JKSCI

한국컴퓨터정보학회논문지
Journal of The Korea Society of Computer and Information
Vol. 27 No. 8, pp. 253-261, August 2022
https://doi.org/10.9708/jksci.2022.27.08.253

The Effect of the Project Learning Method on the Learning Flow and AI Efficacy in the Contactless Artificial Intelligence Based Liberal Arts Class

Ae-ri Lee*

*Professor, Dept. of Liberal Arts, Catholic Kwandong University, Gangneung, Korea

[Abstract]

In this study, the educational effect were sought to be identified after developing and applying project learning for the artificial intelligence based liberal arts education for the non-computer majors. A paired-sample t-test was performed within each group to determine the extent of improvement in the learning flow and artificial intelligence efficacy in the experimental and control groups. After class, an independent sample t-test was performed to examine the statistical effects of pre-test and post-test on the learning flow and artificial intelligence efficacy in the experimental and control groups. The experimental group and control group demonstrated significant improvements in the learning flow and artificial intelligence efficacy before and after class, each respectively. There was no statistically significant difference in the learning flow between the experimental group for which the project learning method was applied and the control group for which only theory and practice were conducted in the artificial intelligence class. It was also confirmed that the experimental group for which the project learning method was applied improved the efficacy of artificial intelligence to a significant level compared to the control group which only proceeded with theory and practice.

▸ **Key words**: Learning Flow, Artificial Intelligence, Project Learning, AI Efficacy, Liberal Arts Class

[요 약]

본 연구에서는 컴퓨터 비전공자 대상의 인공지능 교양 교육을 위한 프로젝트 학습법을 적용한 후 교육적 효과를 파악하고자 한다. 실험집단과 통제집단 각각의 학습몰입, 인공지능 효능감의 향상 정도를 파악하기 위하여 각 집단 내에서 대응표본 t-검정을 실시하였고, 수업 후 실험집단과 통제집단의 학습몰입과 인공지능 효능감에 대한 사전검사와 사후검사의 통계적 효과를 알아보기 위해 독립표본 t-검정을 실시하였다. 그 결과 실험집단과 통제집단은 각각 수업 전과 후 학습몰입과 인공지능 효능감에서 유의미한 향상을 보였다. 인공지능 수업에서 프로젝트 학습방법을 적용한 실험군과 이론과 실습만 진행한 통제집단 간의 학습몰입은 통계적으로 유의한 차이가 없었지만, 프로젝트 학습방법을 적용한 실험집단은 이론과 실습만 진행한 통제집단에 비해 인공지능의 효능감이 유의미한 수준으로 향상되었음을 확인하였다.

▸ **주제어**: 학습몰입, 인공지능, 프로젝트 학습, 인공지능 효능감, 교양수업

• First Author: Ae-ri Lee, Corresponding Author: Ae-ri Lee
*Ae-ri Lee (allee@cku.ac.kr), Dept. of Liberal Arts, Catholic Kwandong University
• Received: 2022. 06. 29, Revised: 2022. 08. 01, Accepted: 2022. 08. 03.

http://www.ksci.re.kr pISSN:1598-849X | eISSN:2383-9945

I. Introduction

The 4th industrial revolution, which is called the intelligent revolution, such as the convergence of new technologies and the connection of all objects and services, is undergoing change towards the future of intelligent society. The artificial intelligence (AI) across various fields is attracting attention by using vast amounts of the generated information. In everyday life, the artificial intelligence assistants are installed on various things beyond smartphones, and the convenience of life is increasing, such as the artificial intelligence recommending various contents according to individual tastes through a recommendation algorithm. In addition to which, the artificial intelligence technology is used in various ways not only in the financial field and in security solutions, but also for the creation of works such as art and music. As such, the artificial intelligence technology is complexly infused with the development of big data and Cloud environments, thereby effectively resolving problems in the real[1][2].

