Education

Enhance teaching methods in the digital environment: a case study of students's self-study competence

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Abstract
The world is changing in context of the 4th Industrial Revolution and the digital era, it is urgent to apply digital transformation in education and training. Innovating teaching and learning methods in the digital environment based on enhancing self-learning capacity of learners is essential to achieve digital transformation effectively in education and training.
The study intraduct viewpoint on concepts and of digital environment, digital self-learning and digital self-learning competency, blended learning; and analyze on the scientific basis and conditions for innovating the teaching method of self-study in digital the environment. This study has proposed three solutions for self-study based teaching method in the digital environment in higher training, especial in technical universities: (1) experimental self-study in the digital environment, (2) innovating teaching method of self-study in the digital environment, (3) innovating the self-study teching method to improve memory capacity in the digital environment.
An objective of this study is to clarify the term "teaching and learning in the digital environment". The research results to create a premise for further research, building a theoretical basis on how to teach self-study in a specific university training discipline (example for Electrical Engineering) to illustrate in the digital environment and implementing sample lesson plans and specific lectures to develop self-study competency of the students in a digital environment, achieving higher educational and training efficiency, and meeting current digital transformation requirements.

Keywords: digital environment, digital self-study, digital self-study competence, blended learning, teaching methods

1. Introduction

Self-study competence is a learning method where students direct their own studying outside the classroom and without direct supervision (Roll, 2021; Valverde *et al*., 2021) [18, 23]. Self-study and traditional classroom learning can be used together to help your child get the most out of his or her learning experience (Jones & Lee, 2021) [14]. Together, these methods help students learn and retain information better, helping boost comprehension, grades, and motivation. Digital experiential learning is a concept that places individuals in an interactive learning environment, either physically or virtually (Chen & Hsu, 2020; Hite *et al*., 2019; Meyer *et al*., 2019) [5, 10, 15]. The goal is to replicate and engage in real-world scenarios to teach particular skills or techniques. Traditional methods of learning, such as classroom instruction and videos, are slowly being phased out in favor of a more hands-on approach like digital experiential learning (Hung *et al*., 2022; Chick *et al*., 2020; Chandrasekera & Yoon, 2018; Paepe *et al*., 2018) [13, 6, 4, 16].

Over the past two decades, information and communication technology (ICT) has developed rapidly, they have strongly influenced the change of education in general and teaching competency in particular (Thanh *et al*., 2021; Avando Bastari *et al*., 2021) [22, 3]. The results reported that the use of an online environment combined "face to face" classes had an impact on the development of thinking for students (Hung *et al*., 2021;

Thanh, Thanh, & Tien, 2019) [12]. The develop students' creative competency will help students participate and self-assess learning outcomes. The develop of technology and the role of it in flipped classroom model to promoting and the growth of online learning environments should be enhanced (Thanh *et al*., 2021; Thanh, Thanh, & Tien, 2020) [22, 20]. Research shows a positive impact on students' activities and learning outcomes at many levels and subjects (Amoako & Brantuo, 2021) [2]. Besides the goal of introducing a style-based blended teaching-learning model to develop learning competencies in general, and at the same time develop a specific competency for the competence to integrate tools to support learning activities, in which ICT is the core tool, direction is completely consistent with the online teaching method in education and training in educational institutions, and adapting to the current Covid-19 pandemic (Hung *et al*., 2021; Peterson *et al*., 2020) [12, 17].

There are a lot of research projects on developing self-study competence through experiential activities in real environment (Xia *et al*., 2021; Thanh, 2018; Nguyen Thi Nga, 2010) [24, 19]. However, in the digital environment, experience activities imply their own characteristics and are different from the real environment. So, what is the "Digital environment"? How is the nature of teaching and learning in the "digital environment" different from traditional teaching and learning? How to teach self-study in the digital environment? It will be explained in the

paper. In order to exactly understand the nature of the digital environment, we need to clarify the terms: physical environment, experiential learning theory, digital self-study, digital self-study competence to build an experiential learning theory that leads to innovate teaching and learning.

This study focuses on researching the scientific basis of experiential learning in the digital environment. We propose solutions to develop students' self-study competence for enhance teaching method in the digital environment.

2. Methods

This research used mixed which qualitative and quantitative methods to analysis and assessment (Almeida, 2020; Creswell, 2008; Creswell, 2011) [1, 7]. Due to the limited scope of the article, the content of this section only focuses on higher-level experiential learning which are experiences: group discussion, experiment & practice, and immediately passing the knowledge that is already gained to others for a specific subject: Embedded systems.

