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SELF-DIRECTED LEARNING IN ENGINEERING TECHNOLOGY TRAINING - RESEARCH RESULTS AT HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY AND EDUCATION VIETNAM

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ABSTRACT

With the development of science and technology, the explosion of information and the strong impact of the Industrial Revolution 4.0, teaching and learning methods in universities have changed rapidly. In addition, the learning needs of learners are increasingly diverse. In that context, self-directed learning is considered one of the appropriate application methods for the orientation of innovation in teaching methods in the training of engineering technology at Ho Chi Minh City University of Technology and Education, Vietnam today. This article uses the method of researching existing documents and the method of pedagogical experimentation to study the self-directed learning approach, the process of applying the self-directed learning approach in teaching and organizing pedagogical experimental teaching to evaluate the effectiveness of this application in training engineering technology at Ho Chi Minh City University of Technology and Education. The research results contribute to promoting the training process in learning for students of engineering technology, contributing to the innovation of teaching methods of engineering for Universities of Technology and Education in Vietnam.

Keywords: self-directed learning; engineering technology training; students of Universities of Technology and Education in Vietnam

1.0 INTRODUCTION

Self-directed learning is used to distinguish from directed learning. The self-directed learning method has been studied by authors around the world since the second half of the 20th century and was built on a theoretical basis about 70 years ago. Author Houle, (1961), Research on adult learning motivation [10], author Allen Tough, (1971), published "Learning projects for adults" [6], author Knowles, (1975), published "Self-directed learning" [12]; describes the process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, building learning goals, identifying human and material resources for learning, implementing appropriate learning strategies and evaluating learning outcomes. An important research effort was the dissertation of Lucy Madsen Guglielmino (1977), who developed the “Self-Directed Learning Readiness Scale (SDLRS)”, an instrument that has been used by many researchers to measure self-directed readiness or to compare different aspects of self-directed learning with many characteristics [11]. In 1987, the International Society for Self-Directed Learning was established in the United States, which holds an annual international symposium on self-directed learning (https://www.sdlglobal.com/). This is a

forum for sharing self-directed learning research and building self-directed learning theory. Selected articles have been published in paper form until 2000 and on CD since that time.

By 2003, the Symlion group of self-directed learning had launched an International Journal of Self-Directed Learning. Subsequently, a separate website (https://www.sdlglobal.com/) was established. The International Self-Directed Learning Symposium provides an international forum for discussing important current developments in the research and application of self-directed learning. The program design emphasizes presentations of recent research findings. The International Journal of Self-Directed Learning is online, published twice a year. Through this, the conference papers aim to share perspectives and experiences on self-directed learning widely in the world so that researchers around the world have the opportunity to access this new information.

Researchers have attempted to develop a variety of tools to measure and evaluate learning outcomes, such as the development of the Comprehensive Guided Learning Readiness Scale and the Continuous Learning Ability Scale and Qualitative Data were the new impetus for learning outcomes research by Lucy Madsen Guglielmino Guglielmino in 1978.

Regarding learning outcomes strategies, in 2004, Tracy Thompson and Sherry Wulff implemented the Guided Learning Experience Strategy in intermediate and advanced chemistry courses. This action research project, based on instructor-observed learning problems, was linked to students' self-directed learning skills. Initial findings suggest that the systematic implementation of curriculum-focused learning outcomes strategies has strong potential to support students' development as autonomous learners and to enhance the teaching environment. Regarding the learning style, in 2013, Abdel-Hady El-Gilany, Fawzia El Sayed Abusaad studied the Readiness for Self-Directed Learning and Learning Styles of Saudi Arabian University Nursing Students. This study was conducted to determine the level of readiness for self-directed learning among Saudi Arabian nursing students; to determine their learning styles and to find out the relationship between the two concepts. The high level of self-directed learning and the predominant convergent learning style among university nursing students will have positive implications for their post-service continuing education and nursing education.