In order to respond to such trend of the times, Korea's education is also trying to change. Education is also focused on the national competency to revitalize software education and lay the foundation for the artificial intelligence education. However, Korea's artificial intelligence education was inadequate to foster the talents necessary for the intelligent information society. It is clear that through the artificial intelligence education, students need to understand artificial intelligence and increase their capabilities to use artificial intelligence well by removing vague fears about it. In order for the students of this era living in the era of the 4th industrial revolution to lead a prosperous and self-directed life, it is necessary to provide an experience of directly learning artificial intelligence education programs along with the software education[3][4].

In particular, the artificial intelligence based course is the first case where the artificial intelligence education is introduced for the national curriculum, and it is aimed at the students who have no experience in the artificial intelligence related education at all. Considering which, it is necessary to prepare for the artificial intelligence education by considering the cognitive development level of the students from elementary, middle school to university. Hence, even at universities, regardless of major programs, all students need the artificial intelligence based liberal arts education[5]. University liberal arts classes are aimed at the students with various majors, and it is difficult to have and maintain the learning motivation compared to classes of their own major programs[6][7]. Accordingly, in this study, by applying the project learning method to the artificial intelligence based liberal arts class and presenting it, and reflecting such limitations, the demands of the times and the characteristics of liberal arts education, project learning for the artificial intelligence based liberal arts education for non-computer majors was sought to be developed and applied, and the educational effect thereafter was sought to be identified.

II. Related works

1. Project learning

Project learning is a teaching and learning method which allows the learners to define problems on their own, establish a plan to solve them, and directly implement them to ensure that they can experience the actual problem-solving process[8]. In the project learning, the learners take the initiative in learning, actively select the specific content, direction, and the depth of learning, and ultimately create the concrete and visible products that solve the problem they have chosen[9][10].

The project learning process is structured and focused on completing the final product for

problem solving within a set period of time, and it can be divided into a preparatory stage to prepare all matters necessary for project execution, a development stage to set a topic and execute a problem-solving process, and a final stage to prepare, present, and evaluate the final product[11].

First, the preparation stage is the stage of preparing all the necessary materials for carrying out the project. In this stage, the students form a team to work on the project together, understand the content related to the learning topic, and search for the necessary materials. Subsequently in the development stage, the students define the problem they want to solve in detail, explore the data needed to solve it, and share ideas for solving the problem[12]. At this time, the students directly implement and complement each other's ideas through the continuous cooperation and interaction to create the final result. In the final finishing stage, the final results are summarized and presented, and the results of each team are shared. At this time, the students have time to evaluate each other's results and reflect on their own. Project learning can bring about various educational effects by providing a learning environment which creates creative results by integrating the existing knowledge and experiences with a new knowledge[14].

Most of the lectures at universities are conducted contactless due to the unavoidable circumstances since the outbreak of COVID-19 in 2020, and as of 2020, most of the liberal arts lectures are still conducted contactlessly. Since the core of the contactless project-based learning is to conduct a project through cooperative learning in an online learning environment, positive interdependence with fellow learners is required. Positive interdependence appears as a positive interaction, and knowledge is shared through the exchange of opinions and information with fellow learners. This determines the performance of not only individual learners but also the entire team[11][12]. The online learning environment has a positive aspect in that it enables meaningful interactions with the fellow learners and instructors by utilizing the advantages of various multimedia tools[13].

2. Learning flow

In general, learning flow refers to a state in which a learner achieves an optimal experience by fully concentrating on a specific situation or task. Learning flow is a concept which refers to the quality of the learner's effort for the desired learning result, and the intensity of the learner's concentration, interest, and effort appearing in the learning process[14][15].

In an immersive state, learners can maximize their potential in performing activities or tasks, while at the same time feeling subjective satisfaction and happiness. Since this learning flow is an important variable predicting academic achievement and an essential variable mediating the relationship between learning motivation and learning outcomes, it has been studied as a key variable in the literature studying academic achievement [16]. In a study between the flow and learning achievement, it was reported that learning flow had a significant effect on learning satisfaction and academic achievement in e-learning courses, and it was also reported as a conclusion that flow had a positive effect on learning satisfaction[16]. The conditions for experiencing flow in online classes are such that the instructor has to have a clear goal, present uncomplicated practical tasks, and an environment in which learning can be accomplished through mutual communication is required[17][18].