The form of teaching under Blended learning were selected by us to carry out the research method of this study. A class of 150 students will be supported by 150 virtual instructors on a one-to-one mapping (one teacher teaches one student) is model with digital Blended learning.

3. Result and discussion

Physical environment and experiential learning

The physical environment is composing of the tangible physical entities and objects that the human can see, observe and perceive, including: the social environment, the natural environment and the man-made environment:

- The natural environment around us has existed for million years, such as the atmosphere, rivers, oceans, forests, natural resources, plants and animals, natural phenomena, etc.
- The social environment includes: politics, economy, culture, sports, history, education, etc revolves around people and be considered as a source of life and goals for themselves.
- The artificial environment includes the chemical and physical components that created and controlled by humans, such as amenities in life such as cars, airplanes, houses, buildings high-rise buildings, urban areas, amusement parks, etc.

Theory of experiential learning in the physical environment:

- In entity environments, learners not only acquire knowledge in isolation, but also acquire knowledge through surrounding entities. Learning is a process in which learners interact and work with the environment to build knowledge, skills, and attitudes.
- Currently, experiential Learning is a trend in teaching. Many studies have proven that knowledge presented by teachers via reading, seeing, listening, speaking is ineffective experience and difficult to remember.
- In more detail, to remember, read accounts 10%, listen does 20%, and see does 30%. Other types of experiences such as practice, experiment, role-play, simulation and the

highest level of learners after understanding the lesson for others to reach the highest level of effectiveness accounts 90% to remember.

- In an entity environment without connection, teaching and learning at school is completely independent, not connected to the surrounding entity. The theory of experiential learning was initiated by David Kolb a century ago, when the concept of a digital environment was not yet existed. Therefore, this theory is only valid in the physical environment.

Digital environment (cyber) and smart manufacturing

The digital environment is the physical environment with additional digital space - Cyber. In addition, digital technology organically integrates with social organizations (businesses, agencies, residential communities, etc.), physical resources and assets (houses, vehicles, roads, etc.) and the natural eco-environment make up the ubiquitous digital environment.

An entity that, when digitized as data, creates a digital version, corresponding to an address in digital space, and its operations are connected to digital versions of the entity. other entities, exchanging information back and forth into a digital system. When every entity is digitized, identified, and has an address on the Internet, it will create IoT (internet of things) and smart manufacturing.

The feature of smart manufacturing is connection via sensors, Wi-Fi communication to record all relevant data and transmit to the server for processing to make exact decisions. Smart manufacturing is a product of Industry 4.0, the core of which is AI (artificial intelligence), machines replacing human mental labor, allowing people to calculate real digital control systems in the digital environment.

In the digital environment, entities are gradually digitized creating data that can be interconnected to create a digital space. When every entity is digitized, the data will become big data, making the digital space more abundant and diverse with increasing connectivity.

Some examples of smart manufacturing in the digital environment.

On the parts of self-driving cars (smart driving, automatic driving) are attached sensors (sensors) and GPS positioning, it generates signals to digitize. The physical environments such as roads, bridges, intersections, barricades, etc. is also digitized thanks to the mounting of sensors, GPS navigation, dash cam system, reverse camera. At that time, the car can operate thanks to the control system in the digital space, so it does not need a direct driver to automatically avoid obstacles in the connected digital environment.

Humans themselves (which are physical entities) always have "inseparable" devices such as mobile phones, rings, clothes, shoes, they can all be fitted with sensors, fixed GPS location, i.e. digitized. It is even possible to manufacture specialized medical electronic equipment, integrating blood pressure monitors, electrocardiograms, walking steps, and blood glucose measurements with nano-size (digitized to transmit signals to the system). system) "implanted" into the patient's body, so that the doctor can monitor the patient remotely, also

known as "smart examination".

In short, smart manufacturing is the connection of entities in the digital environment to create digital assets with superior value compared to traditional products.

Self-study and digital self-learning competence
Self-study

Self-study is a simple understanding of the process of working on your own, absorbing knowledge without the guidance of others. You yourself have to research, reason, think. Then we will master the process of acquiring knowledge; including the time to study, the amount of knowledge to be loaded with the learning method.

Self-study competence

Self-study competence is the competence to identify learning tasks voluntarily and proactively; set learning goals by themselves and strive to achieve them; have effective learning methods; adjust their own errors and limitations when

performing learning tasks through self-assessment or suggestions from teachers and friends; actively seek support when having learning difficulties.