In 2018, Tim Piper, Thomas Smith, Jorge Jeria, Robert Intrieri, studied the Development of the Self-Directed Learning Scale for Assignment. The development and validation of the Self-Directed Assignment Scale scores will be explored. Self-directed learning tool for homework scales was tested on 368 self-motivated exercisers and 217 exercise novices. The scores from the instrument showed a high level of support validity and predictive ability to classify exercisers. The purpose of this study was to develop and provide validation evidence for scores from an instrument to measure self-directed learning in exercisers. The instrument developed for this study will be referred to as the self-directed learning Exercise Scale.

Self-Directed Learning for Doctoral Students, 2020, Tracy H. Porter, Cheryl Rathert, and Diane A. Lawong, published an effort called Self-Directed Learning: Lessons from the Doctoral Student Experience. This study has several implications for doctoral students, faculty advisors, and universities. First, it is the only study to apply self-directed learning at the doctoral level and thus adds to the literature on self-directed learning. Second, these results provide a potential

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approach that university leaders may want to consider for their doctoral training programs as it may be desirable.

Research on self-directed learning practices has ascertained various potential benefits of learner achievement. As mobile technology offers highly practical and portable usage for self-directed learning, studies on language learning practices through technology-based applications have become prevalent among adult learners. This study aimed to examine learners digitalized self-directed language learning practices for enhancing their English language skills at the tertiary level [15]. It was also concluded that learners need a well-organised self-directed learning practice in digital platforms. The study addresses key attributes of practical implications adhering to digitalized self-directed language learning practices for more efficient outcomes in advancing language skills.

Researchers have also identified the importance of self-directed learning teaching methods. Self-directed learning is applied in many different fields and many different educational subjects. From analyzing the conditions for self-directed learning, the authors propose a number of measures: Deep learning, a suitable combination in schools in the 21st century, Current important developments in research and application of self-directed learning, connecting self-directed learners around the world, to improve the effectiveness of self-directed learning activities.

In Vietnam, self-study activities related to self-directed learning have been paid attention since the feudal period when education was not yet developed. Some recent studies have also affirmed the importance of teaching according to the self-directed learning method. In the article "Organizing oriented learning activities in the credit system through teaching activities" by author Nguyen Thi Cam Van. According to the author, one of the "basic principles of the credit system training method is to allow students to choose the time, learning content, and roadmap suitable to their own abilities and conditions. To meet this condition, students themselves must have a spirit of self-awareness, positivity and especially must have a proactive learning method. Self-directed learning is an activity that demonstrates the learner's high initiative throughout the entire learning process. According to the author, from their own needs, interests and learning conditions, learners proactively determine their learning methods, develop learning plans, implement plans and evaluate learning outcomes. Or, the self-directed learning process is a highly proactive learning process of learners right from the early stages of determining directions and strategies for learning" [4]. In a study on teaching engineering using self-directed learning methods, the authors Vo Thi Xuan, Bui Van Hong, Truong Minh Tri, (2016) stated: "Ho Chi Minh City University of Technical Education approaches self-directed learning in teaching engineering, to train high-quality human resources in science and technology, truly becoming the locomotive of the development process of the fourth industrial revolution, in the context of the country's international integration" [1]. From there, the author proposed a technical training model according to the self-directed learning approach, with the goal of building a technical teaching process according to the self-directed approach, the general structure of the self-directed learning approach, the cognitive characteristics of students, the characteristics of technical content and the appropriate teaching process. In 2017, Bui Van Hong and Truong Minh Tri applied this model in training the Engineering Technology major at Ho Chi Minh City University of Technical Education. The experimental results showed the feasibility and effectiveness of the model [13].

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Higher education plays an important role in the task of training high-quality human resources to serve the country's socio-economic development. In the teaching process, the role of lecturers is gradually changed from imparting knowledge to guiding, orienting, and organizing students to self-study and self-research to discover new knowledge, thereby developing self-study capacity and creative problem-solving capacity. Teaching according to the self-directed learning method always focuses on learners to promote high levels of initiative, self-awareness, and positivity in the learning process. Learners proactively build learning plans based on the goals, content of subjects, sciences, and majors. The self-directed learning process helps to form and train learners' self-directed capacity. Educating learners at any level of education is aimed at improving learners' capacity. Self-directed learning is a form and measure for learners to improve and enhance their learning capacity.