According to the studies related to the project and learning flow, activity and flow in which learners can become the subject of learning in classes by using project learning were found, and the elementary school learners not only actively engaged in activities through projects, but also felt their confidence and sense of affiliation about learning[19][20].

III. Research Method

1. Research subject

This study was conducted with the students taking 'Understanding and Utilization of Artificial Intelligence', which is a liberal arts elective course for all grades of C University without any project experience or prior education. Due to the COVID-19 situation, all classes were conducted contactlessly. The experimental group was consisted of the students who took classes in the first semester of 2022 (39 students) and was operated by applying a contactless project class method, while for the classes taken by the control group, as a class for the second semester of 2021 (37 students), it was operated by providing online videos and taking classes. Both semesters were aimed at the students who did not major in computer science. Table 1 illustrates the current status of the study subjects.

Table 1. Descriptive statistics.

Characteristics \ Group		Experimental group (N)	Control group (N)
Gender	Male	20	21
	Female	19	16
total		39	37

2. Research content

This study attempted to examine the changes in the students' learning flow and artificial intelligence efficacy by applying the project learning method for the artificial intelligence based liberal arts classes. The classes for which project learning was applied were used as independent variables, and the pre- and post-test control group's experimental designs were designed in which the students' learning flow and their sense of efficacy towards artificial intelligence were set as dependent variables.

Table 2. Summary of class progress

Learning unit	Week	Contents
Foundation -Lecture	1	Classification and evolution of artificial intelligence
	2	Threats and ethics of artificial intelligence, reliability and security
	3	Machine learning and the machine learning algorithms
	4	Artificial neural networks and deep learning
Practice	5	Relationship between dataset and prediction, data bias
	6	Practice of text recognition classification
	7	Practice of number recognition and decision tree classifier
	9	Understanding and practice of image recognition of artificial intelligence
	10	Practice of natural language processing and artificial intelligence chatbot
Intensive -Team project	11	Recommend Menu project
	12	Guess Feelings Project
	13	Mask entry project
	14	Artificial intelligence chatbot project
	15	Announcement of project outcomes

This study was organized by dividing the 15-week class into 3 modules. The basic module covering the basic concepts and theoretical contents of artificial intelligence from week 1 to week 4, and practice module from week 5 to week 10 in which the contents learned in the basic module are practiced through the actual artificial intelligence platforms and various tools, and classes are held for 15 weeks in the order of the intensive module from week 11 to week 14, where team projects are conducted. Of which, the basic module and the practice module provide video lessons for both the experimental group and the control group to ensure that the lessons are applied. The experimental group carried out the team project in the advanced module, and the control group maintained the practice module[6][21][22][23].

The basic module and practice module are conducted as online content classes, and in the advanced module where team projects are carried out, the real-time classes through Webex and online content classes are run concurrently, and flip learning is also applied when running the real-time classes.

The relevant details are as illustrated in Table 2. In the team project of the advanced module, students complete the team project through the stages of preparation- planning- execution- organization during class time. At this time, the composition of each group and the subject of the project were determined by the instructor. In order to prevent the free ride by team members, which is the most problematic in the team activities, each team member evaluates each team on the team project evaluation paper, and presents the anecdotal basis for awarding points to team members to increase the reliability of the score and prevent free ride[24][25].

3. Measuring tool

To analyze the learning effect of the artificial intelligence class applied in this study, the pre- and post-questionnaires were conducted before and after project learning. All variables were measured on a 5-point Likert scale (Not at all - Strongly agree). Table 3 below shows the survey questions.

In this study, the test tool for examining the effect of project-based artificial intelligence class on learning flow was based on the questions extracted from the Experience Sampling Form, the test tool modified and supplemented by J. Lee was used[16]. According to the results of recent studies, the measurements using these test tools are considered to be relatively objective and reliable measurements. In this study, Cronbach's α turned out to be .83.

