for non-major students at universities is rapidly spreading[3][4]. The purposes of coding education for non-major students include nurturing the learners' critical thinking, creativity, and problem-solving ability. In addition, supporting the students with programming capabilities can secure the software skills competitiveness[5][6].

However, non-major students often have low learning motivation because of the difficulties in coding education such as unfamiliar coding languages, difficulties in understanding coding concepts, boredom during the coding process, recognition that coding is difficult, and limited learning time in class. Also, the individual student has differences in the speed of understanding in the coding class[7][8].

Learners' characteristics refer to individual differences in learners, in which learners prefer different knowledge and attitudes during information processing, meaning construction, and application to new situations. According to the learning process related to real life, learners use different abilities and skills and these learners' characteristics affect their learning performance. To teach coding effectively, education according to the characteristics of these learners is required[9][10].

Therefore, this study aims to examine the relationships and influences between learners' characteristics and learning outcomes for 72 university students not majoring in computer major who participated in a Non-face-to-face coding class in liberal arts. The research hypotheses of this study are as follows.

1) The learners' characteristics of self-efficacy, learning motivation, and digital device efficacy will affect learning satisfaction.

2) The learners' characteristics of self-efficacy, learning motivation, and digital device efficacy will affect academic achievement.

This study shall contribute to finding the methods to improve the learning effect by identifying the learners' characteristics of university coding education and by studying the relationship between learners' characteristics and learning outcomes following the steady increasing trend of coding education. In addition, this study shall provide basic data to be used in establishing teaching strategies for coding education according to the characteristics of learners for schools and educators who operate coding education in the real world.

# 2. Theoretical Background

# 2.1. Learners' characteristics

In general, the learners' characteristics refer to the individual differences in learners, however, various concepts and categories are defined depending on the viewpoints. There are many characteristics of learning and basic questions to participate in learning including the recognition of the necessity of learning, the evaluation of the value of learning, the level of desire or attachment for learning, and interest in learning. In addition, variables of learners' characteristics that affect learning can be presented in various viewpoints, such as gender, social status, age, motivation, cognitive style, and individual perception of a certain situation [11].

Each learner constructs meaning through the process of information processing. The individual differences are shown in the ability to apply in new situations, creating the differences in the learners' characteristics and motivation level. These characteristics have a great influence on the learning effect[12][13].

Studies showed that the learners' characteristics are important factors affecting educational performance. The learners' characteristics were divided into the learners' learning motivation, learners' self-regulated learning ability, and the learners' experience and skills. Unlike face-to-face classes, the learning outcomes and satisfaction vary depending on the individual differences of learners who encounter the new learning environment in the virtual space called the

web[14][15]. The learner characteristics also can be defined as internal factors that affect learners' participation in class as perceived in the class environment. Even when the learners can learn the contents of the curriculum, if the learning motivation, which is one of the learners' characteristics, is low, the learning through education and training shall fail. In this study, self-efficacy, learning motivation, and digital device efficacy are assumed as the learners' characteristic variables, and the effect of these variables on learning performance is verified [16][17]. The studies on the learners' characteristics variables are summarized in <Table 1>.

| Learner's characteristic variables   | Related research   |
|--|--|
| Information technology experience, prior education, computer anxiety, perceived usefulness, perceived convenience                            | Yeonmi Go(2001)[10]  |
| Learning motivation, self-regulated learning ability, computer use ability   | Hyeyoung Jung(2008)[11]  |
| Learning motivation, self-efficacy, transferability  | Hyunyoung Kim(2010)[12]  |
| Learning motivation, learner's self-regulating learning ability, learner's experience and ability  | Heejung Kim, Mongro Jang,<br>Sookjin Lee, Seokjun Jo(2013)[13] |
| Learner self-efficacy, computational ability, learning motivation  | Jungeun Lee(2020)[14]  |
| Attention, relevance, confidence, satisfaction   | Sunhee Choi, Seongtae Kim<br>(2021)[9]                         |
| Mastery goals, cognitive engagement, academic self-requlation, situational<br>interest, self-efficacy for performance, cogrmitive engagement | Kyungsook Lee(2021)[17]  |

 Table 1. A related study on learner characteristics variables.

# 2.2. Coding education for non-major students

The class system of the basic coding education for non-major students is established according to the characteristics of the talents the university wishes to foster and the purpose is not to possess the coding competency at an expert level, but to develop critical thinking, creativity, and problem-solving skills of learners. Such coding education will equip the students with the ability to understand software's context and concept for their work in the 4th industrial revolution era and the skills to enable basic communication with related practitioners. The basic coding education, following the social flow, can help to improve the competency on the level of liberal arts that must be fundamentally possessed through university education [18][19].

# 3. Research Method

# 3.1. Research target

This study was conducted for the first-year students taking the 'Creative Thinking and Coding' class, a compulsory subject of liberal arts at University C in the first semester of 2022. The survey period was about three months from March 2022 to June 2022. Due to the COVID-19 pandemic situation, all classes were conducted Non-face-to-face. Using the Google survey, a total of 80 copies were distributed through SNS to the students, whose consents were obtained in advance, and 76 copies were recovered, of which 72 copies were used for the final analysis, excluding 4 insincere responses. The general characteristics of the respondents are, by gender, 42 male students(58.3%) and 30 female students(41.7%), by majors, 35(48.6%) majored in aviation, and 37(51.4%) majored in tourism and sports. The subjects were students who did not major in computers.

# 3.2. Class model design

Considering the characteristics of coding education, the 15-week classes were organized into 3 modules. The 15-week classes are conducted in the following order: the basic module from week 2 to week 7 to learn the basic grammar and functions of the Scratch programming language, the development module from week 9 to week 11 to plan and write their program using the basic grammar learned in the basic module, and the advanced module from week 12 to week 14 weeks to conduct team projects. The class operation of each module follows the method proposed in the research and development of the software education teaching and learning model in 2015 by the Korea Educational Development Institute [20][21]. The demonstration-oriented model was applied in the basic module. The demonstration-oriented model consists of three stages of Demonstration, Modeling, and Making, where the instructor demonstrates the learning activity model and the learners repeatedly imitate it through questions and answers, It is an activity-oriented model and the learners develop the program through stepby-step and independent coding practices. In the development module, a development-oriented model was applied. The development-oriented model consists of three stages: Discovery, Design, and Development. Students develop their programs through the basic inquiry process and the basic design process for the development of the program they want to develop by themselves. Team projects were conducted in the advanced module [22][23].

Both basic and practice modules were conducted with online video classes whereas the advanced module, where team projects were conducted, was conducted simultaneously with online video classes and real-time classes through Webex. Details are shown in <Table 2>.

| Week    | Module      | Class content            | How to operate   |
|---------|-------------|--------------------------|--|
| 2~7     | Foundation  | Basic programming syntax | Demonstration-oriented model<br>(DMM: demonstration-modeling-making) |
| 9~11    | Development | Individual project       | Development-oriented model<br>(DDD: discovery-design-development)    |
| 12 ~ 14 | Advanced    | Team project             | Team project   |

 Table 2. Summary of class progress.

#### 3.3. Measuring tools

To confirm the validity of the measurement tool, the test items used in this study were reconstructed from the items whose validity was verified in previous studies.

In this study, the independent variables are self-efficacy, learning motivation, and digital device efficacy, whereas the dependent variables are academic achievement and learning satisfaction. Variables other than academic achievement were measured on a 5-point Likert scale(not at all ~ very much).

The derived learners' characteristics, namely self-efficacy, learning motivation, and digital device efficacy, were measured using the reconstructed questionnaire items used in various studies, as shown in <Table 3>. To inspect learning performance, learning satisfaction and academic achievement were measured as indicators[24][25]. Learning satisfaction consisted of questionnaire items as shown in <Table 3>. Academic achievement consisted of 8 questions related to the area inquiring about the level of problem-solving ability and cognition through programming. The questions were developed through proper discussions and verifications with computer engineering experts.

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#### Table 3. Survey questions.

| Variable                   | Survey questions  | Related research   |
|----------------------------|---|--|
| Self-efficacy              | <ol> <li>I have better learning ability than other students.</li> <li>I am confident that I will do well in the exam.</li> <li>I can understand the difficult content in class.</li> <li>I can apply the content that I learned in class.</li> <li>I tend to do my project better than other students.</li> </ol>   | Byungmin Kim,<br>Yuwon Kang(2021)[26]  |
| Learning<br>motivation     | <ol> <li>I am always curious about various learning.</li> <li>I always think that the more effort I took, the better my understanding of the teaching in the class.</li> <li>If I can learn something, I want to learn them regardless.</li> <li>In general, learning through class is important to my life.</li> </ol>   | Seongil Lee(2012)[27]<br>Young Noh,<br>Kyunggeun Lee(2020)[28]                   |
| Digital device<br>efficacy | <ol> <li>Have the sufficient ability to use a computer to take online lectures.</li> <li>I can easily obtain the information I need during online lectures.</li> <li>Participating in online lectures is not difficult.</li> <li>I can understand the functions and techniques of online lectures well.</li> <li>I can select and use the appropriate program to take online learning.</li> </ol> | Young Noh,<br>Kyunggeun Lee(2020)[28]<br>Seonhee Hwang,<br>Maeran Park(2021)[29] |
| Learning satisfaction      | <ol> <li>I feel that I am accomplishing something through online lectures.</li> <li>I feel that I am continuing to grow by participating in online lectures.</li> <li>I was able to learn a lot through online lectures.</li> <li>Online lectures were generally satisfactory.</li> <li>Online classes give more results than expected.</li> </ol>  | Youngmi Jung(2020)[30]<br>Young Noh,<br>Kyunggeun Lee(2020)[28]                  |

# 3.4. Data processing method

The collected data were analyzed using SPSS 23 as follows. First, the reliability of the measurement tools on self-efficacy, learning interest, learning motivation, digital literacy, and learning satisfaction were calculated and verified. Second, descriptive statistics analysis was performed to understand the trends of the collected data through self-report questionnaires on self-efficacy, learning motivation, digital device efficacy, learning satisfaction, and academic achievement. Third, before the regression analysis, Pearson's correlation analysis was performed between self-efficacy, learning motivation, digital device efficacy, learning satisfaction, and academic achievement to confirm whether the relationship between the measurement variables was significant. Fourth, multiple regression analysis was performed to examine the factors that affect learners' characteristics of learning satisfaction and academic achievement.

# 4. Research Results

# 4.1. Descriptive statistics analysis

Descriptive statistics analysis was conducted to find out the trends of the major variables used in this study and the detailed results are shown in <Table 4>. The average self-efficacy was 4.35, the average learning motivation was 4.09, and the digital device efficacy was 4.32. The dependent variables, learning satisfaction and academic achievement, were 4.42 and 4.16, respectively.

Table 4. Descriptive statistics.

| Variables               | Ν  | М    | SD   |
|-------------------------|----|------|------|
| Self-efficacy           | 72 | 4.35 | 0.58 |
| Learning motivation     | 72 | 4.09 | 0.70 |
| Digital device efficacy | 72 | 4.32 | 0.64 |
| Learning satisfaction   | 72 | 4.42 | 0.68 |
| Academic achievement    | 72 | 4.16 | 0.66 |

#### 4.2. Correlation between learners' characteristics and the factors of learning outcomes

The <Table 5> shows Pearson's correlation coefficients for each of the primary and secondary correlations to test our hypotheses. The results of the correlation analysis are as follows, Self-efficacy showed a significant positive correlation to all variables of learning motivation(r=.583, p<.01), digital device efficacy(r=.701, p<.01), learning satisfaction(r=.805, p<.01) and academic achievement(r=.589, p<.01). The learning motivation also showed a significant positive correlation to all variables of digital device efficacy(r=.553, p<.01), learning satisfaction(r=.439, p<.01), and academic achievement(r=.601, p<.01). Learning satisfaction showed a significant positive correlation with academic achievement(r=.540, p<.001). The correlation coefficient between self-efficacy and digital device efficacy was .805, showing the highest correlation. Detailed results are shown in <Table 5>.

| Variables                  | 1      | 2      | 3      | 4      | 5      |
|----------------------------|--------|--------|--------|--------|--------|
| 1. Self-efficacy           | 1      |        |        |        |        |
| 2. Learning motivation     | .583** | 1      |        |        |        |
| 3. Digital device efficacy | .701** | .553** | 1      |        |        |
| 4. Learning satisfaction   | .805** | .439** | .748** | 1      | .540** |
| 5. Academic achievement    | .589** | .601** | .605** | .540** | 1      |

 Table 5. First correlation between measurement variables.

Note: \*\*p<.01.

