MINISTRY OF EDUCATION AND TRAINING
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PRACTICING CORE SKILLS OF ENGINEERING STUDENTS

Specialization: Education
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SUMMARY OF THESIS

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The work was completed at Ho Chi Minh City University of Technology and Education

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INTRODUCTION

1. The reason for choosing the topic

Core skills include a set of skills that are essential for employee growth and success. Zalizan (2007) defines quality skills as general skills necessary for a person to develop their full potential in study and in the workplace (p. 14). Among the many skills, such as communication skills, problem-solving skills, creative thinking skills, systems thinking skills, teamwork skills, and time management skills, as well as foreign language skills, it depends on the field which skills will be promoted through more training. Research on these skills in universities currently has not received adequate attention. In the "Self-Assessment Report" (for the purpose of registering for accreditation of higher education quality) in 2016, the University of Information Technology, Vietnam National University Ho Chi Minh City, found that "students' weaknesses include English proficiency and soft skills" (from "Self-assessment report – application for higher education accreditation," September 28, 2016, internal circulation document). When considering only students in the engineering sector, a 2019 research study by authors Vu Hong Van and Trinh Thi Thanh pointed out that out of a total of 500 students surveyed from four universities with technical training (including the University of Technology, the University of Natural Sciences, the University of Transport, and the University of Technology and Education), 92.0% of students were not actively seeking soft skills classes, and nearly half of the students (45.0%) did not participate in Union and Association movements aimed at improving soft skills. Additionally, almost half of the students (45.3%) did not recognize that teachers form soft skills for students through teaching. Students lack the initiative to practice soft skills, and soft skills training is not a compulsory subject (Vu Hong Van & Trinh Thi Thanh, 2019). The quality skills of engineering students are an important foundation for success in this field. Alongside solid professional knowledge and skills, problem-solving skills are an indispensable skill that allows them to analyze requirements, define needs, and create effective solutions. Communication skills help them interact effectively with others, and creativity aids them in adapting to changes in technology. The lack of quality skills will lead to disadvantages for students in both the learning process and professional practice. Elisabeth Dunne et al. (2006) argue that quality skills are key to personal development (Elisabeth Dunne, p. 511), and Michael Carr and Eabhnat Ni Fhloinn (2009) suggest that quality skills must become compulsory for students during their training (Michael Carr, 2009, p. 20).

From the theory and practice discussed above, a question arises: How can we effectively shape and cultivate the quality skills of engineering students to meet the demands of their careers? To address this query, it is essential to define the concept and characteristics of quality skills within the engineering sector. This involves identifying specific quality skills and elucidating the factors that influence the training of these skills. By doing so, we can construct a systematic process for training quality skills in the context of engineering education. Nevertheless, certain issues have remained unanswered in prior studies, creating a research gap that requires further exploration. Recognizing this gap, the PhD student has chosen the topic "Practicing Core Skills for Engineering Students" as the focal point of their research thesis.

2. Objectives of the study

Building upon a foundation of theoretical research, the thesis comprehensively analyzes and evaluates the present state of quality skills training for engineering students within universities in Ho Chi Minh City. Subsequently, the thesis formulates a structured process for imparting quality skills to engineering students through instructional methods.

3. Objects and Research Subjects

3.1 Research Object

The technical teaching activities for engineering students.

3.2 Research Subjects

Practicing the core skills of engineering students.

4. Research Hypothesis

The practice of imparting quality skills training through the teaching of engineering students has not yielded significant results. If the process of training quality skills through teaching engineering students, as proposed, is applied, then the effectiveness of improving the quality skills of students in engineering majors will be greatly enhanced.

5. Research Mission

- Overview of research related to the thesis topic.
- Establishing a theoretical foundation for training quality skills among engineering students.
- Assessing the practicality of imparting quality skills through teaching engineering students at universities in Ho Chi Minh City.
- Organizing the process of training core skills through teaching for engineering students.
- Pedagogical experiences.

6. Limiting the Scope of Research

6.1. Content Limitations

The thesis focuses on studying three quality skills: Creative problem-solving skills, technical communication skills, and technical systems thinking skills of students majoring in Electrical and Electronic Engineering within the group 713 - Engineering and Electrical Engineering Technology, under industry group 712 – Technical Technology, according to the list of training majors Level IV of Circular 09/2022/TT – BGDDT dated 6/6/2022. The thesis also practices these three skills through teaching and learning.

