IT Humanities Education Program to Improve Digital Literacy of the Elderly

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Abstract

Due to the influence of the COVID-19 pandemic, more older people are exposed to Information Technology(IT) in their daily lives. However, due to the lack of digital literacy capabilities of the elderly, it is difficult to use digital devices, making it difficult to live. Therefore, this paper outlined the impact of the digital divide on daily life and the ability of the elderly to use digital information. Through this, we propose an educational program that combines IT and humanities to improve digital literacy in the elderly. IT and humanities do not seem to match, but the convergence of the two is essential. Hardware and software, technology and technology, technology and design are being combined. Accordingly, technology and humanities can combine competency is becoming more critical. Therefore, the educational program proposed in this thesis combines a decision tree with a game and allows the elderly to acquire IT knowledge while playing a game naturally. This educational program was conducted for 23 older adults in their 60s in J city, South Korea. The average satisfaction of the study participants in education was 4.13(±0.65). In addition, the post-test mean of the recognition area in digital literacy was 3.02(±0.64) ($p<.05$), and the post-test mean of the behavior area in digital literacy was 3.67(±0.59) ($p<.01$), which was statistically significant compared to the pre-test.

Keywords: IT humanities education, digital literacy, digital divide, education of older adults, information technology (IT)

1. Introduction

Digital literacy is a concept that evaluates and judges information beyond simply understanding news and messages in digital media and creates new knowledge using selected information. The World Economic Forum announced in 2016 that it includes digital literacy among the core competencies of the fourth industrial revolution era (Kim & Shim, 2020). However, most older adults often have relatively low digital literacy compared to other age groups (Ball et al, 2019, Yoon et al, 2020). Moreover, since most of the information is delivered and shared through digital devices such as smartphones, TVs, and PCs, the elderly with low digital literacy have difficulty acquiring a variety of high-quality information, eventually leading to social alienation (Tsai et al., 2017). Therefore, improving the digital literacy of the elderly is an urgent issue to be studied. Recently, education on using kiosks for the elderly and Internet use has been frequently conducted. However, it simply stays in education on how to use the Internet or digital devices, but it is not enough for the elderly to understand and use Information Technology (IT) creatively.

Meanwhile, the 4th Industrial Revolution, which began based on IT, changed much of our lives. The emergence of new concepts in occupations shortened the cycle of convergence and new technologies between heterogeneous

industries (Park & Ko, 2012, Herr et al, 2019). In addition, as the quantity and quality of knowledge change, it is becoming essential to create another knowledge through intersection and fusion between knowledge. In particular, IT humanities, which combines humanities with information and communication technology, plays a significant role in selecting the direction of development so that IT can be developed as a technology for humans (Choi & Park, 2021). ICT, a relatively latest technology for the elderly, might be a strange and challenging concept, but humanities linked to history, culture, and philosophy may be more familiar. Therefore, it is desirable to develop an educational program that combines IT and humanities to reduce the information gap of the elderly and improve digital literacy (Blažič & Blažič, 2020).

2. Related Research

2.1 Digital Divide among Older Adults

Digital devices such as mobile financial certificates, QR codes, and touch screen non-face-to-face stands are already permeated throughout everyday life. Lack of capacity to use digital technology can be seen as a barrier to these jobs and their income (Kim, 2020). Therefore, the digital divide phenomenon can significantly influence various aspects of daily life. First, information on vaccines and masks became critical due to COVID-19. However, not having access to the Internet, which has the most information, is a massive shock to those vulnerable to infectious diseases. Second, the digital gap in reality, where non-face-to-face life becomes familiar, will eventually lead to socio-economic gaps, which will serve as an opportunity to entail concerns about social alienation and social division (Choi & Kim, 2021). Third, families with low ability to use information technology have not been able to participate generally in education these days when non-face-to-face education is becoming more common (Kim & Park 2012, Jung & An, 2021). Eventually, the digital gap brings about the educational gap.