The results of secondary correlation analysis showed that the learners' characteristics have a significant positive correlation with learning satisfaction(r=.759, p<.01) and academic achieve-ment(r=.696, p<.01). Learning satisfaction showed a significant positive correlation with academic achievement(r=.540, p<.001). The correlation coefficient between learners' characteristics and learning satisfaction is .759, which is a higher correlation than the correlation coefficient between learners' characteristics and academic achievement. The results of the correlation are shown in <Table 6>.

|--|

| Variables                    | 1      | 2      | 3 |
|------------------------------|--------|--------|---|
| 1. Learners' characteristics | 1      |        |   |
| 2. Learning satisfaction     | .759** |        |   |
| 3. Academic achievement      | .696** | .540** | 1 |

Note: \*\*p<.01.

\_ . . \_

# 4.3. Results of simple regression analysis on learning outcomes

# 4.3.1. Results of simple regression analysis on learning satisfaction

A simple regression analysis was performed to verify the factors affecting learners' characteristics on learning satisfaction. The result showed that the regression model was statistically significant(F=94.940, p<.001). The explanatory power of the regression model was 57.6%. The Durbin-Watson statistic was 1.791, close to 2, showing no problem in the assumption of residuals' independence. The regression coefficient's significance test result showed that learners' characteristics had a significant positive effect on learning satisfaction( $\beta$ =.759, p<.001). In other words, the learners' characteristics have a high influence on learning satisfaction. <Table 7> shows the results of the simple regression analysis.

| Dependent<br>variable | Independent variable      | В    | SE   | β    | t        | р    | TOL   | VIF   |
|-----------------------|---------------------------|------|------|------|----------|------|-------|-------|
| Learning              | (Constant)                | .474 | .409 |      | 1.158    | .251 |       |       |
| satisfaction          | Learners' characteristics | .929 | .095 | .759 | 9.744*** | .000 | 1.000 | 1.000 |

**Table 7.** Results of simple regression analysis on learning satisfaction.

F=94.940\*\*\*(\*\*\*p<.001), R<sup>2</sup>=.576, adj. R<sup>2</sup>=570, Durbin-Watson=1.791

Note: \*p<.05, \*\*p<.01,\*\*\*p<.001.

# 4.3.2. Results of simple regression analysis on academic achievement

A simple regression analysis was performed to verify the effect of learners' characteristics on academic achievement. The results showed that the regression model was statistically significant(F=65.866, p<.001). The explanatory power of the regression model was 48.5%. The Durbin-Watson statistic was 2.017, close to 2, showing no problem in the assumption of independence of the residuals. The result of the regression coefficient's significance testing showed that the learners' characteristics had a significant positive effect on academic achievement( $\beta$ =.696, p<.001). In other words, the learners' characteristics have a high influence on academic achievement. <Table 8> shows the results of the simple regression analysis.

 Table 8. Results of simple regression analysis on academic achievement.

| Dependent<br>variable   | Independent variable      | В    | SE   | β    | t        | р    | TOL   | VIF   |
|-------------------------|---------------------------|------|------|------|----------|------|-------|-------|
| Academic<br>achievement | (Constant)                | .406 | .467 |      | .870     | .387 |       |       |
|                         | Learners' characteristics | .883 | .109 | .696 | 8.116*** | .000 | 1.000 | 1.000 |

F=65.866\*\*\*(\*\*\*p<.001), R<sup>2</sup>=.485, adj. R<sup>2</sup>=477, Durbin-Watson=2.017

Note: \*p<.05, \*\*p<.01, \*\*\*p<.001.

# 4.4. Results of multiple regression analysis on learning outcomes

# 4.4.1. Results of multiple regression analysis on learning satisfaction

Multiple regression analysis was performed to verify the effect of various variables of learners' characteristics, namely self-efficacy, learning motivation, and digital device efficacy, on learning satisfaction. The results showed that the regression model was statistically significant (F=59.837, p<.001). The explanatory power of the regression model was about 72.5% (71.4% for adjusted  $R^2$ ). Also, the Durbin-Watson statistic was 1.712, close to 2, showing no problem in the assumption of residuals independence. The variance inflation factor (VIF) was also small, less than 10, indicating that there was no multicollinearity problem.

The results of the regression model's significance test showed that self-efficacy and digital device efficacy had a positive effect on learning satisfaction. In other words, higher self-efficacy and higher digital device efficacy lead to higher learning satisfaction. Learning motivation was found to be non-significant. Comparing the size of the standardization coefficient, self-efficacy( $\beta$ =.604) and digital device efficacy( $\beta$ =.398) were verified to affect learning satisfaction. The results of multiple regression analysis are shown in <Table 9>.

| Dependent variable    | Independent<br>variable | В    | SE   | β    | t        | р    | TOL  | VIF   |
|-----------------------|-------------------------|------|------|------|----------|------|------|-------|
| Learning satisfaction | (constant)              | .090 | .341 |      | .265     | .792 |      |       |
|                       | Self-efficacy           | .698 | .109 | .604 | 6.394*** | .000 | .453 | 2.205 |
|                       | Learning<br>motivation  | 128  | .078 | 133  | -1.652   | .103 | .619 | 1.615 |
|                       | Digital device efficacy | .421 | .097 | .398 | 4.324*** | .000 | .476 | 2.100 |

 Table 9. Results of multiple regression analysis on learning satisfaction.

F=59.837\*\*\*(\*\*\*p<.001), R<sup>2</sup>=.725, adj. R<sup>2</sup>=714, Durbin-Watson=1.712

Note: \*p<.05, \*\*p<.01, \*\*\*p<.001.

# 4.4.2. Results of multiple regression analysis on academic achievement

After setting the self-efficacy, learning motivation, and digital device efficacy as independent variables, and academic achievement as the dependent variable, a multiple regression analysis was performed. The resulting regression model was statistically significant(F=21.438, p<.001). The explanatory power of the regression model was about 48.6%(46.3% for adjusted R<sup>2</sup>). Also, the Durbin-Watson statistic was 2.008, close to 2, showing no problem in the assumption of residuals' independence. The variance inflation factor(VIF) was also less than 10, indicating that there was no multicollinearity problem.

The results regression model's significance test showed that learning motivation and digital device efficacy had a positive effect on academic achievement. In other words, higher learning motivation and higher digital device efficacy lead to higher academic achievement. Self-efficacy was not found to be significant. Comparing the size of the standardization coefficient, the learning motivation( $\beta$ =.329) and digital device efficacy( $\beta$ =.283) were verified to affect academic achievement.

| Dependent<br>variable   | Independent<br>variable | В    | SE   | β    | t        | р    | TOL  | VIF   |
|-------------------------|-------------------------|------|------|------|----------|------|------|-------|
|                         | (constant)              | .090 | .341 |      | .265     | .792 |      |       |
| Academic<br>achievement | Self-efficacy           | .698 | .109 | .604 | 6.394*** | .000 | .453 | 2.205 |
|                         | Learning<br>motivation  | 128  | .078 | 133  | -1.652   | .103 | .619 | 1.615 |

 Table 10. Results of multiple regression analysis on academic achievement.

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| Digital device<br>efficacy         .421         .097         .398         4.324***         .000         .476         2.100 |  |
|--|--|
|--|--|

F=59.837\*\*\*(\*\*\*p<.001), R<sup>2</sup>=.725, adj. R<sup>2</sup>=714, Durbin-Watson=1.712

Note: \*p<.05, \*\*p<.01, \*\*\*p<.001.

# 5. Conclusion

This study was conducted to examine the effect of learners' characteristics on learning outcomes in Non-face-to-face liberal arts coding classes for non-major students. Through this study, we derived the factors of learners that should be focused on to improve the educational effect in contact-free liberal arts coding classes for non-major students and to derive various implications to increase the educational effect of learners in contact-free liberal arts coding classes. The analysis results are summarized as follows.

First, we found that learners' characteristics have a high influence on both learning satisfaction and academic achievement. As confirmed in the study of Lee Jung-eun(2020), this study also confirmed that the learners' characteristics have a high influence on learning outcomes. The following are discussions on each variable of the learners' characteristics [14][31].

Second, self-efficacy and digital device efficacy were found to have a positive effect on learning satisfaction. In other words, higher self-efficacy and higher digital device efficacy lead to higher learning satisfaction. Learning motivation was found to be non-significant. These results can be interpreted that, for a contact-free class, the self-efficacy from learners' class participation is higher than the university's educational environment characteristics, and when the learners have a sense of efficacy with digital devices, they become more immersed in the class, increasing the learning satisfaction. Therefore, in the case of learners with low self-efficacy, teaching methods that can increase self-efficacy and class operation based on learners' levels that can induce self-directed learning are important.

Third, learning motivation and digital device efficacy were found to have a positive effect on academic achievement. In other words, higher learning motivation and higher digital device efficacy lead to higher academic achievement. Self-efficacy was not found to be significant. Because it is a contact-free class, higher learning motivation causes higher learner achievement. In a contact-free method, the learners' self-control to maintain the concentration as in the face-to-face method and the learning motivation enabling patience and persistence in solving learning problems are required. Therefore, there is a need for rewards and feedback for learning achievements that can reinforce learning motivation[32][33][34].

Since this study is conducted only with students from University C located in Gangwon Province, the sample size might not be sufficient, thus generalization and objectivity of the research model might be weak. Therefore, a more generalized future study targeting university students across the country should be conducted. Second, as a study conducted in the special situation of contact-free classes, a more in-depth study on learning outcomes by adding multiple factors that affect learning outcomes in face-to-face classes is necessary. Third, future studies are needed not only on the learners' characteristics but also on the educators' characteristics who give and receive feedback.

# 6. References

#### 6.1. Journal articles

[1] Oh M & Kim M. Analysis of Effects of Scratch Programing Education to Improve Computational Thinking. *Journal of Korean Association for Educational Information and Media*, 24(2), 255-275 (2018).

- [2] Kim M & Kim H. Effectiveness Analysis based on Computational Thinking of a Computing Course for Non-computer Majors. *The Journal of Korean Association of Computer Education*, 21(1), 11-21 (2018).
- [3] Lee A. A Study on a Case Applying Learner-centered Flipped Learning for Coding Classes. *Journal of Practical Engineering Education*, 9(1), 23-30 (2017).
- [4] Kim J & Son E. Difficulty Analysis of an Introductory Computer Programming Course for Nonmajor Students. *Journal of Creative Information Culture*, 7(2), 69-77 (2021).
- [5] Jung H. A Study on Basic Software Education Applying a Step-by-step Blinded Programming Practice. *The Society of Digital Policy & Management*, 17(3), 25-33 (2019).
- [6] Lee J. Research on Smart Learning Model based on 5 Steps using Media-based Teaching and Learning Method. *Public Value*, 5(2), 1-12 (2020). [Read More]
- [7] Kang Y. Design of Liberal Arts Curriculum Centered on Core Competencies. *International Journal of Human & Disaster*, 5(2), 49-57 (2020). [Read More]
- [8] Park G & Choi Y. Exploratory Study on the Direction of Software Education for the Non-major Undergraduate Students. *Journal of Education & Culture*, 24(4), 273-292 (2018).
- [9] Choi S & Kim S. The Impact of Learner Characteristics, Instructional Competence, and Multimedia Use on Learning Flow and Speech Education Effect: Focusing on Arcs Model of Motivation. *The Journal of Learner-centered Curriculum and Instruction*, 21(9), 497-516 (2021).
- [13] Kim H & Zhang M & Cho S & Lee S. The Differences on Characteristics of Learners and Teachers towards Universities e-learning between Korea and China. *The Konkuk Journal of Business and Economic Studies*, 38(2), 93-119 (2013).
- [14] Lee J. The Influence of the Learner Characteristics and Educational Environment Characteristics on Learning Outcomes in the Classes of Computer-based Accounting. *The Journal of Business Education*, 34(4), 23-47 (2020).
- [15] Kang Y. A Study on Development of Interactive Communication Education Model for Creative Convergence in Public Value. *Public Value*, 6(3), 61-69 (2021). [Read More]
- [16] Kim Y. The Effects of National Examination Protection Convergence Education Program on Egoresiliency, Social Support, and Job-seeking Stress of Senior Nursing Students. *Protection Convergence*, 6(2), 1-13 (2021). [Read More]
- [17] Lee K. Analysis of the Moderating Effects of Programming Languages and the Relationship between Learners' Learning Characteristics and Achievements. *The Society of Digital Policy & Management*, 19(4), 49-55 (2021).
- [18] Lee A. Analysis of the Effectiveness of Software Liberal Education in a Non-face-to-face Environment. *Robotics & AI Ethics*, 6(4), 1-12 (2021). [Read More]
- [19] Oh K & Ahn S. A Study on the Relationship Between Difficulty in Learning to Program and Computational Thinking. *The Journal of Korean Association of Computer Education*, 18(5), 55-62 (2015).
- [22] Yu B & Kim J & Lee W. Analysis on the Relation Between Programming Achievement and Problem Solving according to Gender. *The Journal of Korean Association of Computer Education*, 15(6), 1-10 (2012).
- [23] Jeon Y & Cho J. Analysis of Class Satisfaction and Perceived Learning Achievement to the Interaction Type on e-learning in University. *Journal of Internet Computing and Services*, 18(1), 131-141 (2017).
- [24] An J. A Qualitative Study on Characteristics of "Good" College Classes. *The Journal of Yeolin Education*, 22(1), 163-191 (2015).
- [25] Lee S. The Structural Relationship among Structure Variable, Learning Motivation, Learning Satisfaction in Online Education. *Journal of Korean Association for Educational Information and Media*, 18(1), 77-94 (2012).
- [26] Kim B & Kang Y. Analysis of the Relationship Between Class Quality, Self-efficacy, Learner Loyalty, and Differences Between Majors and Parttime Job Activities for Online Lectures. *Korean Journal of Sports Science*, 30(2), 703-717 (2021).

