International Journal of Internet, Broadcasting and Communication Vol.13 No.2 112-119 (2021)
http://dx.doi.org/10.7236/IJIBC.2021.13.2.112

IJIBC 21-2-15

Current Status and Improvement Plan of Programming Education for Electronics Engineering

Seung-Woo LEE, Sangwon LEE*

Professor, Department of Electronic Engineering, Seokyeong University, Korea
swlee@skuniv.ac.kr
** Professor, Department of Computer & Software Engineering, Wonkwang University, Korea*
sangwonlee@wku.ac.kr

Abstract

In the Fourth Industrial Revolution and the foundation of software and hardware technologies through ICT, the technology to analyze the principles of information processing activities is the ability to implement programming. In this study, to improve the programming academic performance of electronics majors, firstly, we presented an effective teaching method in order to promote employment in the programming field by improving problem-solving skills and logical thinking skills in the programming field that electronics majors do not prefer. Secondly, we plan to promote intelligence informatization by converging intelligence information technology into the existing electronics industry by developing software utilization skills through programming curriculum that reflects the specificity and reality of electronics. Lastly, as computer programmers, we would like to expand creative talent education by developing learners' capabilities to cultivate smart talents who have both hardware and software capabilities.

Keywords: *Survey, Employment Rate, Programming, Academic Performance, Teaching Method*

1. Introduction

Coding is the task of dealing with systems using program language, but is based on creativity and scientific logic. Current paradigm that leads Information Communication Technology (ICT) is the 4th Industrial Revolution, Artificial Intelligence (AI), blockchain and the Internet of Things (IoT) are promising technologies for the future related to the 4th Industrial Revolution and are based on coding capabilities. Programming is the process of automating a solution to a problem by implementing it in a program language, with the ability to design solutions for problem solving from a computer science perspective and implement them as software. Entering the era of the Fourth Industrial Revolution, coding skills have become one of the most notable abilities as software takes up not only industry and education but also real life due to the mandatory training of professionals in the IT industry. In order to combine competitiveness in the era of the fourth industrial revolution, ICT utilization ability with coding ability is necessary, which is also related to employment.

This study aims to contribute to the improvement of the employment rate by analyzing the employment rate of Department E in the electronic engineering field of S University in Seoul. In this study, we intend to seek educational measures that can be used for employment and academic guidance of students as a way to

Manuscript Received: March. 3, 2021 / Revised: March. 7, 2021 / Accepted: March. 11, 2021
Corresponding Author: sangwonlee@wku.ac.kr
Tel: +82-63-850-6566
Professor, Department of Computer & Software Engineering, Wonkwang University, Korea

improve the employment rate of the department by reflecting this reality. As a factor in the employment rate of universities, first, the problem of electronic engineering graduates not being employed in various majors but only in certain fields was identified, and second, the problem of giving up employment by avoiding taking programming courses [1]. Therefore, in order to improve the employment rate in the future, this study aims to teach electronics majors variously developed teaching methods through programming subjects to improve interest in the programming field and thereby increase employment rates. Firstly, we wanted to improve the employment rate to major in programming by strengthening self-directed learning for electronics majors through various teaching methods developed. Secondly, we wanted to develop optimal teaching methods that electronics majors contribute to improving the academic performance of programming-related subjects under strategies to increase interest in the field of programming to induce employment. Finally, through the information derived from the analysis results of the survey conducted in this study, we wanted to propose efficient operation of electronic engineering programming curriculum and ultimately effective teaching methods to promote academic achievement.

2. Examining the Status and Perceptions of Programming Education

2.1 Programming Training Status

So as to grow into a core human resource leading society in the age of convergence, it is important to learn the principles and skills of computing to develop the capabilities necessary to solve problems creatively and efficiently [2]. Recently, the Ministry of Education, Science and Technology has put forward a future education policy that emphasizes convergence thinking and creative problem solving [3], and programs are computer-understandable forms of problem-solving. Program work aims to develop algorithmic thinking and problem-solving skills, and has been developed to help students express rich imagination and creativity through simple syntax. Such program education should be education only for programs or programming itself, and education that can lead students to solve problems they encounter in real life through programming, rather than to foster software developers [4].