Blended learning (B-learning)

B-learning is a form of teaching organization that combines traditional face-to-face teaching and online teaching to optimize the strengths of each form, ensuring the best high educational efficiency.

Digital technology, digital self-learning, digital B-learning

Digital technology is the integration of 6 digital technologies: IoT (internet of things), CPS (Cyber-Physical Systems), Cloud computing.

(Cloud computing), 5G (telecom network)-5th generation information, big data (big data), Data science (Data science includes: AI-artificial intelligence, data mining-data mining, deep learning - deep learning.
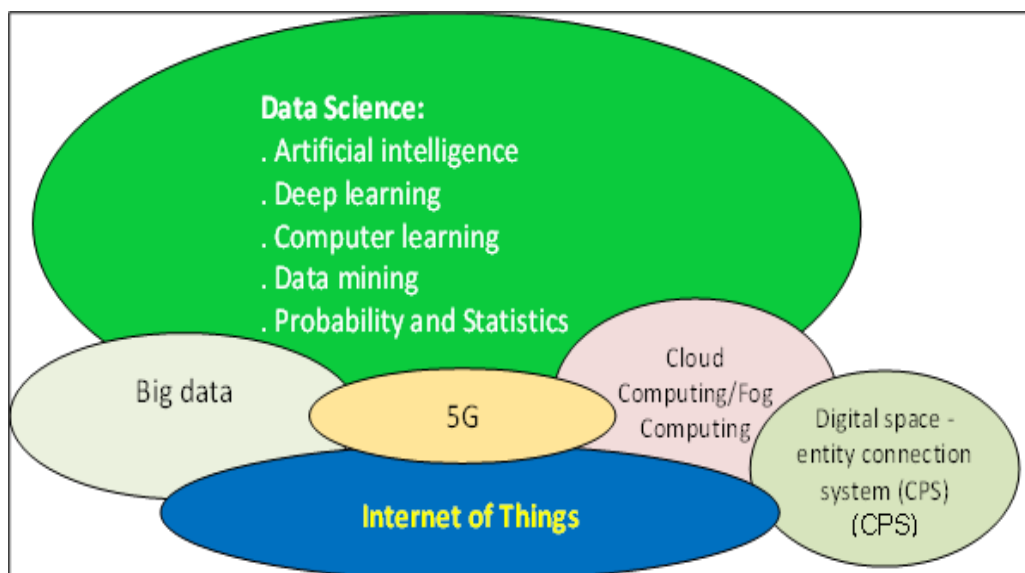

Fig 1: Digital technologies

Digital technology is the foundation and motivation of innovation in management and teaching methods, especially in higher education under the new educational philosophy: digitalized-based education to create knowledge.

The process of forming/acquiring human knowledge/perception in general including the learning

process of students. Data collected through digital means/entities will be processed into information, be analyzed and evaluated to form knowledge. This is a transition from low to high, from wide to deep, from general to detailed as shown in Figure 2.
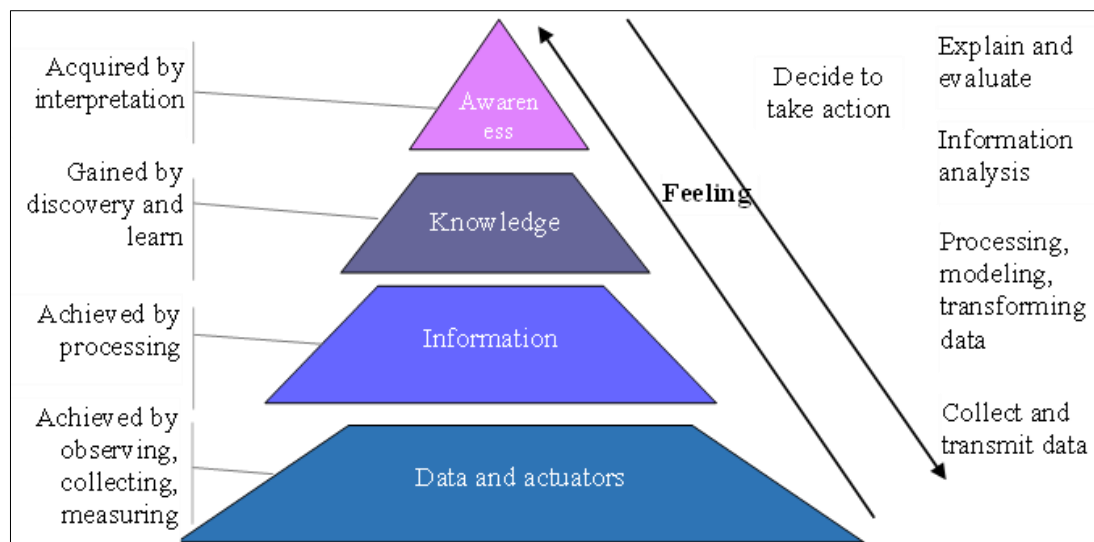
Fig 2: The process of transforming data into knowledge/cognition