6.2. Limited Time

The research period spans from the academic year 2018-2019 to the academic year 2021-2022.

6.3 Limitation of the survey context

Survey context: Universities in Ho Chi Minh City which have specialized Electrical and Electronic Engineering and Electrical Engineering Technology, including Ho Chi Minh City University of Technology, Ho Chi Minh City University of Technology and Education, and Ho Chi Minh City University of Industry and Trade. Pedagogical experiments will be conducted at Ho Chi Minh City University of Technology and Education.

6.4 Limits on Survey Subjects

The survey subjects comprise teachers and students majoring in Electrical and Electronics Engineering and Electrical Engineering Technology at Ho Chi Minh City University of Technology, Ho Chi Minh City University of Technology and Education, and Ho Chi Minh City University of Industry and Trade.

7. Research Methods

7.1 Theoretical Research Method Group

- *Purpose*

Systematize published research works and scientific documents related to the research problem to serve the analysis, overview, assessment, and development of the theoretical basis of the topic for deeper analysis of the nature of the research problem.

- *Content*

Research works and scientific documents published domestically and abroad.

- *Perform*

Utilize methods of analysis, synthesis, and systematization of related documents, arranging them into a coherent system to construct the theoretical basis of the topic.

7.2. Group of Practical Research Methods

7.2.1. Questionnaire Survey

- *Purpose*

Gather opinions of teachers and students regarding the actual implementation of quality skills training for students through teaching.

- *Content*

Conduct surveys on the cognitive status of teachers and students regarding the training of quality skills for students through teaching at three institutions: Ho Chi Minh City University of Technology, Ho Chi Minh City University of Industry and Trade, and Ho Chi Minh City University of Technology and Education.

- *Perform*

Develop questionnaires for students and teachers comprising both closed and open-ended questions, along with a multiple-choice question system. Process the collected data after conducting the surveys, analyzing the results, and assessing the situation.

7.2.2. Pedagogical Observation

- *Purpose*

Provide additional insights into the actual implementation of quality skills training and the progress in students' quality skills.

- *Content*

Observe classroom lessons (both the current state and experimental sessions).

- *Perform*

Create schedules for observations and track class attendance.

7.2.3. Interview

- *Purpose*

Delve deeply into the issues requiring clarification from the questionnaire.

- *Content*

Obtain perspectives from teachers, students, and experts on the actual implementation of quality skills training through teaching engineering students.

- *Perform*

Prepare interview transcripts and conduct interviews with teachers and students.

7.2.4. Pedagogy Experimental

- *Purpose*

To verify the effectiveness and suitability of the illustrative design.

- *Content*

Application of illustrative design in teaching practice.

- *Perform*

Apply the illustrative design to teaching electives and specialized subjects in the experimental class. Utilize the lesson plan prepared by the teacher in the control class and measure the achieved results.

7.2.5. Expert interview

- *Purpose*

To validate the practicality, feasibility, and soundness of the method for training quality skills in engineering students through teaching.

- *Content*

Inquiries related to the practicality, feasibility, and soundness of the method for training quality skills in engineering students.

- *Perform*

Consult experts in the fields of engineering and education concerning methods for training quality skills in engineering students through teaching.

8. DATA PROCESSING METHODS

- *Purpose*

To process the collected qualitative and quantitative information.

- *Content*

The data collected from surveys and interviews.

- *Perform*

Utilize SPSS statistical software to process quantitative data. Select and aggregate qualitative data according to response trends.

9. CONTRIBUTION OF THE THESIS

Theoretically:

The thesis has developed a theoretical foundation for the research problem. It has clarified the aspects of quality competence that have been studied by scientists and identified the gaps in the problem for analysis, synthesis, and creation. This serves as the theoretical basis for training quality skills in engineering students. The theoretical content is structured according to each aspect and closely

interconnected to establish a research framework throughout the thesis. The thesis has developed the theoretical foundation for the research problem, including the concept of quality skills, the role of core skills, the stages of quality skills formation, the quality skills of engineering students, and methods of training quality skills for engineering students. The approach to training core skills through teaching for engineering students is designed to align with the subjects and teaching conditions. Consequently, the thesis proposes a process for training core skills for students in the engineering sector.