Next, the questionnaire questions to measure the learner's sense of efficacy in using artificial intelligence were composed by extracting and modifying a part of the computational thinking ability efficacy area among the software education effectiveness measurement index of Lee and the inspection tool of Hahn was modified and used[4][26]. For example, 'I am confident in drawing a sequence of how to solve problems in my head after receiving software education.' was revised to 'After receiving artificial intelligence training, I am confident in drawing a sequence of how to solve problems in my head.' A total of 5 questions were used, and they were measured on a 5-point Likert scale ranging from 'Not at all' to 'Strongly agree'. The question reliability was .88.

Table 3. Reliability of the survey questions

Areas	Details of questions	Factor value	Cronbach 'α
Learning flow	1. Time seems to fly when I am taking class.	.870	.838
	2. I rarely pay attention to other matters while in class.	.755	
	3. I am not affected by my surroundings despite interferences.	.752	
	4. I can focus on my class.	.785	
Artificial intelligence efficacy	5. In the artificial intelligence class, I think on my own to solve a given problem and find a solution.	.889	.888
	6. I can ask questions about how the artificial intelligence works or find out why.	.851	
	7. If I keep learning about the artificial intelligence, I can create the artificial intelligence I want.	.850	
	8. I am confident about drawing a sequence of how to solve problems in my head after receiving the artificial intelligence training.	.883	
	9. I felt a sense of accomplishment through the activities I directly participated in the artificial intelligence class.	.844	

4. Data processing

Based on this study, in order to verify the difference between the group for which the project learning method was applied and the group for which the traditional class was applied in the artificial intelligence class, the questionnaires on learning flow and artificial intelligence efficacy were distributed and recovered. After measuring the reliability of the questionnaire results using the SPSS 23 statistical program for the collected data, the reliability statistic Cronbach's α value was presented. After class, an independent sample t-test was performed to examine and understand the statistical effects of pre-test and post-test on learning flow and artificial intelligence efficacy in

the experimental and control groups. Furthermore, a paired-sample t-test was performed within each group to determine the extent of improvement in learning flow and artificial intelligence efficacy in the experimental and control groups.

IV. RESEARCH RESULTS

1. Comparison of pre-post tests of the control group

A paired-sample t-test was performed to verify as to whether there was a significant difference between the pre-test and the post-test on the learning flow and the artificial intelligence efficacy for the control group, which only performed the basic module-practice module. As a result, it was found that there was a significant difference between the pre-test and the post-test of learning flow (t=16.97, p<.001). Significant differences also turned out between the pre and post-tests on the efficacy of artificial intelligence (t=16.48, p<.001). As a result of the average comparison performed, the post-test (M=4.11) turned out to be higher than the pre-test (M=2.09). The comparison results of the pre-post tests of the control group are shown in Table 4.

Table 4. Comparison of pre-post tests in the control group

Variables		N	M	SD	t	p
Learning flow	pretest	37	2.65	.63	16.97***	.000
	posttest	37	4.18	.60		
Artificial intelligence efficacy	pretest	37	2.09	.57	16.48***	.000
	posttest	37	4.11	.63		

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

2. Comparison of pre-post test of the experimental group

A paired-sample t-test was performed to verify as to whether there was a significant difference between the pre-test and the post-test on learning flow and artificial intelligence efficacy of the experimental group for which the project learning method was applied. Table 5 below shows the comparison results of the pre-post tests of the experimental group.

As a result, it was found that there was a significant difference between the pre-test and the post-test of learning flow (t=12.49, p<.001). Significant differences were also found between the pre- and post-tests on the efficacy of artificial intelligence (t=21.50, p<.001). As a result of the average comparison, the post-test (M=4.52) turned out to be higher than the pre-test (M=1.91).