For the Engineering Technology sector, it is the sector that trains technical human resources in Vietnam. Currently, the country is in the process of industrialization and modernization to integrate with the world economy, promoting the development of industries related to machinery and high technology. One of the highly appreciated sectors is precision engineering. For students to know how to design and calculate parameters for types of machine parts, mechanical equipment, machinery needed for production activities such as gears, construction material production lines, etc. and participate in supervising the production process of those devices, installing equipment for customers or even participating directly in that production process. At the same time, operate, inspect and plan operations, warranty, periodic maintenance, troubleshooting of machinery systems of enterprises, companies, etc. This is a sector that is considered to attract a large labor force when the country enters industrialization and modernization. Depending on the industry, students entering the mechanical engineering industry are still hesitant because it is very difficult; because the scope of activities is very wide. Therefore, in training and teaching students in the engineering industry, it is necessary to foster students' love for the major, passion for the industry, logical thinking, creativity, perseverance and carefulness in work. In particular, it is necessary to create motivation and needs for students to orient their learning goals, build scientific learning plans in each stage and measures and means to help students achieve those goals soon. Help students manage and use their time effectively; help students adapt best to changes in the school's training model. From training practice, it shows that: Teaching according to the self-directed learning method is an effective measure to help students identify specific goals in each stage and measures and means to achieve those goals: Help students manage and use their time effectively; Help students adapt best to changes in the school's training model.

Universities, which have trained in Engineering Technology in recent years, although the Board of Directors, lecturers, staff, and workers have continuously improved and enhanced the quality of training. However, the majority of students have realized the importance of studying, some students have made arrangements or plans for their own studies, but there are still students who are not interested and do not have the habit of self-directed learning. During the learning process, few students know where to start, what steps to follow, and adjust the plan according to their own needs and abilities. Therefore, teaching according to the self-directed learning method for students in the Engineering Technology sector is extremely necessary.

From the above analysis, it can be seen that self-directed learning and application in teaching engineering is one of the important orientations in training students in the Engineering

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Technology sector. Especially for Vietnamese technical pedagogical universities, it is still a new issue in research as well as in practical implementation.

With the advantages of teaching according to the self-directed learning method, it is consistent with the viewpoint of educational innovation. Improving the capacity for autonomy in learning, lifelong self-learning, scientific research, etc. for students in the context of international integration. Therefore, teaching according to the self-directed learning method needs to be further researched and improved. Applying it to educational practice in Vietnam to train human resources with high technical qualifications and quality to truly become the locomotive of the development process of the fourth industrial revolution, in the context of the country's international integration, digital transformation in education is necessary and has practical significance.

2.0 RESEARCH METHODS

The article uses the following educational and social science research methods:

2.1 Research method of existing data

- Research educational scientific works, theoretical documents related to the topic.
- Combine methods: analyze, synthesize, classify, systematize different viewpoints on self-directed learning, thereby building basic viewpoints on self-directed learning as a basis for orientation for application, directly serving the research tasks of the topic.

2.2 Pedagogical experimental method

2.2.1 Implementation method

The author has applied the controlled experimental method, the experimental and control classes all study under the same learning conditions in terms of lecturers, teaching aids, detailed subject outlines and learning materials. In which:

* For control classes, lecturers organize normal teaching according to their own methods and experiences.

* For experimental classes, the pedagogical impact during the experiment is the impact on the teaching process according to self-directed learning. Therefore, lecturers are guided in advance on the implementation process, from which they organize practical teaching according to the illustrated design.

