A comparison study on perception of care robots, digital literacy and empathic ability according to major
-in the university students majoring in health and engineering-

Do-Young Lee[1], Sang-Seok Yun[2*]
[1]Assistant professor, Department of Nursing, Changshin University
[2]Assistant professor, Division of Mechanical Convergence Engineering, Silla University

전공에 따른 케어 로봇에 대한 인식, 디지털 리터러시 및 공감능력에 대한 비교 연구
-보건계열 및 공학계열 대학생을 대상으로-

이도영[1], 윤상석[2*]
[1]창신대학교 간호학과 조교수, [2]신라대학교 융합기계공학부 조교수

Abstract This study was aimed to understand the recognition of care robots which would enhance the medical quality of life under the 4th industrial revolution in the university students majoring in health and engineering who would lead the development of the future medical industry and to find out the differences of their digital literacy and empathic ability. This was a descriptive correlation study to analyze the recognition of university students on care robots, their digital literacy and empathic ability. Both students majoring in health and engineering recognized the needs of care robots, while their education experiences were not sufficient. Moreover, statistically fewer university students majoring in health heard about care robots than those in engineering, and their need of taking classes was lower, too. No statistically significant differences were found in digital literacy and empathic ability between the two majors, while significant difference was found in the relationship bundling capability out of behavioral empathy, a sub-domain of empathic ability. The study results are anticipated to suggest the future educational direction in the medical field according to the 4th industrial revolution and to be the fundamental data for understanding and preparation of the students depending on the majors.

Key Words : Care robots, Digital literacy, Empathic ability, Major

요 약 본 연구에서는 4차 산업형명의 의료 삶의 질을 향상시켜줄 케어로봇에 대하여 미래 의료 산업 발전을 주도할 보건전공 대학생과 공학전공 대학생의 케어로봇에 대한 인식을 확인하고, 이들의 디지털 리터러시 및 공감능력의 차이를 확인하고자 하였다. 본 연구는 대학생의 케어로봇에 대한 인식과 디지털 리터러시 및 공감능력에 대해 분석하기 위한 서술적 상관관계 연구이다. 보건계열 대학생과 공학계열 대학생은 케어로봇에 대한 필요성을 인식하고 있었으나, 교육 경험이 두 군 모두 미흡하였다. 더욱이 보건계열 대학생의 경우 케어로봇에 대해 들어본 경험이 공학계열 학생보다 통계적으로 낮았으며, 수강 요구도 또한 낮았다. 보건계열 대학생과 공학계열 대학생의 디지털 리터러시는 통계적으로 유의한 차이가 없었고, 공감능력 통계적으로 유의한 차이가 없었지만 하위영역인 행동적 공감에서 관계형성능력은 통계적으로 유의한 차이가 있었다. 본 연구를 통하여 추후 4차 산업에 따른 의료 분야의 교육의 다학제간의 방향성을 제시하고 전공에 따른 학습자들을 위한 이해와 준비의 기초자료가 될 수 있기를 기대한다.

주제어 : 케어로봇, 디지털 리터러시, 공감능력, 전공

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*교신저자 : 윤상석(ssyun@silla.ac.kr)
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1. Introduction

It is anticipated that "everything will be completely changed" upon seamless convergences of physical, digital, and biological technologies according to the 4th industrial revolution[1].『The Future of Jobs』 presented in the World Economy Forum[2] that had announced the 4th industrial revolution in the world predicted creations of 2.02 million new occupations as well as losses of 7.1 million occupations[3]. Without coping with the influences and changes of the 4th industrial revolution, it is inevitable to be eliminated, and the educational field faces the needs of significant changes[4].

'Education contents' were major subjects for changes in the educational field in the past 3rd industrial revolution when brought 'knowledge information society[4],' and many studies have been conducted to suggest the directions of education contents and methods in the future society that would fit the paradigm shift of new education such as 'grand-shift of education,' 'future education,' 'neo-animism,' and so on according to the 4th industrial revolution in the Korean educational field[4,5].

In the university education, the limitations to cope with the rapidly changing future environment and competitive market were recognized only with education of knowledge and technologies related to the major, which highlighted the importance of competence to be able to be adapted and changed in a variety of ways[6]. Universities have the responsibility to teach the students practical skills to be used when they have jobs[7], and one of the alternatives and diagnoses on the educational contents in the 4th industrial revolution era is multidisciplinary system[4]. Many functions and occupations created by demands from the industrial fields as well as diversified and complicated societies require professional knowledge in multiple fields[8].