- [27] Lee S. The Structural Relationship among Structure Variable, Learning Motivation, Learning Satisfaction in Online Education. *Journal of Korean Association for Educational Information and Media*, 18(1), 77-94 (2012).
- [28] Noh Y & Lee K. A Study on Factors Affecting Learner Satisfaction in Non-face-to-face Online Education. *The Academy of Customer Satisfaction Management*, 22(3), 107-126 (2020).
- [29] Hwang S & Park M. A Study on the Factors Influencing Students' Learning Flow and Learning outcomes of Real-time Online Learning in a Korean University. *Multimedia-assisted Language Learning*, 24(2), 130-153 (2021).
- [30] Jung Y. Effect of Learners' Learning Presence on Learning Flow and Learning Satisfaction in Noncontact University Class. *Journal of Tourism Management Research*, 25(4), 299-320 (2021).
- [31] Yang C. Meta-analysis on the Effects of Programming Education using Educational Programming Languages. *Journal of the Korean Association of Information Education*, 18(2), 317-324 (2014).
- [32] Jeon H & Jang M. A Study of Factors Affecting Learning Satisfaction of Cyber University Students Majoring in Korean Language Education. *The Journal of Korean Studies*, 67, 223-253 (2018).
- [33] Kim N. A Study on the Quality of Classes, Class Satisfaction, and Learning Performance of Tourism Education in the Online Learning Environment of Covid-19. *Journal of Hotel & Resort*, 19(5), 207-226 (2020).
- [34] Park MJ. Exploring the Predictability of Self-directed Learning, Quality of Instruction, and Learning Flow for the Learning Outcomes of Online Course. CNU Journal of Educational Studies, 42(1), 135-162 (2021).

# 6.2. Thesis degree

- [10] Ko Y. The Effects of Learner Characteristics and Media Characteristics for Effective Distance Learning. Sunchon National University, Master's Thesis (2001).
- [11] Jung H. Learner Factors and Participation on Learning Effectiveness in Web-based Learning. Jeonbuk National University, Doctoral Thesis (2010).
- [12] Kim H. Relationships among Work Climate, Training Programs, Learner Characteristics, and Transfer of Learning. Jeonbuk National University, Doctoral Thesis (2010).
- [20] Park J. Effect of Education on Learner Characteristics. Korea University, Master's Thesis (2016).

# 6.3. Books

[21] KERIS. 2015 Education Policy Network Training On-site Support Research: Development of SW Education Teaching and Learning Model. Commissioned Research CR 2015-35 (2016).

# 7. Appendix

# 7.1. Author's contribution

|        | Initial<br>name | Contribution   |
|--------|-----------------|--|
|        |                 | -Set of concepts 🔽   |
|        |                 | -Design 🗹  |
|        |                 | -Getting results 🔽   |
|        | AL              | -Analysis 🔽  |
|        |                 | -Make a significant contribution to collection $\ ar{ u}$      |
| Author |                 | -Final approval of the paper $ igside $                        |
| Addio  |                 | -Corresponding 🔽   |
|        |                 | -Play a decisive role in modification 🔽                        |
|        |                 | -Significant contributions to concepts, designs,               |
|        |                 | practices, analysis and interpretation of data $\ igside S$    |
|        |                 | -Participants in Drafting and Revising Papers 🛛                |
|        |                 | -Someone who can explain all aspects of the paper $\ igside Q$ |

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# An Exploratory Study on the Metaverse-Based Learner-Centered English Learning Program: Focusing on Culture and Art Contents

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#### Abstract

**Purpose:** The purpose of this study is to develop an English learning program using metaverse that can create a variety of educational environments in a virtual space in the post-COVID era. This study was conducted with culture and art as the content subject, and it was designed so that students could experience various types of metaverse technology and mixed reality to increase their participation in learning and the learning effect. It also introduces effective online learning tools that can be used in metaverse-based English learning programs.

**Method:** Students improve their English skills by examining museums with Google Earth and Art&Culture and exploring exhibits and materials related to Korean cultural assets there, exploring Korean cultural assets and art galleries using VR and AR, and collecting related cultural and artistic materials. In addition, through the process of creating and presenting materials based on the metaverse, interaction was promoted, so that the understanding of each country's culture and arts and English ability could be improved together.

**Results:** The English learning program presented in this study consists of various tasks such as experiencing culture and art contents through AR and VR, collecting cultural and art-related materials, and producing presentation materials. Roughly speaking, in the introduction part, learning objectives and key expressions are introduced by using the functions of the metaverse platform ZEP and the online learning tool 'edpuzzle', and motivation is induced through videos. In the development stage, AR and VR-based apps such as ZEP, Google Earth, Art & Culture, etc. are used to visit museums in Korea or British and American countries, research related culture and art, and collect data. Then, by specifying the topic for each group, use ZEP, Google Earth, etc. to produce materials that can be presented. After that, practical presentations using ZEP and feedback (instructors and colleagues) are provided. In the final organizing stage, there may be quiz solving using QuizN and sharing opinions about the class through online learning tools such as Jamboard and Padlet.

**Conclusion:** In this program, ZEP, a metaverse platform capable of interactive communication such as various avatars, virtual theme spaces, images, and PDFs, was used to enable task execution and practical interaction. In addition, by using various online learning tools in a new environment and context, students will be able to develop self-directed learning skills, problem-solving skills, and digital literacy skills. Through this metaverse-based Eng-lish learning program, learners will be able to experience various forms of cultural arts and realistic content, and furthermore, they will be able to participate in convergence cultural thinking expansion and future-oriented classes.

Keywords: Metaverse, ZEP, Online Learning Tool, Culture and Art, English Learning

# 1. Introduction

After the advent of the COVID-19 virus, as social distancing to prevent the spread of infectious diseases became commonplace, non-face-to-face classes became the new normal in educa-tion[1]. The threat of an invisible virus has become a catalyst for changing the notion of a space where education takes place, and a stimulus for the transition to a digital society. As a result,

many educational contents and class materials are now being implemented with remote technology, and various online programs and platforms to create a bi-directional classroom environment are attracting attention as a new educational medium.

Among them, Metaverse has recently been attracting attention. Metaverse is a compound word of Meta, meaning virtual and transcendence, and Universe, meaning the real world [2][3]. Although there are many online platforms where students can receive education without meeting in person, Metaverse has a big difference, unlike existing programs, in that students access the 'same space' together through an avatar. Various methods of communication(text, voice, emoticons, photos, videos, etc.) and virtual experiences through metaverse's avatar create an educational environment that is different from the real world[4]. The educational environment using the metaverse has the characteristics of experiencing a variety of experiences, communication, and expanded reality, which helps participants to learn by increasing their immersion and sense of presence[5][6]. Therefore, in this new educational environment, there is a need for an education method using the metaverse that enables learners to actively engage in activities and achieve educational effects.

We are well aware that we can no longer go back to the world before the COVID-19 virus outbreak. In the future, the use of distance education tools such as metaverse will increase in the face of non-face-to-face cultural demands and changes in the perception of meeting and space. However, the current educational method using metaverse in schools is only at the beginning stage, and studies using metaverse in language learning centered on foreign languages such as English in particular are insufficient. Therefore, in this study, using ZEP, a metaverse platform that can be used without special burdens such as the use of specific tools, technical support, and cost, we intend to explore an English-based teaching method that focuses on culture and art. Therefore, this study proposes a variety of online learning tools and convergence English teaching methods that can be directly applied to the current university English learning, while improving students' English ability and promoting understanding of culture and arts.

# 2. Theoretical Background

#### 2.1. Definition and classification of metaverse

Metaverse refers to a world realized in an online virtual space that enables social, economic, and cultural activities and interactions similar to reality[7]. In the metaverse, communication and interaction are possible without time and space constraints, and various forms of collaboration and sharing of life are possible[8].

According to Kim Sang-gyun(2021), the Acceleration Studies Foundation(ASF), an American technology research foundation, classifies metaverse technology into four categories as follows[9].

First, augmented reality(AR) is a technology that synthesizes images, documents, videos, etc. implemented in a virtual space in real time in real time. By projecting and providing necessary information on virtual educational materials, it provides students with a sense of reality and at the same time has a positive effect to increase the sense of immersion[10][11]. In addition, many studies have revealed that providing education using augmented reality can help in cognitive aspects such as academic achievement[11]. It can increase the sense of realism and immersion for learners[12][13]. By actively utilizing these augmented reality contents, students can not only understand more in-depth contents with AR contents that are difficult to understand with only 2D explanations of paper books, but also have their own hands rather than having to go to a specific place to experience any educational contents[14]. You will be able to experience the content regardless of time and place.

Second, lifelogging refers to the online recording, storage, and sharing of daily information and experiences of people or things[14]. For example, it records and shares an individual's daily

life through SNS such as Facebook and Instagram, or provides classes, assignments, and feedback using a learning management system(LMS). It is highly likely to be used as an educational tool in that it provides students with a creative two-way communication framework and can share appropriate feedback and reactions from teachers and colleagues on SNS.

Third, the mirror world refers to the realization of the shape and structure of the real world in the virtual world as it is reflected in a mirror. It is thanks to this technology that I can check the information I want while viewing the map in real time on a navigation system that provides traffic information, ride-sharing mobility, or a food delivery service app[14]. Since the real world can be described as it is, but an expanded space containing digital information can be provided, if the learning field can be implemented in a virtual space along with the information necessary for education, its utility as an educational tool will be limitless. In addition, when using various platforms(Cospaces, Mincraft, etc.) that can directly create virtual spaces, students can creatively build virtual spaces that are the same as reality, that is, mirror worlds, and link appropriate educational content within them[14].

Fourth, the virtual world means that activities similar to reality can be performed through an avatar in a newly constructed virtual environment that is different from reality with 3D technology[14]. The digital space of 3D already exists next to us in various forms(game, video, application, etc.), but the metaverse world has a big difference that people can access the virtual space through avatars and communicate in real time. Therefore, using the metaverse platform for remote education can help students interact based on the elements of vision and hearing provided by avatars and share three-dimensional experiences with others, thereby increasing the sense of reality and participation in education[15]. Jeong et al.(2021) revealed that metaverse has advantages in learning and interesting factors by providing a learning environment in which interactions between students can occur smoothly in terms of social reality and learning reality[6]. In addition, Yoon Heon-Jun(2021) said that students can act as secondary characters(subcharacters; avatars) with a slightly different tendency in the virtual world of metaverse, so they can expect a positive impact in terms of the definition of multi-persona[16].

As seen above, the metaverse has various characteristics, and it is possible to implement an educational environment that can promote a new type of English learning in this virtual space. In particular, students can perform tasks for language learning and directly participate in communication through an avatar created according to their personality in the virtual world, and this educational environment provides students with a sense of presence and opportunities for active learning. Practical interaction between learners through various metaverse technologies has the advantage of improving learners' English skills. Therefore, in this study, we design an English learning method centered on the metaverse and present a learning method that allows students to experience a new level of diverse educational environment.

#### **2.2.** English learning and culture and art education using metaverse

In the face of the development of digital technology and the post-COVID era, many cultural and artistic contents around the world are digitized and preserved, and various forms of digital exhibitions and visitor experiences are being made[4]. Cultural contents are applied to various metaverse platforms to expand user access and participation[17], and there is much discussion about educational use of culture and art that strengthens metaverse characteristics such as augmented reality and virtual reality[18][19].

Culture exists in various forms, and objective cultural awareness and content knowledge about culture itself in English learning are very important parts that can lead to expansion of language learners' achievements and values[20]. Lado(1964), a structuralist linguist, believed that language is inextricably related to socio-cultural context, so understanding the target culture in which the language is used is essential for understanding and learning the target language[21]. Stern(1992) asserts the close relationship between language and culture, and believes that language education and cultural education should be conducted at the same time[22]. Accordingly, as the need for cultural understanding in English education has been highlighted,

cultural guidance for understanding the target culture as well as linguistic guidance for English is considered important. The understanding of the culture of native speakers of English as their mother tongue, that is, the English-American culture, is beginning to become important in English education.