2.2.2 Learning outcome assessment tools

Evaluate students' learning outcomes based on the level of achievement of teaching objectives, the assessment content includes:

* Level of completion of learning tasks

* Ability to report learning outcomes

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* Learning attitude

2.2.3 Processing the results of pedagogical experiments

* Assess the level of achievement of teaching objectives of students in experimental and control classes based on cumulative scores and calculated as an average percentage compared to the maximum score (10-point scale) according to the following formula (1):

$$\overline{X\%} = \frac{1}{N.10}\left[\sum_{i=1}^{n} F_i.x_i\right].100 = \frac{1}{N}\left[\sum_{i=1}^{n} F_i.x_i\right].10 \quad (1)$$

In there:

: Cumulative score as a percentage average
: i-th cumulative score
: frequency of score occurrence
: number of students in the class

* Create Fi distribution table, fi frequency table and fa progressive convergence frequency table

* Calculate statistical characteristic parameters, including:

+ Average value of points:

$$\bar{x} = \frac{1}{N}\sum_{i=1}^{n} F_i.x_i \quad (2)$$

+ Variance:

$$S^2 = \frac{1}{N}\sum_{i=1}^{n} F_i(x_i - \bar{x})^2 \quad (3)$$

+ Adjusted variance:

$$\sigma^2 = \frac{N}{N-1}S^2 \quad (4)$$

+ Standard deviation:

$$\sigma = \sqrt{\sigma^2} \quad (5)$$

+ Coefficient of variation:

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$$V\% = (\frac{\sigma}{\bar{x}})100 \quad (6)$$

In there:

: i-th cumulative score
: frequency of score occurrence
: total sample test

* Test for differences between mean scores using the t statistic (T – test).

3.0 RESEARCH CONTENT

3.1 Self-directed learning in engineering technology teaching

3.1.1 Self-directed learning in engineering technology teaching

Teaching engineering technology according to the self-directed learning method is the process in which lecturers support and guide students to determine their engineering technology study plan based on their abilities, needs and conditions to proactively choose their personal goals according to the set orientation.

Within the scope of this topic, it is understood as follows: "Teaching engineering technology according to the self-directed learning method is a teaching activity, based on the teaching objectives identified in the training program of the industry, lecturers guide, orient and organize students to perform learning tasks to achieve teaching objectives, in accordance with the plan, progress and learning methods determined by students according to their learning needs and conditions."

3.1.2 The structure of self-directed learning

Self-directed learning in teaching includes the interactive relationship between: Objectives - Content - Teaching methods - Teaching aids - Teaching organization forms - Assessment. The structure of self-directed learning teaching is illustrated in (Figure 1.1) which is the interactive relationship between Lecturer - Teaching aids - Students taking place in the classroom space.

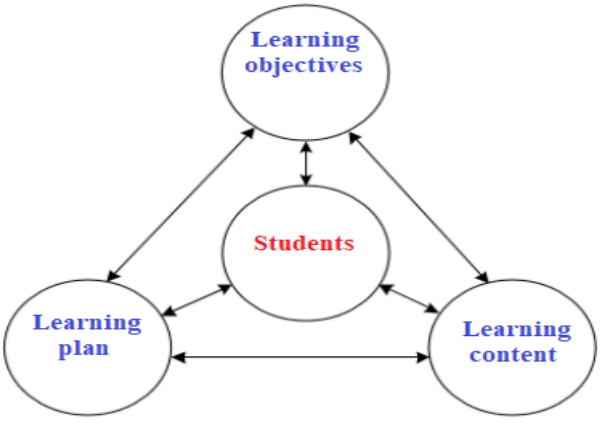

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Figure 1.1 Structure of self-directed learning in teaching

In there:

- Learning objectives: Are the learning outcomes that students need to achieve at the end of the learning process.

- **Learning content:** Is the level of knowledge, skills and necessary understanding that students identify and plan to accumulate to achieve learning objectives.

- **Learning plan:** Is the roadmap to achieve educational goals for both lecturers and students, including: time, location, method, level of learning content and necessary resources to support learning activities.

- **Students:** Subjects of learning activities, proactively implementing the learning process through learning plans and learning content, to achieve predetermined learning objectives.