Digital self-study competence

In addition to the competence as defined for self-study competence, "digital self-study competence" also includes the competence to exploit digital technology to self-study in the digital environment to personalize learners, to transform data to knowledge and perception as shown in Figure 2. Studying in the same class, in the same learning environment, in the same digital environment, the student who has better "digital self-study competence", that student will acquire knowledge than better.

Digital B-learning

Digital B-learning is a high-level development of traditional B-learning, where face-to-face teaching between teachers and learners is conducted in a digital environment owning to digital technology.

This is also considered as the main content of the thesis focusing on research. B-learning is a method, a specific environment for students to exploit in order to carry out self-study effectively.

Scientific basis for innovating the teaching method of self-study in the digital environment

Change thinking

Digital assets are bigger than tangible assets.

The digital environment will have many new creative opportunities, changing the traditional educational management method. The new method may not be related to the old one, if refuse adapt, they will be excluded from the digital environment.

The most important thing is to change the traditional mindset to the digital mindset - digital assets are bigger than tangible assets.

The digital environment facilitates connection, the entities in the University are digitized and connected forming the digital assets of the University. The reputation of a university depends on its digital assets. If the prestigious university is hundreds of years old, has hundreds of famous professors, has a library containing thousands of book but without digitization, there

will be no "digital assets" to share and cooperate with other university. The rank of this University will decrease on the World University map when ranking. In today's flat world, those university, even though located in the City Center, are still considered " "Oasis ".

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In Vietnam, the Prime Minister has set a goal by 2025: "100% of learners and teachers are managed by records with uniform identifiers across the country". At that time, any school that is still "faithful" to the management by administrative procedures, does not digitize records, that school will "alone a horse" digital assets" will be zero and self-elimated themselves because they do not connect, cannot communicate with the surrounding digital environment.

The comparison is lame but easy to understand, the traditional teaching method is like an oil lamp, and the teaching method in the digital environment is like an electric light. The same means of lighting, but the principle of operation of these two means of lighting is not related to each other. Oil lamps work on the principle that, using a lighter to light the wick, the oil in the wick will burn and create a yellow flame. Someone joked

that, if someone applied the principle of lighting a kerosene lamp to an electric lamp, it means that if someone puts a lighter on a high-voltage electric station, they will commit suicide because they will immediately receive a loud explosion like a bomb that destroys an entire neighborhood with hundreds of people.

The teaching method in the digital environment is not much related to the traditional teaching method because the scientific background is completely different such as kerosene lamp and electric lamp. Only with such a change in mindset can we "put teaching and learning in a digital environment".

Conditions for innovating the way of teaching self-study in the digital environment.

When there were no computers and the Internet was not as popular as it is today, learners who wanted to gain knowledge had to go to school and listen to teachers' lectures, take full notes, and go home to re-learn what they heard in class. Over time, that way of teaching and learning becomes a subconscious for teachers and learners. If you want to study on your own, you can only buy books or borrow your notebooks to take home for self-study. To get better at the library to borrow books for self-study. Thus, the condition for self-study is that beyond the will of the learners themselves, there must be additional conditions such as having books, having a library, the more books the library has, the more learners need to do. Possessing as many reference books as possible is considered a good condition for self-study.

In a digital environment where digital technologies are the foundation, the conditions for self-study are different from before. Schools must have big data, big digital assets, so that learners have the right to exploit research, specifically.

Building digital resources and digital assets of the University. Instead of building classrooms and libraries with many expensive printed books, they switched to invest in building telecommunications infrastructure, BTS telecommunications stations, connecting 5G and 6G telecommunications networks. Quickly digitize all printed books and put them online or in extremely large digital libraries so that learners can exploit them as shared references; Quickly digitize the University's data including: lectures, information about school, lecturers and students, teaching & learning materials; When the data has been digitized, the next step is to connect the big data and equip the corresponding equipment and smart software.

Updating the level, thinking, skills of using digital technology and teaching how to find information for learners.

