



# Self-Directed Learning to Teaching the Subject of Technical Drawing for Students: A Research Result at Ho Chi Minh City University of Technology and Education

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Science and technology are increasingly developing, knowledge is increasing, so the students' learning needs are more and more diverse, and teaching design is increasingly focused on learners. Therefore, self-directed learning is considered as one of the appropriate methods for orientation of teaching method innovation in teaching technical drawing at Ho Chi Minh University of Technology and Education, Vietnam (HCMUTE) today. The article uses existing documentary research method and experimental education method to study self-directed learning approaches and its application process in teaching and organizing experimental teaching, thereby evaluating its effectiveness in teaching technical drawing at HCMUTE. Research results of the article contribute to promoting the learning process for students in the field of engineering and technology, supporting innovation of technical teaching methods for universities of technology and education in Vietnam.

**Key words:** *Self-directed learning; Technical drawing subject; Vietnamese students; Technical teaching*

## Introduction

The development of science, technology, the explosion of information and the strong impact of the Industrial Revolution 4.0 have changed very quickly the way of teaching and learning in universities. In addition, the learning needs of learners are increasingly diverse in terms of learning goals, content and methods. The learners' role is more and more interested in the



learning process. The teaching designs of teachers increasingly focus on learners with taking learners as a center and lifelong learning. In that context, self-directed learning is considered as one of the appropriate learning perspectives to apply for the innovation of teaching methods in current teaching, including innovation in teaching method of technical drawing subject at HCMUTE.

Self-directed learning is used to differentiate it from teacher directed learning. This form of learning has been studied by authors around the world since the second half of the twentieth century and built on a theoretical basis about 65 years ago. Since then, self-directed learning has been applied and developed by many scientists, such as Houle (1961) Researched the adults' learning motivation (Houle, C. O., 1961), Allen Tough (1971) published "Learning projects for adult" (Allen Tough, 1971), Knowles (1975) published "Self-directed learning" (Knowles, M., 1975), which describing the process that individuals actively, with or without support of others, diagnose their learning needs, develop learning objectives, identify human and material resources for learning, perform appropriate learning strategies, and evaluate their learning results. An important research effort is thesis of Lucy Madsen Guglielmino (1977), who is author of "*Self-Directed Learning Readiness Scale (SDLRS)*", a tool is then used by many researchers to measure readiness for self-direction or to compare different aspects of self-directed learning through many characteristics (Lucy Madsen Guglielmino, 1977). In 1987, an international organization for self-directed learning that was established in the United States, annually held an international symposium on self-directed learning (<https://www.sdlglobal.com/>). This is a forum for sharing studies on self-directed learning and building self-directed learning theories. Selected articles have been published in writing until 2000 and on CD since that time. By 2003, Symlion thematic group of self-directed learning had launched an international Journal of self-directed learning and then established separately a website (<https://www.sdlglobal.com/>). The Symposium of International Self-Learning provides an international forum for discussing current important developments in research and application of self-directed learning. The program design emphasizes presentations on recent research findings. The Online International Journal of Self – Directed Learning is published twice a year, thereby, the speech in the conference on views and experiences on self-directed learning will be shared widely in the world so that researchers around the world have the opportunity to access this new information.

Regarding strategies of the self-directed learning, in 2004, Tracy Thompson and Sherry Wulff implemented a guided strategy in self-directed learning in intermediate and advanced courses. This research project in this activity, based on instructor-observed learning problems, is linked to students' self-directed skills. Preliminary findings suggest that the systematic implementation of strategies of self-directed learning that focus on curriculum has a strong potential to support student's development as autonomous learners. and to enhance the teaching environment (Tracy Thompson and Sherry Wulff, 2004).



Regarding the style in self-directed learning, in 2013, Abdel-Hady El-Gilany, Fawzia El Sayed Abusaad studied the readiness of self-directed learning and the learning style of nursing students at Saudi Arabia University. This study was performed to determine the readiness in self-directed learning of nursing students in Saudi Arabia; to define their style of learning and to find the link between the two concepts. The high degree of self-directed learning and the dominant converging learning style among nursing students will have positive implications for their post-work regular nursing education and learning (Abdel-Hady El-Gilany, Fawzia El Sayed Abusaad, 2013).

