

Developing Digital Capacity for Teaching Staff of Technology and Technical Majors according to the Multi-Intelligence Theory

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ABSTRACT

The article reflects and analyzes the characteristics and requirements of organizations teaching technical and technological specialties according to multi-intelligence theory, especially prior to the development of education and training activities in the Revolutionary Industry 4.0 and digital transformation in the context of higher education today. The article analyzes the concepts and content of teaching technology and technical majors according to the multiple intelligence theory; the requirements of the teaching staff in teaching majors of technology and technical. In addition, the article offers the solutions to develop digital capacity for teaching staff of technology and technical majors according to the multi-intelligence theory.

KEYWORDS: *technology and technical majors, theory of multiple intelligences, digital capacity, higher education, training activities.*

1. Introduction

In recent years, the 4th industrial revolution (Industry 4.0) has been mentioned widely in scientific research seminars. It is believed to have had a profound effect on all aspects of human life. Therefore, it is extremely necessary to proactively equip the technological knowledge and skills to seize the opportunities brought by the Industry 4.0 as well as to anticipate the challenges of this era. On the road to equipping human resources, the role of the school is very important. In the traditional teaching method, the lecturer is the presenter and the center in the teaching process, while the student is the object, the listener, passively remembers, takes notes and thinks under the guidance of the teacher. However, these methods are no longer suitable for the development trend in the 4.0 technology era. In particular, in teaching engineering and technology majors, the product of this activity is human resources for Industry 4.0 to respond to the development of society.

No. 29-NQ/TW Resolution in November 4, 2013 of the 8th Plenary Session of the XI term on fundamental and comprehensive reform of education and training determined: "Continuing to strongly innovate of teaching and learning methods in a modern direction; promoting the positivity, initiative, creativity and application of learners' knowledge and skills; overcoming the one-way, machine-memory transmission method. Encourage self-study, create a basis for learners to update and renew knowledge, skills, and capacity development. Shifting from learning mainly in class to organize diverse forms of learning, paying attention to social activities, extra-

curricular activities, and scientific research. Promote the application of information and communication technology in teaching and learning”.

In order to response to the new requirements of the modern higher education, applied research and digital capacity development for university lecturers, especially lecturers teaching technical majors, are required. Applying the modern teaching theories in the process of renovating teaching methods at university level with the requirement of enhancing the activeness, initiative and creativity of learners has been and is one of the issues of interest to research on both theoretical and practical levels.

2. Literature review

In the modern education, there are many theories that are applied to improve the efficiency and quality of teaching, contributing to improving the quality of human resources for the purpose of social development. The field of engineering and technology that requires a diverse and up-to-date student output capacity, accompanies the development of the 4th Industrial Revolution. The development of digital capabilities for the teaching staff, specialized in engineering and technology, especially in the application of multi-intelligence teaching theory, is necessary and associated with professional capacity development activities of the teaching staff.

3. Methodology

The article mainly uses the method of collecting information through reading books and documents in order to find out basic concepts and ideas, which are the basis for the paper's theory. Using the method of analyzing basic views and concepts of the theory of multiple intelligences, teaching engineering and technology majors, etc., thereby proposing solutions to develop digital capabilities for teaching staff, who teaches engineering and technology majors under the theory of multiple intelligences.

4. Research

4.1. The theory of multiple intelligences

The concept of intelligence is undergoing major changes with more diversity when moving from Intelligence quotient (IQ) to multiple intelligences. According to the “Multiple Intelligence” Theory of American psychologist Howard Gardner (1983), there are the following main forms: (1) Logical-Mathematical Intelligence; (2) Verbal-Linguistic Intelligence; (3) Visual-Spatial Intelligence; (4) Bodily-Kinesthetic Intelligence; (5) Musical Intelligence; (6) Intrapersonal Intelligence; (7) Interpersonal Intelligence; and (8) Natural Intelligence. The given forms of intelligence are the premise and basis for creating diverse capacities of different individuals and these competencies need to be formed and developed in the teaching process, especially in teaching in the higher education. In teaching engineering and technology majors, attention should be paid to the following competencies:

a. Logical-Mathematical Competence: Expressed in thinking abilities such as: calculation, analysis, synthesis, assessment, judgment... People with good thinking capacity often have good memory, good reasoning and conceptual skills, generalization, identification (images, numbers...), these are necessary competencies for learning and researching in most fields, especially in the fields of computing, science, technology, engineering.