The major objectives of programming education are as follows. Firstly, students can understand a framework that oversees all the problems of how to input information into a computer, how to process the input information, and how to output the processed results. Secondly, students can develop higher thinking skills such as logical thinking, problem solving, creativity, and creative activities [5]. Thirdly, developing coding skills can provide a wide range of career choices in the Fourth Industrial Age. Factors that increase the efficiency of programming education include curriculum, teaching methods, faculty qualities, learner's player learning, learner's coding interest, coding confidence, recognition of programming values, and learning motivation. Programming training can improve reflective thinking ability to identify logical relationships and find solutions, proliferative thinking ability to produce diverse ideas, and confidence and independence in solutions found by learners [6]. Professors should develop various coding-related teaching methods to improve programming academic performance through self-directed learning, considering learners' motivation for learning, positive perceptions of learning, self-efficacy, and satisfaction and awareness of learning.

2.2 Satisfaction with Programming Training

The curriculum of electronics engineering is divided into five major tracks: information and communications and signal processing tracks, systems and control tracks, semiconductor and electronics tracks, microwave and optical tracks, and computer and circuit design tracks [7]. The curriculum of programming, used in detailed electronics tracks, is widely used in the order of systems and control tracks, information and signal processing tracks, computer and circuit design tracks, semiconductor and electronics tracks, and microwave and optical tracks. Therefore, the importance of programming skills is understood in the order of each major track above. Specifically, information and signal processing tracks, systems and control tracks, various programming languages (such as C, C++, VC++, Python) are used to abstract problems in various disciplines through the programming process and cultivate the ability to design solutions and automate them with software.

Almost graduates of the electronics field have been employed or are hoping to get a job on semiconductor and electronic materials tracks, microwave and optical wave tracks, and computer and circuit design tracks, which are areas where programming courses are underutilized. In particular, semiconductor and electronic material tracks, microwave and optical wave tracks, and computer and circuit design tracks do not require computer science concepts and principles other than programming capabilities. Therefore, Section 3 aims to promote effective programming education in electronics curriculum by developing programming-related teaching methods that increase the interest, value recognition, learning motivation, coding confidence, and interest of electronics majors.

3. Programming Improvement Plan for Electronics Engineering

3.1 Computer Programming Teaching Content

The curriculum of programming for Department E in electronic engineering at S University of Science and Engineering in Seoul was partially revised in 2019. Prior to 2018, the electronics programming curriculum consists of C Programming 1, 2 in the first and second semesters, and Advanced Programming 1, 2 in the first and second semesters. Advanced Programming 1 and 2 teaches object-oriented language. In the third and fourth grades, learners are teaching how to implement programming collaboratively or self-directedly, focusing on practical problems and situations in each major course. The electronic engineering curriculum consists of a major refinement course, a major basic course, a major deepening and application course, and a major practice course and a new technology application course [7].

In order to overcome the limitations of technological advancement in the electronics field, the importance of software technology is highlighted in the future ICT industry. It is so because ICT convergence is rapidly growing as a next-generation power industry. To reflect this situation, we would like to reorganize the electronics programming curriculum that emphasizes coding education in order to have sufficient programming capabilities for electronics majors. Figure 1 shows the procedure to develop effective programming teaching methods with five major stages. All the stages or steps would be helpful for researchers or educators to design their teaching methods for programming.

