A STUDY ON INFORMATION TECHNOLOGY COMPETENCE IN THE CONTEXT OF EDUCATIONAL INNOVATION

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Abstract

Current advancements in information technology play an important role in our lives, bringing forth economic prosperity, happy societies and smart education. Information technology competence is defined as the ability to perceive today information technology knowledge, of training comparative, analytical thinking for association, judgment and reasoning for effective problem-solving tasks. This article presents our study on the major concepts and individual's awareness of information technology competence to apply and improve information technology competence in education and training and in building models for pedagogical students, developing awareness for pedagogical students, contributing to improving the quality of education.

Keywords: *Information technology, information technology and communication, information technology competence, informatics.*

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NGHIÊN CỨU VỀ NĂNG LỰC CÔNG NGHỆ THÔNG TIN TRONG BỐI CẢNH ĐỔI MỚI GIÁO DỤC

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Tóm tắt

Sự phát triển của công nghệ thông tin ngày nay có vai trò quan trọng trong cuộc sống, kinh tế thịnh vượng, xã hội hạnh phúc và giáo dục thông minh. Năng lực công nghệ thông tin là quá trình nhận thức kiến thức công nghệ thông tin ngày nay, rèn luyện tư duy so sánh, phân tích, liên tưởng, phán đoán và suy luận để giải quyết vấn đề hiệu quả. Bài viết trình bày về nghiên cứu các khái niệm và phát triển nhận thức năng lực công nghệ thông tin để vận dụng phát triển năng lực công nghệ thông tin trong giáo dục đào tạo và xây dựng mô hình cho sinh viên sư phạm, phát triển nhận thức cho sinh viên sư phạm góp phần nâng cao chất lượng giáo dục.

Từ khóa: *Công nghệ thông tin, công nghệ thông tin và truyền thông, năng lực công nghệ thông tin, tin học.*

1. Introduction

Information technology (IT) is an abstract concept related to hardware, software, programming to create applications, websites, use of information technology products, computers, social networks, digital transformation, Information and Communications Technologies (ICT). Today, the digital era is exploding in the 4.0 revolution of the 21st century, leading to a variety of regulations on IT skill standards, IT human resource skill standards, many concepts of digital competency, and digital competency frameworks for Vietnamese students, ICT competency framework for lecturers. In addition, many specialized IT terms appear such *as big data, AI, IoT, blockchain,* general information technology education programs, the concept of IT competency becomes more complicated in the context of educational innovation. Therefore, the combination of domestic and foreign research, based on Vietnamese and international IT guiding documents and standards to determine core IT knowledge, is extremely important and necessary for students to understand and grasp to master knowledge. From there, students can apply it into practice, think about how to solve problems through information technology applications, and accumulate experience to determine the most effective solution, which is IT capacity appropriate to the context current educational innovation.

In 2013 it was Resolution 29 on comprehensive fundamental reform of education and training. At this time, the strong 4.0 revolution also occurred worldwide, which was considered comprehensive in all countries. The achievement of the 4.0 industrial revolution is the use of a network of control systems for automatic systems in all areas of social life. UNESCO has identified: learning to know; learning to do; learning to live and work together; learn to be human. UNESCO's university products are creative, action-oriented, self-studying and international. Digital transformation changes all aspects of economic, educational and social life through data and technology implemented in the network environment, helping people communicate and access documents more intelligently, but requires Understanding technology to disseminate life, learning and education with convenience and speed. International Certificate ICDL (International Computer Driver's License) - International IT skills certification set established in 1997 to improve IT skills globally and Vietnam is a member of the organization ICDL.

On December 26, 2018, the Ministry of Education and Training issued Circular 32/2018/TT-BGDDT, officially marking the birth of the general education program, especially the information technology program "Informatics education plays a role in leading in preparing students to find, receive, expand knowledge and create in the era of the fourth industrial revolution and globalization. Informatics has a great influence on ways of living, thinking and acting, and it is an effective tool to help turn learning into lifelong self-study. Informatics helps students adapt and integrate into modern society, form and develop students' information technology capacity to study, work and improve the quality of life, contributing to the career of construction and protect the Fatherland". Vietnam has many documents regulating the application of IT in education and IT competency frameworks for teachers. In 2014, the Ministry of Information and Communications regulated IT skill standards, IT human resource skill standards were regulated in 2015 and amended in 2021. In 2018, the Ministry of Education and Training regulated teacher professional standards with 5 standards including 15 criteria and 3 levels of assessment.