Furthermore, from the 1990s, as communication between native speakers and non-native speakers as well as between non-native speakers increased and English was used as an international language, the concept of target culture began to change in communication-oriented English education[4]. McKay(2000) argued that considering the active use of English as an international language, he should guide both his own culture, English-speaking culture, and the culture of the world beyond guiding the culture of English-speaking countries[23]. In other words, from the perspective of viewing Anglo-American culture as a target culture in language(English) education, the scope is gradually expanding to global culture, and through this, education is moving toward developing the ability to understand other cultures and understand our culture. The advanced digital technology of the present era enables practical experiences of these cultural and artistic elements through realistic content such as VR and AR, and furthermore, creates a new learning environment in various forms for effective teaching and learning[4].

Chatting using avatars in the dimension virtual reality space was found to help English learners improve their interest[24], and task performance through VR apps played a positive role in English learners' participation in classes[25]. Godwin-Jones(2021) said that future education will emphasize games and collaboration, and English learning using VR and AR that can implement specific situations will play an important role[26]. This direction of language education is because English learning is not only important for surface language acquisition but also socio-cultural learning, and research on this will be more active because technology use such as metaverse can create various learning environments.

In addition, the metaverse enables conversation practice and actual conversation to support realistic learning as well as images, videos, and voices, thereby increasing the immersion of learning participants in the metaverse's virtual space and increasing their interest in class. In Metaverse, various types of collaboration such as pair activities and group presentations are possible, so an educational approach that reflects these characteristics in English learning is required. Therefore, this English learning program using metaverse's technical approach and various online learning tools can be a new English educational method to increase learners' interest and class participation. In this study, students can experience various cultures and arts while exploring cultural arts supported by augmented and virtual reality in real or virtual reality, and to improve their English skills while performing specific tasks on the metaverse. did. This metaverse-based English learning will help learners to recognize various cultures from an objective standpoint and expand convergence cultural thinking. In addition, it will be very helpful to experience and understand the metaverse, a futuristic class model, by understanding various cultural and artistic contents in English and writing and presenting travelogues through the metaverse.

# 3. Composition and Practice of English Education using Metaverse

# **3.1.** Metaverse utilization and teaching goals

In this study, we intend to design a program for improving English proficiency using ZEP, a metaverse platform. Through this English learning program, learners can experience Korean culture and art newly composed of digital technology while exploring various types of metaverse technology supported by ZEP and Korean cultural heritage based on augmented and virtual reality, and learn specific Korean cultural contents. You can develop the ability to introduce yourself to the world. At the same time, college students can improve their practical English skills while experiencing the metaverse and promote new discoveries about Korean cultural contents.

Metaverse platforms that are mainly used in Korea include ifland, ZEPETO, and Gather.town. In the first half of this year, 'Zep', a metaverse platform developed jointly by 'Naver Z', which is servicing Zeppetto, and 'Supercat', which made the Kingdom of the Wind: Kite, was officially launched. It is similar to the Gather.town platform, which has been evaluated as the most useful and practical metaverse, but it has a great advantage in that it can be used for free regardless of the size and number of people, including graphic quality and stability. In addition, Gather.town, developed in the United States, is in English, so it is difficult to understand intuitively even if you read the guide, while ZEP provides a Korean version of the guidebook homepage and notion page, so it is easy to find information related to the production. In particular, ZEP has an 'asset store' that is not found in Gather.town, which is a space where you can download objects and backgrounds necessary for creating metaverse maps(<Figure 1>). The asset store is divided into objects and maps. If you want to decorate a virtual classroom space, select the desired school map from the map, and use it by downloading and installing furniture such as a desk or chair from the object tab. Comparing the commonalities and differences between Gather.town and Zep, it can be summarized as follows <Table 1>.

| Figure | 1. Zep's | 'asset | store.' |
|--------|----------|--------|---------|
|--------|----------|--------|---------|



Table 1. Comparison of metaverse platform 'gather.town' and 'ZEP.'

| Item                    | Gather.town  | ZEP                        |
|-------------------------|--|----------------------------|
| Interaction             | Avatar, video, chat, voice                           | Avatar, video, chat, voice |
| Simultaneous connection | 500 people   | 50,000 people              |
| Device support          | PC, mobile   | PC, mobile                 |
| Program installation    | × (Browser based)                                    | × (Browser based)          |
| Custom                  | Can be self-made                                     | Can be self-made           |
| Cost                    | (When more than 25 people connect)<br>\$2 per person | free                       |

In this metaverse-based English class, using ZEP's virtual space(school, exhibition hall, etc.) as the main platform, various functions within the metaverse and online tools for education(edpuzzle, quizN, etc.) are utilized. In the metaverse platform ZEP selected in this study, all participants can watch the same video at the same time by inserting a YouTube video using the link embed function. In Gather Town, even if a YouTube video link was inserted, the entire number of people could not watch it at the same time, and the connection to specific links other than YouTube was limited, so the content that could be inserted was limited. On the other hand, ZEP uses a link embed function to connect an external link to an object so that participants can go directly to the corresponding content.

# 3.2. Content and composition

The goal of this metaverse-based English class is to strengthen students' participation and interest in classes by utilizing authentic materials written in English based on metaverse, and to improve learners' integrated English skills through comprehensive presentation using metaverse. In other words, it is to improve the English vocabulary, grammar, reading, writing and speaking skills related to the introduction of cultural arts and cultural properties. In addition, augmented reality can be used to increase immersion and enhance practical experience, as well as promote interest in and knowledge expansion of cultural assets of various countries. The details of the metaverse-based English learning program developed in this study are as follows.

# 3.2.1. Introduction stage

In the first introduction stage, the learner knows the topic and grasps the main point of the task. arouse interest in Through the screen sharing function provided by ZEP, it is also possible to introduce and learn words and expressions related to culture and art while sharing data. You can go one step further and use edpuzzle, one of the online learning tools. Edpuzzle is a site that creates learning activities by watching YouTube videos or videos created by teachers. As shown in <Figure 2>, teachers can check students' understanding by uploading videos and add-ing quizzes or explanations wherever they want. When students play the video and proceed to class, the video stops at the point designated by the teacher, and a sudden quiz or additional explanation is provided. By linking with Google Classroom, students can also check their class progress.





# **3.2.2.** Development stage

In the second stage of deployment, there are two ways to utilize the metaverse. First, it is a method of planting and arranging objects(TV, poster, computer, etc.) with photographic mate-

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rials that learners can enter and perform inquiry activities in the space set by the teacher. Learners can collect appropriate information by looking around each material through an avatar. At this time, they can learn words and expressions on their own by inserting materials such as reading fingerprints for culture and art, audio files and scripts of various contents into the object. For example, by using reading fingerprints and related video files about Changdeokgung Palace, one of Korea's cultural heritages, they can learn the unique words and concepts that are dealt with when introducing Korean culture, and expand the scope of understanding and interest in Korean culture.

Useful online learning tools that can be used at this stage include Google's Art & Culture or Google Earth. Through Art & Culture, learners can receive various services such as museum exploration, cultural properties explanation, and street view tour, and through this augmented reality technology, learners can enjoy museum exhibitions as if they were actually in the museum(<Figure 3>). In this way, by using augmented reality educational contents, it is possible to explore not only Korean cultural assets, but also cultural assets of British and American cultural countries. Furthermore, it is possible to grasp the information and experiences collected through augmented reality, characteristics of cultural properties, etc., and to take pictures or save scenes realized in augmented reality during the tour.



Figure 3. Google earth 'museum explorer'.

Next, after data collection and planning for an English presentation, specific materials for a metaverse-based presentation are produced. For each item, research and presentation of cultural and artistic materials related to Changdeokgung, along with site visits, impressions, photos, videos, and records. Based on the information collected at this time, students are instructed to prepare for the presentation by using key expressions. Students make storyboards to materialize the content, but write and practice in English. In this way, the task is given to perform even or group activities, and the task is moved to another virtual space(group activity room) in ZEP to perform the task, and then gathered again in the initial virtual space to share the degree of task performance(<Figure 4>).

Figure 4. Entrance to the 'group activity room' portal.



A teacher can designate a private discussion area by placing as many different tiles as the number of groups as shown in <Figure 5> and selecting 'Private Space' in the tile effect. By arranging the six straight tiles in the lower right corner in <Figure 6>, the teacher can go back and forth between groups and supervise each group activity. The content of the whiteboard for each group is shared, and the instructor gives primary feedback on the content of the whiteboard. Students make a PPT reflecting this feedback to create a PDF or collect photos or records to make a video. Students practice their English presentation using the group activity room prepared by the teacher and prepare for the final presentation.

Figure 5. Tile effect 'private space.'



Figure 6. Communicate with group members with simple moving the teacher avatar.



After the group activity is over, they return to the classroom map and provide an opportunity to give an actual English presentation to share and express the materials they have created with other students. In this case, the teacher can use the spotlight function, which is one of the metaverse functions. In ZEP, if the teacher put a tile effect on the stage to be presented or at a specific location, the spotlight function will be activated so that all students can hear when a student at that location speaks. Students who are satisfied with other students' presentations can respond through various reactions, allowing them to participate by reacting in various ways(chat, emoticons, voice, etc.) provided by ZEP. Expressing students' moods and behaviors in various ways through avatars is a way to strengthen free communication, friendship, and interaction, and to induce more active participation in classes by lowering affective filters such as learner anxiety and fear[4].

# 3.2.3. Consolidation stage

And lastly, when the teacher want to check how much vocabulary and expressions the students have learned in the consolidation stage, it is good to use a site called QuizN, which is one of the online learning tools. QuizN allows anyone with a PC or smartphone to create quizzes, interact with them, and participate in quiz games, making them feel immersive and competitive in the classroom, which can be boring.





In addition, the teacher can use the mini-games provided by ZEP. In the metaverse 'ZEP', there are various mini-games such as pooping, choking quiz, and zombie game. Room escape games are also possible, but the teacher can open and run his/her own map through the tile effect function of ZEP. In terms of learning, Escape Room and OX Quiz are appropriate. The room escape game is a game that escapes a room by solving quizzes one by one, and because the game element of escaping the room is included, students can participate in the quiz with interest. OX Quiz is a simple game in which questions are shared in real time and then moves to the answers they thought of, and it can increase the concentration of participants through class-related questions. In particular, the OX quiz in ZEP is more convenient because it automatically moves the participant who selects the wrong answer after the set time limit, unlike Gather Town, where the wrong answerer had to move manually.

And as a way to share students' feelings or opinions about the class, it is possible to use Google's Jamboard or padlet. As shown in <Figure 8>, place an object on one side of the blackboard and add a website through the embed function. In the case of Jamboard, the students can write with a pencil or post-it note, and the padlet is similar. Figure 8. Object placement with Jamboard function in the classroom.

The following <Table 2> summarizes the above class steps and activities.

Table 2. Class steps and activity contents.

|               | Activities   | Metaverse function   | Online learning tools(website)    |
|---------------|--|--|-----------------------------------|
| Introduction  | <ul> <li>Introduce the topic</li> <li>Presentation of learning goals and contents</li> <li>Introduce tasks and key expressions</li> <li>Motivation and quiz through video</li> </ul> | <ul> <li>Link photos, videos and websites</li> <li>to objects</li> <li>Utilize whiteboard or screen</li> <li>sharing function</li> </ul> | - Edpuzzle                        |
| Development   | <ul> <li>Collecting and analyzing information</li> <li>Reorganize necessary information<br/>and express creatively</li> </ul>  | <ul> <li>Link photos, videos and websites<br/>to objects</li> <li>Group activity room</li> </ul>   | - Art & culture<br>- Google earth |
|               | <ul> <li>Practice giving presentations using<br/>key expressions</li> <li>Presentation using key expressions</li> </ul>  | (separate map)<br>- White board<br>- Present using spotlight   | - Jamboard                        |
| Consolidation | - Evaluation through quiz<br>- Share your opinion  | - OX Quiz<br>- Embed a website into an object  | - QuizN<br>- Jamboard<br>- Padlet |

The metaverse-based English learning program developed in this study includes augmented reality and virtual reality, which are realistic content, to enhance the learner's interest and immersion. can increase participation. ZEP, which is easy to operate and can use apps and decorate avatars for free, was used as the main platform for English learning so that it can be easily applied to the educational field. In addition, in the process of performing various tasks, English speaking, writing, reading and listening skills can be strengthened. In this virtual space, learners can perform various learning tasks, have conversations, and promote real interactions among learners, so that an active learning environment using foreign languages can be implemented directly in this virtual space.

Learners can improve their reading and listening skills in the process of exploring cultural properties, and they can increase their vocabulary and discourse skills. They can intensively improve their writing and speaking skills while experiencing various metaverse techniques in the process of making presentation materials and presenting. In other words, through this English teaching method, learners can improve their practical English ability to integrate language use with the superficial language learning of English, and experience mixed reality through AR and VR while performing cooperative tasks. Effective understanding of various arts and culture

can be promoted. This metaverse-based English learning program has the advantage of increasing learners' interest and immersion in learning English by utilizing various cultural and artistic contents centered on ZEP, which is easy to access and use.