In 2018, Tim Piper, Thomas Smith, Jorge Jeria, Robert Intrieri, studied to develop the scale of self-directed learning for the exercises. Development and validation of the scores in self-directed learning would be explored. The self-directed system for the scale has been tested on 368 people with exercising autonomy and 217 new ones. The score from the tool shows a high level of valid support and predictability for classifying the practitioner. The purpose of this study is to develop and provide strong evidence for scores from a measure of the self-directed learning in people who do physical exercise. The tool developed for this study will be called the scale for exercises of self-oriented learning (Tim Piper, Thomas Smith, Jorge Jeria, and Robert Intrieri, 2018).

Research on self-directed learning of doctoral students, in 2020, Tracy H. Porter, Cheryl Rathert, and Diane A. Lawong have made efforts to research self-oriented learning: lessons to assess the experience of doctoral students. This study has a number of implications for doctoral students, teaching advisor and universities. Firstly, this is the only study applying the method of self-oriented learning for the doctoral level and is therefore added to the documents on self-oriented learning. Second, these results provide a potential approach that university leaders may want to consider for their doctoral programs as it may be desirable (Tracy H. Porter, Cheryl Rathert, and Diane A. Lawong, 2020).

Researchers have also determined the importance of method of self-oriented teaching. Self-directed learning is applied to many different fields, many different educational objects. From the analysis of the conditions for the self-oriented learning, the authors propose a number of measures: Deep learning, an appropriate combination in schools in the 21st century, The current important developments in research and applying self-directed learning, connecting self-directed learners around the world, in order to improve the efficiency of activity of self-directed learning.

In Vietnam, self-learning that relates to self-directed learning have been in the spotlight since feudalism when education had not yet developed. However, self-directed learning is now still a new concept, without affirming its role in the training and education. Some recent studies have also confirmed the importance of self-directed learning method. In the article of “*Organization of self-directed learning activities in credit education through teaching*” by



Nguyen Thi Cam Van who supposes that one of the “basic principles for the credit-based training method is to allow students to choose learning time, content, and route for their own abilities and conditions. For satisfaction of this condition, students must self-equip a spirit of self-awareness, positivity and especially an active learning method. Self-directed learning is an activity that shows a high level of initiative of learners in the entire learning process. According to the author, on the basis of their own needs, interests and learning conditions, learners actively determine learning methods for themselves, make and perform learning plans, and evaluate learning results. Besides, the self-directed learning is an active process at high level of learners right from the beginning to determine learning directions and strategies” (Nguyen Thi Cam Van, 2016). Through studies on technology education according to self-directed learning method, the authors, including Truong Minh Tri et al., (2016) commented that: “*HCMUTE approaches self-directed learning in technology education to train high-quality science and technology human resources, thereby really becoming the leader for development of the fourth industrial revolution in the context of international integration*” (Truong Minh Tri et al., 2016, 2018). From that, the author has proposed a technical training model according to self-directed learning method, with the objective of building a technical teaching process based on self-directed approach, general structure of the self-directed learning approach, characteristics of student’s awareness, characteristics of technical content and an appropriate teaching process. In 2017, Truong Minh Tri et al., applied this model in teaching technical drawing for students in the field of engineering and technology at HCMUTE. The experimental results show the feasibility and effectiveness of this model (Truong Minh Tri et al., 2017).

Technical drawing is a subject that plays an important role, occupying a large capacity in the training program of the engineering branch in Vietnam. Through Technical Drawing, students have the ability to design, calculate parameters for mechanical parts of mechanical machinery and equipment, such as: gears, production lines of building materials, ... and participating in supervising the equipment manufacturing process, construction and installation of equipment. This is an important area of expertise to be developed for engineering students. However, Technical drawing is a difficult subject for students. The learning content is abstract and in practice. Therefore, students must have passion, good motivation to study, in addition to the ability to think logically, creatively, persistently and carefully at work. In the teaching process, teachers must identify students' learning needs, thereby guiding students to self-defined goals and build learning plans based on teaching objectives of the identified subjects. Current teaching practice shows that teachers still consider Technical drawing as a theoretical subject, so teaching methods and teaching organization still carry one-way knowledge transmission, not yet promote their ability of learning by self-study. Meanwhile, self-directed learning has characteristics that are consistent with the learning requirements of Technical Drawing. Applying self-directed learning in teaching Technical drawing will help teachers build teaching plans based on students' self-learning abilities. Teachers play the role of instructing and supporting students to study by themselves based on self-identified learning goals, plans and progress.