On the practical side:

The thesis illustrates how the challenge of training quality skills in engineering students is being implemented in practice, offering valuable reference data for other researchers. The suggestions presented in the thesis have been carefully chosen and adapted to suit the audience, context, and capabilities of the implementing organization. The thesis has assessed the reality of quality skills training through teaching at universities with technical training programs and has identified the factors contributing to inadequate quality skills training. Furthermore, it has organized experimental teaching to apply the quality skills training process for engineering students at Ho Chi Minh City University of Technology and Education.

10. STRUCTURE OF THE THESIS

In addition to the introduction, conclusions and recommendations, references, and appendices, the thesis is divided into 4 chapters, which are:

Chapter 1: Literature Review

Chapter 2: Theoretical Basis of Engineering Students Core Skills Practicing

Chapter 3: The current situation of Core Skills Practicing through Teaching at Some Universities in Ho Chi Minh City

Chapter 4: Organizing Core Skills Practicing through Teaching for Engineering Students

CHAPTER 1
LITERATURE REVIEW

1.1. Review on Skills of College Students

Research on the skills of university students worldwide and in Vietnam mainly focuses on hard skills, technical/professional skills, and soft skills, non-technical skills. These studies include the works of Hamburg and Velden (2013), Abdyrov, Galiyev, Yessekeshova, Aldabergenova, and Alshynbayeva (2016), Tounonen (2019), OECD (2019), Elasawah, Ho, and Ryan (2021), Do Khanh Nam (2016),

Nguyen Kim Cuong (2018), Truong Thi Diem and Le Van Toan (2019), Nguyen Duy Mong Ha et al (2021).

1.2. Review on Core Skills and Core Skills of Engineering Students

The term "Core skill" refers to the essential and indispensable skills required for learning and work. It is also known by other names such as key skills, deep learning skills, and 21st-century skills, transformational skills. Notable studies include those by Gonzales (2011), Uriel (2014), and Frederick (2017), as well as Gonzales et al (2011). Quality skills are categorized based on various perspectives, including: Communication skills, Teamwork skills, Problem-solving skills, Planning skills, Information technology skills, Critical thinking skills, and Creative thinking skills.

1.3. Review on Practicing Core Skills for Students in University

1.3.1 Forming and Practicing Core Skills through Subjects

The subjects at the university are highly suitable for developing quality skills such as Communication Skills and Teamwork. These include: University Study Skills, Creative Thinking Skills and Time Management, Presentation Skills and Job Search, Skills for Working in a Technical Environment, and the Systems Thinking Course. In these subjects, teachers can integrate quality skills into the teaching structure, providing students with opportunities to practice these skills.

1.3.2 Forming and Practicing Core Skills through Extracurricular Activities

Claudette Christison (2013) and Nghia Tran (2017) have highlighted the benefits that extracurricular activities offer students. They confirmed that students engaged in experiential activities tend to have higher academic achievements (Christison, 2013), and they develop communication skills, job interview skills, teamwork skills, and planning skills (Nghia Tran, 2017). Nashwan and Dlalah (2020) identified the role of extracurricular activities in enhancing the thinking and creativity skills of students at the University of Isra (Jordan). Extracurricular activities are those organized outside the classroom that complement in-class activities and align with the school's educational goals and vision for students (Nashwan & Dlalah, 2020).

1.3.3 Forming and Practicing Core Skills through Self-Training

Students are the main participants in the process of forming and developing their own quality skills. Therefore, it is entirely appropriate for students to exhibit self-discipline and proactivity in searching for materials, classes, and courses for self-study and self-improvement in core skill development.

1.3.4 Forming and Practicing Core Skills through Professional Internships

Research on internships in enterprises (internships) has captured the attention of many researchers due to its relevance to specific industry resources. Apart from

the formation and development of quality skills in educational institutions, internships in companies hold great significance as they contribute to enhancing students' skill levels.