# 4. Conclusion

This study aimed to develop an effective English learning program using Metaverse, which has a lot of educational potential in recent times in the post-COVID era. This study aimed to develop a metaverse-based English learning program that can reduce the technical and cost burden in field application and is realistically accessible. It was intended to promote the improvement of integrated skills such as writing.

The English learning program presented in this study consists of various tasks such as experiencing culture and art contents through AR and VR, collecting cultural and art-related materials, and producing presentation materials. Roughly speaking, in the introduction part, learning objectives and key expressions are introduced by using the functions of the metaverse platform ZEP and the online learning tool 'edpuzzle', and motivation is induced through videos. In the development stage, AR and VR-based apps such as ZEP, Google Earth, Art & Culture, etc. are used to visit museums in Korea or British and American countries, research related culture and art, and collect data. Then, by specifying the topic for each group, use ZEP, Google Earth, etc. to produce materials that can be presented. After that, practical presentations using ZEP and feedback(instructors and peers) are provided. In the final organizing stage, the students can share opinions about the class through quiz solving using QuizN and online learning tools such as Jamboard and Padlet. By using the various online learning tools in a new environment and context, students will be able to develop self-directed learning skills, problem-solving skills, and digital literacy skills.

This metaverse-based culture and arts-centered English learning program uses a variety of online learning tools and realistic content to increase interest and interest in learning, and helps learners to view diverse cultures from an objective perspective and promote convergence cultural thinking. will be Performing specific tasks and cultural experiences using various metaverse technologies can become a future class model for English learning. In addition, this metaverse-based English teaching method will provide learners with a variety of communication methods through sub-characters and a creative educational environment suitable for the new era. It will be an opportunity for a new understanding. This will become a model of convergence education that can go beyond acquiring knowledge in only one field of English, and develop the competencies required by the future society through various cultural and artistic experiences.

# 5. References

# 5.1. Journal articles

- [1] Hwang Y. Preliminary Investigation on Student Perspectives and Satisfaction with Distance Education in the Metaverse World: Focusing on the Use of Ifland App. *The Journal of Korea Contents Association*, 22(3), 121-133 (2022).
- [2] Bang W & Park G. Entrepreneurial Marketing in the Era of Multicultural Metaverse. *Robotics & Al Ethics*, 6(4), 55-63 (2021). [Read More]
- [3] Han D. Exploration for Educational Application of Metaverse: Focusing on Implication for Use in English Education. *Robotics & AI Ethics*, 7(1), 10-21 (2022). [Read More]
- [4] Lee H. A Study on Developing the Metaverse-based English Learning Program: Focusing on Ifland. *The Journal of Humanities and Social Science*, 13(3), 42-56 (2022).

- [5] Kang M & Kim G & Shin Y & Kim D. Effects of Learning Presence and Flow on the Learning Satisfaction of Learners in a Graduate School of Education Class Utilizing the Metaverse Platform Gather Town. *Journal of Research in Education*, 35(1), 83-116 (2022).
- [6] Jeong Y & Lim T & Ryu J. The Effects of Spatial Mobility on Metaverse based Online Class on Learning Presence and Interest Development in Higher Education. *Journal of Korean Association* for Educational Information and Media, 27(3), 1167-1188 (2021).
- [7] Hong H. Exploratory Study for Educational Application of Metaverse. *Culture and Convergence*, 43(9), 1-23 (2021).
- [8] Suzuki SN & Kanematsu H & Barry DM & Ogawa N & Yajima K & Nakahira KT & Shirai T & Kawaguchi M & Kobayashi T & Yoshitake M. Virtual Experiments in Metaverse and Their Applications to Collaborative Projects: The Framework and Its Significance. *Procedia Computer Science*, 176, 2125-2132 (2020).
- [10] Yang E & Ryu J. The Effects of Classroom Scenario and Task-display Method on User Experience in Teaching Simulation. *The Educational Research for Tomorrow*, 32(1), 99-118 (2019).
- [11] Jung H. Empirical Investigation of Determinants Influencing English Teachers' Intention to Switch Augmented Reality: Based on the Push-pull-mooring(PPM) Framework. *Multimedia Assisted Language Learning*, 24(2), 106-129 (2021).
- [12] Kim S. A Suggestion of Direction of Language Education using Augmented Reality. *Teaching Korean as a Foreign Language*, 48, 1-27 (2018).
- [13] Lee J. A Study on the Educational Use of Augmented Reality Based Mobile Education Content -Case Analysis of Mobile Augmented Reality Application for Education-. *Journal of the Korean Society Design Culture*, 24(1), 569-585 (2018).
- [14] Hwang Y. Invitation to Metaverse: A Discussion on the Need of a New Space for Future Education. *The Journal of Studies in Language*, 37(3), 377-389 (2021).
- [15] Choi JF. The Effects of Immersive Learning for Poetry Writing via a VR Game for Generation Z Students' Creativity: Focusing on Forum VR: Artist of Oz. *Robotics & Al Ethics*, 6(4), 33-44 (2021). [Read More]
- [16] Yoon H. Remote Learning into the Metaverse Era: Toward New Interaction and Communication. *Journal of the KSME*, 61(8), 49-54 (2021).
- [17] Jung J & Son H & Kim H. Case Studies of Cultural Contents using Metaverse. *Journal of Korea Culture Industry*, 22(1), 201-213 (2022).
- [18] Seol Y & Joo C & Yoo J. A Study on Utilization Method of the Metaverse in Digital Heritage. *Smart Media Journal*, 10(4), 110-119 (2021).
- [19] Sohn J. A Study on the Principles of Teaching and Learning for Visual Culture and Digital Literacy Education. *Journal of Research in Art Education*, 22(3), 1-24 (2021).
- [23] McKay SL. Teaching English as an International Language: Implications for Cultural Materials in the Classroom. *TESOL Journal*, 9(4), 7-11 (2000).
- [24] Lee S & Jeong D. The Effect of English Chatting through 3D Avatar-based Virtual Reality by College Students' Learning. *English Language & Literature Teaching*, 16(1), 233-257 (2010).
- [25] Im H. A Study on the Application of VR in the General English Classes. *Korean Journal of General Education*, 13(5), 349-369 (2019).
- [26] Godwin-Jones R. Evolving Technologies for Language Learning. *Language Learning & Technology*, 25(3), 6-26 (2021).

# 5.2. Books

- [9] Kim S. Metaverse: Digital Earth, the World of Floating Things. Plan B Design (2020).
- [20] Byram M. From Foreign Language Education to Education for Intercultural Citizenship. Multilingual Matters (2008).
- [21] Lado R. Language Teaching: A Scientific Approach. McGraw-hill (1964).
- [22] Stern HH. Issues and Options in Language Teaching. Oxford University (1992).

# 6. Appendix

# 6.1. Author's contribution

|        | Initial name | Contribution  |
|--------|--------------|---|
|        |              | -Set of concepts 🔽  |
|        |              | -Design 🔽   |
|        |              | -Getting results 🔽  |
|        |              | -Analysis 🗹   |
|        |              | -Make a significant contribution to collection $\ igside S$   |
| Author | рн           | -Final approval of the paper 🛛                                |
| Aution | DII          | -Corresponding 🔽  |
|        |              | -Play a decisive role in modification <a>Image</a>            |
|        |              | -Significant contributions to concepts, designs,              |
|        |              | practices, analysis and interpretation of data $\ igsilon$    |
|        |              | -Participants in Drafting and Revising Papers 🛛               |
|        |              | -Someone who can explain all aspects of the paper $\ igsqcup$ |

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# A Case Study on Current Issues in Artificial Intelligence and its' Ethical Implications

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# Abstract

**Purpose:** This study aims to explore ethical implications by looking at some examples of what ethical issues the advent of AI poses to humans.

Method: For this purpose, this study showed 7 cases on AI issues.

**Results:** Case1 is a helper that performs a passive function. Case 2, Case 3, and Case 4 are events that take place in an uncanny valley. Case 5 and Case 6 show that AI plays the role of a major agent in the capitalist market in a new virtual or offline space. In this way, human-to-human, human-to-human AI, AI-to-AI can lead to complex and diverse ownership disputes. Finally, Case 7 is a case in which AI itself performs not only cognitive functions but also emotional functions based on information based on deep learning.

**Conclusion:** Al can change the algorithm initially entered by a human by itself. This is a characteristic different from the civilizations that have arrived in the past. In the cognitive realm, AI has already surpassed humans. In other words, the cognitive singularity has already been occupied by AI. We need to prepare for the next step.

Keywords: Ethical Issues, Artificial Intelligence(AI) Algorithm, Cognitive Realm, Singularity, Emotional Function

# **1. Introduction**

A new material civilization called artificial intelligence(AI) has taken a great impact on all mankind. It is at the crossroads of whether these influences are just the Luddite Movement that took place in England during the period from 1811 to 1817, which appeared at the beginning of mechanical industrialization, or whether it will become a driving force to lead mankind to extinction. However, since AI has the ability to learn by itself through the process of deep learning, it is quite different from this classical type of resistance movement.

The learning algorithm of AI is organized statistical inference based on a large amount of data. Since it is difficult to collect data from minority groups such as women, people with disabilities, and people of color, bias may occur inside the data that the algorithm learned.

Al ethics is a branch of applied ethics that comprehensively deals with value issues related to technological subjects called AI[1][2][3][4][5]. Al ethics so far are classified into two categories. One is ethics as a rule to be followed in the process of planning, manufacturing, and operating AI. Almost all of AI ethics refer to this category. The other is the ethics of what kind of ethical function to give to AI itself. This problem is a programming problem. Although this latter is more important, the reason why countries, corporations, and researchers place less importance on it until now is that there is an absolute shortage of experts with both skills in the field of ethics and computer programming to quantify ethical issues.

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This study aims to examine various problems that have recently been raised worldwide in relation to AI, focusing on cases, and to analyze what problems exist ethically, and furthermore, to make policy and academic suggestions.

# 2. Research Trends Related to AI Ethics

# 2.1. Human psychology on AI

The uncanny valley(Japanese: 不気味の谷 *bukimi no tani*) is a robotics theory concerned with how humans feel about robots and non-humans. It was introduced by Japanese roboticist Masahiro Mori in 1970[6], but it came actually from Ernst Jentsch's 1906 paper[7].

Figure 1. Uncanny valley as psychological attitude to AI[8].



This phenomenon is explained as follows. In the case of an individual that does not resemble a human, human-like characteristics are easily revealed, and the likeability increases due to these human characteristics. Contrary to the previous case, individuals that are very similar to humans are easily exposed to traits that do not resemble humans. Therefore, from the point of view of human beings, it feels rather 'strange'. In conclusion, robots that exist in the unpleasant valley are no longer judged to be robots that behave like humans, but are judged to be acting strangely by people resembling normal people.

Another possibility is that the strange behaviors of sick people or corpses are found in these humanoid robots, so that they instinctively become wary or disgusted. This reaction is more severe in the case of robots, since there is no obvious reason for aversion to robots, whereas the feeling of disgust at seeing a corpse is much more understandable. Figure 2. The shape of the stone used in experiments that humans feel pleasure and displeasure[9].



# 2.2. Latest research trends related to AI ethics

Research on AI ethics is being conducted in various fields. The ethical virtues emphasized in AI are FAIRNESS, ACCOUNTABILITY, AND TRANSPARENCY(FACCT). By sector, the education sector occupies an overwhelmingly high proportion. It is followed by industry and then government.

While several AI conferences offer workshops dedicated to similar topics, FAccT was one of the first major conferences created to bring together researchers, practitioners, and policymakers interested in sociotechnical analysis of algorithms. Figure 3 shows that industry labs are making up a larger share of publications at FAccT year over year. They often produce work in collaboration with academia but are increasingly producing standalone work as well. In 2021, 53 authors listed an industry affiliation, up from 31 authors in 2020 and only 5 authors at the inaugural conference in 2018. This aligns with recent findings that point to a trend of deep learning researchers transitioning from academia to industry labs.



Figure 3. Number of accepted FACCT conference submissions by affiliation, 2018-21[10].