In the relationship in (Figure 1.1), the teaching structure model follows the self-directed learning approach with the parallel roles of students and lecturers. As the subject of learning activities, students proactively determine their university study goals clearly and specifically. Based on that, students build their own study plans and determine the appropriate level of learning content. From there, they proactively organize learning activities according to the plan and content that have been determined, with the necessary support of lecturers to achieve learning goals. For students to achieve good learning results, learning goals must be determined in accordance with the characteristics and cognitive abilities of students; learning plans and learning content must be built and determined in accordance with pre-determined learning goals.

In the interactive relationship between lecturers and students, through their experience, lecturers guide students to acquire knowledge, practice skills according to teaching goals, and thus, the experience of lecturers is transformed into new knowledge and skills for students. On the contrary, each student has different needs for content and learning methods depending on their level and learning style. In order to achieve good learning results, lecturers must choose and use appropriate teaching methods.

3.1.3 Self-directed learning process

With the view that self-directed learning is a learning process, many processes have been published by authors around the world, in which there are differences in the way of dividing the stages as well as the steps of the stages. Self-directed learning plays a particularly important role in the context of national integration, when the amount of knowledge is increasing in society. Self-directed learning helps students to master, consolidate, expand, deepen their knowledge, practice professional skills and techniques. Promote proactive learning and actively develop independent and creative thinking, form capacity, interest, habits, and methods. Turn the training process into a self-training process, as a basis for lifelong learning. From the analysis of published self-directed learning processes, the author would like to propose a self-directed learning process (Figure 1.2) including the following five stages:

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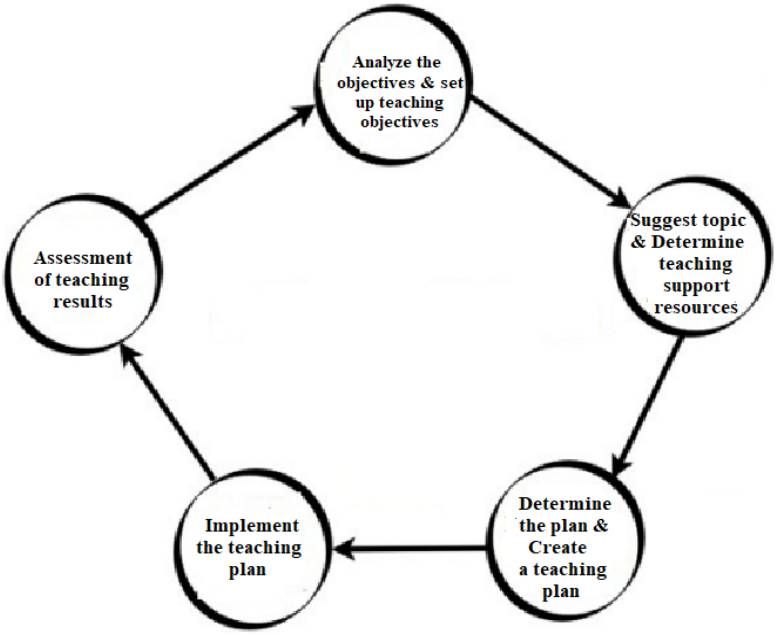

Figure 1.2 Self-directed learning process

The teaching process according to the self-directed learning approach includes five steps, including:

Step 1: Analyze the objectives & Set up teaching objectives

Teaching objectives have been determined in the training program. Based on the course program, the lecturer analyzes the general objectives of the training program, the intermediate objectives of the course, selects integrated content of the course, and content with enough time for students to perform learning tasks. Analyze lesson objectives to determine the necessary skills and knowledge that need to be equipped for students. Based on that, students set up their own learning objectives in accordance with their personal needs and learning tasks.