1.4. Studies on Practicing Core Skills for Engineering Students

Rayan and Shetty (2008) conducted research on developing communication skills for engineering students by addressing communication anxiety among students at Jeppiaar University of Technology, Chennai, India. A significant percentage of students lack communication skills. Aharon (2012) proposed the development of systems thinking skills for 2nd-year engineering students through project introductions. These projects are specialized in electrical engineering and are engaged in groups with the guidance of technical advisors. Achim, Popescu, Kadar, and Muntean (2013) suggested the development of creative thinking skills for engineering students through training programs and case studies at the Romanian University. Arthur et al (2014) introduced a module for teaching quality skills to first-year civil engineering students. Yusof, Phang, and Helmi (2014) proposed a cooperative problem-solving teaching method to develop problem-solving skills for engineering students in 2 phases: 1/ Preparation and planning; 2/ Implementation stages of cooperative problem-solving teaching. Jaiswal and Karabiyik (2022) recommended agent-based modeling exercises in a university-level systems methods course to assess students' systems thinking skills.

Conclusion of Chapter 1

Through the analysis, synthesis, classification, and systematization of domestic and foreign documents on "Training Quality Skills of Engineering Students," several conclusions can be drawn as follows: Quality skills are known by various names such as "Key Skills," "21st Century Skills," "General Skills," and "Transferable Skills." The quality skills of engineering students are categorized based on the perspectives from the reviewed works, including Communication Skills, Teamwork Skills, Problem-Solving Skills, Creative Thinking Skills, and Systems Thinking Skills.

Research on core skills training can be approached through several methods: teaching, extracurricular activities, self-study, and professional practice. Studies have demonstrated the effectiveness and feasibility of training these skills through teaching. Given the current landscape of technical training universities in Vietnam, the training of quality skills needs to clarify the theoretical foundation of quality skills and the conditions under which quality skills training can be effectively implemented through teaching.

CHAPTER 2
THEORETICAL BASIS OF ENGINEERING STUDENT CORE SKILL PRACTICING

2.1 Concepts

2.1.1 Core Skills of Engineering Students

2.1.1.1 Skill

A skill is defined as “The ability to apply knowledge and experience in a practical field to take action to achieve specific goals.”

2.1.1.2 Core Skills

The term "core," according to the Vietnamese dictionary, refers to "the most important thing, the most essential thing" (Institute of Linguistics, 2003, p. 213). Quality skills are crucial and indispensable abilities, necessary for anyone seeking employment. From the perspective of Phan Van Nhan et al (2016), “Core skills are general and fundamental skills that every employee must possess in their performance capacity. These skills revolve around the capability to apply knowledge, skills, and techniques cohesively in real work situations” (Nhan, 2016, p. 74). In the context of this thesis, core skills are understood as "The ability to integrate knowledge and experience to execute practical professional actions, a necessity for any employee."

2.1.1.3 Technique

In the context of this thesis, the concept of "technology" is defined as follows: "Technology is a productive labor tool, a system of machinery and equipment (engineering system) created based on the processes of production. Natural laws are utilized to serve the production process and other human needs. Additionally, technology represents a systematic approach to carrying out specific activities in a scientific manner."

2.1.1.4 Engineering Student

The Vietnamese dictionary characterizes students as individuals engaged in university-level education (Institute of Linguistics, 2003, p. 860). According to Circular 09/2022/TT-BGDDT dated 06/06/2022 in the list of training majors for the technical block, there are 2 codes at level 3 in the engineering group: 751 - Engineering Technology and 752 - Engineering. Engineering students refer to individuals studying at the university level within the fields of Engineering Technology and Engineering. Core skills of engineering students encompass abilities that every engineering student must possess to integrate knowledge and experience for engineering learning actions.

2.1.2 Practicing Core Skills of Engineering Students

2.1.2.1 Practice

As per the Vietnamese dictionary, "Practice" involves "Repeatedly engaging in an activity to achieve stable and proficient qualities or qualifications" (Institute of Linguistics, 2003, p. 620).

2.1.2.2 Organizing Core Skills Practicing for Engineering Students

Organizing the training of quality skills for engineering students encompasses the process by which teachers design and implement teaching methods and activities. These methods and activities aid students in integrating knowledge and experience to perform technical learning actions, thereby developing quality skills to a specific level. This process also involves evaluating the implementation.

2.2. Core Skills of Engineering Students

2.2.1 Theory of Core Skills

Nature of Core Skills: General properties; Specific properties; Inevitability.

Stages of Forming Core Skills: No skills yet; Preliminary skills; Acquired skills; Expert skills.