To apply this situation, universities try the integrated education applying multidisciplinary system[9].

Digital literacy, which is a capability containing multiple cognitive skills required for executing tasks in the digital environment beyond simple technical skill to handle digital devices properly[10], has been expanded to the concept of 'survival skill' that everyone should have as the member of society[11]. In addition, empathy is an understanding of others' internal status including thinking and feeling[12], and it has been called as 'the socializing skill[13]. Digital literacy and empathy are main competences to be required for university students[6,14].

Hence, the objectives of this study were to understand the recognition on care robot which would enhance the medical quality of life under the 4th industrial revolution in the university students majoring in health and engineering who would lead the development of the future medical industry; and to find out the differences of their digital literacy and empathic ability. The study will suggest the future educational direction in the medical field according to the 4th industrial revolution to be the fundamental data for understanding and preparation of the students depending on the majors.

2. Method

2.1 Study design

This was a descriptive correlation study to analyze the recognition of university students on care robot, their digital literacy and empathic ability.

2.2 Participants

Convenience sampling was performed in this study among the university students nationwide who understood the study purposes and

consented to participate in the study voluntarily. To limit the majors that would work for the development and usage of care robot, university students majoring in health and engineering were selected as the study subjects. A previous study which had been investigated on e-health literacy using university students majoring in health and engineering was used to calculate the sample size of the study[15]. Calculation of sample size using G*power 3.1.9.2 Program[16] revealed 134 subjects with significance level of 0.05, size of efficacy 0.30, and power 0.95 using two-tailed test. Considering 30% of drop-out rate, 174 subjects were calculated, which set the subjects with 100 persons per each group.

2.3 Measurements

2.3.1 General characteristics

General characteristics consist of 8 questionnaires including age, gender, preferred class type, grade, residential area, personality, degree of major adaptation, and satisfaction level of major.

2.3.2 Recognition on care robot

Questionnaires on the recognition of care robot were modified based on the previous studies[17,18]. With respect to the recognition tool on care robot, its validity was requested to two professors on health, two professors on engineering, and two healthcare professionals over 10 years of practices in the medical institutions whether each questionnaire was proper to check the recognition on care robot, and whether any missing parts were existed. The rate of Content Validity Index (CVI) was calculated by number of experts that had selected 'Valid' and 'Very Valid' out of 4-point Likert Scale including 'Never Valid' with 1 point, 'Not Valid' with 2 points, 'Valid' with 3 points, and 'Very Valid' with 4 points, divided by number of total experts. CVI of all questionnaires was over 0.8, and final questionnaires were selected after modification and supplementation on the nursing terminology upon applying the opinions of experts. Two questionnaires on the experiences of care robot and four on the attitude to care robot were developed.

2.3.3 Digital literacy

Digital literacy means the skill to understand the digital devices and accept to operate them; to solve the problems based on digital devices, online contents, and information; and to create new contents using collected information and communication, collaboratively[19]. The tool developed by Shin & Lee was used in this study[20]. It consists of four domains including ICT basic competency, utilization capability to basic works, adaptation capability to software-centric society, and capability using social media and collaboration with a total of 18 questionnaires. The tool is made of 5-point Likert scale, meaning higher capability of digital literacy as the score is higher. Cronbach'α at the development was 0.91[20], while that in this study was 0.86.

2.3.4 Empathic ability

The tool developed by Hur, Nam & Nam[21] was used for measurement of empathic ability. It consists of three dimension with cognitive, emotional, and behavioral empathy, and each empathic ability is made of two sub-domains. Cognitive empathic ability is made of 'ability to accept viewpoints' and 'ability to control thinking'; emotional empathic ability is made of 'ability to express feeling' and 'ability of emotional immersion'; and behavioral empathic ability is made of 'communication skill' and 'relationship building capability.' Each sub-domain consists of 6 questionnaires, with a total of 36 ones. The tool is made of 5-point Likert scale, meaning higher empathic ability as the score is higher. Cronbach'α at the development was 0.85[21], while that in this study was 0.86.