b. Bodily-Kinesthetic Competence: Shown in the ability to move (command, control, perform...) various types of movement of body parts such as legs, arms, trunk, eyes, mouth... create ingenuity and flexibility in performing movements. Majors related to technology and engineering often spend a lot of time on practical activities, internships and experiments. These are activities that require ingenuity, meticulousness and very careful manipulation.

c. Verbal-Linguistic Competence: Shown in the ability to express and language tools (speaking, reading, writing...) with rich imagination, sensitivity, charisma. This is also a necessary capacity in teaching technology, engineering, and requiring a very high creativity and imagination. In addition, this ability is also suitable for transforming from the language of nature and social life into machine languages.

d. Visual-Spatial Competence: Expressing outstanding advantages in thinking about images, space, layout, colors (objects, positions, coordinates ...) through the characteristics of the senses. Just like Bodily-Kinesthetic competence, this capacity is essential for teachers as well as learners in practical, and experimental activities, thereby making accurate comments on the change of events or current object.

e. Intrapersonal Competence: Shows a rich inner life, tends to be centripetal. People with Intrapersonal competence are very self-aware, have the ability to recognize, accurately assess their emotions and behaviors, and control themselves. This is a hidden form of intelligence commonly found in people who like to think, have the ability to concentrate, work independently, be patient... have the ability to see things and phenomena at a deep level... Very suitable for fields that require research and creativity...

Discovering, forming and developing outstanding competencies in each individual in the teaching process is one of the important orientations of an effective teaching strategy. Teaching as a basic and specific activity in the educational process takes place in real life with diverse forms inside and outside the school. Author Tran (2020) cited the definition of Babanski , that *“teaching is two sides of a process that always interacts, complements each other, regulates each other, and penetrates each other through collaborative activities in order to give learners the ability to develop intellectually, contribute personality perfection”*. The nature of the teaching process is a complete system and can be diagrammed as follows.

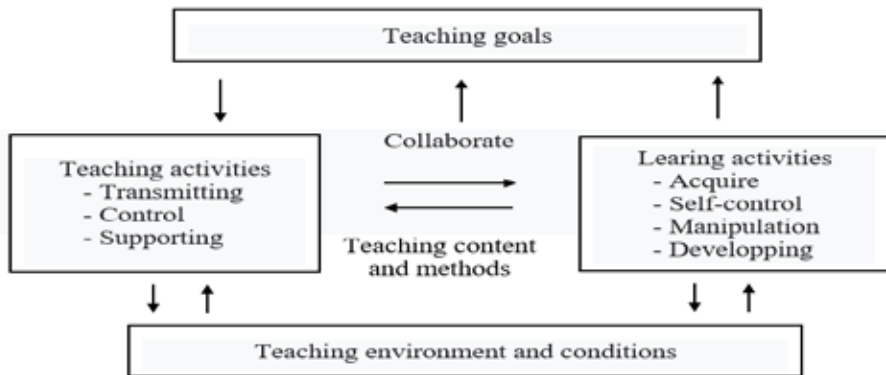


Figure 1. Structure and function of the teaching process

According to the modern concepts, when implementing a teaching activity, the teacher must know how to choose, reasonably and effectively coordinate teaching methods so that learners not only have knowledge, understanding, skills, but also create conditions for them to recreate, apply and develop those knowledge and skills, and thereby form and develop intelligent forms.

Multi-intelligent teaching activities at university level must attach seriously to the goal of forming and developing competencies (thinking capacity, action capacity, professional capacity) for the learners. From the point of view of pedagogical psychology, the learner's capacity is best formed and developed during the subject's cognitive and practical activities. If the teaching process pays due attention to the active, proactive and creative activities of the learners, they will have the opportunity to form and develop the ability to detect and solve problems; adaptive and creative capacity in practical activities and professional work.

4.2. Characteristics of teaching the engineering & technology majors according to the theory of multiple intelligences

4.2.1. Features of learning activities in the engineering & technology majors

According to Wikipedia, technology is an invention, change, and the use of knowledge of tools, machines, techniques, skills, systems, and organizational methods, aimed at solving a specific problem, improving an existing solution, achieving a goal, or performing a specific function requires high levels of gray matter. Technology significantly affects the ability of humans and other animals to control and adapt to their natural environment. Simply thinking, technology is the application of scientific discoveries to practical and specific goals or products for human life, especially in the industrial or commercial field. The term technology can be used in a general sense or for specific fields, for example "construction technology"; "information technology".