2.2.2 Theory of Core Skills of Engineering Students

2.2.2.1. According to the specific approach of the technical profession, the quality skills are reflected in the output standards of the training program. Engineering students need to achieve very specific goals of knowledge, skills, and attitudes (Crawley, Malmqvist, Ostlund, & Brodeur, 2007, pp. 209-301): Technical reasoning and problem-solving skills; Experimentation and knowledge discovery skills; Systems thinking skills; Teamwork skills; Communication skills.

2.2.2.2. According to the training program output standard approach, the quality skills are reflected in the output standards of the training program. Engineering students need to achieve very specific goals of knowledge, skills, and attitudes (Crawley, Malmqvist, Ostlund, & Brodeur, 2007, pp. 209-301): (1) Technical reasoning and problem-solving skills; (2) Skills of experimentation and knowledge discovery; (3) Systems thinking skills; (4) Teamwork skills; (5) Communication skills.

2.2.2.3. Identify the Core Skills of engineering students in an engineering learning environment

In a technical learning environment, three core skills need to be developed and trained for solving engineering learning tasks: Creative problem-solving skills; Technical systems thinking skills; Technical communication skills.

Technical Communication Skills: A subset of communication skills. Technical communication skill involves conveying technical information using technical

language for analysis, synthesis, and presentation of technical subjects. It is specific to engineering students due to the predominant use of technical language. This skill is employed by engineering students to address engineering problems and interact within the technical community, typically in an educational setting. This aligns with the "Communication skills" output standard.
Problem-Solving Skills: A subset of problem-solving skills. Creative problem-solving skills entail the ability to devise novel ideas and implement appropriate solutions in response to challenging scenarios. Innovative problem-solving skills encompass solving technical learning issues in an innovative and creative manner. This meets the requirements of the technical training curriculum and fulfills the "Argument and problem-solving skills" and "Experimenting and knowledge discovery skills" output standards.
Technical Thinking Skills: A subset of systems thinking skills. Technical systems thinking skill involves analyzing, synthesizing, and generalizing technical systems. Technical support thinking skill refers to students' systematic thinking about technical systems. Engineering learning encompasses studying engineering systems, ranging from simple to complex. Developing this skill satisfies the "System thinking skills" output standard.

2.3. Approaches to Form and Practice Core Skills for Students

2.3.1 Through Teaching

2.3.2 Through Internships

2.3.3 Through Extracurricular Activities

2.4. Methods of Training Core Skills of Engineering Students through Teaching

2.4.1 Methods of Training Technical Communication Skills

The logical teaching method is applied to practice technical communication skills for students. Teaching activities include: Equipping students with a conceptual system and technical language; Utilizing technical language to gather information; Employing graphics to present technical reports; Illustrating technical reports through multimedia technology; Providing relevant technical documents.

2.4.2 Methods of Training Technical Systems Thinking Skills

Teachers employ the logical teaching method, which is suitable for implementing teaching activities to develop students' technical support thinking skills. Activities include: Introducing a technical system from the whole to the part; Employing the system perspective in teaching; Proposing various reasoning approaches for students to explore a specific system; Guiding students in developing innovative thinking; Employing analytical and synthetic methods to

form technical support thinking; Guiding students in thinking prior to utilizing a system technique.

2.4.3 Methods to Practice Creative Problem-Solving Skills

The project-based teaching method and the group-based teaching method are suitable for practicing problem-solving skills among students. Teaching activities during implementation include: Integrating real-life problems into lessons; Assigning technical tasks for students to solve; Organizing problem-solving sessions; Guiding students in employing creative thinking methods. Learning activities encompass: Problem identification, information collection and processing, proposing and implementing optimal solutions, evaluating options, generating new ideas.

2.5. Organise core skills practicing for engineering student

Through teaching, teachers engage in practicing quality skills with students.

The process of organizing core skills practicing for engineering students in 3 stages: Design - Implementation - Evaluation

Design: Analyze the lesson and identify the quality skills that require training during the lesson.

Implementation Organization: Each quality skill will be accompanied by corresponding teaching activities tailored to its level.

Practicing Technical Communication Skills through Teaching

Throughout the teaching process, instructors can integrate activities to enhance technical communication skills for students, progressing from basic to advanced levels. The table below outlines teaching and learning activities designed to help students practice this skill from level 1 to level 3.