Table 5. Comparison of pre-post tests in the experimental group

Variables		N	M	SD	t	p
Learning flow	pretest	39	2.76	.72	12.49***	.000
	posttest	39	4.19	.65		
Artificial intelligence efficacy	pretest	39	1.91	.65	21.50***	.000
	posttest	39	4.52	.62		

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

3. Comparison of pre-test between the experimental group and the control group

To verify that the experimental group and the control group are homogeneous groups, the t-test of the pre-test results of learning flow and artificial intelligence utilization efficacy was conducted. In the pre-test of the efficacy of artificial intelligence application, the control group turned out to be slightly higher than the experimental group, and in the pre-test of the efficacy of using artificial intelligence, the control group turned out to be slightly higher than the experimental group. However, there was no statistically significant difference. Hence, it may be claimed that the experimental group and the control group were the same group before the experimental treatment in terms of learning flow and artificial intelligence utilization efficacy. Table 6 below shows the Comparison of pretest between experimental group and control group.

Table 6. Comparison of pretest between experimental group and control group

Variables	Group	N	M	SD	t	p
Learning flow	Experimental group	39	2.76	.72	.734	.465
	Control group	37	2.65	.63		
Artificial intelligence efficacy	Experimental group	39	1.91	.65	-1.268	.209
	control group	37	2.09	.57		

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

Table 7. Comparison of posttest between experimental group and control group

Variables	Group	N	M	SD	t	p
Learning flow	Experimental group	39	4.19	.65	.113	.911
	Control group	37	4.18	.60		
Artificial intelligence efficacy	Experimental group	39	4.52	.62	2.785**	.007
	Control group	37	4.11	.63		

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

4. Comparison of post-test between the experimental group and the control group

An independent sample t-test was performed to verify as to whether there was a significant difference in variables according to the application of the project learning method in the artificial intelligence class. As a result, there was no statistically significant difference in learning flow between the experimental group and the control group after the application of the project learning method in the artificial intelligence class.

The comparison of post-test between the experimental group and the control group is shown in figure 7. It was found that there was no difference in learning flow between the experimental group for which the project learning method was applied and the control group for which the traditional teaching method was applied. Meanwhile, after applying the project learning method in the artificial intelligence class, the artificial intelligence efficacy of the experimental group and the control group demonstrated significant differences depending on whether the project learning method was applied (t= 2.785, p<0.01), and the experimental group (M=4.52) turned out to be higher than the control group (M=4.11). Hence, it was found that the effectiveness of using the artificial intelligence was effective when the project learning method was applied.

V. Conclusions

This study applied the project learning method in the contactless artificial intelligence based liberal arts class and analyzed its effect. First, the class application is divided into three modules, proceeding in the sequence of a basic module that deals with basic concepts and theoretical contents of artificial intelligence, a practice module where the contents learned in the basic module are practiced through actual artificial intelligence platforms and various tools, and the advanced module in which the team project was made. In the advanced module, the students performed their own projects according to their own time schedule. In this process, the project was carried out in a contactless environment by supporting the students through individual interviews through the social media and webex between the professor and the students. The study results are summarized as follows.

First, the control group demonstrated significant improvements in the learning flow(t=16.97, p<.001) and the artificial intelligence efficacy(t=16.48, p<.001) before and after class. And the experimental group demonstrated significant improvements in the learning flow (t=12.49, p<.001) and the artificial intelligence efficacy(t=21.50, p<.001) before and after class. In any teaching method, if the high-quality content is provided to the learners and the efficient class operation is conducted, it may be claimed the learning flow and

the learning outcomes are improved.

Second, there was no statistically significant difference in the learning flow between the experimental group for which the project learning method was applied and the control group for which only theory and practice were conducted in the artificial intelligence class. This is consistent with many studies which claimed that the various factors such as class quality, professor support, self-efficacy, teaching presence, and digital literacy influence learning flow in the contactless classes[18][27]. It is apparent that various factors must be considered for the learner flow for the contactless classes.