Engineering is the application of scientific knowledge to bring practical value. Some of the engineering activities include the design, manufacture, and operation of structures, machines, processes, and systems in the most efficient and economical manner. The discipline of engineering is so broad that it encompasses a range of more specific engineering fields, each of which emphasizes specific areas of technology and application patterns. The ECPD (predecessor of ABET) of the American engineers defines "engineering" as "the creative application of scientific principles to the design or development of structures, machines, and systems, tools, or manufacturing processes, or structures using them individually or in combination; or in the construction or operation of the foregoing with full awareness of their design; or to predict their performance characteristics when operated under certain conditions; all of these are geared towards a desired performance, economy of operation, and safety for humans people and wealth."

It can be seen that the teaching of the engineering and technology majors is a highly specific teaching activity that requires the teacher to have knowledge of tools, machines, techniques, professional skills, systems, and organizational methods, to

solve a specific problem, in addition to understand the application of that scientific knowledge to bring practical value.

Learning activities in engineering and technology majors often have the following characteristics:

1. Is a thinking cognitive or oriented-action cognitive, purposeful activity that focuses on analysis of human and the human relationship with the artificial world;

2. Learning activities are only really effective when the students have learning demands (from conflicts in terms of awareness or capacity);

3. Learning activities in the engineering and technology majors require a close combination between logical thinking and emotional activities, between perception and action... it is a complete integration between theory and practice, which gives the possibility of a deeper understanding of reality;

4. Learning activities are highly individual, and at the same time are influenced and dominated by the learning environment (conditions of equipment for learning, capacity of groups of students, classes...);

5. Learning activities can only show results and effectiveness through practical application and creative development;

6. Learning activities are expressed at different levels of knowledge, skills and attitudes. The learning process is a step-by-step process of developing at high levels of both knowledge and skills (according to B.Loom's ladder);

7. New knowledge and skills are always formed and developed based on existing knowledge and basic practical and practical skills. To have those abilities, students must have an active and creative way of learning, practice self-reliance in searching, selecting, processing information and spending a lot of time on activities such as practice, internship, experiment.

It can be seen that the study of engineering and technology majors is a highly specific activity that requires higher education institutions to have appropriate, active and effective teaching methods.

4.2.2. Requirements of teaching engineering & technology majors according to the theory of multiple intelligences

Teaching engineering and technology majors according to the theory of multiple intelligences is a suitable teaching model, due to the characteristics of engineering and technology teaching. It is a fully integrated process between theory and practice, towards students have the ability to have a deep understanding of reality, thereby applying the learned knowledge to solve practical problems. However, applying too many types of intelligence in teaching to students might lead to overload and it is difficult to develop specific methods of concentration, which might lead to the fact that the assessment also becomes more expensive and complicated, difficult to control the evaluation quality. To reduce the above problem, it is advisable to choose specific types of intelligence suitable to apply to teaching engineering and technology majors to students.

Table 1. Requirements for basic competency of Engineer and Technology students

Requirements for basic competencies of the students in the field of engineering & technology		Intelligent form used
Elemental Ability	Behavioral indicators	
Identify and raise the practical problems	<ul style="list-style-type: none"> - Find out the real problem situations - Identify and clarify the practical problems - State the exact problem that needs to be solved 	Intrapersonal Intelligence, Verbal-Linguistic Intelligence, Interpersonal Intelligence, Visual-Spatial Intelligence
Analyze the practical problems and collect relevant information	<ul style="list-style-type: none"> - Exchange, discuss and analyze the elements that need to be solved in the practical problems - Identify the information to be collected and the channels involved - Collecting and expressing information in the language of science and technology, transferring to simulation model 	Logical-Mathematical Intelligence, Verbal-Linguistic Intelligence, Visual- Spatial Intelligence
Propose and implement the solutions to solve the practical problems	<ul style="list-style-type: none"> - Proposing and analyzing solutions - Presenting and choosing the optimal solution - Define the strategy, organization and implementation of the practical problem solving 	Verbal-Linguistic Intelligence, Visual-Spatial Intelligence, Bodily-Kinesthetic Intelligence, Interpersonal Intelligence
Presenting and reporting results from the practical problems	<ul style="list-style-type: none"> - Expressed through spoken language such as: presentation, discussion, debate - Expressed through written language such as experimental reports, products through practical operations, experiments - Ability to use aids, tools, machines, techniques, systems 	Interpersonal Intelligence, Bodily-Kinesthetic Intelligence, Verbal-Linguistic Intelligence
Evaluate the solutions and the results	<ul style="list-style-type: none"> - Evaluate the effectiveness and value of the solution, the results achieved after solving the practical problem - Identify knowledge and practical experience gained during practical problem solving - Propose the organizational methods, solutions to solve a problem, improve an existing solution 	Verbal-Linguistic Intelligence, Visual-Spatial Intelligence, Intrapersonal Intelligence