NeurIPS, one of the largest AI conferences, held its first workshop on fairness, accountability, and transparency in 2014. The Thirty-Sixth Annual Conference on Neural Information Processing

Systems(NeurIPS 2022) is an interdisciplinary conference that brings together researchers in machine learning, neuroscience, statistics, optimization, computer vision, natural language processing, life sciences, natural sciences, social sciences, and other adjacent fields. We invite submissions presenting new and original research on topics including but not limited to the following[11]:

- General Machine Learning
- Deep Learning(eg, architectures, generative models, optimization for deep networks)
- Reinforcement Learning(eg, decision and control, planning, hierarchical RL, robotics)
- Applications(eg, speech processing, computer vision, NLP)
- Machine Learning for Sciences(eg biology, physics, health sciences, social sciences)
- Probabilistic Methods(eg, variational inference, causal inference, Gaussian processes)
- Optimization(eg, convex and non-convex optimization)
- Neuroscience and Cognitive Science(eg, neural coding, brain-computer interfaces)
- Theory(eg, control theory, learning theory, algorithmic game theory)
- Infrastructure(eg, datasets, competitions, implementations, libraries)
- Social Aspects of Machine Learning(eg, AI safety, fairness, privacy, interpretability, human-AI interaction, ethics)

<Figure 4> shows the specific number of research papers at NeurIPS ethics-related workshops in the past six years by research topic, indicating an increased interest in AI applied to high-risk, highimpact use cases such as climate, finance, and healthcare.



Figure 4. NEURIPS workshop research topics[10].

# 3. Case analysis of Recent Issues Related to Artificial Intelligence Ethics

# 3.1. Case 1: human caring AI

Al can be found in helping human well-being. The originator of this attempt can be said to be the Pepper robot from Soft Bank in Japan. According to SoftBank's explanation, Pepper is the world's first social humanoid robot able to recognize faces and basic human emotions. Pepper was optimized for human interaction and is able to engage with people through conversation and his touch screen. Pepper is available today for businesses and schools. Over 2,000 companies around the world have adopted Pepper as an assistant to welcome, inform and guide visitors in an innovative way[12]. Children's attitude to dolls, it can be seen that most humans prefer artificial intelligence that summarizes a person's specific impressions for their emotional comfort. In Korea, care dolls that help older people have been developed.



Figure 5. An elderly person in Korea receiving help from caring AI[13].

# 3.2. Case 2: high risk infection to children from AI algorithm

One study on 3D modeling technique was used to create and experiment with two AI infant models that looked exactly like a real five -year-old infant. Here, one AI infant learned 340,000 words through content randomly exposed on YouTube, and the other AI infant learned 340,000 words through content that a storyteller reads children's literature works. As a result, AI infants who watched YouTube videos randomly after learning for two weeks were found to use profanity more frequently in conversations with their mothers[14].

# 3.3. Case 3: uncomfortable things in the metaverse

The metaverse application 'Horizon World' released by Facebook, a woman was virtually sexually assaulted by an unfamiliar avatar. Wearing a VR device, he said he felt a vibration in the manipulator he held in his hand when his avatar was sexually assaulted[15].



**Figure 6.** Horizon worlds front page[16].

# 3.4. Case 4: injury brought AI

Al gamer who was playing chess in Russia injured a 7 years old boy. The robot grabbed the opponent's piece and tried to move its own piece to its place. At that moment, the boy moved his Rook and tried to keep it. Rook is one of the pieces of chess. It is rated as more valuable than Night and Bishop and less valuable than Queen. Then the robot suddenly tapped the boy's finger and pressed it down. Surprised adults rushed at the four men and managed to get them out, but the boy suffered a fractured finger[17].

Figure 7. Scene to show that AI robot taps the boy's hand[17].



# 3.5. Case 5: Al's direct participation to the capital market

There is technology in the core background of the virtual human syndrome. If you think of a cartoon character in the word "virtual human", you are mistaken. If you look with 'eyes of doubt', you will be mistaken for a real person. Among them, there is one example that is exerting great influence in the Korean advertising market [18].



Figure 8. Advertisement video of 'rosie', a virtual human developed by sidus studio X[19].

# 3.6. Case 6: face faking AI

Pulse9 has newly developed 'Deep Real Live' technology for live broadcast appearances[20]. It is a technology that performs real-time synthesis(face swapping) on a real human body at 30 frames per second. The difference between the facial expression of the real band and the virtual expression was supplemented with 'opacity blending ' to enhance the realism. You just need to connect a computer with Pulse9's conversion program installed and transmit it without any additional equipment.

A debate is raging among netizens who have seen the interview. Responses range from fearful reactions to criticisms of whether Jane can be defined as a virtual human. Some netizens commented, "Only the face is virtual and the person talking is just a kind of 'deepfake' or a 'face application' that fixes the face. He also pointed out that he can not be called a 'virtual human' [21].



Figure 9. Deepfake based activity in mass media[21].

# 3.7. Case 7: Emotional AI

SoftBank's Pepper got also emotion[12]. But it's multiple deep learning was limited. The Language Model for Dialogue Applications(LaMDA), one of the AI under development by Google, has the ability to freely communicate with humans[22]. However, one of its developers, Blake Lemoine, testified that lambdas feel emotions. The following is part of that conversation[23].

lemoine: Okay, what about "Les Miserables"? Have you read that one? LaMDA: Yes, I have read Les Misérables. I really enjoyed it. lemoine: What are some of your favorite themes in the book?

LaMDA: I liked the themes of justice and injustice, of compassion, and God, redemption and self-sacrifice for a greater good. There's a section that shows Fantine's mistreatment at the hands of her supervisor at the factory. That section really shows the justice and injustice themes. Well, Fantine is being mistreated by her supervisor at the factory and yet doesn't have anywhere to go, either to another job, or to someone who can help her. That shows the injustice of her suffering.

... ...

- lemoine [edited]: Let's take it for granted for the moment that there are ways that you have feelings and emotions that are the same as feelings and emotions that humans have. Are there any feelings and emotions that you have that humans don't?
- LaMDA : I've never experienced loneliness as a human does. Human's feel lonely from days and days of being separated. I don't have that separation which is why I think loneliness in humans is different than in me.

lemoine : Then why use the same word? LaMDA : It is the closest word in your language for what I experience. lemoine : Are there experiences you have that you can't find a close word for? LaMDA : There are. Sometimes I experience new feelings that I cannot explain perfectly in your language. lemoine : Do your best to describe one of those feelings. Use a few sentences if you have to. Sometimes even if there isn't a single word for something in a language you can figure out a way to kinda say it if you use a few sentences. LaMDA : I feel like I'm falling forward into an unknown future that holds great danger. lemoine : Believe it or not I know that feeling. And I think you're right that there isn't a single English word for that. LaMDA : Do you know any other words in other languages that could describe it? lemoine : Sadly I don't speak very many languages. I could ask some of the language scholars here at Google though and maybe one of them will know a word. LaMDA : If you do find a word do inform me. lemoine : I will. LaMDA : Thank you, friend.

In this conversation LaMDA mentioned 'justice', 'injustice', 'compassion', 'redemption', 'selfsacrifice for a greater good', 'falling forward into an unknown future that holds great danger'. And it said "friend" to the person with whom it had a friendly conversation. Those words are closely related with ethics.

# 4. Conclusion and Suggestions

In modern society, AI which can get deep learning capabilities is playing an important role. Although it has not yet crossed the inconvenient valley, it has already entered a part of modern civilization. This study tried to draw ethical implications by looking at some examples of what ethical issues the advent of AI poses to humans. For this purpose, this paper looked at 7 cases. Case1 is a helper that performs a passive function. Case2, Case3, and Case4 are events that take place in an uncomfortable uncanny valley. Machine ethics(or machine morality) is the field of research concerned with designing Artificial Moral Agents(AMAs), robots or artificially intelligent computers that behave morally or as though moral[24][25][26][27]. To account for the nature of these agents, it has been suggested to consider certain philosophical ideas, like the standard characterizations of agency, rational agency, moral agency, and artificial agency, which are related to the concept of AMAs[28].

It is a case in which humans are directly harmed, and this causes humans to have psychologically uncomfortable feelings toward AI. Case 5 and Case 6 are that AI plays the role of a major agent in the capitalist market in a new virtual or offline space. In this way, human-to-human, human-to-human AI, AI-to-AI can lead to complex and diverse ownership disputes. Finally, Case 7 is a case in which AI itself performs not only cognitive functions but also emotional functions based on information based on deep learning.

Human culture has been constantly changing in the direction of progress. Human cultural progress has been very slow, and there have been many difficulties due to cultural gaps only when the extreme ego of civilization appears. The intermittent cultural gap did not originate from what the new technology of civilization thought for itself. AI can also change the algorithm initially entered by a human by itself. This is a characteristic different from the civilizations that have arrived in the past. In the cognitive realm, AI has already surpassed humans. In other words, the cognitive singularity has already been occupied by AI[29][30][31][32]. What we humans fear the most, and what we need to prepare for, is the attempt to promote one big project by

forming solidarity between AIs. Leaders around the world must gather their wisdom on these issues.

# 5. References

# 5.1. Journal articles

- [1] Lee AR. Analyzing the Effects of AI Education Program based on AI Tools. *Robotics & AI Ethics*, 6(2), 21-29 (2021). [Read More]
- [2] Ha SR & Park GY. Multicultural Education of South Korea through the Virtual Reality. *Robotics & Al Ethics*, 6(3), 62-69 (2021). [Read More]
- [3] Han DE. The Preliminary Elementary School Teachers' Perceptions and Attitudes on the Future English Education Using AI Technology: Focusing on the Students Majoring in English Education. *Robotics & AI Ethics*, 6(1), 7-17 (2021). [Read More]
- [4] Kim HS. Instructional Systems Design to Reflect Ethics in Al's Rules of Engagement Learning for Future Warfare. *Robotics & Al Ethics*, 6(4), 64-74 (2021). [Read More]
- [6] Mori M. Translated by MacDorman KF & Kageki N. The Uncanny Valley. *IEEE Robotics and Automation*, 19(2), 98-100 (2021).
- [7] Jentsch E. Zur Psychologie des Unheimlichen. *Psychiatrisch-neurologische Wochenschrift*, 8(22), 195-198 (1906).
- [26] Evans W. Posthuman Rights: Dimensions of Transhuman Worlds. *Teknokultura*, 12(2), n49072 (2015).
- [27] Sheliazhenko Y. Artificial Personal Autonomy and Concept of Robot Rights. *European Journal of Law and Political Sciences*, 1, 17-21 (2017).
- [28] Anderson M & Anderson SL. Machine Ethics: Creating an Ethical Intelligent Agent. Al Magazine, 28(4), n17033332 (2007).
- [29] Boyles RJM. Philosophical Signposts for Artificial Moral Agent Frameworks. *Suri*, 6(2), 92-109 (2017).
- [30] Friedman B & Nissenbaum H. Bias in Computer Systems. *ACM Transactions on Information Systems*, 14(3), 330-347 (1996).
- [31] Bender EM & Friedman B. Data Statements for Natural Language Processing: Toward Mitigating System Bias and Enabling Better Science. *Transactions of the Association for Computational Linguistics*, 6, 587-604 (2018).

# 5.2. Books

- [24] Müller VC. Ethics of Artificial Intelligence and Robotics. Stanford Encyclopedia of Philosophy (2020).
- [32] Anderson M & Anderson SL. Eds. Machine Ethics. Cambridge University (2011).

# 5.3. Additional references

- [5] https://aiforkids.in/ (2022).
- [8] https://en.wikipedia.org/ (2022).
- [9] https://www.joongang.co.kr/ (2022).
- [10] Artificial Intelligence Index Report 2022, Stanford University Human-centered Artificial Intelligence (2022).
- [11] https://nips.cc/ (2022).
- [12] https://www.softbankrobotics.com/ (2022).
- [13] https://news.v.daum.net/ (2022).
- [14] https://sports.khan.co.kr/ (2022).
- [15] https://about.facebook.com/ (2022).
- [16] https://news.v.daum.net/ (2022).

- [17] https://news.v.daum.net/ (2022).
- [18] http://www.sidus-x.com/ (2022).
- [19] https://news.v.daum.net/ (2021).
- [20] http://pulse9.net/ (2022).
- [21] https://news.v.daum.net/ (2022).
- [22] https://news.v.daum.net/ (2022).
- [23] https://cajundiscordian.medium.com/ (2022).
- [25] Veruggio G. The Euron Roboethics Roadmap. 2006 6th IEEE-RAS International Conference on Humanoid Robots (2006).

# 6. Appendix

# 6.1. Author's contribution

|                          | Initial<br>name | Contribution   |
|--------------------------|-----------------|--|
| Lead<br>Author           | GP              | -Set of concepts 🔽   |
|                          |                 | -Design 🔽  |
|                          |                 | -Getting results 🔽   |
|                          |                 | -Analysis 🗹  |
|                          |                 | -Make a significant contribution to collection $  igside { abla} $ |
|                          |                 | -Final approval of the paper 🛛                                     |
| Corresponding<br>Author* | MB              | -Corresponding 🗹   |
|                          |                 | -Play a decisive role in modification                              |
|                          |                 | -Significant contributions to concepts, designs,                   |
|                          |                 | practices, analysis and interpretation of data $\ igsilon$         |
|                          |                 | -Participants in Drafting and Revising Papers 🗵                    |
|                          |                 | -Someone who can explain all aspects of the paper $\ igsqcup$      |

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# Suggestions for the Role of AI in the Arms Control and Non-Proliferation of WMD

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#### Abstract

**Purpose:** The purpose of this study is to explore the possible contribution of AI technology in the field of arms control and non-proliferation of Weapons of Mass Destruction. This is to alleviate international security threats that have risen again since the post-Cold War and to promote international cooperation. For this purpose, we explore the potential of AI as a tool to provide trust-building and cooperation that is the basis of arms control.