As aforementioned, digital self-learning capacity is the competence to exploit digital technology to self-study in the digital environment in order to personalize learners, to turn data into knowledge and awareness. When all data and documents have been digitized, the information load is constantly increasing, becoming a massive digital resource like a "bagua matrix", if learners do not have skills in using digital tools, they cannot understand how to choose the necessary information. They will be like getting lost in the forest, "the train enters the ghost", there is no way to get out.

Instead of maintaining the traditional teaching method, we switch to instruct students to self-study in the digital environment, that is:

- Training students in the competence to discover and create knowledge, data mining, this goal is the main measure of the training quality of each university in the globalization period.

  In the era of information explosion, knowledge is not only what is recognized by scientists from the traditional point of view but is the result of each person's experience and information processing. Information itself has no value and it has value only when it is processed and turned into knowledge. Therefore, the self-learning process is the process of establishing and creating valuable information on the Internet or it is the process of finding information on the Internet. Teaching how to self-study turns to teaching how to search for information online in general, and search for information on the University's digital resources in particular.

- When we want to find documents relating to something, if we use Google to search with keywords, we will get a lot of documents that are not what we are looking for, as well as many related documents that are not found out.

  There are at least two ways for AI to participate in solving this problem:

  One is a search system that allows to put the question in the form of natural language, analyze it to understand the meaning of the question and have a mechanism to search for documents in the library in this sense.

- Second, the search system will model words. Each model is a collection of many other words with their pro competence distribution according to statistical rules. Instead of searching online or in the library for keywords, the system will search with a set of words. With these 'smart' methods, we will live more easily in the vast and mysterious Internet space.

In summary, the condition for self-study teaching in the digital environment is to have digital learning materials, digital assets and learners must have digital self-learning competence, capacity and skills to exploit digital data during searching information when self-study.

Some innovative solutions for self-study teaching in the digital environment of higher education

Self-experiment and practice on digital environment.

Experiential learning theory initiated by David Kolb is only suitable in the unconnected entity environment. Although Experiential learning such as experiment, practice, role-playing, simulation achieves a high level of effectiveness, making it easy for students to understand, long-remember, and verify the theory they have learned, but implementation in physical environment is very difficult. An experiment, practice is done by a group of 2 students, a lecturer only instructs a maximum of 10 groups at the same time.

In the laboratory, there are technical instruments, measuring instruments, equipment such as lights, air conditioners, curtains, writing boards, pens, books, teacher's desk notebooks, student desks are objects, independent entities. In the "smart lab", those entities are all fitted with sensors to digitize and put

into the wireless smart gate module. The process of transmitting information in the intelligent laboratory is collected by temperature and air quality sensors, displayed on management devices of teachers and schools, providing a total solution of IoT smart classroom.

Owning to digital technology the experimental instruments are digitized, and it is possible to control and collect surveys remotely. Example FPGA test kit on RemotRemoteLab-FPGA system is conducted remotely by students. The RemotRemoteLab-FPGA system allows students to implement digital circuits on Altera's DE1 KIT, in which the CycloneII - EP2C20F484C7 chip will be programmed to create a digital circuit.

Through the Internet, the lecturer guides students online so that students can conduct their own experiments as well as lessons on digital electronic design, design embedded systems with KIT DE1 and all activities performed on the Internet. KIT will be displayed on the screen just like doing it directly with KIT, specifically pressing buttons, displaying on LED, then students perform this whole experiment at home, far away from school. In the physical environment, when the University has not been digitized, not connected, usually, an FPGA test kit is only used by students in the school, going to the school and only a few students are carried out at the same time. time. When the FPGA Experimental Kit is put on the digital system, the price of this kit may be more expensive than the old one, but when it is widely deployed in large numbers for all students of the same major in the country, it saves money. a huge amount compared to the traditional experimental implementation. At this time, the laboratory model will have to change so that students can do their own practice experiments online at any time, students at anywhere can connect to practice experiments and online experiments.

Innovating the way of self-study teaching in the digital environment.