4.3. Requirements of the teaching staff in teaching the engineering and technology majors

Lecturers are high-level intellectuals who are the key force determining the quality of training through the direct transmission of ideas, orientations, knowledge and good life values to learners - the young generation, the future of the country. Although each school has its own specific goals and training requirements for each profession, the development of teaching staff is important for meeting the requirements of improving the quality of education in the modern Education. That is also the premise to motivate the lecturers to work hard and bring positive energy to the students, contributing to bringing about a profound change to the training quality of the university in particular and to the educational background of the university and education of the country as a whole.

At the higher education, the teaching staff, especially those in the field of engineering and technology, are mainly highly qualified scientists and professionals, engaged in scientific research, with practical experience participation in science, technology and engineering activities. Thus, in order to teach well at university, a lecturer must satisfy two competencies simultaneously: professional capacity and pedagogical capacity. If the teacher is not able to search and select information; have no ability to detect and solve problems, it is difficult to lead learners to the above-mentioned goals, and it is difficult to teach "how to learn, how to think" to students at university level.

To teach well at the university level, lecturers who teach majors in engineering and technology must satisfy some of the following requirements. First, they should have teaching competence, including a foundation of professional knowledge that meets the requirements for the major of teaching, the ability to develop teaching plans and develop a rich curriculum. Timely update the changes and innovations of science and technology in today's era. Able to organize diverse classes, apply practical facilities, experiments, and advanced teaching technologies to improve teaching quality, increase multi-dimensional interaction in the classroom. Second, they should have the ability to communicate, inspire, connect and improvise flexibly: this skill requires both a training process as well as the passion and enthusiasm of the lecturer, especially the passion for the technology and engineering majors. Thirdly, participating in scientific research will contribute to the development of lecturers' thinking, creativity, ability to work independently, knowledge and methods of scientific awareness. In the process of performing scientific tasks, lecturers will be trained and developed more independent thinking, "critical thinking", knowing how to defend their scientific position, and this is also the process by which the lecturers themselves update the information and knowledge effectively. Fourth, it is impossible to train people to make certain products without having practical experience in that field. Fifth, they should have the ability to learn and develop for the whole of life. This ability requires teachers to constantly improve their expertise, but also to constantly update skills and knowledge of foreign languages, information technology, economics, socio-political in order to be able to adapt to the continuous

development of the technology and techniques. Sixth, lecturers should also obtain professional ethics, including honesty, trustworthiness, passion and long-term commitment to the teaching career, dedication and devotion to the assigned work, always applying standard rules of conduct in communication, lecturers are highly qualified people, developing a habit of studying and researching constantly.

In addition, with the continuous development of the 4th industrial revolution and the requirements of the innovation of modern education, lecturers in the field of engineering and technology need to develop more digital capabilities. In the context that poses a great challenge to Vietnamese higher education in training high-quality human resources, capable of adapting and mastering technology in the country's digital transformation process, the development of the digital capabilities for education staff in general and teaching staff in particular is extremely urgent.

4.4. Solution to develop the digital capacity for the teaching staff of the engineering & technology majors according to the multi-intelligence theory

4.4.1. Concept and structure of digital competency framework

According to Secker, the concept of digital competence has been around for more than 20 years and is often used together with concepts such as digital skills, information competence, communication competence or academic competence. There is a huge amount of information that exists in digital form and learners need to be able to reasonably doubt, think critically to evaluate it and grasp how to use digital tools in information sharing. information for research and self-expression.