Therefore, research on IT competencies in the current context of educational innovation is urgent to systematize and generalize the theoretical basis of core common IT competencies, studying the current situation and then finding the most effective development solutions in the context of educational innovation suitable for the Mekong Delta region for the high intellectual class with the mission of Teacher "For the benefit of ten years' tree-planting, for the benefit of a hundred years' man-raising".

2. Content

2.1. Information technology competency

The French term for IT is informatique, translated into English as informatics. However, in English terms, informatics is also translated as computer science, which is a science that studies the process of

automating the organization, storage, processing and transmission of information of a computer system. By 1958, the term "information technology" (information technology - IT) appeared in an article published in Harvard Business Review. After the world joined the global Internet network, IT has been widely used, including information technology, from the 1990s to the present.

The Organization for Economic Cooperation and Development (OECD) believes that "capacity is the individual's ability to meet complex requirements and successfully perform tasks in a specific context."

According to the overall program of Circular 32 of 2018, "Competency is a personal attribute formed and developed thanks to existing qualities and the process of learning and training, allowing people to mobilize and synthesize knowledge, skills and other personal attributes such as interest, belief, will,... to successfully carry out a certain type of activity, achieving desired results under specific conditions" Program for Education and Development (Ministry of Education and Training, 2018).

The Information Technology Association of America states that “IT is the research, design, development, operation, support and management of computer-based information systems, especially software applications and computer hardware”.

According to the Law on Information Technology passed by the 11th National Assembly of the Socialist Republic of Vietnam at its 9th session on June 29, 2006, "IT is a collection of scientific and technological methods and modern technical tools for producing, transmitting, collecting, processing, storing and exchanging digital information".

Le (2019) said that "IT competency is a complex structure that includes an individual's IT integration knowledge, skills and attitudes to effectively perform a task or job in defined situations". She added that IT covers IT.

Therefore, IT capacity covers the IT capacity in the IT education program in the development program, including 5 component capacities: (1) Using and managing information and communication technology means; (2) Behave appropriately in the digital environment; (3) Solve problems with the support of information and communication technology; (4) Applying information and communication technology in learning and self-study; and (5) Cooperation in the digital environment (Ministry of Education and Training, 2018) to meet the trend of digital transformation and integration.

The Ministry of Information and Communications has stipulated a standard for skills in using information technology including 15 modules. Six modules from 1-6 apply to students taking the basic IT application certificate and the remaining 9 modules are advanced IT applications. Currently, a basic IT application certificate is an IT output standard, one of the university graduation conditions for students.

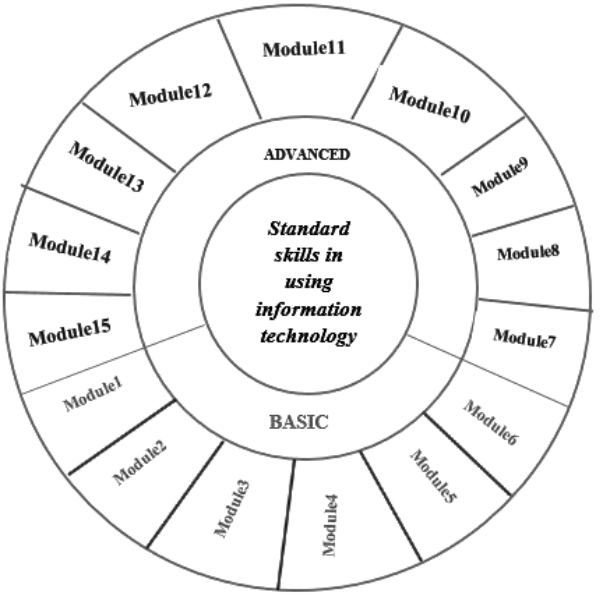

Figure 1. Standard skills in using information technology

In 2015, the Ministry of Information and Communications regulated professional information technology human resource skills standards including 5 orientations: Database (DBSS), Network system (NWSS), Information technology system management (SMSS), Software Design and Development (SDSS) and Information Security Skills were amended in 2021 with the CSSS symbol. The 5 orientations are evaluated at 4 levels: rank 4 (Intermediate), rank 3 (College), rank 2 (University) and rank 1 is postgraduate. IT pedagogical training programs need to incorporate a complete and comprehensive curriculum to create human resources to meet high demands in the current context.