2.4 Data Collection

An internet platform nationwide was used for the data collection. The data were collected by self-reported survey questionnaires upon receiving the consents to participate in the study from only those who read the study purposes and contents and agreed the participation voluntarily. They were informed thoroughly on the withdrawal process according to the ethical standards and data utilization only for the study purposes, and the data were treated and coded anonymously. The survey lasted about 10 minutes, and small gifts were provided to the subjects who participated in the survey.

2.5 Statistical Analysis

The collected data were analyzed using IBM SPSS statistics 23 Program (SPSS Inc., Chicago, IL, USA), and the detailed analysis methods are as follows.

General characteristics of the subjects were analyzed with frequency, mean, and standard deviation, and paired T-test was used for the difference between the two groups. Degree of the subjects' recognition on care robot was analyzed with frequency and percentage, and paired T-test was used for the difference between the two groups. Degree of the subjects' digital literacy and empathic ability were analyzed with mean and standard deviation, and

〈Table 1〉 General characteristics and differences of the subjects (n=200)

Characteristics	Categories	Total (n=200)	SPH (n=100)	SE (n=100)	t/F(p)
		n(%)	n(%)	n(%)	
Age	M±SD	22.29±2.601	22.35±2.790	22.22±2.410	0.36(.718)
Gender	Males	71(35.5)	25(25.0)	46(46.0)	3.00(.003)
	Females	129(64.5)	75(75.0)	54(54.0)	
Perferred class	Contact class	45(22.5)	18(18.0)	27(27.0)	1.55(.124)
	Non-Contact class	107(53.5)	55(55.0)	52(52.0)	
	Mixed	48(24.0)	27(27.0)	21(21.0)	
Grade	Fresmen	31(15.5)	14(14.0)	17(17.0)	1.74(.085)
	Sophomore	47(23.5)	19(19.0)	28(28.0)	
	Junior	58(29.0)	29(29.0)	29(29.0)	
	Senior	64(32.0)	38(38.0)	26(26.0)	
Residential area	Seoul	70(35.0)	28(28.0)	42(42.0)	2.50(.014)
	Gyeonggi	60(30.0)	29(29.0)	31(31.0)	
	Gangwon	5(2.5)	3(3.0)	2(2.0)	
	Gyeongsang	42(21.0)	26(26.0)	16(16.0)	
	Jeolla	8(4.0)	4(4.0)	4(4.0)	
	Chungcheong	12(6.0)	8(8.0)	4(4.0)	
	Jeju	3(1.3)	2(2.0)	1(1.0)	
Personality	Extrovert	30(15.0)	17(17.0)	13(13.0)	0.46(.649)
	Introverted	99(49.5)	53(53.0)	46(46.0)	
	Mixed	71(35.5)	30(30.0)	41(41.0)	
Adaptation to the majo	Adapting well	97(48.5)	52(52.0)	45(45.0)	1.07(.289)
	Difficult but try to adapt	88(44.0)	39(39.0)	49(49.0)	
	Have difficulty adapting	15(7.5)	9(9.0)	6(6.0)	
Major satisfaction	Dissatisfied	14(7.0)	5(5.0)	9(9.0)	1.94(.055)
	Average	116(58.0)	54(54.0)	62(62.0)	
	Satisfied	70(35.0)	41(41.0)	29(29.0)	

* SPH: students majoring in health; SE: students majoring in engineering

paired T-test was used for the difference between the two groups.

3. Results

3.1 General characteristics and differences of the subjects

Table 1 shows the general characteristics of the subjects and their differences.

Mean age of total subjects was 22.29 years old, 22.35 years old for the university students majoring in health and 22.2 years old for those majoring in engineering, demonstrating no difference between the two groups (t=0.36, p=.718). In terms of gender, 35.5% (71 persons) were males and 64.5% (127 persons) were females. Females shared 75.0% (75 persons) among those majoring in health and 54.0% (54 persons) among those majoring in engineering, demonstrating significant difference of gender rate between the two groups (t=3.00, p=.003). 'Non-contact class' was a preferred class without significant difference between the two (t=1.55, p=.124), and Seoul and Gyunggi-do Province were the most in terms of residential area without significant difference between the two (t=2.50, p=.014). More subjects answered 'introverted' for their personality, 53.0% (53 persons) majoring in health and 46.0% (46 persons) in engineering, without significant difference between the two (t=0.46, p=.649). With respect to the adaptation to the major, 52.0% (52 persons) of the students majoring in health answered 'adapting well' and 49.2% (49 persons) majoring in engineering did 'difficult but try to adapt,' without significant difference between the two (t=1.07, p=.289). For the satisfaction level on the major, both groups answered the most with 'normal' followed by 'satisfied' and 'dissatisfied' without significant difference between the two (t=1.94, p=.055).

