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Establishment of ICT Specialized Teaching-Learning System in the Era of Superintelligence, Super-Connectivity, and Super-Convergence

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Abstract

Joint research on software, electronic engineering, computer engineering, and financial engineering and the use of ICT knowledge through network formation play an important role in strengthening science and technology-based innovation capabilities and facilitating the development and production process of products using new technologies. For the purpose of this study, I would like to strategically propose ICT specialized education in the 4th industrial revolution. To this end, the ICT specialization model, ICT specialization strategy analysis, and ICT specialization operation and effect were explored to establish ICT specialization strategies centered on software, electronic engineering, computer engineering, and financial engineering in the era of super-intelligence, hyper-connected, and hyper-convergence. Secondly, a roadmap for detailed promotion tasks related to efficient ICT characterization based on core strategies, detailed promotion tasks, and programs was proposed, focusing on talent related to ICT characterization. Thirdly, we would like to propose a reorganization of the academic structure and organization related to ICT characterization. Finally, we would like to propose the establishment of a future-oriented education system related to ICT specialization based on the advanced education and research environment.

Keywords: *Core Strategies, Expected Effects, Implementation Tasks, Specialization, Undertaking Tasks.*

1. Introduction

Strengthening science and technology innovation capabilities is essential to improving national competitiveness. Information and Communication Technology (CT) includes digital technologies such as computers, the Internet, communication networks, software, and hardware, and encompasses all technologies related to the collection, storage, processing, transmission, and sharing of data and information. Currently, ICT technology is being used in all industries to increase productivity and efficiency, promote innovation and creativity, and create new businesses. In order to meet the needs and expectations of customers, companies are continuously introducing ICT technology to upgrade the value and quality of products to pioneer new markets

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and strengthen their competitiveness. As software development capabilities related to artificial intelligence, big data application, and mobile computing based on the 4th industrial revolution secure core national competitiveness in the future society, systematic software education development measures should be prepared to adapt to these changes.

Electronics, which is widely spread around semiconductors and circuits, communication and systems, microprocessors, and embedded systems, provides various systems necessary for humans by combining manual and active devices. Recently, it has been rapidly developing into large-scale nano-integrated circuits, embedded systems, and mobile communication, and electronic engineering will continue to be used in many academic fields, and it will be endless research and development [1]. Computer engineering is a study that explores computer systems that combine hardware, software, and these components through understanding and utilization of computers, and aims to cultivate talent to lead technology powerhouses [2]. Financial information engineering requires training financial technology experts who can immediately adapt to the financial industry field through learning the foundation theory of the financial engineering field for complex and uncertain financial problems in the future. In particular, it is required to train practical financial engineering experts with the ability to creatively apply financial information analysis, continuous development of financial products suitable for customers' needs, and risk management for financial assets [2].

In the modern ultra-intelligent, hyper-connected, and hyper-converged society, talent with development and application skills in the ICT field is absolutely necessary for the groundbreaking expansion of digital space. To meet these demands of the times, it is necessary to train excellent engineers with a balance in various fields without being biased in any one of the existing hardware, software, computer engineering, and financial engineering. In particular, customized capabilities suitable for the fourth industrial revolution are required by systematically strengthening education necessary for the design and operation of embedded systems, the Internet of Things (IoT), autonomous vehicles, high-speed information and communication (AI), machine learning, extended reality (XR), metaverse, cloud services, edge computing, fintech, and Blockchain [1]. This paper aims to contribute to strengthening Korea's competitiveness by establishing an ICT-specific teaching-learning system based on software, electronic engineering, computer engineering, and financial engineering.

2. ICT specialization strategies in the age of superintelligence, superconnection, and superconvergence

2.1. ICT specialization goals

As a global practical education and development strategy to cultivate ICT talents, we aim to specialize in the strengths of basic science in connection with three core strategies: creative practical education related to superintelligence, establishment of infrastructure related to super-connected intelligence. In the era of efficient super-intelligence, super-connection, and super-convergence, the ICT characterization model is presented in Table 1.

Based on ICT University's major capabilities in software, electronics, computer science, and financial information engineering, intelligent information technology, a key technology of the fourth industrial revolution in the future, will be determined as a key element of ICT specialization. The above ICT-related departments link basic subjects such as mathematics, probability, and statistics to strengthen creative practical education, establish intelligent information talent training infrastructure, and strengthen industry-academic cooperation based on superintelligence, hyperconnection, and hyperconvergence. First, we intend to pursue practical education by conducting various studies and effective industry-academia cooperation projects,

secondly, linking employment with industry-academia cooperation companies, and thirdly, dispatching field training and establishing a practical education system. [3].