From the above analysis, it can be seen that applying self-directed learning in innovating teaching methods of Technical drawing for engineering students in Vietnam is consistent with the innovative trend of teaching methods in current context and lifelong learning. The objective of this study is to propose the process of applying self-directed learning in teaching Technical Drawing for students in engineering, the article presents the results of experimental research on pedagogy for teaching design and illustration of the study at Ho Chi Minh University of Technical Education, Vietnam. The experimental teaching results show that this application is suitable for students and brings better learning results.

### **Research Methodology**

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

#### **Existing documentary research**

- Research educational scientific works, theoretical documents related to the project.
- Combine the methods of: analysis, synthesis, classification, systematization for different perspectives on self-directed learning, thereby building the basic point of views on self-directed learning as a basis for applying and assisting directly the research mission of the project.

#### **Experimental education**

##### ***1. How to implement:***

The author applied the comparative experimental method. The experimental education classes and comparative classes all have the same learning conditions in terms of teachers, teaching facilities, detailed subject outline and curriculum. In which:

- For comparative classes, teachers conduct teaching normally according to their own methods and experiences.
- For experimental education classes, the educational impact in the experimental process is the impact of teaching process based on self-directed learning method. Therefore, teachers are instructed in advance of the process and method to perform, and then organize to teach practice as illustrated design.

## 2. Tools for evaluating learning results:

Evaluate learning results of the students based on teaching objectives they got, contents of the evaluation consist of:

- Level of completing the learning mission
- Ability to report learning results
- Learning attitude

## 3. Calculate experimental education results:

- Evaluate students' achievement of teaching objectives in the experimental education classes and comparative ones based on cumulative scores as average percentage against the maximum scale (on a scale of 10) according to the following formula (1):

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

Where:

$\overline{X\%}$  : Cumulative scores by average percentage

$x_i$  : the cumulative score  $i$

$F_i$  : frequency of score  $x_i$

$N$  : class size

- Create a distribution table  $F_i$ , frequency table  $f_i$  and progressive convergence frequency table  $f_a$

- Calculate the characteristic parameters, including:

+ Average score value:

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

+ Variance:

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

+ Corrected variance:

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

+ Standard deviation:

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

+ Coefficient of variation:

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

In which:

$x_i$ : the cumulative score  $i$

$F_i$ : frequency of score  $x_i$

$N$ : total tested sample

- Test the difference between the average scores using statistical value  $t$  (T – test).

## **Theoretical Framework**

### **Self-directed learning to teaching technical drawing**

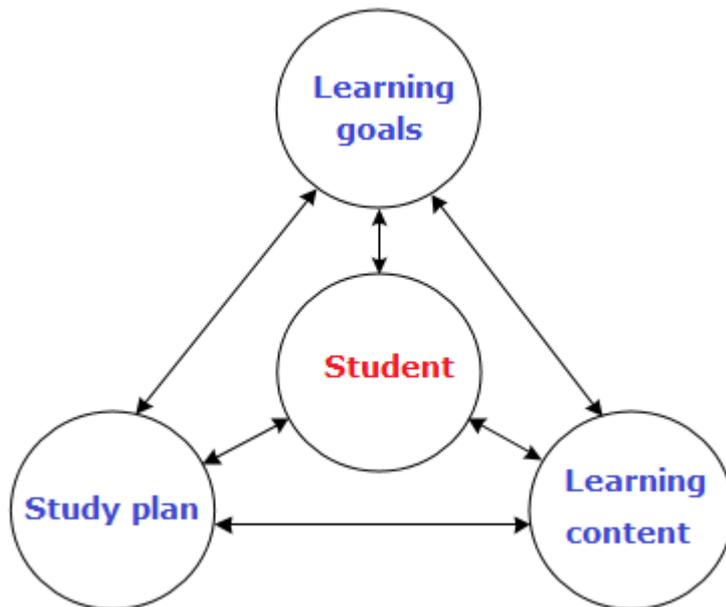
#### ***1. The structure of self-directed learning:***

Technical drawing subject with contents of the state standards on the presentation of technical drawings, projection and cutting methods, sections, etc. In the course of acquiring knowledge from this subject, students only need to master how to read technical drawings, assembly drawings, and be able to make a detailed drawing. The subject is represented by drawings, because drawings is the voice of techniques, and expressed in accordance with state regulations and standards. Teaching technical drawing based on the self-directed learning method is a process that teachers support and guide students to determine a learning plan for technical drawing based on their abilities, needs and conditions so that they take the initiative to choose their own objectives to strive as predetermined direction.