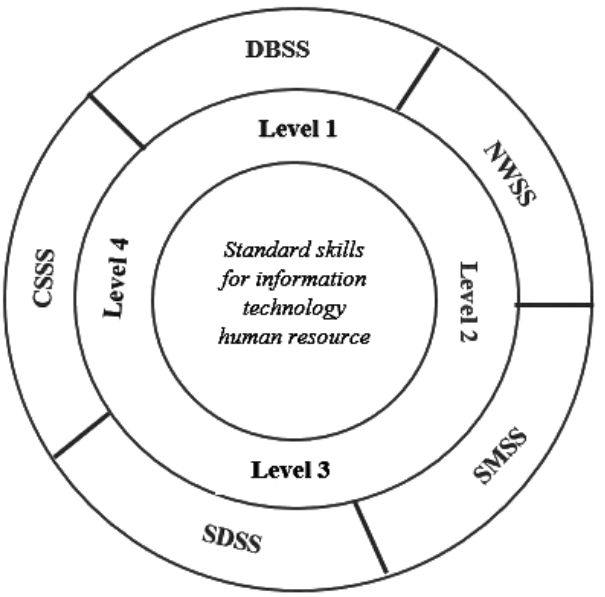

Figure 2. Standard skills for information technology human resource

2.2. Information technology competency in the context of educational innovation

Do and colleagues (2022) compiled the Digital Competency Monograph and proposed a digital competency framework for Vietnamese students including 7 competency groups: (1) Operating equipment and software; (2) Exploitation of information and data; (3) Communication and collaboration in the digital environment; (4) Digital safety and security; (5) Digital content creation; (6) Learning and developing digital skills; (7) Use digital capabilities for your career.

Monograph on digital competencies by Do and his colleagues on developing comprehensive digital competencies for students to become responsible, proactive, and creative digital citizens in learning and career development. The book includes 8 chapters: Overview of digital capabilities; Digital technology drives; Digital communication methods; Digital Citizenship; Information extraction; Enhance the state of digital development; Digital competencies for study and career; and Digital Competency Assessment (Do et al., 2022).

Tran and Do researched three universal digital competency frameworks. Firstly, UNESCO's digital competency framework supplements the European digital competency framework DigComp 2.0 including 7 competency groups: Operating equipment and software; Information and data capacity; Communication and collaboration; Digital content creation; Security; Problem solving; Career-related competencies. Second, the digital competency framework of the Council of Australian University Librarians (CAUL - Council of Australian University Librarians) includes 6 groups: Ability to use information and communications technology; Learning and developing digital skills; Digital creativity, problem solving and innovation; Cooperation, communication and integration; Information capacity, communication capacity, data capacity and understanding; Digital identity and perceived well-being. Third, the JISC digital competency framework also has a competency group equivalent to CAUL. There are also Facebook's We Think Digital and Critical Thinking programs in 2019. Vietnam has not yet built a separate digital competency framework. Inheriting from research results, the authors propose 7 competency groups: Operate equipment and software; Information and data capacity; Communicate and collaborate in a digital environment; Digital content creation; Security and safety in cyberspace; Learning and developing digital skills; Career-related digital competencies (Tran & Do, 2021)

Based on the IT competency model of the Association for Computing Machinery (ACM) and the IEEE computer community, the world's 4-year IT university training program, version 2 in 2017 called IT2017, hopes to create a future model of Academic excellence to information technology graduates who will be prepared for new technological challenges in the global economy. Impagliazzo et al. (2016) researched and developed the IT 2017 competency model for information technology education over two years based on previous guidelines and other perspectives with a concise platform of the project, a number of activities carried out, progress achieved and expectations for future development including necessary capacity (Table 1) and IT application capacity (Table 2).

UNESCO version 3 develops an IT and communications competency framework for teachers in 2018 including 18 competencies with 6 aspects and 3 levels of assessment (UNESCO, 2018), the 3rd version develops an IT competency framework for teachers, supplementing lifelong learning knowledge

Table 1. Basic information technology competencies

Essential Competency Areas	Study hours	Preparation hours	Total
Integrated Systems Technology	20	60	80
Platform Technologies	15	45	60
Web and Mobile Systems	25	75	100
Networking	35	105	140
Cybersecurity Principles	40	120	160
Software Fundamentals	30	90	120
Information Management	40	120	160
System Administration and Maintenance	20	60	80
User Experience Design	20	60	80
Global Professional Practice	25	75	100
System Integration and Architecture	20	60	80
TOTAL	**290**	**870**	**1160**