The ability to use digital information is the ability of the elderly to acquire, understand, and apply it in real life. It indicates whether one can take the lead in living beyond adapting to an intelligent society. The elderly use mobile devices the most at 43.7% to acquire information, and messengers such as Kakao Talk the most at 44.1% to share and relationships (Hwang, 2020).

2.2 Decision Tree

Decision trees are a classification model that divides the space of independent variables while sequentially applying various rules. Since it can be used for both classification and regression, it is referred to as a classification and regression tree (Song & Lu, 2015). The classification method using decision trees is as follows.

1. One independent variable from several independent variables is selected, and the threshold for the independent variable is determined. It is called a classification rule. A method of finding the optimal classification rule will be described in detail later.
2. The entire learning data set (parent node) is divided into a data group (child node 1) in which the value of the independent variable is less than the reference value and a data group (child node 2) in which the value of the independent variable is greater than the reference value.
3. Steps 1 to 2 are repeated for each child node to create a sub-child node. However, if only one class of data exists in the child node, the child node is no longer divided and stopped.

If child node division is continuously applied in this way, it can be expressed in a tree where the node continues to increase.

Classification can be performed in the above three steps through the decision tree, but a prediction can also be made based on classification learning. When the entire training data is applied to the decision tree, each data goes down a specific node. Each node has a data set of its choice. In this case, the class of data belonging to the node is obtained and defined as the conditional probability distribution P(Y=k|X) node. The corresponding formula is as shown in (1).

$$P(Y=k|X)\text{node} \approx (N\_\text{node},k)/N\_\text{node} \quad (1)$$

When predicting the class of the test data Xtest, the class is predicted using the conditional probability distribution of the node reaching the end by applying the classification rule from the highest node in order. The corresponding formula is as shown in (2).

$$\hat{Y}=\text{argmax}_k \; P(Y=k|Xtest)\text{last node} \quad (2)$$

A decision tree is an expression of the decision-making process. In addition, it is used to reach conclusions based on

data obtained from past decisions and is frequently used in artificial intelligence. Therefore, the decision tree cultivates learners' basic knowledge of IT and improves data-based logical decision-making skills because it provides scientific decision-making processes based on facts and values.

3. Development of Decision Tree Education Program for Improve Digital Literacy of the Elderly

Among the various problem situations of the elderly, the digital divide is a significant factor that requires prompt solutions. Moreover, it can cause problems such as increased social alienation and depression, reduced income, and deprivation of educational opportunities (Lee et al., 2016). Therefore, this paper proposes an education program to bridge this information gap.

The purpose of our development of this education program is to help the elderly acquire the information necessary to live in the information age and understand the decision-making tree. It is a fundamental intellectual makeup of artificial intelligence. Thus, it is expected that the older people will ultimately live independently with other age groups in the information age and actively contribute to society. To this end, we conducted a program development council and selected specific educational programs through literature research. Through this process, we established a content system for the education program. As a result, we designed this education program for the elderly in their 60s or older, and it can be used at lifelong education centers or universities for the elderly.

The proposed education program was planned for ten sessions, but according to the needs of field lecturers, it can be divided into 2-3 sessions and applied to classes in a modular manner. The educational program was largely divided into 'Understanding the decision tree' and 'Applying the decision tree.' The educational content in the first area includes the concept, structure, application field, comparison with random forests, and design criteria of decision trees based on an overall understanding of the supervised learning algorithm. In the second area, a class activity to find passengers on the Titanic ship is conducted by applying the diversity respect method and design principle using decision trees and random forest. This educational activity includes philosophical, humanistic, and psychological elements by combining the understanding of various people, such as race, gender, and age, with advanced technologies. In designing an educational game called 'Save the Titanic using the decision tree' in the program, we introduced a Titanic movie, historical events related to the Titanic, and the causes of the sinking. By incorporating a humanities approach into IT education, it was possible to increase the understanding of unfamiliar IT and to feel how to apply IT to real-life problem-solving. Table 1 is the curriculum for the education program. And Figure 1 is an example of academic materials for the education program.