Therefore, Self-directed learning to teaching involves an interactive relationship between: Learning Goals – Learning Content – Learning Plan (Figure 1) (Truong Minh Tri et al., 2017).

In which:

- Learning goals: The learning result that students need to achieve after the learning process ends.
- Learning content: The level of necessary knowledge, skills and understandings that students identify and make plans to accumulate and achieve learning objective.
- Learning plan: A route to achieve the educational objective of both teachers and students, including: time, location, manner, the level of learning content and the resources needed to support learning activities.
- Student: Subject of learning activity, actively perform learning process through learning plans and content in order to achieve predetermined learning objective.



**Figure 1. The structure of self-directed learning to teaching**

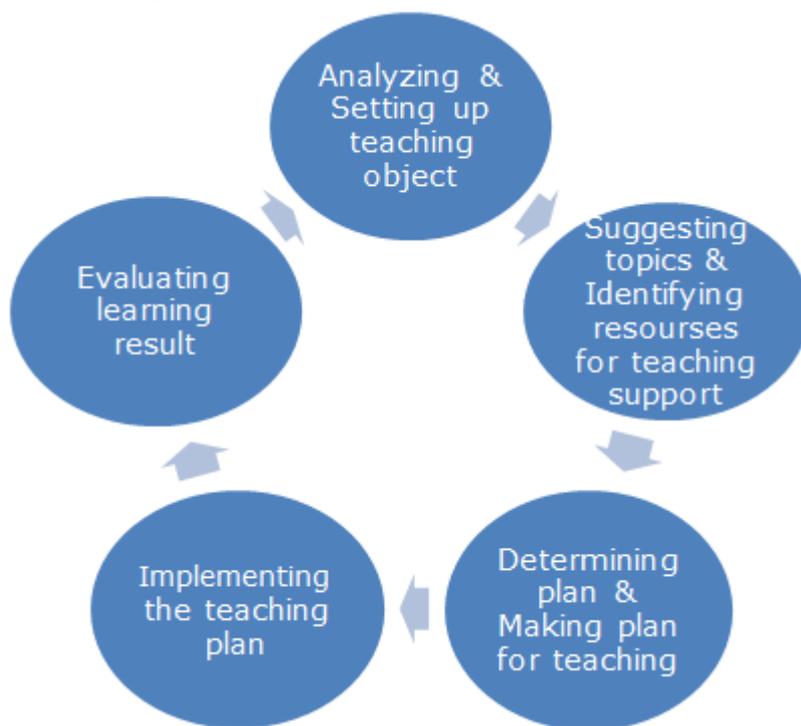
In the relationship in (Figure 1), teaching structure model according to self-directed learning approach with the parallel role of students and teachers. Students play role as subject of learning activities, actively define their objectives in university in a clear and specific way. On that basis, students build their own learning plans and determine the appropriate level of learning content. Then, they actively conduct learning activities through identified plans and content under the necessary support of teachers to achieve learning objective. For achieving good learning results, student must identify learning objectives in consistent with their characteristics and cognitive capacity; the learning plans and content also need to be developed and defined provided that they are consistent which pre-defined learning objectives.

In the interaction relationship between teachers-students, by their own experience, teachers instruct students to acquire knowledge, train skills according to their teaching objectives, and

so on, teachers' experiences are transforming into new knowledge and skills for students. On the contrary, each student has different learning content and manners depending on their learning capacity and style in order to get good learning results, teachers, therefore, need to select and use appropriate teaching plans.

## ***2. Self-directed learning procedure:***

Under the point of view that self-directed learning is a learning process, there have been many procedures published by authors around the world, with differences in how the stages and steps of stages are splitted. Self-directed learning plays a particularly important role in the country's integration context when volume of knowledge is increasingly high in society. Self-directed learning helps students to master, consolidate, expand, deepen knowledge, practice skills and know-how; promote the initiative in learning and actively develop independent thinking, creativity, ability, excitement, habits and methods; turn the training process into a self-training process, as the basis for lifelong learning. From analysis of the published self-directed learning procedures, the author proposed a self-directed learning procedure (Figure 2) that consists of the following five stages (Truong Minh Tri et al., 2017):



***Figure 2. The self-directed learning procedure***

The teaching procedure based on a self-directed learning approach consists of five steps, namely:



### **Step 1: Analyze objective & Set up teaching objective**

The teaching objectives that have been identified in the training program. Based on program of the subject, teachers analyze the common objective of the training program, the intermediate objective of the subject, chooses the integrative content of the subject with sufficient time for students to perform learning missions and simultaneously analyze lesson objectives to determine skills and knowledge needed to equip students. Based on that, students set learning objectives by themselves in consistent with their individual needs and learning mission.