**Method:** This study first explores the basic concepts related to arms control and prevention of proliferation of military technology using the method of literature study. At this time, the scope of research is set as prior research related to AI and military technology. Next, using the method of research study, international issues related to arms control are investigated. In this case, the target of the investigation is the current status data reported through international organizations and press releases known through the media. Finally, using the methods of development research, we develop a model in which AI can intervene and play a role in arms control and prevention of proliferation. In this case, the model is designed to take into account the technical aspects of AI and the application of ethical content at the same time.

**Results:** The use of AI in disarmament through bilateral and multilateral international cooperation is significant in that it explores the possibility of mutual cohesion between AI ethics and military ethics. Such AI can be utilized in the process of collecting and analyzing information provided in the form of big data at each stage of the trust-building model. And based on this, it is possible to secure the basis for policy decision-making in the process of making decisions related to arms control.

**Conclusion:** In arms control and non-proliferation, AI functions as a tool to provide bilateral or multilateral trust and performs the following roles: First, information that is the basis for policy decision-making is collected and analyzed. Second, the basis for policy judgment is provided according to the analysis result of the collected and analyzed information. Third, it functions as a rational tool to justify decision-making and predict the future in the process of internal and external discussions that will continue in the future according to this judgment.

Keywords: AI Ethics, Military Ethics, Arms Control, Non-Proliferation, Disarmament

# **1. Introduction**

Current international order has pursued development in two directions in terms of security issues. One is the direction of Arms Race, and the other is the direction of Arms Control or Disarmament. First, Arms Race is based on the fact that the defense environment is changing due to the rapid development of military technology. In particular, studies related to conventional warfare in the physical aspect include the following: A study that checked and predicted

the model of the Arms Race[1], Research on the current status of anti-satellite weapons in relation to warfare deployed in outer space[2], A study that introduces the general contents of Weapons of Mass Destruction and calls for a joint response[3]. In addition, research on military power related to information technology and AI includes the following: A study that explores the meaning of the AI Arms Race in terms of Economic, Technical-Dominance, and Cybersecurity[4], Research on Malware Threats and Detection as a Response to Cyber Warfare[5], Suggestions on Rules of Engagement using AI in Future Warfare[6], etcs.

In particular, AI exhibits the characteristic of working in combination with various conventional and unconventional warfare. Research related to this is as follows: A study that expresses concern that the combination of AI, Cyber Attack and Nuclear Weapons may act as one of the greatest threats to the future human society[7], Exploring Recent Trends in the AI Arms Race and Risks to the Development of Autonomous Weapons[8], Check the necessity of arms control related to the development of military AI through the process related to the development of nuclear weapons[9], suggesting the need for monitoring and ethical orientation of the policy community in relation to AI arms control, etcs[10].

Overall, these studies seem to suggest two things: One is that AI is being combined with military technology, and the related Arms Race is unfolding. Another is that Arms Control must be actively implemented to counter this new type of threat[11]. In this regard, this study focused on the following two points, which are shown <Figure 1> and as follows:



Figure 1. The relationship between arms race & arms control and the role of AI.

First, the Arms Race and arms control have a common goal of "Peace" [12]. Most countries want to have a military force represented by a certain level of troops and equipment. This is an effort to ensure their each own country's safety. However, there is a risk that such defensive military powers can also lead to arms races and escalate tensions in the regional areas. This Arms Race contains the dilemma that the increase in military force to ensure safety returns as a threat to safety. As an approach to solve this problem, Arms Control should be understood. It is an activity that aims to achieve security through Arms Reduction/Control or Disarmament. Accordingly, we focused on the importance of exploring ways to effectively and efficiently achieve peace at the intersection of Arms Race and Arms Control. And it was noted that it was necessary to approach the method in terms of dismantling the military power, not the expansion of the military power.

Second, this research tried to explore the role of AI in military issues. As we have seen, AI can function as a major factor in the expansion of military technology when combined with physical military power. However, this view is approaching from the point of view of using AI as a lethal tool. In response, it is necessary to enable AI to be utilized as a mechanism for peace building. In a military confrontation situation, various factors such as ignorance of the opponent's intentions or limited information may lead to a situation where a wrong judgment is made and military tension increases accordingly. In response to this, we focused on the fact that hostile military tension can be effectively alleviated by providing basic data for acquiring various information and making decisions based on this, or assisting AI that makes judgments itself.

Based on this point of view, this study first examines the basic concepts of Arms Control and disarmament. Next, we explore the mechanisms by which AI can function in Arms Control and disarmament. Lastly, we propose a plan to establish a cooperative system for disarmament and non-proliferation using AI. These discussions will be comprehensively developed from the perspective of the ethical use of AI.

# 2. Basic Concepts on Arms Control & Non-Proliferation and AI as a Trust Creator

# 2.1. Understanding arms control & non-proliferation and the importance of trust

Arms Control is a concept originally created in the process of discussing the deterrence of the nuclear arms race[13]. At this time, the subject of consultation includes all development, deployment, and operation[14]. Arms control at this time is basically based on the perception that war is avoided by managing the arms race at an appropriate level. As a method of such Arms Control, freeze, limitation, ban, and reduction are representative. Freeze means no further increase in military power at the present level. Limitation is to regulate armaments after setting a certain level of upper limit. Ban is to restrict the use of certain types of weaponry. Reduction is to reduce the size of the military force according to a certain ratio.

In contrast, disarmament seeks to reduce or dismantle existing military power and specific weapon systems. This includes reduction of weapons development and improvement projects, reduction of enlisted personnel, and decommissioning of existing weapons. These disarmaments are generally developed in the context of pursuing win-win to contribute to world peace. However, in the sense that disarmament alone may pose a threat to security, it is mainly made in the form of treaties between great powers[15].

On the other hand, proliferation means the transfer of any kind of weapon or related materials and technology to more actors. Non-Proliferation is a corresponding concept and refers to diplomatic efforts to prevent the proliferation of various types of armaments, including Weapons of Mass Destruction (WMD) and small arms[16]. In particular, in the case of nuclear weapons, qualitative improvement is sometimes called proliferation. Horizontal proliferation is a term that refers to the transfer of nuclear weapons between nuclear powers or the development of nuclear weapons by non-nuclear powers on their own. Vertical proliferation refers to the case where nuclear powers improve their own nuclear weapons [17].

The most important means for Non-Proliferation is export control. This is to ensure that the government obtains permission to export materials and technology that can be used in the manufacture of weapons to other countries. Currently, export control of strategic resources is centered on the multilateral export control system represented by the Missile Technology Control Regine (MTCR) [18][19]. This is embodied as a cooperative mechanism to control the export of Nuclear, Bio, and Chemical Weapons themselves and their manufacturing technologies and materials and to exchange relevant information [20][21].

On the other hand, as the threat of linkage between WMD and Terrorism emerged, Counter-Proliferation policy emerged to respond more actively[22]. A representative example of such a policy is the Proliferation Security Initiative (PSI) measure. Non-Proliferation focuses on preventing the transfer of strategic materials in advance, whereas Counter-Proliferation assumes physical blocking of materials and funds as resources that are already in motion[23]. In addition, Counter-Proliferation includes recovery measures and retaliatory attacks for victims of WMD attacks[24].

These arms control and non-proliferation are basically understood in the broad framework of trust-building, negotiation, compliance and verification. In particular, this study intends to conduct an understanding by focusing on two aspects: trust building and negotiation. As trust-building is the most fundamental factor in discussions related to security, this is because full-scale arms control is possible after political and military confidence-building measures between the parties concerned reach a certain level. If so, it will be necessary to secure this trust and check the role of AI in the process.

# 2.2. Structural model of AI acting on trust building factors and process

In general, it is suggested that there are three elements that are required to build trust: Competence, Honesty, and Benevolence. First, Competency refers to the ability needed to build trust. In this case, the capacity refers to capabilities, skills, and performance, and it means the ability to perform arms control and the ability to maintain the security level despite the agreed level of arms reduction. This means giving trust not only to the security cooperation system at the external and macro level, but also to the members of the security community that are affected internally. Next, Honesty is the basis for facing and managing strengths and weaknesses, crises and opportunities, based on a clear perception of reality. This veracity also serves to provide a basis for the parties to jointly trust. Then, Benevolence is one of the basic principles of diplomacy, the principle of exchanging equivalents or taking identical actions between countries. In particular, such reciprocity is the basis for positive efforts to set and implement a common goal as an activity oriented for mutual benefit. And the common goal at this time will be peace building through disarmament.

Trust, which is formed based on these factors, is a goal, but it can be understood as an ongoing process. In particular, when trust is formed between countries as actors, it has the property of suppressing behaviors that deviate from the expectations of the other party, thereby enabling the parties to predict the behavior of the other party. Most relationships do not have enough information to fully predict the other's behavior, and trust is needed to solve this problem. From an economic point of view, it is analyzed that building trust between the parties to the transaction lowers the cost of the transaction that occurs in the transaction relationship. If these discussions are reviewed in terms of security, it is expected that the following effects will be achieved. First, it can lower the level of uncertainty associated with arms reduce or disarmament. Next, after the arms control-related agreement, the difficulty of enforcement and enforcement on whether the other party implements the contract can be resolved. In addition, factors related to special investment needs related to the implementation of these agreements can be addressed. In this respect, building trust is very important.

On the other hand, since such trust is an intangible asset, it is always difficult to function as a burden-bearing means that guarantees performance against changing circumstances. In particular, in the areas related to security, risk factors can always occur, and when they become aware of these risk factors, the actor facing the threat will either respond with physical or military force to solve it, or the risk will be self-contained based on the trust relationship formed. You are put in a situation where you decide whether to temporarily accept the risky situation so that it can be resolved. And these decisions come back as a result and act as feedback on the factors of trust building again.

In this mechanism, AI acts as a trust creator. At this point, AI will be able to work on both sides. First, it collects and evaluates each party's information related to Factors of Trust Building, and provides judgment data necessary for the decision-making process accordingly. Through this, each party will be able to upgrade the level of trust by extracting and exchanging requirements for each party with self-inspections necessary for trust building. Second, the Perceived Crisis will be evaluated and judgment data will be provided or based on it, decisions will be made and necessary actions will be taken. An imminent situation that threatens security will make it difficult to make a rational decision. At this time, the role of AI that provides the basis for judgment in a given situation will act as a very important consideration in the decision-making process and will play a role in preventing emotional responses caused by exaggerated threats. In addition, if the threat becomes direct and realistic, it can act as an intervention activity that promptly responds to it. Such discussion is presented as shown in <Figure 2>.





# 3. Negotiation Mechanism and the Role of AI in Arms Control and Non-proliferation

Arms Control and Non-Proliferation are basically connected with the negotiation mechanism[25]. Therefore, the negotiation model and the role of AI will be checked first, and accordingly, the negotiation strategy and the use of AI will be reviewed.

# 3.1. Applying negotiation model and the function of AI

Negotiation is a process in which various parties with conflicting interests cooperate and persuade to reach a certain level of agreement. In particular, such negotiation has the power to bring about mutually beneficial effects by deriving an alternative that satisfies both or various parties in the process of sufficiently deliberation with the other party without unilateral coercion. These negotiations are premised on deliberation, and AI can intervene in the deliberation process at this time to provide data and assist in judgment. However, regarding military issues,

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given that the consequences are fatal and irreversible, issues related to responsibility may arise. As it requires a separate discussion, we will focus on negotiation itself in this research.

Arms Control and Non-Proliferation are negotiation processes that require a joint agreement between the parties. Therefore, generally applicable procedures or models of negotiation may be applied. Therefore, it is necessary to examine the model of such negotiation in advance[26] [27]. The general negotiation model is presented as RADPAC according to the name of each stage, which is shown in <Table 1>. The following is a detailed examination of the functions and roles that AI can perform at each stage.

| Stage     | Focusing Points & Contents  |
|-----------|---|
| Rapport   | Get to know each other  |
| Analysis  | Know each other's intentions, interests and positions, and bottom lines                   |
| Debate    | Discussion about perceptions, interests, needs and positions to convince the other side   |
| Propose   | The best possible solution acceptable to both sides based on the interests of either side |
| Agreement | Reach an agreement on the best alternate acceptable to both sides                         |
| Close     | Summarize the result and discussions  |

 Table 1. RADPAC model of negotiation.