Table 1. Curriculum

	Area	Content	Learning Activity
1	Understanding the decision tree	Supervised learning	• Unplugged activity • Online learning tool (Liveworksheets)
2		The concept of decision tree	
3		The structure of decision tree	
4		The field of decision tree application field	
5		Comparing the decision tree with the random forest	
6	Applying the decision tree	Designing a decision tree	• Learning aids • Discussion • Gamification
7		Diversity respect using decision trees and random forests	
8		Decision tree and random forest design principles	
9		Save the Titanic using decision tree 1!	
10		Save the Titanic using decision tree 2!	

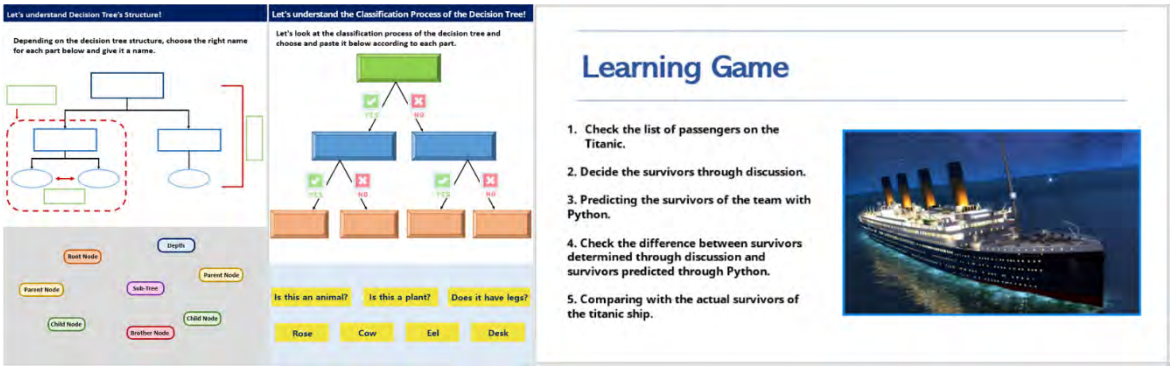

Figure 1. Educational Materials

4. Effectiveness Analysis

After developing the training program, we investigated the satisfaction with training in study participants to analyze its effectiveness and observed changes in digital literacy before and after training. The study was conducted according to the guidelines of the Declaration of Helsinki.

4.1 Satisfaction Survey

Two surveys were conducted to analyze the effectiveness of the proposed education program. Moreover, firstly, a survey was conducted on the satisfaction of the education program. The satisfaction survey tool was designed to ask about the satisfaction level of the educational program's content, educational activities, and educational materials. The number of questions was composed of 5 according to each area and 15 questions. It was designed on a Likert 5-point scale. In this study, we used the SPSS 24.0 program to analyze the effectiveness of the program implementation.

We conducted the satisfaction survey on 23 older adults in their 60s who directly participated in the educational program proposed in this paper, and the overall satisfaction was 4.13(±0.65). In detail, educational content was 4.22(±0.64), educational activity was 3.94(±0.76), and educational material was 4.05(±0.69). The detailed results are shown in Table 2 and Figure 2.

Table 2. Result of the Satisfaction Survey by Item Area

	Number	Mean	Standard Deviation
Educational Content	23	4.22	0.64
Educational Activity	23	3.94	0.76
Educational material	23	4.05	0.69
Total	23	4.13	0.65

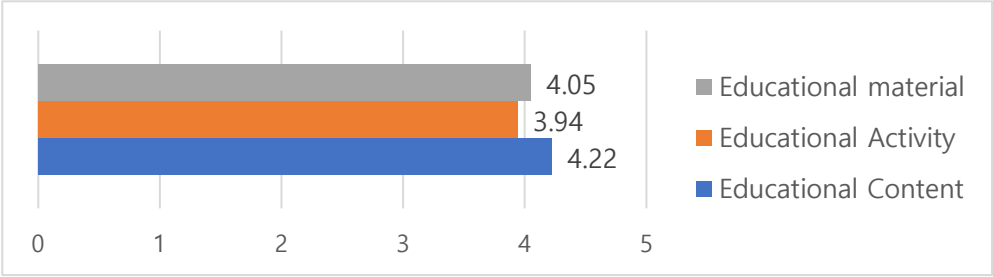

Figure 2. Comparison of Satisfaction Survey

In addition, we compared the satisfaction survey results according to the gender and age of the study subjects. As a result of the study, male satisfaction (4.15±0.67) was higher than women's (3.98±0.77). In addition, the average