+ Practice technical communication skills through teaching

Teaching Activities	**Student Achievements**	**Practice Activities**	**Level of Skill Formation**
1. Equip students with a system of concepts, symbols, and technical languages (Utilizing the analysis-synthesis method)	- Acquire knowledge about technical objects -	- Grasp the system of concepts and symbols	**1. Unskilled:** Possess knowledge about skill implementation
2. Assign learning tasks: Read technical drawings (Using the analytical method)	- Analyze technical objects	- Interpret technical drawings	**2. Preliminary skills:** Capable of performing drawing interpretation tasks, yet some errors and mistakes may be present.

3. Assign learning tasks: Design technical drawings (Employing the general method)	- Synthesize technical objects	- Design technical drawings	**3. Skilled:** Proficient in performing drawing design operations with considerable accuracy, though minor errors might occur, achieving certain outcomes in familiar situations.

If regularly trained in activities at level 3, students will reach level 4 as proficient and level 5 as expert.

+ Practicing technical systems thinking skills through teaching

Teaching activities	Students' achievements	Practice activities	Level of skill formation
1. Presenting an introduction to a technical system from the whole to the part (by analytical method)	- Identifying the whole and the parts of the whole and the relationship between the parts in the whole	- Understanding parts of the whole	**1. Unskilled:** Students have knowledge about a specific technical system.
2. Organize for students to describe and explain technical systems, structures, operating principles of technical objects (diagrams, drawings, etc.) (by analysis and synthesis methods)	- Analysis technical system	Description of technical system Explanation of technical system	**2. Preliminary skills:** Can perform the operation of describing and explaining the structure and operating principle of the technical system, but there are still some errors and misunderstandings.
3. Organize for students to design a specific technical system (by general method)	- Synthesize the technical system	- Design a specific technical system	**3. Skilled:** Implement the design an accurate technical system but with a few minor errors, achieving certain effectiveness in familiar situations.

If regularly trained in activities at level 3, students will reach level 4 as proficient and level 5 as expert.

+ Practice creative problem solving skills through teaching

Teaching activities	Students' achievements	Practice activities	Level of skill formation
1. Present the theory of solving a technical problem (by analytical method)	- Identify a specific technical problem to be solved.	- Understand the steps to solve a particular technical problem.	**1. Unskilled:** have knowledge of the technical problem to be solved.

2. Organize for students to solve simple problems (by project teaching method).	- Analyze a technical problem and apply creative thinking methods to solve technical problems.	- Identify technical problems. - Planning to solve technical problems. - Proposed Solutions	**2. Preliminary skills:** Perform operations to implement a simple technical problem-solving project fully with a few errors and mistakes.
3. Organize for students to solve complex problems (by project teaching method).	- Solve a technical problem in practice.	- Identify technical problems. - Make a plan to solve the problem. - Proposing and selecting the optimal solution. - Experiment with the solution by model.	**3. Skilled:** Perform project implementation operations to solve complex technical problems fully, with novelty, with a few minor errors.

If regularly trained in activities at level 3, students will reach level 4 as proficient and level 5 as expert.

- Evaluation: evaluate learning results and evaluate the results of training quality skills: Rubric assessment is designed for each quality skill.

2.6. CONDITIONS FOR PRACTICING CORE SKILLS THROUGH TEACHING

Conditions for training programs; conditions for teachers; conditions for students; facility conditions.

CHAPTER 2 CONCLUSION

In this chapter, the thesis has introduced instrumental concepts, including: the training concept, the skill concept, the core skill concept, the engineering student concept, and the concept of core skills for engineering students. The thesis has analyzed the roles and stages in the formation of quality skills, as well as the basis for determining quality skills to effectively implement technical learning activities for engineering students. It has also analyzed the characteristics and indicators of each quality skill: technical communication skills, innovative problem-solving skills, and technical cooperation thinking skills.

The organization of training core skills is carried out in three phases: Design, Implementation, and Evaluation. During the implementation stage, the thesis has identified methods for training core skills through teaching engineering students, including the logical teaching method and the project-based teaching method. These methods are then concretized through teaching and learning activities to form and develop the indicator skills for each core skill. The thesis also elucidates the training of these core skills based on the level of application in

teaching and highlights the conditions necessary for organizing the training of core skills through teaching.