Step 2: Suggest topics & Determine teaching support resources

Based on the learning objectives of the course, the cognitive characteristics of the learners, the lecturer designs learning topics, and should design integrated topics. Suggest learning topics: the lecturer discusses with students to know their needs, abilities, levels, and learning conditions so that students can perform learning tasks. Topics can be designed in the following directions:

- According to students' level
- According to students' interests and hobbies
- According to students' learning style

Based on their personal learning goals, students proactively choose for themselves learning materials, textbooks, learning topics and necessary learning tools.

Step 3: Determine the plan & Create a teaching plan

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Determine the teaching plan: through the learner's learning direction combined with the training plan, timetable, the lecturer determines the teaching plan from the planned plans or flexibly changes according to the actual situation of the student's learning direction. Students proactively create a learning plan: the level of learning content according to the needs and cognitive capacity includes tasks such as: specific tasks, implementation time, learning methods and suitable learning environment to master the learning content and achieve their own learning goals.

Step 4: Implement the teaching plan

The lecturer guides students to perform learning tasks according to the selected topic to master the learning content, in order to develop knowledge, skills and necessary understanding in accordance with the established learning goals. Depending on each topic, lecturers can organize learning forms: learning in class, learning in the workshop, group work, organizing learning on the digital teaching page... and combine teaching methods such as presentations, raising and solving problems, discussions, etc. Students actively learn the learning content, research and master the learning content, in order to develop knowledge, skills and necessary understanding in accordance with the established learning objectives.

Step 5: Assessment of teaching results

Lecturers assess students' learning results according to the teaching objectives and assigned learning tasks. Assessment of learning results combines lecturers' assessment and students' self-assessment, including:

- Process assessment
- Final assessment

Students self-assess their individual learning results according to the learning objectives.

The above teaching process has shown the characteristics of teaching according to the self-directed learning method. Lecturers conduct teaching activities in a certain order, students are guided by lecturers according to a specific process, corresponding to the steps of the teaching process according to the self-directed learning method. Implementing the process, students are formed and developed skills to approach self-directed learning such as: Setting goals, identifying support resources, Planning, Implementing the plan and Evaluating learning results. The teaching process of the lecturer is carried out according to the direction of the students, expressed through: Analyzing objectives, suggesting topics, determining plans, implementing plans and Evaluating teaching results.

3.2 Application and research results at Ho Chi Minh City University of Technical Education

Applying the controlled experimental method to teach undergraduate classes in engineering technology at Ho Chi Minh City University of Technical Education. The classes are first trained in the expertise of the subjects with the same entrance score and level. Each pair of experimental and control classes are in the same course, study at the same time, study in the

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same learning environment under the same learning conditions of lecturers, teaching aids, detailed subject outlines and study materials. In which:

- For control classes, lecturers organize normal teaching according to their own methods and experiences. Students in the class do practical exercises of the subjects with the same topic of the experimental class.

- For experimental classes, lecturers are in charge of pedagogical impact on the teaching process according to the self-directed learning method. During the experimental process, the impact on teaching methods and teaching organization forms was based on the differentiation of learning objectives and learning content expressed through different integrated topics that students chose. Lecturers were instructed in advance on the process and measures for teaching subjects according to the self-directed learning method. We conducted a pedagogical experiment on 250 students along with 250 students in the control class of engineering technology, with topics integrating lectures. The learning outcomes of students in the experimental and control classes were assessed based on the level of completion of the test contents corresponding to the experimental teaching content. The cumulative score of each student in the experimental and control classes was the average of the test scores on a 10-point scale and rounded, according to the principle: 0.5 = 1. Specifically illustrated in (Table 1.1).