satisfaction score of subjects aged 60 to 65 was 4.23(±0.59), and those aged 65 to 69 were lower at 3.58(±0.85). The detailed study results are shown in Table 3 and Figure 3.

Table 3. Result of the Satisfaction Survey by Gender and Age group

		Number	Mean	Standard Deviation
Gender	Male	13	4.15	0.67
	Female	10	3.98	0.77
Age	60-65	12	4.23	0.59
	65-79	11	3.58	0.85

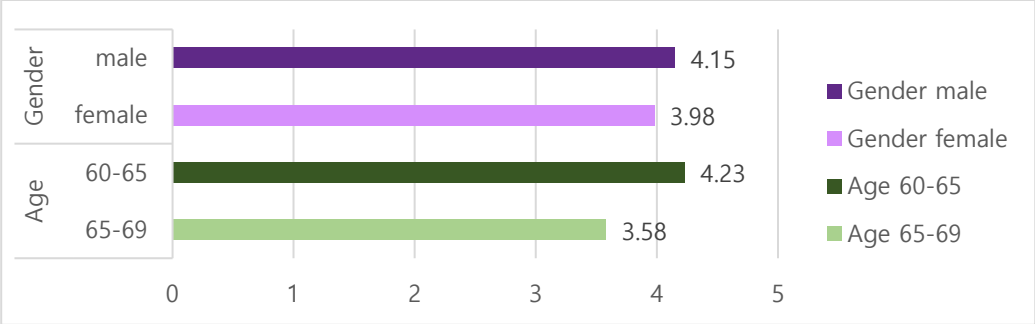

Figure 3. Comparison of Digital Literacy Survey

4.2 Digital Literacy Survey

Among the two surveys conducted for effectiveness analysis, the second survey analyzes changes in digital literacy. For this analysis, we divided 23 out of 42 older adults into experimental groups and 19 into comparative groups in their 60s attending the J city lifelong education center. We applied the educational program developed in this paper to the experimental group and conducted the general Internet and digital device use education to the comparative group.

As a digital literacy evaluation tool, the digital literacy competency self-diagnosis evaluation tool developed in the study of Yang et al (2020) was modified and used to suit old age. Instruments are divided into two areas: recognition and behavior (Yang et al., 2020). The sub-factors of the recognition area are value, self-efficacy, and emotion. The recognition area includes questions asking whether the Internet is a useful space as a learning space or leisure space and whether reading and writing something on the Internet is as valuable as reading and writing books. Moreover, the sub-factors of behavior are self-regulation, participation, ethics, security, and critical reading. We designed a total of 30 questions consisting of 5 questions per sub-factor and a Likert 5-point scale. In the Behavior area, questions such as whether the Internet is being used as a space to actively communicate with others and whether useful information collected from the Internet is shared with others are included.

To analyze changes in digital literacy, we used the SPSS 24.0 program as in the satisfaction analysis. Meanwhile, the sample of this study was composed of less than 30 people, so the normal distribution was not achieved. Accordingly, the analysis was conducted using a nonparametric statistical technique that can be used when analyzing with less than 30 study subjects. According to the experiment, we conducted the Wilcoxon Signed Rank Test to apply for the program and verify the pre-post difference within the group. In addition, we conducted the Mann-Whitney U Test to confirm the difference between groups in the pre-post score difference.