Third, it was confirmed that the experimental group for which the project learning method was applied improved the efficacy of artificial intelligence to a significant level compared to the control group that only proceeded with theory and practice. After applying the project learning method in the artificial intelligence class, the artificial intelligence efficacy of the experimental group and the control group demonstrated significant differences depending on whether the project learning method was applied ($t= 2.785$, $p<0.01$), and the experimental group ($M=4.52$) turned out to be higher than the control group ($M=4.11$). This may be attributed to the fact that the project learning method of this study did not merely allow one to learn the technical elements to implement the artificial intelligence, but provided a learning experience for one to produce and utilize it as a concrete result[10][17]. This is consistent with the results of the previous studies, and the artificial intelligence project learning method applied for this study is effective in positively changing the learners' sense of efficacy towards the artificial intelligence by providing them with an experience to utilize the newly learned skills and solve them cooperatively and successfully[18].

Based on this study, it was confirmed that the project learning method for the contactless artificial intelligence based liberal arts classes had a positive effect on improving the students' learning flow and artificial intelligence efficacy. Through the follow-up studies, even more diverse and meaningful results may be derived if the factors for additional variables(such as various factors such as class quality, professor support, self-efficacy, teaching presence, and digital literacy influence) affecting the learning flow are subdivided and proceeded.

REFERENCES

[1] A. Lee, "Analyzing the Effects of AI Education Program based on AI Tools". Robotics & AI Ethics, Vol. 6, NO. 2, pp. 21-29, Jun. 2021.

[2] Y. Lee, "Development and effectiveness analysis of artificial intelligence STEAM education program", Journal of The Korean Association of Information Education, Vol. 25, No. 1, pp. 71-79, Feb. 2021.

[3] A. Lee, "The Effect of Artificial Intelligence Literacy Education on University Students Ethical Consciousness of Artificial Intelligence", Robotics & AI Ethics, Vol. 6, No. 3, pp. 52-61, Sep. 2021.

[4] J. Han, "Changes in attitudes and efficacy of AI learners according to the level of programming skill and project interest in AI project". JOURNAL OF The Korean Association of information Education (JKAIE), Vol. 24, No. 4, pp. 391-400, Aug. 2020.

[5] E. Kang And J. Lee, "Artificial Intelligence Liberal Arts Curriculum Design for Non-Computer Majors", Journal of Digital Contents Society, Vol. 23, No. 1, pp. 57-66, Dec. 2022.

[6] A. Lee, "A Study on a Case Applying Learner-Centered Flipped Learning for Coding Classes". Journal of Practical Engineering Education, Vol. 9, No. 1, pp. 23-30, Jun. 2017.

[7] N. Kim, "A Study on the Satisfaction of Non-face-to-face Online Class -Focused on K University", The Journal of Humanities and Social Science, Vol. 11, No. 5, pp. 1145-1158, Oct. 2020.

[8] K. Chang, "Case Study on Project Based Learning in Distance Education: Focusing on Learners' Learning Experiences", Journal of Educational Technology, Vol. 36, No. 3, pp 775-804, Oct. 2020.

[9] H. Hong, "The effect of project based learning experience on the improvement of core competencies and learning flow of university students". The Journal of Learner-Centered Curriculum and Instruction, Vol. 20, No. 20, pp. 789-816, Oct. 2020.

[10] Y. Lee And E. Kim, "An Analysis of Learning Outcomes and Learning Satisfaction of Project-Based Learning in non-face-to-face Learning Environment". Journal Of The Korea

Contents Association, Vol. 21, No. 6, pp. 814-825, Jun. 2021.

[11] M. Cheong And G. Shin, "The effects of the project -based learning on improvement of creative thinking, creative disposition and problem solving of college students", The Korean Journal of Educational Psychology, Vol. 18, No. 3, pp. 287-301, Sep. 2004.

[12] S. Lee And S. Yang S And H. Jung, "A Case Study on a Programming Subject through Project-Based Learning in the COVID-19 Environment", Journal of the Korea Institute of Information and Communication Engineering, vol. 25, No. 11, pp. 1655-1662, Nov. 2021.

[13] S. Park, " The Study of Project Class on Learning Involvement and Learning Interest", Journal of Holistic Convergence Education, Vol. 23, No. 3, pp. 29-43, Sep. 2019.