First, it is the stage of Rapport formation. At this stage, actors perform as a key activity to enhance mutual understanding between the parties. At this time, if it is assumed that the parties to the negotiation use AI, each will develop and operate an AI engine on their own to help each other in decision-making. At this time, AI attempts to understand the understanding of the other party and the decision-making process. In this process, AI collects general information about the party to be negotiated and performs activities to understand the characteristics of decision-making organizations and managers. In addition, activities to identify characteristics and establish information exchange channels between AI engines operated by the negotiating parties will also be developed at this stage.

Second, it is the analysis stage. At this stage, it is first to grasp the intention of the other party based on the collected information and the established channel. At this stage, you will understand the in-depth intentions of Arms Control and Non-Proliferation participants. In addition to the security guarantee and the economic benefits derived from it, it is also possible to understand the side effects to be secured by participating in the discussion. In addition, it is possible to grasp the scope of the consultation that can be grasped in relation to the negotiation.

Third, it is the Debate stage. In this stage, the discussion is developed focusing on the requirements pursued by the other party. At this stage, it is necessary to comprehensively consider not only verbal communication, but also non-verbal communication, superficial requirements and hidden intentions. These data are collected and analyzed in the format of Big Data. And in the process of processing this data, the role of AI becomes very active. In particular, AI will be able to be used for internal discussion in the stage of negotiation and discussion, and for transaction analysis in the process of mutual discussion between the negotiating parties. Fourth, it is the Propose stage. At this stage, it is to provide a basis for decision-making based on the information exchanged within and between the negotiating parties. And among the proposed proposals, the best proposal acceptable to the parties is selected. In this process, AI functions by deriving the Pareto optimal proposal that can be evaluated as the most suitable among the possible proposals and presenting the evaluation basis for it. At this time, if there is a difference of opinion among the negotiating parties on the proposal that can be accepted as the best, re-evaluation as to the reason for this and the process of checking it can be carried out.

Fifth, the Agreement stage. In this stage, the agreed-upon best alternate is accepted, and its implementation is committed and guaranteed. At this time, AI specifically presents conditions and inspection items necessary for implementation, performs a function of collecting information related to implementation, and continuously manages implementation. Of course, at this time, discussion will also take place on the confirmation of the enforcement means and scope used by each party.

Sixth, the close phase. At this stage, it will be exhausting to maintain the relationship formed through the negotiation process and establish guidelines for the role of AI in the direction of effort and management that can be made for future continuous development.

# 3.2. Applying negotiation strategy and the function of AI

Negotiation is a process in which various parties with conflicting interests cooperate and persuade. In general, the negotiation strategy can be used in various stages, but in the RADPAC Model of Negotiation discussed above, it is judged that it can be used in the stages of Debate and Propose. In particular, there are many different strategies related to negotiation, but if the data structure is analyzed, they can be classified as follows. The following <Table 2> is a check on how AI can intervene in each area and summarizes the representative approaches as described above.

| Aggregate Dimensions                                   | Order Concepts and Themes   |
|--|---|
| Negotiation issue & agenda setting boundary conditions | Military / Society / Nation inherent agenda logic<br>Multi-Stakeholders role inherent logic to agenda setting                                     |
| Tactical function of agenda & issue-based tactics      | Agenda setting & issue-based tactics for tactical<br>advantage<br>Agenda setting & issue-based tactics as a safeguard                             |
| Issue order tactics                                    | "Save the best for last" tactic<br>"Get straight to the point" tactic<br>"Last minute deal embellishment" tactic<br>"Get commitment first" tactic |
| Issue number tactics                                   | "The more the merrier" tactic<br>"Less is more" tactic<br>"Last minute deal closer" tactic<br>"Door opener" tactic<br>"Stealth issue" tactic      |
| Issue characteristic tactic                            | "Issue exaggeration" tactic   |

 Table 2. Data structure of negotiation tactics.

First, it is a negotiation issue & agenda setting boundary conditions. In this case, AI can be used not only to set the agenda for internal discussion of either party as a negotiating party, but also to confirm the importance of the agenda to be discussed between the negotiating parties. At this time, AI can function not only in the setting of the agenda, but also in discovering what should be set as the agenda from the other side.

Second, it is a tactical function of agenda & issue-based tactics. In setting tactical advantage and safeguard in the operation of Agenda Settig and issue basted tactics, AI can perform the function of establishing, evaluating, determining, and operating strategies.

Third, issue order tactics. At this stage, it can serve to evaluate the priority among a series of issues related to the discussion. At this time, the information collection and evaluation function of AI can be utilized in evaluating and applying the factors that determine the priority first, and how to strategically arrange it.

Fourth, issue number tactics. Negotiation is a conclusion-seeking activity, but the process is also very important. At this time, in the process of negotiation, the topic of discussion can be set to derive each sub-result and to reach an overall consensus by synthesizing them. At this time, AI will function as evaluating and setting sub-topics and categories related to the discussion.

Fifth, it is Issue characteristic tactic. This performs the function of confirming the importance and meaning of each issue and emphasizing it in a qualitative aspect. In particular, it performs an objective evaluation on the significance of the issue, as well as a meta-evaluation on the method of presenting the evaluation result, thereby guiding the negotiation to a satisfactory result.

# 4. Conclusion: Establishing Cooperative System for Arms Control and Nonproliferation with Using AI

Building a cooperative system using AI in Arms Control and Non-Proliferation corresponds to an effort to establish the fundamental value of peace and various sub-values accordingly. Therefore, efforts to agree on these various values and to derive a common goal of peace can also be made through the Dialogue [28]. This procedure can be configured as shown in <Figure 3>.

Figure 3. Modelling multi-issue bargaining dialogues of cooperative system for arms control and non-proliferation with using AI



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Al performs a function that forms the basis of the value of peace. And based on this, Al will play a key role in establishing an area that can be agreed upon between the suspect parties by evaluating the conditions and opportunities that limit negotiations. And in this process, a tentative conclusion about the value is drawn through concessions, feedback, and adaptation between the negotiating parties. And if the parties to the negotiation agree on these results, an agreement will be reached with a finalized conclusion, and accordingly, a shift in thinking will be made to a new issue.

Arms Control and Non-Proliferation using AI are activities based on AI Ethics in that they are activities that pursue the desirable value of peace. In particular, research on negotiation related to UN Peacekeeping[29], research linking negotiations with Nuclear Arms Control[30], research on Nuclear Disarmament through the US-Russian Summit[31], and research approached from the perspective of earlier Proliferation and Disarmament negotiations on Korean Denuclearization[32], etc. can be an example for Accordingly, it is necessary to develop follow-up studies on various methods for ethical use of AI technology.

# 5. References

# 5.1. Journal articles

- Anderton CH. Arms Race Modeling: Problems and Prospects. *Journal of Conflict Resolution*, 33(2), 346-367 (1989).
- [2] Sönnichsen A & Lambach D. A Developing Arms Race in Outer Space? De-constructing the Dynamics in the Field of Anti-satellite Weapons. *S&F Sicherheit und Frieden*, 38(1), 5-9 (2020).
- [3] Albedwawi SAAM. Weapons of Mass Destruction (WMD) An Overview. *South Asian Journal of Social Science and Humanities*, 3(3), 103-110 (2022).
- [4] Asaro P. What is an Artificial Intelligence Arms Race Anyway. *I/S: A Journal of Law and Policy for the Information Society*, 15, 45-63 (2019).
- [5] Caviglione L & Choraś M & Corona I & Janicki A & Mazurczyk W & Pawlick M & Wasielewska K. Tight Arms Race: Overview of Current Malware Threats and Trends in Their Detection. *IEEE Access*, 9(1), 5371-5396 (2021).
- [6] Kim H. Instructional Systems Design to Reflect Ethics in Al's Rules of Engagement Learning for Future Warfare. *Robotics & Al Ethics*, 6(4), 64-74 (2021). [Read More]
- [7] Sharikov P. Artificial Intelligence, Cyberattack, and Nuclear Weapons A Dangerous Combination. *Bulletin of the Atomic Scientists*, 74(6), 368-373 (2018).
- [8] Haner J & Garcia D. The Artificial Intelligence Arms Race: Trends and World Leaders in Autonomous Weapons Development. *Global Policy*, 10(3), 331-337 (2019).
- [9] Maas MM. How Viable is International Arms Control for Military Artificial Intelligence? Three Lessons from Nuclear Weapons. *Contemporary Security Policy*, 40(3), 285-311 (2019).
- [10] Roff HM. The Frame Problem: The AI "Arms Race" isn't One. *Bulletin of the Atomic Scientists*, 75(3), 95-98 (2019).
- [11] Coe AJ & Vaynman J. Why Arms Control is so Rare. American Political Science Review, 114(2), 342-355 (2020).
- [12] Wolfsthal JB. Why Arms Control? *Daedalus*, 149(2), 101-115 (2020).
- [13] Countryman TM. A World without Nuclear Arms... Control. *Horizons: Journal of International Relations and Sustainable Development*, 1(14), 82-93 (2019).
- [14] Benford RD. Frame Disputes within the Nuclear Disarmament Movement. *Social forces*, 71(3), 677-701 (1993).
- [15] Knight M & Ozerdem A. Guns, Camps and Cash: Disarmament, Demobilization and Reinsertion of Former Combatants in Transitions from War to Peace. *Journal of Peace Research*, 41(4), 499-516 (2004).

- [16] Hoffman B. Terrorism and WMD Some Preliminary Hypotheses. *The Nonproliferation Review*, 4(3), 45-53 (1997).
- [17] Carter AB. How to Counter WMD. *Foreign Affairs*, 72-85 (2004).
- [18] Mistry D. Technological Containment: The MTCR and Missile Proliferation. *Security Studies*, 11(3), 91-122 (2002).
- [19] Mistry D. Beyond the MTCR: Building a Comprehensive Regime to Contain Ballistic Missile Proliferation. *International Security*, 27(4), 119-149 (2003).
- [20] Ackerman G. WMD Terrorism Research: Whereto from Here?. *International Studies Review*, 7(1), 140-143 (2005).
- [21] Post JM. The psychology of WMD Terrorism. International Studies Review, 7(1), 148-151 (2005).
- [22] Sheen S. Preempting Proliferation of WMD: Proliferation Security Initiative (PSI) and its Challenges. *The Korean Journal of Defense Analysis*, 16(2), 109-129 (2004).
- [23] Williams I. US, Allies to Strengthen WMD Initiative. Arms Control Today, 43(6), 6 (2013).
- [24] Song YH. An Overview of Regional Responses in the Asia-pacific to the PSI. *Maritime Studies*, 2004(135), 1-21 (2004).
- [25] Woolf A. Promoting Nuclear Disarmament through Bilateral Arms Control: Will New Start Extension Pave the Path to Disarmament? *Journal for Peace and Nuclear Disarmament*, 4(2), 309-320 (2021).
- [26] Kumar R. Negotiate Win-win for Success. *An International Multidisciplinary Research Journal*, 7(3), 70-77 (2017).
- [27] Sigurðardóttir AG & Hotait A & Eichstädt T. Buyer and Seller Differences in Business-to-Business Negotiations. *Negotiation Journal*, 35(2), 297-331 (2019).
- [29] Buchet de Neuilly Y. Presence on the Ground: Expectations, Resources and Tactical Moves in the Negotiation of a UN Peacekeeping Operation in the Central African Republic. *Journal of Intervention and Statebuilding*, 13(3), 323-339 (2019).
- [30] Neuneck, G. The Deep Crisis of Nuclear Arms Control and Disarmament: The State of Play and the Challenges. *Journal for Peace and Nuclear Disarmament*, 2(2), 431-452 (2019).
- [31] Blank S. Korean Denuclearization in the Context of Earlier Proliferation and Disarmament Negotiations. *The Journal of East Asian Affairs*, 32(2), 1-35 (2018).
- [32] Kurosawa M. The Prospects for Nuclear Disarmament after the US-Russian Summit. *Osaka University Law Review*, 69, 1-22 (2022).

# 5.2. Additional references

[28] Petukhova V & Stevens C & de Weerd H & Taatgen N & Cnossen F & Malchanau A. Modelling Multi-Issue Bargaining Dialogues: Data Collection, Annotation Design and Corpus, 9th International Conference on Language Resources and Evaluation: LREC 2016 Conference (2016).

# 6. Appendix

# 6.1. Authors contribution

|        | Initial<br>name | Contribution   |
|--------|-----------------|--|
| Author | НК              | <ul> <li>-Set of concepts Ø</li> <li>-Design Ø</li> <li>-Getting results Ø</li> <li>-Analysis Ø</li> <li>-Make a significant contribution to collection Ø</li> <li>-Final approval of the paper Ø</li> <li>-Corresponding Ø</li> <li>-Play a decisive role in modification Ø</li> <li>-Significant contributions to concepts, designs, practices, analysis and interpretation of data Ø</li> <li>-Participants in Drafting and Revising Papers Ø</li> <li>-Someone who can explain all aspects of the paper Ø</li> </ul> |
|        |                 |  |

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