3.2.1 Results

Table 1.1 Summary of learning outcomes of students in experimental and control classes

Class code	Experimental and control class		Nu. of Stu.	Score (xi)					
				5	6	7	8	9	10
16145CL2	TN1	EDDG230120_07CLC	39	0	1	4	26	8	0
	ĐC1	EDDG230120_08CLC	37	1	2	12	17	5	0
16149CL1	TN2	DGED121023_11CLC	33	2	4	8	16	3	0
	ĐC2	DGED121023_10CLC	33	3	2	10	15	3	0
16146CL4	TN3	162EDDG240120_01CLC	39	0	1	7	24	7	0
	ĐC3	162EDDG240120_02CLC	33	1	7	15	9	1	0
16149CL3	TN4	162DGED121023_11CLC	33	1	2	6	16	8	0
	ĐC4	162DGED121023_10CLC	32	2	10	11	8	1	0
16145CL1	TN5	EDDG230120_11CLC	40	1	3	9	23	4	0
	ĐC5	EDDG230120_12CLC	32	2	2	12	13	3	0
16145CL7	TN6	EDDG230120_15CLC	31	2	2	12	13	2	0
	ĐC6	EDDG230120_13CLC	25	3	10	7	4	1	0

16146CL5	TN7	162EDDG240120_05CLC	25	1	0	3	12	8	1
	ĐC7	162EDDG240120_03CLC	21	0	0	4	16	1	0
16145CL2	TN8	EDDG230120_10CLC	10	1	0	2	6	1	0
	ĐC8	EDDG230120_09CLC	37	1	10	20	6	0	0

(*Source: Training Department - Ho Chi Minh City University of Technical Education - excerpt from March 12, 2025)

Table 1.2 Frequency distribution table, frequency and cumulative frequency of test items

Xi point	Number of students achieving xi points		% Number of students achieving xi points		% Number of students achieving xi score or higher	
	TN	ĐC	TN	ĐC	TN	ĐC
0	0	0	0.00	0.00	0.00	0,00
1	0	0	0.00	0.00	0.00	0,00
2	0	0	0.00	0.00	0.00	0,00
3	0	0	0.00	0.00	0.00	0,00
4	0	0	0.00	0.00	0.00	0,00
5	08	13	3.20	5.20	100.00	100.00
6	13	43	5.20	17.20	96.80	94.80
7	51	91	20.40	36.40	91.60	77.60
8	136	88	54.40	35.20	71.20	41.20
9	41	15	16.40	6.00	16.80	6.00
10	1	0	0.40	0.00	0.40	0.00
Tổng	**nTN = 250**	**nĐC = 250**	**100.00**	**100.00**	/	/

3.2.2 Discuss

The results of data processing from the Frequency Distribution Table, Frequency and Cumulative Frequency of Tests (Table 1.2) show that the learning scores of the experimental classes are higher than those of the control classes, proving that teaching by self-directed learning method in the experimental class is higher than that in the control class.

From the results of processing the pedagogical experimental data, it is shown that: the learning quality of students in the experimental classes is higher than that of the control class, specifically the test scores of the experimental classes are higher than that of the control class:

- Average score of experimental class ($\overline{XTN} = 7{,}71$) higher than the control class ($\overline{X\text{Đ}C} = 7{,}19$).

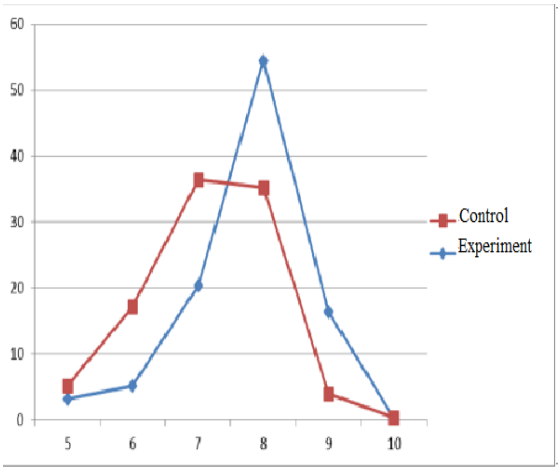
- Standard deviation of experimental class ($\sigma_{TN} = 0{,}911$)lower than the control class ($\sigma_{\text{Đ}C} = 1{,}024$)shows that the dispersion around the mean of the scores in the experimental

class is smaller than that of the control class, and the scores of the experimental class are distributed closer to the mean than the control class.