Source: John et al. (2016)

Table 2. Applied information technology competencies

Applied Competency Areas	Study hours	Preparation hours	Total
Cloud Computing	30	90	120
Virtual Systems and Services	30	90	120
Internet of Things	30	90	120
Data Scalability and Analytics	30	90	120
Applied Networks	30	90	120
Cybersecurity Evolving Challenges	30	90	120
Software Development and Management	20	60	80
Social Responsibility	20	60	80
Mobile Applications	25	75	100
TOTAL	**245**	**735**	**980**

Source: John et al. (2016)

for sustainable development to help teachers and students develop and receive knowledge, deepen knowledge and create knowledge about: (1) IT in educational policy; (2) Curriculum and assessment; (3) Pedagogy; (4) Application of digital techniques; (5) Organization and administration; and (6) Learning the teaching profession. ICT in education policy is the aspect related to the use of ICT in education policy decisions, including the development of policies on ICT, data management and privacy. Curriculum and assessment focuses on the use of ICT in curriculum design, implementation, assessment, use of technology to improve teaching methods, create digital teaching materials and assess learning outcomes. Training teachers on the use of IT in teaching and classroom management include developing teaching skills using technology and evaluating the effectiveness of using technology in teaching. Applying digital technologies is the use of appropriate tools and methods in teaching and learning, including the use of educational software, mobile applications, online platforms and other technologies to create rich, interactive learning environments. Organization and administration is the use of IT in educational management and organization, data management, online learning systems and promoting collaboration among members of the educational community. Teaching professional learning involves the use of ICT to support teachers' professional learning and professional development, including accessing online educational resources, participating in expert communities, and share knowledge.

Today digital transformation is the most prominent trend in the IT industry, but it is the 4.0 revolution that is the super weapon of the entire industry. In the fields of education, economics, and health, digital transformation has become a daily habit in all activities. According to Deputy Minister of Information and Communications, Nguyen (2022) posited that digital transformation in the unit is to pose problems, build tools and use tools to solve the problems, helping people work faster and bring higher productivity. Digital transformation includes digital government (Table 3) reducing administrative procedures and providing good service quality to serve people better, digital economy (Table 4) with the desire for a richer and digital society (Table 5) towards a happier life.

Table 3. Digital government

PEOPLE	GOVERNMENT
Reduce administrative procedures	Make more timely decisions
Provide better quality public services	Issue better policies
Providing new public services	Use source priority

Table 4. Digital economics

Bringing business activities to the digital environment using the Vietnamese digital platform			
1.	Network information security	9.	Transportation, warehousing, logistics management
2.	Multi-channel customer care	10.	Overall business management
3.	Electronic Portal/Site Administration	11.	Tourism management and business
4.	Cloud computing	12.	Finance and accounting, invoices and digital signatures
5.	Electronic contract	13.	Online paying
6.	New generation online meeting	14.	Ecommerce
7.	Human resources, work connection	15.	Marketing
8.	Sales Manager	16.	Consulting and training

Table 5. Digital society

Bringing people's activities to the digital environment using the Vietnam digital platform			
1.	Network information security	9.	Meeting online
2.	Digital map	10.	Contact
3.	Go	11.	Social network
4.	Read a book	12.	Shopping
5.	Tourism	13.	Health
6.	Entertainment	14.	Pay
7.	Delivery	15.	News
8.	Study	16.	Browsers and search engines

After researching regulatory documents and domestic and foreign research related to information technology capabilities for pedagogy students in the context of educational innovation. The author has read, analyzed, synthesized, and systematized an information technology competency model in the context of educational innovation for pedagogical students as follows:

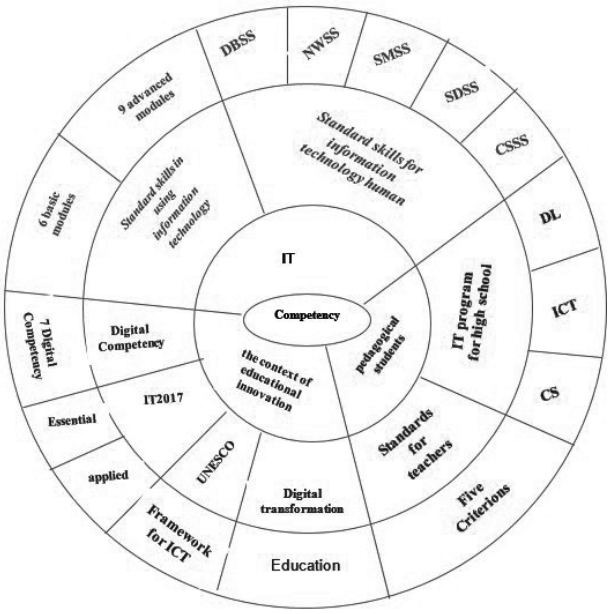

Figure 3. Modeling information technology competences in the context of innovation