Table 1. ICT characterization model

Goals	Cultivate leading talents in the ICT industry in the era of superintelligence, hyper-connectedness, and hyper-convergence
Key strategy	Superintelligence ➜ Reinforcement of creative practical education Hyperconnection ➜ Establishment of intelligent information human resources development infrastructure superconvergence ➜ Infrastructure innovation through strengthening industry-academia cooperation
Core technology	Superintelligence ➜ Intelligent information SW, artificial intelligence, future computing, and intelligent content Hyperconnection ➜ Future network, radio technology, FinTech Superconvergence ➜ New ICT material parts, new industries emerge
Department of ICT	Software Electronics Computer Engineering Financial Information Engineering
Compulsory subject	Mathematics Probabilities Statistics

2.2. Analysis of ICT specialization strategies

In order to create new value and competitiveness in an intelligent information society based on the 4th Industrial Revolution, the need to secure intelligent information technology, foster SW and HW-related industries, and establish a strategy and system for ICT specialization based on the 4th Industrial Revolution. To respond to the changes in the trend of intelligent information technology and convergence of other industries and technologies in response to the 4th Industrial Revolution, we intend to effectively foster leading talents in the ICT industry, including software, electronics, and computer engineering. Currently, due to the rapid growth of the information knowledge industry and the universal spread of smart devices in response to the era of the 4th industrial revolution, users' demands for financial services through the convergence of finance and IT are increasingly diversified. Accordingly, it aims to cultivate leading professionals related to blockchain that fosters ICT expertise in domestic and foreign convergence collaboration as well as active coping capabilities to rapidly changing ICT trends related to finance.

Today, as a data distribution processing technology in ICT specialization, blockchain technology, which is expanding not only in finance but also in life and business, is introducing blockchain technology in various companies and government organizations based on strong invariance and reliability. Financial information engineering has rapidly shifted and evolved into digital finance with the development of high-tech technologies such as the convergence of IoT, AI, big data, and cloud, visualization of blockchain technology, and the emergence of Robo-advisors since 2014. As the need to develop fintech-related financial services for Internet banks and digital convergence banking services is increasing at home and abroad, financial experts based on ICT expertise are needed to actively respond to future social changes. The analysis of ICT characterization

strategies in the era of efficient super-intelligence, super-connection, and super-convergence is presented in Table 2.

Table 2. Analysis of ICT specialization strategies

Field of ICT	Specialization Tools	Specialization strategies for human resources development
Software	Computing thinking ability	Develop the software expertise and development capabilities needed in a hyper-connected, intelligent society in the future
Electronic engineering	Electronic system fabrication	Training large-scale nano-integrated circuits, embedded systems, and smart engineers related to mobile communication
Computer engineering	Hardware and software convergence	Training personnel to design, develop, and operate computer systems that combine SW and HW-related components based on engineering methodologies
Financial Information Engineering	Financial engineering and financial information	Fostering financial experts to contribute to blockchain technology and fintech-related international financial industries

Table 3. ICT specialized operation and effect analysis

Specialization	Field of ICT	Strengthening talent related to ICT specialization
Operation	Software	Strengthening creative talent with thinking and application skills based on SW engineering knowledge
	Electronic engineering	Strengthening global talent with HW convergence capabilities leading the rapidly changing era of the Fourth Industrial Revolution
	Computer engineering	Strengthening industrial talent by securing SW and HW-linked technology pursuing practical industrial values for the country and society
	Financial information engineering	Strengthening job-type talent with practical financial information industry capabilities centered on demand in the financial market in line with the era of knowledge and information
	▼▼▼	
Effect	Building an intelligent information society optimal in the age of superintelligence, superconnection, and superconvergence	

2.3. ICT specialized operation and effectiveness

The ICT specialized operation process implemented by the above processes based on software science, electronic engineering, computer engineering, and financial information engineering is as follows. First, the software department seeks to foster ICT talent to lead a software-oriented society that combines expertise and practical application skills in the software field based on computing thinking skills. Second, the Department of Electronic Engineering actively responds to rapidly changing technological changes in the field of electronic engineering and seeks to train smart engineers to lead an ICT-centered society with practical application capabilities. Third, the Department of Computer Engineering seeks to foster ICT high-tech professionals who

can creatively understand and solve various problems occurring in the information technology industry based on computer engineering capabilities. Fourth, the Department of Financial Information Engineering seeks to foster financial experts who will contribute to the fintech-related international financial industry by visualizing blockchain technology and developing AI technology based on mathematical and information technology utilization skills in financial engineering and financial information [4]. The ICT specialization effects implemented by the above processes based on software, electronic engineering, computer engineering, and financial information engineering are as follows, and the impact of strengthening talent necessary in the knowledge and information society is shown in Table 3. In the era of efficient super-intelligence, super-connection, and super-convergence, ICT characterization operation and effect analysis are presented in Table 3.