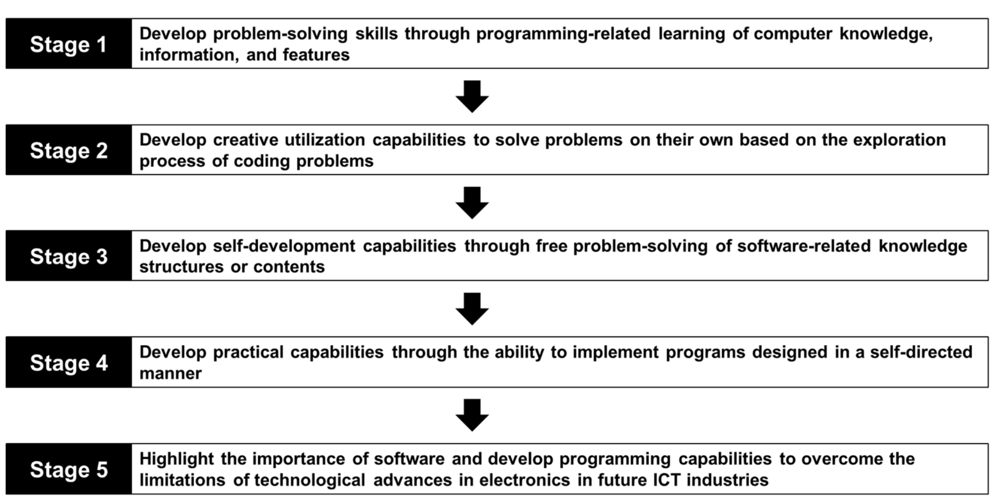

Figure 1. Developing Effective Programming Teaching Methods

3.2 Research on Computer Programming Teaching Content

For our study, we would like to examine through a survey whether the programming curriculum revised in 2019 is effective for electronics engineering majors. Firstly, before 2019, the first-year C Programming course and second-year C++ Programming course were opened for two semesters. However, since 2019, C Programming has been established in the first semester of the first year and C++ Programming in the second semester. The curriculum, which reduced C Programming and C++ Programming courses to one semester, will have an effect on improving academic performance. To this end, a survey on whether to add C Programming and C++ Programming subjects was conducted to identify the needs for the opening of C Programming and C++ Programming subjects by changing the interest of the subjects above. Secondly, through a survey on whether to open additional subjects related to C++, Python, Java, Web Programming, etc., we wanted to analyze the effectiveness of the proposed teaching methods by identifying the changes in C++, Python, Java, and Web Programming. Thirdly, by teaching interactive teaching methods and team project teaching methods through programming subjects, experimental studies were conducted focusing on the hypothesis that students' awareness of programming preferences could voluntarily induce changes in consciousness to increase employment rates in the above fields.

It was, through this, intended to analyze whether the teaching methods presented in the revised programming curriculum were appropriate to improve the programming learning effectiveness. In particular, questions about whether to add C Programming subjects are systematically required to acquire procedural-oriented development language programming techniques, C++ questions about object-oriented development language acquisition, VC++ questions about Java. For this study, the Department E of Electronics Engineering at S University in Seoul was selected and 40 students each grade participated in the study voluntarily, respectively, a survey was conducted from December 2 to 13, 2019.

Table 1 shows the analysis of the results of the questionnaire on whether electronics majors want to open C Programming courses and C++ Programming courses in two semesters respectively. According to Table 1, there is a gradual decline, especially in the number of majors admitted in 2019. The reason is that the majors who entered in 2019 experienced programming-related player learning since elementary, middle and high school, so they are believed to have been educated under a curriculum environment familiar with C Language and C++ Language. Therefore, it is considered sufficient to open C Programming courses and C++ Programming courses for one semester each. In particular, as the fourth industrial revolution enters a hyper-intelligent society that connects people, things, and space, services such as artificial intelligence, robots, IoT, and virtual reality are changing the structure of learners' lifestyles. Learners who have grown up under such an environment are found to be familiar with coding themselves through prior knowledge acquisition of programming while naturally recognizing the importance of coding training.

Table 1. Analysis on whether to Open Additional Programming Courses (units: frequency (%))

Item	Year	N	Experimental Result
Hope to Create Additional C Programming Courses	1	40	13 (32.5%)
	2	40	19 (47.5%)
	3	40	24 (60.0%)
	4	40	25 (62.5%)
Hope to Create Additional C++ Programming Courses	1	40	12 (30.0%)
	2	40	21 (52.5%)
	3	40	27 (67.5%)
	4	40	26 (65.0%)

Analysis on the results of the questionnaire on coding interests, coding confidence, algorithmic thinking skills, and proliferation thinking skills that yield diverse ideas after teaching and learning each of the above methods is presented in Table 2. Comparing the survey data by grade with the changes in the grade, the satisfaction level was high in all categories and the developed teaching methods were effective because they were on the rise.