In today's digital society trend, it is inseparable from the use, application, and support of IT in life, helping to solve work quickly and more effectively, and studying conveniently in the digital environment. However, the more the digital environment develops, the greater the challenge is with intentional information theft and network security. Therefore, students are taught knowledge and educated about information security in the digital environment, adapting to trends and international integration. To make this integration more effective in the future, the team of computer pedagogical teachers plays a core role in teaching and educating students to live, study, and work to adapt to changes in the world. Currently, under the 2018 general education program students are taught in the direction of developing qualities and competencies; pedagogical students must also be trained to meet the new curriculum, thus fostering and improving IT capacity for IT education students is urgent.

2.3. Information technology competency of pedagogical students

In 2018, the Ministry of Education and Training issued 2 circulars affecting the entire general education sector, promulgating a comprehensive general education program and regulating professional standards for teachers at general education establishments including 5 standards (Teachers' qualities, Professional development, Building an educational environment, Developing relationships between school, family and society), 15 criteria with 3 levels of evaluation "pass", "Good" "and" very good". The general information technology education program issued in 2018 has 3 knowledge strands (DL, ICT, CS), two orientations are applied informatics and computer science. These include 7 learning topics for each grade and 5 competency groups for each level.

The general education program (Ministry of Education and Training, 2018) innovates the educational contents based on the 5 qualities of hard work, kindness, honesty, responsibility and patriotism. These qualities aim to build a young generation with moral awareness and social responsibility. Instead of focusing only on professional knowledge, this program emphasizes the development of qualities and 10 competencies of students such as: (1) Autonomy and self-learning are the ability to self-manage and self-control the process. learning program; (2) Communication and cooperation is the ability to communicate effectively and work in groups; (3) Problem solving and creativity is the ability to think logically, solve problems and create new ideas; (4) Language is the ability to use language accurately and flexibly; (5) Calculation is the ability to use mathematical calculations and rules; (6) Science is the ability to grasp and apply scientific knowledge; (7) Technology is the ability to use ICT; (8) IT is the ability to use and apply IT to solve problems; (9) Aesthetics is the ability to evaluate and express beauty in the fields of art and culture; (10) Physical fitness is the ability to maintain health and physical strength.

The educational development program is divided into two stages: basic and career-oriented. In which IT education has a role and positive influence on professions and other areas of social life, is a tool to support learning, improve quality of life, contribute to economic development and society. The basic phase focuses on building the necessary knowledge and skills foundation for students. The career orientation stage helps students develop the ability to choose and prepare for their future career. In this program, IT education is considered an important factor and has a positive influence on many other professions

and fields in social life. IT training helps students master IT knowledge and skills, and provides them with a useful tool to improve their quality of life and contribute to economic, social and educational development.

The study summarizes the overall picture of IT capacity, synthesizes guiding documents, industry regulations and trends of world IT organizations along with related published research to serve as a basis for the system to have a complete theoretical framework, conduct an assessment of informatics capacity: Use and management of information and communication technology means; Behave appropriately in the digital environment; Solve problems with the support of information and communication technology; Applying information and communication technology in learning and self-study; and Cooperation in the digital environment according to the 2018 General Education Program through actual surveys and assessing the level of awareness according to the bloom rating scale or 5-level Likert scale after considering and providing appropriate solutions with the development of technology trend.

3. Conclusion

Researching on IT competency in the context of current educational innovation is urgent to systematize and generalize the theoretical basis of IT competency, IT competency in the context of educational innovation, IT competency for pedagogical students. Raising awareness for pedagogical students through the IT knowledge model helps them understand, grasp and master knowledge, apply it in practice, and think about how to solve problems through IT applications and accumulate experience to determine the most effective solution, which is appropriate IT capacity in the context of today's educational innovation. This research section serves as a basis for the author to conduct a field survey and find measures to improve IT capacity according to the functions of educational management: Planning, Organizing implementation, and proposing general direction of relevant agencies and have inspection and evaluation of the implementation according to the plan through experiments.

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