Table 4. Detailed project system diagram related to ICT characterization

ICT specialization capability	Personal development skills, Integration skills, Practical skills, Creative thinking skills, Logical thinking skills, Communication skills, Job consciousness			
		▼▼▼		
Fourth Industrial	Revolution	Key strategy	Detailed Implementation	Tasks Program Performance indicators
Superintelligence	Reinforcement of creative practical education	Curriculum innovation	Curriculum that reflects intelligent informatization	Development of practical subjects
			Development of convergence curriculum	Capstone Design
		Professional training to strengthen major skills	Knowledge information specialized training	Competency building intensive education
			Intensive training to improve major skills	Professional education for leading industries related to knowledge information
Hyperconnection	Establishment of intelligent information human resources development infrastructure	Operate a practical skills enhancement program	Practical seminar	Major study
			practical skills improvement program	Major tutoring
		Activation of student activities	Support for internal and external activities	Participation in an external contest
			Support for student autonomy activities	Learning club with a professor
Superconvergence	Infrastructure innovation through strengthening industry-academia cooperation	Strengthen field trips and spread ICT value	Internship activation	Revitalizing Industry-Academic-Linked Internships
			Support for industry-academic projects	Strengthening research cooperation between industry, academia, and research institutes
		Activation of industry linkage	External cooperation	Strengthening exchange and cooperation among industry experts
			Exchange of field experts	Special lectures invited by industry experts

3. Roadmap for detailed implementation of ICT characterization

3.1. Essential capabilities for ICT characterization

First, by cultivating personal development skills, consideration of one's abilities, establishment of development plans, and practical ability to achieve them are cultivated. Second, by cultivating the ability to synthesize, the ability to comprehensively organize the learned knowledge and theories and reflect them in the problem-solving process is cultivated. Third, by cultivating practical skills, practical problem-solving skills are cultivated by educating the process of solving cases that actually occurred in the industrial field and may occur in the future from the perspective of field experts. Fourth, by cultivating creative thinking skills, it fosters thinking skills that can derive creative solutions to problems by effectively learning science and engineering topics using mathematics, science, and information technology. Fifth, by cultivating logical thinking skills, it fosters the ability to persuade the legitimacy of one's solution to unstructured problems in industrial sites where various solutions and various answers exist based on logical thinking. Sixth, by cultivating communication skills, it fosters communication skills to meet the needs of globalization capabilities in the industrial field, the reality and delivery of achievements, collaboration with members, understanding current issues. Seventh, by cultivating a sense of work, the ability to play a role as a healthy member of society is cultivated by recognizing social and ethical responsibilities as a professional person [5].

3.2. Detailed tasks related to ICT characterization

Table 4 presents a detailed system diagram of ICT specialization-related tasks based on essential capabilities for ICT characterization in the era of superintelligence, super-connection, and super-convergence.

4. Establishment of a future-oriented education system related to ICT specialization

4.1. Reorganization of academic structure and organization related to ICT characterization

Digital technology has transformed the way of satisfying human needs into a simultaneous complex as a new living world that transcends temporal sequencing and spatial exclusivity in human cultural activities. Through this, a civilization-historical transition occurred in which technology was fused, industry was fused, and knowledge was fused. Today, there is a limit to problem-solving only with expertise in a specific major, so it is time for convergence education to cope with this because it is in an intellectual situation that requires the ability to combine various areas, think comprehensively, and think creatively. [6]. In the era of super-intelligence, super-connection, and super-convergence, the reorganization of the academic structure and organization related to ICT characterization is presented in Table 5.