First of all, it is necessary to understand the traditional B-learning as shown in Figure 3.
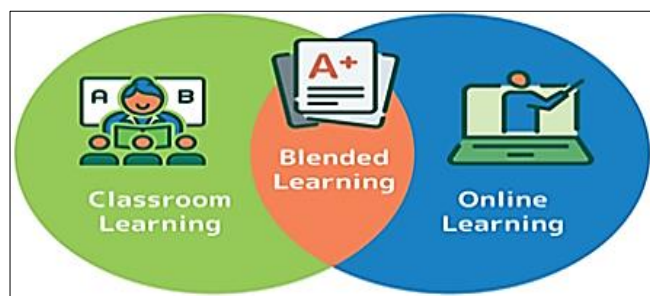

Fig 3: B-learning model between real part (left) and digital part (right)

The number part (right) of B-learning is for students to self-study online lecture video clips, where they do not understand, take notes. The real part (left) of B-learning is held by the lecturer in a workshop, exchanging "face to face" with students. Students ask questions about things they do not understand when they study online, the teacher will answer or students present the topic, the lecturer and other students listen and discuss.

With an experimental implementation class in under model of Digital B-learning more than 150 students, the typical B-learning method is not effective, because teachers cannot manage all students at the same time. When one student presented, only the lecturer and a few students listened attentively, but more than 100 other students such as "broken bees", working alone, playing on the phone, etc. Let the discussion (real part - left side) is effective, the lecturer must divide into 10 groups, each group of 15 students sitting in separate rooms for discussion led by the lecturer (or teaching assistant). However, to get 10 private classrooms and contract with 10 other instructors to support is as difficult as going to Mars.

However, in the digital environment, digital blended learning in combining self-study with "face to face" becomes simple. Because it has been digitized and connected, in the real-left part of Figure 3, lecturers and students can interact, exchange and communicate on the web like a real environment. Instructors can create 10 different classes on the team and simultaneously monitor 10 different discussion groups. Instructors can "move" from class to class instantly to control 10 classes at the same time. Lecturers can "contract" to connect with 10 other lecturers to participate in the seminar control time of 10 student groups by sending a link so that the lecturer can click on it to be able to go to the class immediately.

With the outstanding points of the teaching method in the digital environment, when student self-study online (part number), where the lecture is not understood, students can connect with other lectures and video clips with in-depth instructions to understand. The level of B-learning is higher, the real part (left) will be performed by virtual tutors to guide each student tirelessly, ie "personalizing learning" to each student pellets. A class of 150 students will be supported by 150 virtual instructors on a one-to-one mapping (one teacher teaches one student).

Innovating the way of self-study teaching to improve memory in the digital environment.

In the real environment, when you want to teach at a university, you must have a master's degree or higher, when you want to teach in high school, you must have a university degree in pedagogy. Therefore, it is not easy to become a teacher standing on a podium many stages, many complicated administrative procedures. In fact, many people have a university degree of pedagogy but are not allowed to be teachers but are working as workers in industrial zones or doing military service.

In the digital environment, learning for knowledge, the teaching method in the digital environment is: everyone learns from each other, the first learners teach the latter, the first to understand teaches the latter so everyone becomes a teacher. How to create a classroom on digital space is simple, not complicated like a traditional classroom on the campus of a traditional university.

The most effective experiential learning is that after understanding the lesson, teaching it to others will reach 90% of the memory level. Therefore, when all entities are

connected, the world is in the palm of your hand, the person who learns first, discovers first will teach the next person, not only by imparting knowledge, but more importantly, through teaching to understand deeply color, remember better the content you have studied, turn the knowledge you are learning into your own knowledge.

4. Conclusion

The content of the article is just a few of the personal touches of the authors, we want to clarify the term "teaching and learning in the digital environment" in this article and introduced 3 innovations in creative self-teaching in the digital environment.

Digital self-study, the digital self-study capacity of today's students will change qualitatively as compared to the previous self-study. Therefore, the theoretical basis of "digital self-study" will be different from "self-study" in the "pre-Internet" era. How to make use of digital technology, especially taking advantage of the wisdom of Internet "teachers" and virtual teaching assistants effectively in digital self-study of students is a problem that needs more in-depth study? In terms of educational theory, digital self-learning is an open topic, an unexplored land, this is really a fascinating but equally difficult and complicated scientific topic. Digital transformation in education, digital self-learning competence is the most important competence for learners to achieve the highest results. Because in the digital environment, all knowledge has become the digital property of the University, whoever has the best self-learning competence, he or she will quickly acquire knowledge on the digital platform. So, the problem that needs to be posed is to study how to exploit each person's digital self-learning competency, which is the focus of the education and training digital transformation strategy.

Subsequent studies will focus on building a theoretical basis for self-teaching of Electrical Engineering in a digital environment and implementing specific lesson plans. Learners acquire new knowledge themselves in the subject curricula, thereby contributing to innovating teaching methods in the direction of approaching advanced technologies, meeting the needs of digital transformation in teaching and learning of the industry education in the digital environment.

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