Table 2. Analysis on Satisfaction related to Coding Competency (units: frequency (%))

Item	Year	N	Experimental Result
Coding Interest	1	40	31 (77.5%)
	2	40	32 (80.0%)
	3	40	35 (87.5%)
	4	40	34 (85.0%)
Coding Confidence	1	40	29 (72.5%)
	2	40	30 (75.0%)
	3	40	32 (80.0%)
	4	40	33 (82.5%)
Algorithmic Thinking Skills	1	40	30 (75.0%)
	2	40	34 (85.0%)
	3	40	33 (82.5%)
	4	40	35 (87.5%)
Diffuse Thinking Ability to Generate Diverse Ideas	1	40	32 (80.0%)
	2	40	34 (85.0%)
	3	40	34 (85.0%)
	4	40	35 (87.5%)

Table 3 shows the analysis on the results of the questionnaire on whether electronics majors would like to open subjects related to VC++, Python, Java, and Web Programming in the future. According to Table 3, the interest in the programming sector has improved significantly as the trend of changes has also increased significantly. Especially in the second grade, the interest in object-oriented languages VC++, Python, and Java has increased significantly, indicating that the proposed interactive teaching method has a learning effect and the possibility of getting a job in the programming field has increased. In particular, it is understood that learners perceive that systematically cultivating their own software utilization capabilities is the only way to actively cope with intelligent information technology in the era of the fourth industrial revolution.

Table 3. Analysis on Various Additional Programming Offerings (units: frequency (%))

Item	Year	N	Experimental Result
VC++	1	40	30 (75.0%)
	2	40	36 (90.0%)
	3	40	33 (82.5%)
	4	40	32 (80.0%)
Python	1	40	33 (82.5%)

	2	40	37 (92.5%)
	3	40	31 (77.5%)
	4	40	30 (75.0%)
Java	1	40	32 (80.0%)
	2	40	37 (92.5%)
	3	40	35 (87.5%)
	4	40	34 (85.0%)
Web Programming	1	40	30 (75.0%)
	2	40	32 (80.0%)
	3	40	28 (70.0%)
	4	40	26 (65.0%)

Analysis on the results of the questionnaire on preferences and job preferences for each track is presented in Table 4, after each teaching method developed for electronics majors. The first grade survey data means that the satisfaction of the teaching method was higher as the programming was advanced, and the satisfaction of the developed teaching method increased as the programming was advanced. In addition, computer and circuit design tracks with a low proportion of programming, semiconductor and electronic material tracks, and microwave and optical tracks have also risen slightly in grade-specific surveys and grade-changing trends, indicating an increase in the satisfaction of developed teaching methods. Therefore, the developed interactive teaching method and team project teaching method are considered effective. Especially in the era of the Fourth Industrial Revolution, it is clear that only ICT-linked industries will expand and grow, so learners recognize themselves to cultivate coding skills and software knowledge, essential capabilities to prepare for employment.

Table 4. Satisfaction Analysis on Track Preferences and Job Preferences (units: frequency (%))

Item	Year	N	Experimental Result
Information and Communication and Signal Processing Track	1	40	25 (62.5%)
	2	40	29 (72.5%)
	3	40	32 (80.0%)
	4	40	34 (85.0%)
Systems and Control Tracks	1	40	27 (67.5%)
	2	40	30 (75.0%)
	3	40	32 (80.0%)
	4	40	33 (82.5%)
Semiconductor and Electronic Materials Track	1	40	33 (82.5%)
	2	40	34 (85.0%)
	3	40	38 (95.0%)
	4	40	37 (92.5%)
Microwave and Light Wave Tracks	1	40	29 (72.5%)
	2	40	30 (75.0%)

	3	40	32 (80.0%)
	4	40	33 (82.5%)
Computer and Circuit Design Track	1	40	33 (82.5%)
	2	40	35 (87.5%)
	3	40	37 (92.5%)
	4	40	38 (95.0%)