3.2 Degree and difference of recognition on care robot between the students majoring in health and engineering

Table 2 shows the degree and difference of recognition on care robot between the students majoring in health and engineering.

〈Table 2〉 Difference between the two groups' perception of the care robot (n=200)

Characteristics	Categories	Categories	Total	SPH	SE	t/F(p)
Care robot Experience about	Experiences to hear	Haven None	88(44.0) 112(56.0)	31(31.0) 69(68.0)	57(57.0) 43(43.0)	3.82 (<.001)
	Education experience	Haven None	20(10.0) 180(90.0)	7(7.0) 93(93.0)	13(13.0) 87(87.0)	1.41 (.159)
Care robot Attitude toward	The need for use of care robots in medical work	Very needed Need Usually Need a little Not necessary	23(11.5) 100(50.0) 49(24.5) 28(14.0) 0(0.0)	11(11.0) 47(47.0) 25(25.0) 17(17.0) 0(0.0)	12(12.0) 53(53.0) 24(24.0) 11(11.0) 0(0.0)	1.30 (.256)
	Attitudes towards the adoption and development of care robots in medical practice	Very positive Positive Usually Negative Very negative	35(17.5) 105(52.5) 45(22.5) 15(7.5) 0(0.0)	13(13.0) 51(51.0) 26(26.0) 10(10.0) 0(0.0)	22(22.0) 54(54.0) 19(19.0) 5(5.0) 0(0.0)	5.20 (.024)
	Taking courses opening a training course	I do I never do that Not interested in	76(38.0) 30(15.0) 94(47.0)	28(28.0) 18(18.0) 54(54.0)	48(48.0) 12(12.0) 40(40.0)	7.04 (.009)
	Thinking about the support you need when adopting a care robot	Purchase cost Training Experience Textbooks	64(32.0) 71(35.5) 50(25.0) 15(7.5)	41(41.0) 28(28.0) 25(25.0) 25(25.0)	25(25.0) 41(41.0) 25(25.0) 9(9.0)	3.20 (.075)

* SPH: students majoring in health; SE: students majoring in engineering

〈Table 3〉 Differences of digital literacy and empathic ability (N=200)

Characteristics		Total (n=200)	SPH (n=100)	SE (n=100)	t/F(p)
		M±SD	M±SD	M±SD	
Digital literacy		23.0±0.54	2.38±0.51	2.23±0.57	1.82(.088)
Empathic ability		2.62±0.42	2.65±0.41	2.59±0.42	1.11(.272)
Cognitive empathy	Point of view thinking ability	2.22±0.62 2.96±0.71	2.23±0.59 2.96±0.69	2.22±0.66 2.95±0.73	0.11(.915) 0.16(.876)
Emotional empathy	Ability to express emotions ability to empathize	2.70±0.74 2.56±0.57	2.76±0.74 2.55±0.58	2.64±0.74 2.58±0.57	1.14(.258) 0.55(.582)
Behavioral empathy	Communication skills ability to form relationships	2.34±0.74 2.94±0.94	2.34±0.81 3.08±1.01	2.33±0.66 2.80±0.90	0.16(.875) 2.19(.031)

* SPH: students majoring in health; SE: students majoring in engineering

Statistically significant difference was found on the experiences to hear about care robot (t=3.82, p<.001), while no difference was found on the education experience of care robot (t=1.41, p=.159). No statistically significant difference was found on the needs of care robot utilization (t=1.30, p=.256) and attitude for required support when introducing care robot (t=3.20, p=.075) in the medical practices. However, significant differences were found on the attitude for introduction and development of care robot in the medical practices (t=5.20, p=.024) and needs of taking class when opening the curriculum for care robot (t=7.04, p=.009).

3.3 Differences of digital literacy and empathic ability between the students majoring in health and engineering

Table 3 shows the differences of digital literacy and empathic ability between the students majoring in health and engineering.