As a result of the Wilcoxon Signed Rank Test, digital literacy capabilities were improved in the experimental group, which was a statistically significant difference(p<.05). However, the digital literacy capability was improved in the comparative group, but it was not statistically significant(p>.05). Looking at the test results by region, the pre-average of the experimental group in the recognition region was significantly improved from 2.45(±0.55) to 3.02 (±0.64) after applying for the education program. However, the recognition area of the comparison group increased by 0.17 from a prior average of 2.34(±0.47) to 2.51(±0.35), but it was not statistically significant. On the other hand, in the behavioral area, the experimental group increased statistically significantly from a pre-average of 3.16(±0.66) to a post-average of 3.67(±0.59) (p<.01). However, the comparison group increased from a pre-average of

3.10(±0.81) to a post-average of 3.32(±0.34), but it was not significant. The detailed results are shown in Table 4 and Figure 4.

Table 4. Result of the Digital Literacy Survey

	Group		Mean(Standard Deviation)	z	*p*
Recognition	Experimental Group	Pre	2.45(0.55)	-3.45	.012*
		Post	3.02(0.64)		
	Comparative Group	Pre	2.34(0.47)	-1.69	.102
		Post	2.51(0.35)		
Behavior	Experimental Group	Pre	3.16(0.66)	-2.17	.001**
		Post	3.67(0.59)		
	Comparative Group	Pre	3.10(0.81)	-0.94	.084
		Post	3.32(0.34)		

*p<.05, **p<.01

Figure 4. Comparison of Digital Literacy Survey

5. Conclusion

The digital divide and the decline in digital literacy of the elderly are causing severe social problems such as mental problems and social alienation (Jo et al., 2021, Delello & McWhorter, 2017). Certainly, Education on smartphones and the Internet is also necessary for the elderly (Lee & Park, 2021, Kim & Park, 2020). However, simple education on using smartphones and the Internet is not enough for older adults to play a leading role in the information society. Therefore, this paper proposed an educational program based on learning games and discussions that experience IT through a programing language. Unfortunately, lecturers felt difficulties teaching the programing language, a computing language, to the elderly with low digital capabilities. However, the learners' desire to learn was immense. Therefore, the learners' satisfaction with the class was significantly higher than that of the general lecture-type class by conducting It humanities convergence education. In addition, the digital literacy of the elderly improved statistically significantly after applying for the educational program. It is evidence that this educational program helped the elderly in their 60s improve their digital capabilities. These research results align with the study of Jerman and Blažič (2020) that educational programs, including learning games, are more appealing than conventional teaching of digital inclusion targeting the elderly and inducing learners' interest (Jerman & Blažič, 2020).

However, future studies will require the application of educational programs to more age groups and more than 30 sample groups. Additionally, there is a need to develop educational programs by level. And also, this study applied an educational program to the elderly aged 60 or older who did not have an IT-related job. However, it is expected that they also have a different IT foundation. Therefore, in future studies, it will be necessary to identify the IT knowledge and level of the study subjects and analyze the effects accordingly.

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References

Ball, C., Francis, J., Huang, K.-T., Kadylak, T., Cotten, S. R., & Rikard, R. V. (2019). The physical–digital divide: Exploring the social gap between digital natives and physical natives. *Journal of Applied Gerontology, 38*(8), 1167-1184. https://doi.org/10.1177/0733464817732518

Blažič, B. J., & Blažič, A. J. (2020). Overcoming the digital divide with a modern approach to learning digital skills for the elderly adults. *Education and Information Technologies, 25*, 259-279. https://doi.org/10.1007/s10639-019-09961-9

Choi, E., & Park, N. (2021). The effect of the future IT convergence curriculum on teaching efficacy of prospective teachers. *Journal of the Korean Association of Information Education, 25*(1), 207-215. https://doi.org/10.14352/jkaie.2021. 25.1.207

Choi, E., & Kim, C. (2021). Digital divide and quality of life in old age. *Korean Journal of Research in Gerontology, 30*(2), 37-49. https://doi.org/10.25280/kjrg.30.2.1

Delello, J. A., & McWhorter, R. R. (2017). Reducing the digital divide: Connecting older adults to iPad technology. *Journal of Applied Gerontology, 36*(1), 3-28. https://doi.org/10.1177/0733464815589985

Herr, D. J. C., Akbar, B., Brummet, J., Flores, S., Gordon, A., Gray, B., & Murday. J. (2019). Convergence education -an international perspective. *Journal of Nanoparticle Research, 21*, 229. https://doi.org/10.1007/s11051-019-4638-7.