- Experimental class coefficient of variation ($V_{TN}\ \% = 11{,}81$) smaller than the control class ($V_{ĐC}\ \% = 14{,}24$), This result shows that the knowledge dispersion around the mean score of the experimental class is smaller than that of the control class.

- The frequency graph (Chart 1.1) shows that the percentage of students achieving good and excellent scores in the experimental class is higher than that of the control class. The values of the scores between the experimental and control classes show that the clear difference in test scores between the experimental and control classes is unlikely to occur by chance.

- The convergence frequency graph (Figure 1.2) shows that the progressive convergence curve of the experimental class is always above the control class. The convergence frequency graph of the experimental classes is far to the right, so it can be affirmed that the academic achievement of the experimental classes is higher than that of the control class.



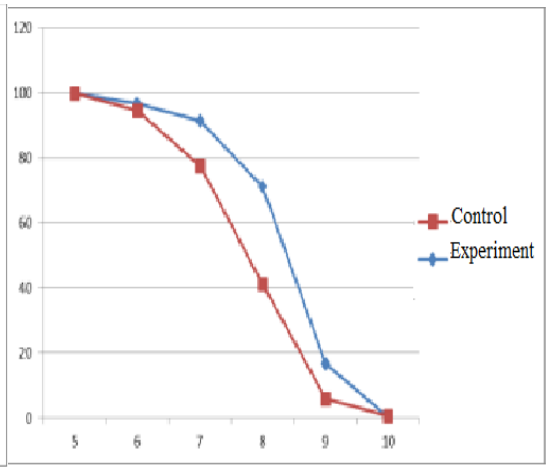


Chart 1.1 Frequency of students achieving xi score **Chart 1.2 Frequency of students achieving xi score or higher**

Thus, the impact of the study has created a large level of influence on the experimental classes. Applying self-directed learning to train engineering technology has a positive impact on students' learning effectiveness.

Table 1.3 Summary table of characteristic parameters

Summary of characteristic parameters	Object	Experiment (TN)	Control (ĐC)
Value with frequency	mode	6	5
Median	median	6	5
Average value (score)	Average score	7.71	7.19

Standard deviation	$\sigma = \sqrt{\sigma^2}$	0.911	1.024
Variance	S2	0.825	1.047
Coefficient of variation	V	11.81	14.24
Verification	T – independent test	0.0000	
Mean deviation	F-Snedecor	F = 0.79 < 1	

3.2.3 Comments

Teaching must ultimately aim to achieve the output standards of the training industry. Thus, the results of teaching and learning according to the self-directed learning method for students of the Engineering Technology major with the learning results of students in experimental classes being higher than the learning results of students in control classes is effective.

4.0 CONCLUSIONS

Based on the results of the experimental pedagogical method, it shows that self-directed learning and application in training engineering technology for students of Vietnam University of Technical Education have a positive impact on students' learning outcomes, improving teaching effectiveness and the effectiveness of using teaching methods. In which:

(1) On the feasibility of the proposed contents

- Applying self-directed learning teaching methods to the teaching process is feasible. Choosing topics that integrate learning according to the needs, as well as learning content according to the self-directed learning methods of students helps lecturers have teaching plans that are suitable for the strengths and needs of students in terms of learning methods, thus promoting students' initiative, positivity and increasing their interest in cognition as well as in practicing skills, thereby improving the effectiveness of teaching and learning.

- Providing teaching content through integrated topics according to the needs and learning objectives of students is appropriate to the training objectives, which is necessary and feasible. Therefore, it can be concluded that teaching by self-directed learning method can be applied to training activities in engineering technology and other engineering fields in training students of technical pedagogical universities in Vietnam.

(2) On the effectiveness of application

Experimental results show that applying self-directed learning in training engineering technology for students at Vietnam University of Technical Education has a positive impact on the learning outcomes of engineering technology students, improving teaching efficiency. In summary, based on testing and evaluation of testing results, it shows that applying self-directed learning to train engineering technology has many advantages, contributing to improving the quality and effectiveness of teaching, especially the digital transformation in education.

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