No statistically significant difference was found on digital literacy between the two groups (t=1.72, p=.88). No statistically significant difference was found on empathic ability between the two groups (t=1.11, p=.272). No significant differences of cognitive empathy were found on 'ability to accept viewpoints' (t=0.11, p=.915) and 'ability to control thinking' (t=0.16, p=.876). In addition, no significant differences of emotional empathy were found on 'ability to express feeling' (t=1.14, p=.258) and 'ability of emotional immersion' (t=-0.55, p=.582). In terms of behavioral empathy, no significant difference was found on 'communication skill' (t=0.16, p=.875) while significant on 'relationship building capability' (t=2.19, p=.031).

4. Discussion

This study was conducted to understand the recognition on care robot which would enhance the medical quality of life under the 4th industrial revolution in the university students majoring in health and engineering who would lead the development of the future medical industry, and to find out the differences of their digital literacy and empathic ability, suggesting the future direction of education in the medical field and preparing the fundamental data for understanding and preparation of the students depending on the majors.

First, significantly more students majoring in engineering had heard about care robot than those majoring in health, however, no difference between the two groups was found on the education experience.

This reflected insufficient level of education on care robot. Hong & Shin[17] analyzed the recognition of nurses in nursing care centers on care robot, reporting only 11.3% showed the education experience on the robot. In Kong's study[18], poor practices using care robot were

revealed, 6.0% of using experiences and 28.0% of education experiences, based on the analysis results on the recognition of workers in nursing care centers on the silver care robot. If care robot which supports the health control and emotional stabilization of human-being was used for the complicated and repetitive works in physical, life, and emotional supports instead of healthcare professionals, it could be the efficient medical system. Hence, lots of information and education should be provided to those who can develop and use these.

Second, for recognition on care robot, no subject in both groups answered 'never necessary,' and 64% and 76% showed the positive attitude on the introduction of care robot in the students majoring in health and engineering, respectively. Yet, in Hong & Shin's study[17], only 35.8% of nurses answered positively on the necessity to introduce care robot, and the reasons of negativity were 'not fit for whole person nursing' (50%) followed by 'not realistic' (40.0%), 'can cause to lower the quality of nursing' (30.0%), 'not necessary' (25.0%), and 'may cause ethical problem' (25.0%). Medical practices require the professional decision and some of them cannot be replaced, however, it is necessary to conduct the study to suggest the utilization plans of care robot depending on the needs.

Third, the analysis results of needs taking class, when opening the curriculum on care robot, revealed that students majoring in health answered 'have never thought about it' the most with 54% while those majoring in engineering answered 'take class' the most with 48%, demonstrating the statistical difference between the two groups. Kong MS[18] reported that nurses in nursing care centers had showed high degree of education needs with 92.0% on silver care robot. Multidisciplinary collaborations are required among care providers[8], and it is necessary to try to lessen the opinion gap by integrated education with engineering and medicine.

Fourth, no statistically significant differences were found on digital literacy and empathy ability between the students majoring in health and engineering, while significant difference was found in the relationship building capability in the sub-domain of empathic ability. This is not consistent with 'whole man nursing' that nurses felt negatively on the introduction of care robot in Hong and Shin's study[17], which most of students majoring in health considered as the outcome of relationship building, a basis of empathy for devotional services to patients.

The results are anticipated to facilitate more studies on the integrative competencies of university students majoring in health and engineering.

5. Conclusion

This study has the meaning to suggest the needs of multidisciplinary integrative education by analyzing the recognition on the care robot and its differences between the students majoring in health and engineering. Further studies are proposed to lessen the gap among multidisciplinary parties to enhance the quality of medical practices.

It is anticipated that more studies will be conducted on the integrative competences of the students majoring in health and engineering.

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이 도 영(Sang-Seok Yun) [정회원]

- 2015년 2월 : 아주대학교 대학원 간호학과 (간호학박사)
- 2018년 3월 ~ 현재 : 창신대학교 간호학과 조교수

〈관심분야〉
만성질환, 스트레스, 간호중재

윤 상 석(Sang-Seok Yun) [정회원]

- 2013년 8월 : 고려대학교 기계공학과 (공학박사)
- 2017년 3월 ~ 현재 : 신라대학교 융합기계공학부 조교수

〈관심분야〉
케어로봇, 지능로봇, 휴먼-로봇 상호작용