Hwang, N. (2020). *Older adults and the digital divide: current conditions and policy implications*. Bangok, Sejong: Korea Institute for Health and Social Affairs.

Jerman, B., & Blažič, A. (2020). Overcoming the digital divide with a modern approach to learning digital skills for the elderly adults. *Education and Information Technologies*, *25*(1). https://doi.org/10.1007/s10639-019-09961-9

Jo, J., Song, S., Kim, E., & Lee, J. (2021). The Challenge of digital technology education for seniors: Focusing on senior learners, instructors and governments. *Journal of Next-generation Convergence Technology Association, 5*(1), 115-123. https://doi.org/10.33097/JNCTA.2021.05.01.115

Jung, S., & An, Y. (2021). A study on the current situation of the achievement gap in schools before and after COVID-19: Focusing on the distribution of academic achievement grades of middle schools in Seoul. *Korean Journal of Sociology of Education, 31*(2), 53-74. https://doi.org/10.32465/ksocio.2021.31.2.003

Kim, H., & Shim, J. S. (2020). Digital literacy of elderly people and social activities. *Korean Journal of Policy Analysis and Evaluation, 30*(2), 153-180. https://doi.org/10.23036/kapae.2020.30.2.006

Kim, J., & Park, N. (2020). A face image virtualization mechanism for privacy intrusion prevention in healthcare video surveillance systems. *Symmetry, 12*(6), 891. https://doi.org/10.3390/sym12060891

Kim, N. (2020). Measures to resolve the digital divide in Non-Face-to-Face society. *Issues and Perspectives, 1774*, 1-4.

Lee, D., & Park, N. (2021). Blockchain based privacy preserving multimedia intelligent video surveillance using secure Merkle tree. *Multimedia Tools and Applications, 80*(26), 24517-34534. https://doi.org/10.1007/s11042-020-08776-y

Lee, H., Lee, S., & Choi, J. (2016). Redefining digital poverty: A study on target changes of the digital divide survey for disabilities, low-income and elders. *Journal of Digital Convergence, 14*(3), 1-12. https://doi.org/10.14400/JDC.2016.14.3.1

Song, Y., & Lu. Y. (2015). Decision tree methods: Applications for classification and prediction. *Shanghai Arch Psychiatry, 27*(2), 130-135. https://doi.org/10.11919/j.issn.1002-0829.215044

Tsai, H. S., Shillair, R., & Cotten, S. R. (2017). Social Support and "Playing Around": An examination of how older adults acquire digital literacy with tablet computers. *Journal of Applied Gerontology, 36*(1), 29-55. https://doi.org/10.1177/0733464815609440

Park, N., & Ko, Y. (2012). Computer education's teaching-learning methods using educational programming language based on STEAM education. In: Park, J.J., Zomaya, A., Yeo, SS., Sahni, S. (Eds.), *Network and Parallel Computing. NPC 2012. Lecture Notes in Computer Science* (7513) Springer, Berlin: Heidelberg.

Yang, K., Seo, S., & Ok, H. (2020). Development of self assessment tool for digital literacy competence. *Journal of Digital Convergence, 18*(7), 1-8. https://doi.org/10.14400/JDC.2020.18.7.001

Yilip, K., & Park, N. (2012). The effect of STEAM education on elementary school student's creativity improvement. In Computer Applications for Security, Control and System Engineering. *Communications in Computer and Information Science* (339). Springer, Berlin: Heidelberg.

Yoon, H., Jang, Y., Vaughan, P. W., & Garcia, M. (2020). Older Adults' Internet Use for Health Information: Digital Divide by Race/Ethnicity and Socioeconomic Status. *Journal of Applied Gerontology, 39*(1), 105-110. https://doi.org/10.1177/0733464818770772

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