5. Conclusions

Industrial Internet (IoT) technology, augmented reality, artificial intelligence, and robot technology play important roles in the fourth industrial revolution. As industries and societies are computerized, automated, and roboticized with ICT technology, the importance of coding capabilities is emerging. In the era of the Fourth Industrial Revolution, intelligent informatization societies require convergent and creative applications of computer and ICT technologies with programming languages as tools. In our study, we showed programming-related teaching methods to improve coding skills of electronics majors, then conduct surveys and statistically analyze them to present effective programming training. Firstly, in the lower grades of electronics engineering, lectures were conducted using lecture-style teaching methods (1st grade) and interactive teaching methods (2nd grade) to foster problem-solving skills. Secondly, the programming subject is a major subject, and if you lose interest in programming in the lower grade, you have the characteristic of giving up not only the programming field but also the related electronic engineering major track, so effective characterized teaching methods are required. Thirdly, the programming curriculum should abstract problems in various fields according to the basic concepts and principles of electronics, design solutions, and then cultivate the ability to implement and automate them with software through the programming process. In order to teach and learn these courses, it is necessary to develop programming-related subjects suitable for electronic engineering curriculum such as ICT, AI, IoT, Bigdata, and so on [8-10]. This enables us to understand efficient resource management methods of computing systems and acquire coding capabilities to creatively implement complex problem solving in various fields of electronics engineering. However, textbook development should be studied in terms of learner-centered education and discussed from a goal-oriented perspective that we want to achieve through learning.

Acknowledgement

This Research was supported by Seokyeong University in 2020.

References

[1] Seung-Woo Lee, "An improvement for the employment rate of the S/W and H/W majors," Journal of Korean Data & Information Science Society, Vol.23, No.3, pp.525-534, (2012).
DOI: https://doi.org/10.7465/jkdi.2012.23.3.525

[2] Ministry of Education, Guide of operating SW education. Seoul: Ministry of Education, (2015).

[3] Ministry of Education, Science and Technology, "The Upcoming Future, South Korea, being Improved by Creative Human Resources and Advanced Scientific Technology," Retrieved from http://www.mest.go.kr., (2010).

[4] Yohan Hwang, Kongju Mun, and Yunebae Park, "Study of Perception on Programming and Computational Thinking and Attitude toward Science Learning of High School Students through Software Inquiry Activity: Focus on using Scratch and physical computing materials," Journal of the Korean Association for Science Education, Vol.36, No.2, pp.325-335, (2016).
DOI: https://doi.org/10.14697/jkase.2016.36.2.0325

[5] Ministry of Education & Ministry of Science, ICT and Future Planning, "Promotion Plan of Human Resource Cultivation for SW-centered Society," (2015).

[6] Won-Young Chang, "A Reflective Review on 2015 Revised Informatics Curriculum and Exploring the Direction of the Next Curriculum Revision: Focusing on Analysis of Curriculum from A General Perspective," The Journal of Korean Association of Computer Education, Vol.23, No.5, pp.1-12, (2020).
DOI: https://doi.org/10.32431/kace.2020.23.5.001

[7] Seung-Woo Lee, "An Analysis on the Relationship of Mathematics/Statistics in Software and Hardware Fields," The Mathematical Education, Vol.47, No.4, pp.505-517, (2008).
UCI: G704-000232.2008.47.4.002

[8] Jangmook Kang and Sangwon Lee, "Strategy Design to Protect Personal Information on Fake News based on Bigdata and Artificial Intelligence," International Journal of Internet, Broadcasting and Communication, Vol. 11, No, 2, pp. 59-66, (2019).
DOI: http://10.7236/IJIBC.2019.11.2.59

[9] Jangmook Kang and Sangwon Lee, "Algorithm Design to Judge Fake News based on Bigdata and Artificial Intelligence," International Journal of Internet, Broadcasting and Communication, Vol. 11, No, 2, pp. 50-58, (2019)..
DOI: http://10.7236/IJIBC.2019.11.2.50

[10] Jangmook KANG, Haibo HU, Yinghui CHEN and Sangwon LEE, "Design of Evaluation Index System for Information Experience based on B2C eCommerce Bigdata and Artificial Intelligence," International Journal of Advanced Smart Convergence, Vol. 8, No, 4, pp. 1-8, (2019).
DOI: http://10.7236/IJASC.2019.8.4.1