[14] P. Blumenfeld And E. Soloway And R. Marx And J. Krajcik And M. Guzdial And A. Palincsar, "Motivating Project-Based Learning: Sustaining the Doing, Supporting the Learning". Educational psychologist, Vol. 26, No. 3-4, pp. 369-398, Jun. 1991.

[15] J. Park And Y. Lee, "The Mediating Effect of Learning Flow on Relationship between Presence, Learning Satisfaction and Academic Achievement in E-learning", Journal of the Korea Society of Computer and Information, Vol. 23, No. 11, pp. 229-238, Nov. 2018.

[16] J. Lee, "Analysis of the structural relationships among self-determination motivation to learn, metacognition, self-directed learning ability, learning flow, and school achievement". Korean Journal of Educational Research, Vol. 48, No. 2, pp. 67-92, Jun. 2010.

[17] S. Park And Y. Kim, "An Inquiry on the Relationships among Learning-Flow Factors, Flow Level, Achievement under On-line Learning Environment", The Journal of Yeolin Education, Vol. 14, No. 1, pp. 93-115, May. 2006.

[18] B. Koo And A. Kim, "The Effect of Instructional Quality, Teaching Presence, and Professor Support on Academic Optimism and Learning Flow among Undergraduate Nursing Students in an Online Distance Education Environment", Journal of Wellness (KSW), Vol. 16, No. 3, pp. 141-148, Aug. 2021.

[19] S. Hwang And M. Park, "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, Vol. 24, No. 2, pp. 130-153, Jun. 2021.

[20] Y. Kim, "The Effects of Social Presence on Learning Satisfaction and Learning Achievement in Cyber University", The e-Business Studies, Vol. 20, No. 1, pp. 199-216, Feb. 2019.

[21] A. Lee, "Analysis of the Effectiveness of Online Education of Liberal Arts Coding Classes in the AI Era: The Mediating Effect of Learning Flow", Robotics & AI Ethics, Vol. 7, No. 1, pp. 22-33, Mar. 2022.

[22] Y. Hwang And J. Yoon, "Analysis of team project class cases and needs in engineering design courses in online education environment", Journal of Digital Contents Society, Vol. 22, no. 7, pp. 1039-1047, Jul. 2021.

[23] E. Sung And M. Baek , "A Study on Development for Teaching and Learning Model of Online Project-Based Learning in Untact Context", Journal of Practical Engineering Education (JPEE) ,Vol. 33, No. 1, pp. 227-270, Feb. 2021.

[24] E. Kim, "A Case of Engineering Team Project Execution in Uncontacted Classes", Journal of Practical Engineering Education (JPEE), Vol. 12, No. 2, pp. 255-264, Dec. 2020.

[25] J. Kim And K. Sohn And E. Lee, "The Effects of Interaction between Instructor-student and Student-student on Learning Achievement in Synchronous E-learning for Major Classes for University Students: The Mediating Role of Learning Flow", Journal of Agricultural Education and Human Resource Development, Vol. 52, No. 3, pp. 25-48, Sep. 2020.

[26] H. Lee And H. Lee And J. Sung And S. Kim And S. Kim, "A study on surveying the actual conditions and evaluating the effectiveness of SW education in elementary and secondary schools". Korea Foundation for the Advancement of Science and Creativity, 2016.

[27] Y. Moon, "The Impacts of E-learning Students' Learning Environment and Motivation on the Learning Effect: Focusing on the Mediating Effect of Learning Flow", Journal of Learner-centered Curriculum and Instruction, Vol. 21, No. 13, pp. 529-544, Jul. 2021.

Authors

Ae-ri Lee received the B.S. and M.S. degrees in Computer Science from Semyung University, Korea, in 1997, 1999. And she received the Ph.D. degree in Computer Engineering from MyongJi University. Korea, in 2007. Dr. Lee joined the faculty of the Department of Liberal Arts at Catholic Kwandong University, Gangneung, Korea, in 2014. She is currently a professor in Department of Liberal Arts, Catholic Kwandong University, Korea. Her research interests include networks and security, IT Conversions, coding education.