### **Step 2: Suggest topics & Identify resources for teaching support**

Based on the learning objectives of the subject and the learner's cognitive characteristics, the teachers carry out design of learning topics and integrative topics should be given priority. Suggest learning topics: Teachers discuss with students about needs, abilities, qualifications, and conditions of learning so that students can perform learning missions. The topics can be designed towards:

- Students' qualifications
- Students' interests, hobbies
- Students' learning style

Based on individual learning objectives, students take initiative to choose learning materials, textbooks, topics and necessary learning facilities.

### **Step 3. Determine option & Make a teaching plan**

Determine teaching option: through learners' learning directions in combination with training plans, timetable, teachers determine teaching options from predetermined ones or flexibly change according to the real situation about the student's learning direction. Students actively establish learning plans: the level of need-based learning content and cognitive abilities, including: specific jobs, implementation time, suitable learning manner and environment for mastering learning content and achieving your own learning objective.

### **Step 4. Implement teaching plans**

Teachers instruct students to perform learning missions according to selected topics to dominate learning content for aim of developing necessary knowledge, skills and understanding in consistent with the set learning objectives. Depending on each topic, teachers can organize learning forms such as: learning in class, learning at workshops, working in group, learning on digital teaching website, etc. and combine teaching methods such as presentation, problem rasing and solving and discussion, etc.

Students actively explore, research and dominate learning content to develop necessary knowledge, skills and understandings in consistent with set learning objectives.

### **Step 5. Evaluate teaching results**

Teachers evaluate students' learning results according to their assigned teaching objectives and learning missions. The learning performance evaluation consisting evaluation of teachers and self-evaluation of student includes:

- Process evaluation
- End-of-term evaluation
- Students self-evaluate their learning results according to learning objectives.

The teaching procedure mentioned above has shown the characteristics of teaching by self-directed learning method. Teachers teaching is performed in a certain order, and students get instruction from teachers according to a specific procedure, corresponding to steps of the teaching procedure based on self-directed learning method. Undergoing this procedure, students will form and develop self-directed learning approach skills such as: *Objective Setting, Identification of support resources, Planning, Implementation and Evaluation of learning result*. The teaching process of teachers is performed towards direction of students, expressed through: *Analyze objectives, Suggest topics, Determine plans, Implement plans and Evaluate teaching results*.

### **Research Results and Discussion**

Apply comparative experimental method to teach undergraduate classes in engineering and technology at HCMUTE. The classes that are educated the technical drawing subject first, have equal entry point and qualification. Each pair of experimental and comparative classes in the same course, studies at the same time, in the same learning environment and conditions, including teachers, teaching facilities, detailed subject outline and curriculum.

In which:

- For comparative classes, teachers carry out teaching normally based on their own methods and experiences, while students in these class do practical exercises with the topic as same as the experimental classes.
- For experimental classes, teachers make pedagogical impact on the teaching procedure according to self-directed learning method. In the experimental process, the impact on teaching methods and teaching organization forms based on the differentiation of learning objectives and learning content are shown through different integrated topics that students selected. Teachers are guided in advance of the process and teaching methods for technical drawing subject according to a self-directed learning method.

We do an educational experiment consisting of 250 students with 250 students of comparative classes in sector of engineering and technology by integrated topics of the lecture. The students' learning results in experimental and comparative classes are evaluated based on completion performance of two tests above, corresponding to two experimental teaching contents. The cumulative scores of each student in both experimental and comparative classes is the average of the tests on a 10-point scale and rounded, according to a rule:  $0,5 = 1$ . The detail is illustrated in (Table 1).