The methods of training core skills through teaching represent a theoretical contribution of this topic, addressing the gap in previous studies regarding the training of core skills for engineering students. These theories serve as a scientific foundation for investigating the current status of practicing core skills at universities in Ho Chi Minh City.

CHAPTER 3
THE STATE OF PRACTICING CORE SKILLS OF ENGINEERING STUDENT THROUGH TEACHING AT SELECTED UNIVERSITIES IN HO CHI MINH CITY

3.1 General Description of the Survey Area

The survey area encompasses three universities in Ho Chi Minh City: Ho Chi Minh City University of Technology and Education, Ho Chi Minh City University of Industry and Trade, and Ho Chi Minh City University of Technology.

3.2 Survey Objectives

The objectives of this survey are to collect, analyze, and assess the current state of quality skills development for engineering students through teaching at three universities: Ho Chi Minh City University of Industry and Trade, Ho Chi Minh City University of Technology, and Ho Chi Minh City University of Technology and Education. This survey aims to provide a practical foundation for constructing and implementing methods to train quality skills for students within the teaching framework.

3.3 Survey Time

Survey Period: From May 2021 to December 2021.

3.4 Survey Content and Participants

Content: Quality skills of engineering students, methods for training quality skills for engineering students, and conditions for training skills among engineering students.

Target Audience: 60 teachers and 856 students.

3.5 Survey Methods and Tools

3.5.1 Survey Methods

3.5.1.1 Questionnaire Survey Method

3.5.1.2 Interview Method

3.5.1.3 Observation Method

3.6 Results of the survey

3.6.1 Current State of Core Skills of Engineering Students

The attainment level of technical communication skills among students primarily ranges at level 2 - preliminary skills, with an average score of 2.42 in the range of 1.8 - 2.6. In

terms of thinking skills, students' technical assistance abilities are at the "primary skills" level, specifically level 2 out of 5, with an average score of 2.46 in the range of 1.8 - 2.6. Regarding problem-solving skills, the breakdown is as follows: 51.5% of students lack skills and possess only basic knowledge, while 42.3% of students exhibit "skillful" abilities. The categories of "proficient" and "expert" skills are not significantly represented.

3.6.2 Current Status of Core Skills Practicing Methods for Engineering Students through Teaching

Teachers mentioned Technical Communication Skills, Technical Coordination Thinking Skills, and Creative Problem Solving Skills. However, the learning activities that have not been clearly demonstrated will develop the manifestations of each quality skill. Survey results regarding the formation and development of technical communication skills among students show that the most frequently applied activity for practicing technical communication skills is "Using technical language to find information" (Average point: 4.15). The activity that students find most challenging is "Researching technical documents, designing, and implementing a technical study" (Average point: 3.41).

In terms of the formation and development of technical coordination thinking skills, teachers often employ the activity of "Using the system perspective" in teaching (Frequency: 51.8%). Students emphasize the importance of considering "different points of view, not just technical ones" (Highest point: 4.05). The activity where students face the most difficulty is "Synthesizing individual components into a technical system correctly," which relies on the overall recognition ability of the system (Average point: 3.35).

Regarding problem-solving skills, teachers frequently employ teaching activities to practice these skills, with an average score ranging from 3.87 to 4.17. Students participate in these activities often, with the highest average score attributed to the "information gathering" activity (Average point: 4.22). In learning activities aimed at practicing creative problem-solving skills, students encounter the most difficulty in the skills of "identifying problems," "proposing suitable solutions," and "evaluating implemented solutions."

In terms of teaching facilities, teachers actively use various means, including teaching aids and tools such as drawings, simulation clips, real methods, components, and crafts.

CONCLUSION CHAPTER 3

Through the study of the current state of training core skills at universities with technical programs located in Ho Chi Minh City, we draw the following conclusions:

Students and even some teachers still exhibit confusion in distinguishing between "Technology" core competencies and professional skills. This indicates a lack of familiarity with the term "Core skills" and a limited focus on research related to core skills at the university level.