Table 5. Academic structure and organization of ICT specialization

ICT specialization capability	Ability to realize transcendent values, solidarity ability, ability to cope with reality, practical action ability, joint decision ability, cooperative ability		
	▼▼▼		
Superintelligence Hyperconnection Superconvergence	Reorganization of Academic Structure and Organization	- Reorganization of ICT-related departments - Reorganization of practical education related to intelligent information - Strengthening of Convergence Academic Unit Linkage	- Enhancement of ICT characterization - Implementation of Practical Training - reorganization to improve the employment rate
	Establishing a diverse and distinctive curriculum	- Reorganization of the liberal arts curriculum - Reorganization of the major curriculum - Operation of a characteristic curriculum - Establishment of competency-based	- Production of competent people - Establishment of an excellent education system - Improving ICT Specialized Education Competitiveness

	curriculum	- Efficient Management of Information Resources
Development of teaching and learning methods	- Support for advanced lecture materials - Enabling Teaching Method Research and Operation - Introduction of active and proactive educational measures	- Securing additional professors - Efficient placement of teaching - Improving the educational environment
Advanced Practical Education	- Innovation in lecture content - the advancement of teaching methods - Introduction of a system for practical education	- Implementation of practical education - Strengthening support for practical education - Building a foundation for advanced education
Building an Advanced Campus	- Expansion and Improvement of Facilities - Advancement of education and research environment through high-tech campus construction	- Expanding Advanced Networks - Establishment of support system for high-tech campus construction of a high-tech campuses

4.2. Advanced education and research environment related to ICT specialization

If informatization and globalization are strengthened as trends in order to advance the educational and research environment related to ICT specialization, the ability to prepare for them is as follows. First, it is the critical thinking ability to create, apply, adapt, and select knowledge on its own, and the creative thinking ability to produce new information. Second, it is a social communication ability to share one's expertise with community members. Third, it is a comprehensive thinking ability and insight that can understand the status of subdivided fields as a whole. Fourth, emotional sensitivity and rational thinking ability that can satisfy reason and emotion are required at the same time. Fifth, we living in a digital way require not only rational, scientific, and mathematical skills, but also artistic sensitivity, humanistic intuition, and moral reflection. In today's information society, knowledge, technology, and industry must be converged and synthesized rather than differentiated and specialized to bring greater overall results [7]. In the era of super-intelligence, super-connection, and super-convergence, the reorganization of the educational and research environment related to ICT characterization is presented in Table 6.

Table 6. Academic structure and organization of ICT specialization

ICT specialization capability		Critical thinking, creative thinking, social communication, comprehensive thinking skills, insight, emotional sensitivity	
		▼▼▼	
Superintelligence Hyperconnection Superconvergence	Strengthening of major skills	- Operation of various practical education - Increasing the percentage of practical courses opened	- Strengthening of major skills through practical education - Customized education
	Implementation of the internship system	- Introduction and operation of intern credit system	- Enhancing the internship system
	Strengthening employment capabilities	- Activating field trips and field trips - Development of employment competency enhancement program	- Improving the employment rate of graduates - Support for the start-up of venture companies in the school
	Securing excellent professors and research personnel	- Expansion of the employment of excellent new teachers - Improvement of new teacher appointment system - Promotion of diversification of the teaching system	- Education by securing excellent faculty - Revitalize research by excellent faculty members - Acquisition of talented research personnel
	Enabling Research	- Establishment of support system for Research Revitalization	- Enhancement of research facilitation by Revitalizing Industry-Academic Research

	- revitalization of the research year - Expansion and efficient management of research funds - Improvement measures for the activation of research institutes	- Establishment of the foundation for Joint Research between Industry-Academia - Strengthening industry-academic cooperation - laboratory maintenance
Improvement of teaching performance evaluation	- Reinforcement of standards for evaluation of teaching performance - Improvement of the lecture evaluation system	- Improvement in the evaluation of teaching performance - Improvement in teaching ability

5. Conclusions

This study discussed the need for ICT specialized education in the era of ultra-intelligence, hyper-connection, and hyper-convergence from the perspective of learner initiative for the series and continuous growth of knowledge informatization education in the fourth industry. To this end, the goal is to establish an optimal intelligent information society in the era of super-intelligence, hyper-connection, and hyper-convergence based on the core strategies and technologies of the ICT specialization model. I would like to present performance indicators. By extracting and selecting content elements presented from essential abilities for ICT specialization, the direction of the future information curriculum is set to reorganize the efficient academic structure and organization based on ICT specialization, and to advance the educational and research environment. Through this, this study aims to derive and dismiss policy implications based on the results of effective cooperative activities such as the flow of ICT knowledge and technology diffusion.

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