UNESCO defines digital competence as the ability to safely and appropriately access, manage, understand, combine, communicate, evaluate and create information through digital technology to serve tasks from across the world, simple to complex as well as start-up. Digital competence is a combination of computer use capacity, information technology capacity, information capacity and communication capacity (UNESCO, 2018).

The Digital Competency Framework is built as a foundation for developing training courses to improve people's digital capabilities in the 21st century. The goal is to help people acquire the necessary digital capabilities for life, study, work and participate in social communication actively, actively and safely in the digital environment. The digital competency framework is widely provided to all organizations and other training units as a reference to develop digital competency programs for each specific audience (Do, 2021).

Table 2. Digital competences Framework

Number	Competence group	Ability Description
1	Operating equipment and software	Identifying, selecting and using the hardware devices and software applications to identify, process data and digital information in problem solving.

Number	Competence group	Ability Description
2	Information and data mining	Identifying the individual information needs; implementing the strategies to find, locating and accessing information; evaluating the news sources and their content; information storage, management and organization; using the information ethically and legally.
3	Communicating and collaborating in a digital environment	Interacting and communicating through the digital technology and practice digital citizenship. Managing your digital identity and reputation in the digital environment. Using the digital tools and technology to collaborate, design, and create resources and knowledge.
4	Digital safety and security	Protecting the devices, content, personal data, and privacy in the digital environment. Protecting your health and spirit. Awareness of the impact of digital technology on social well-being and social inclusion. Awareness of the impact of digital technologies and their use on the environment.
5	Digital Content Creation	Creating and editing digital content. Transform and combine information and digital content into existing knowledge. Understand the licensing and copyright systems involved in the digital content creation process.
6	Learning and developing the digital skills	Identifying the opportunities and challenges in the online learning environment. Understanding individual needs and preferences as a digital learner. Promote open access and information sharing. Be aware of the importance of lifelong learning for personal growth.
7	Using the digital capabilities for your career	Operating the digital technologies in specific career contexts. Understand, analyze, and evaluate data, information, and digital content that is specific to professional practice. Practice innovation and entrepreneurship in a digital environment.

4.4.2. *The Solutions to develop digital capacity for teaching staff*

In general, with the rapid development of society, the innovation of modern education in the era of Industry 4.0, the teaching staff in general has developed both in quantity and in professional quality of subject, contributing to many achievements of the educational career in recent years. Many educational models and active teaching methods have been put into practice. However, digital competence for many lecturers is still a new concept, many lecturers are still afraid to implement digital transformation in teaching activities, afraid to apply teaching methods, media, technology, etc. Modern and advanced teaching technology in the teaching process. It is very necessary to come up with solutions to develop digital capacity for

teaching staff in general and lecturers teaching disciplines related to engineering and technology. Within the framework of the article, the author mentions some of the following solutions. Firstly, raising the awareness for teachers about the concepts and structure of the digital competency framework, the requirements and regulations on necessary digital skills for teachers in the current period such as: finding out, selecting the information; information security skills; skills to access and share information. Secondly, organizing the refresher courses on the modern teaching methods for teachers, and apply digital devices to teaching activities. In the digital age, information often comes to students in multi-directional, multi-dimensional and different ways, so the diverse and flexible use of modern teaching methods will help teachers tackle this situation. Thirdly, participating in courses on foreign languages and information technology applications. These are considered the main tools for communication in the digital age. Fourthly, each teacher needs to constantly learn and develop their digital skills, thereby identifying opportunities and challenges in the digital education environment. Capturing students' thoughts and aspirations in a digital environment. At the same time, be aware of the importance of lifelong learning for personal growth. Fifthly, actively participate in digital education experiences, practices and internships. Through the experience, the lecturers see the method, draw the experiences in the organizing digital teaching activities, thereby making improvements for themselves.

5. Conclusions

The emergence of new technologies has changed the basis of production and services, placing new requirements on the capacity of personnel, thereby asking universities to change accordingly. The development force for the teaching staff in education 4.0 is considered to require all elements of future education to meet the requirements of the 4.0 industrial revolution. Teaching the Technology and technical majors according to multi-intelligence theory requires a lot of competence for lecturers, therefore, it is necessary to continue to have deeper and more comprehensive studies on this topic in the next time.

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