### Experimental education results

**Table 1:** A summary of student's learning results in the experimental and comparative classes

Class code	Experiment and Control Class		No. of Students	Score (xi)					
				5	6	7	8	9	10
16145CL2	E1	EDDG230120_07CLC	39	0	1	4	26	8	0
	C1	EDDG230120_08CLC	37	1	2	12	17	5	0
16149CL1	E2	DGED121023_11CLC	33	2	4	8	16	3	0
	C2	DGED121023_10CLC	33	3	2	10	15	3	0
16146CL4	E3	162EDDG240120_01CLC	39	0	1	7	24	7	0
	C3	162EDDG240120_02CLC	33	1	7	15	9	1	0
16149CL3	E4	162DGED121023_11CLC	33	1	2	6	16	8	0
	C4	162DGED121023_10CLC	32	2	10	11	8	1	0
16145CL1	E5	EDDG230120_11CLC	40	1	3	9	23	4	0
	C5	EDDG230120_12CLC	32	2	2	12	13	3	0
16145CL7	E6	EDDG230120_15CLC	31	2	2	12	13	2	0
	C6	EDDG230120_13CLC	25	3	10	7	4	1	0
16146CL5	E7	162EDDG240120_05CLC	25	1	0	3	12	8	1
	C7	162EDDG240120_03CLC	21	0	0	4	16	1	0
16145CL2	E8	EDDG230120_10CLC	10	1	0	2	6	1	0
	C8	EDDG230120_09CLC	37	1	10	20	6	0	0

**Table 2:** Table of distribution of frequency and accumulative frequency of test

Score xi	Number of students getting score xi		% of students getting score xi		% of students getting score xi and over	
	E	C	E	C	E	C
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
<b>Total</b>	<b>nE = 250</b>	<b>nC = 250</b>	<b>100.00</b>	<b>100.00</b>		

## Discussion

The result of data processing from the Table of distribution of frequency and accumulative frequency of tests (Table 2) shows that the learning scores of the experimental classes are higher than that of the comparative ones, which indicate that teaching by self-directed learning method in experimental classes is more effective than in the comparative ones.

From the results of educational experimental data, we find that: the learning quality of the students in experimental classes is better than that of the comparative classes, namely, test scores of experimental classes are higher than that of the comparative ones:

- Average score of the experimental classes ( $\overline{XTN} = 7,71$ ) is higher than that of the comparative ones ( $\overline{XDC} = 7,19$ ).

- Standard deviation of the experimental classes ( $\sigma_{TN} = 0,911$ ) is lower than that of the comparative ones ( $\sigma_{DC} = 1,024$ ), showing that the dispersion around the average of the scores in the experimental classes is smaller than that of the comparative ones and scores of the experimental classes is closer to the average than that of the comparative ones.

- The coefficient of variation of the experimental classes ( $V_{TN} \% = 11,81$ ) is lower than that of the comparative ones ( $V_{DC} \% = 14,24$ ), showing that the dispersion of knowledge around the average of the experimental classes is smaller than that of the comparative ones.
- The percentage of students with good and excellent scores (8 and 9) in experimental classes is higher than that of the comparative ones (Table 2). Value of scores between experimental classes and comparative ones shows that the distinct difference in test scores of experimental classes and comparative ones is not likely to happen by chance.

Therefore, the study made an impact that has a great influence on the experimental classes. Application of self-directed learning to teach technical drawing has a positive impact on students' learning efficiency.

**Table 3:** Table of typical parameters

Typical parameters	Object	Experiment	Control
Frequency value	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
Variable coefficient	V	11.81	14.24
Verification	T – independent test	0.0000	
Difference of average values	F-Snedecor	F = 0.79 < 1	

## Conclusion

The results based on experimental educational method shows that self-directed learning and its application in teaching technical drawing for Vietnamese students in universities of technology and education has a positive impact on learning efficiency of students, thereby improving efficiency in teaching as well as using that teaching method.

In which:

### *1. Feasibility of the proposed contents:*

- Application of self-directed learning method into the course of teaching technical drawing is feasible. The selection of topics that integrate needs-based learning as well as learning content based on self-directed learning method helps teachers to have appropriate teaching plans for



strengths and needs of students to promote activeness, positivity and boost students' excitement in awareness and skills training, thereby improving teaching and learning effectiveness.

- It is necessary and feasible to provide teaching content through integrated topics based on students' needs and learning objectives. Therefore, it can be concluded that teaching by self-directed learning method is applicable to teaching technical drawing and other technical subjects in the training of students in the field of engineering and technology.

## ***2. Effectiveness of the application:***

The experimental result shows that application of self-directed learning in teaching technical drawing for students of Universities of Technology and Education in Vietnam has a positive impact on the learning result for students in the field of engineering and technology, thereby improving teaching efficiency. In conclusion, on the basis of testing – evaluating test results, it shows that application of self-directed learning to teaching has many advantages, contributing to improving the quality and effectiveness of teaching, especially digital conversion in education of the industrial revolution 4.0.



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