The level of core skills attained by students is not high, with self-assessment scores averaging 2 out of 5. Common difficulties faced by students in implementing core skills include a lack of knowledge about these skills, a shortage of component skills necessary for their execution, and a lack of systematic training in core skills. Subjective factors primarily contribute to the ineffective training of students' core skills, with student engagement being the most influential factor, followed by the positive influence of teachers.

While teachers employ a variety of teaching methods, they tend to be spontaneous and lack systematicity. Teaching activities and skill practice for students vary widely based on class dynamics rather than adhering to the teacher's original pedagogical intent. This discrepancy leads students to be unaware of their deficiencies in core skills and how to learn from each learning activity.

The above-mentioned remaining issues underscore the necessity of implementing a systematic process for training core skills through teaching engineering students. By adopting methods to train core skills through teaching, these challenges can be addressed, guiding teachers to integrate core skills into lesson planning and classroom instruction from the outset.

CHAPTER 4
ORGANIZATION OF PRACTICING CORE SKILLS THROUGH TEACHING FOR ENGINEERING STUDENTS

4.1 Characteristics of Technical Learning Activities

The current trend necessitates engineering students' involvement in the complete life cycle of products, models, and systems, ranging from simple to complex. This includes learning activities associated with technical content, engaging in practical problem-solving situations, fostering self-reliance, self-study, innovative and creative thinking, and tackling interdisciplinary technical scenarios.

4.2 Illustrate practicing core skills through teaching for students in electrical engineering technology

4.2.1 Introduction to Electrical Engineering Technology

4.2.1.1 Output Standards for Training Programs in Electrical Engineering Technology

Knowledge and reasoning to solve technical problems.

Ability to acquire and apply new knowledge, professional skills, and other personal competencies.

Effective communication skills and teamwork abilities in a multi-disciplinary environment.

Proficiency in designing automatic electric transmission and power systems within societal and business contexts.

4.2.1.2 Contents of the Training Program in Electrical Engineering Technology

The comprehensive course training program comprises 132 credits, including 49 in the general knowledge segment (45 compulsory credits and 4 elective credits), 24 credits in the basic knowledge and industry group, 23 specialized knowledge credits, 17 internship credits, 9 elective knowledge credits, and 10 graduation credits.

4.2.1.3 Teaching Methods in Electrical Engineering Technology

The pedagogical approach for Electrical Engineering Technology encompasses both traditional and modern teaching methods, aligned with the distinctive knowledge characteristics of the electrical industry.

4.2.1.4 Conditions for Teaching Electrical Engineering Technology

- Facility Requirements
- Teacher Qualifications
- Student Conditions

4.2.2 The process of practicing core skills through teaching for students in electrical engineering technology

Design: In this phase, teachers analyze the lesson objectives in terms of knowledge, skills, and attitudes, aligned with the output standards. These objectives ensure progressive accumulation of output standards throughout each lesson. Teachers identify pertinent core skills for practice, emphasizing skills crucial for meeting lesson objectives. Chosen core skills should directly contribute to these objectives. Notably, three core skills—Technical Communication Skills, Creative Problem Solving Skills, and Technical Support Thinking Skills—are emphasized by teachers.

Implementation Organization: During this stage, teachers employ appropriate teaching methods to effectively train core skills, tailoring their deployment to the progression of core skill levels, from basic to advanced. The teaching design tool delineates the application of these methods in refining teacher-prepared lesson plans prior to classroom delivery. This tool assists teachers in adapting lesson plans to specific classroom conditions.

Evaluation: In this phase, teachers assess students' learning outcomes post-lesson, employing exercises and tests. Simultaneously, teachers evaluate the degree of success in training core skills through the lesson, utilizing rubrics as assessment tools.

Training core skills through teaching can be executed individually, based on lesson content and objectives. The teacher's discretion determines whether to focus on one, two, or all three core skills.

4.2.2.1 Design Teaching Illustrations to practice Technical Communication Skills and Technical System Thinking Skills through the "Electricity Supply Practice" Course

- Designing the training of technical system thinking skills for Lesson 1, Chapter 1.
- Designing the practice of technical communication skills for Lesson 1, Chapter 2.
- Designing the practice of problem-solving skills for Lesson 5, Chapter 3.

4.3 Pedagogical Experience

4.3.1 Objective

The objective is to experimentally implement the illustrated teaching design from Chapter 4 in practical scenarios. This aims to evaluate the feasibility and effectiveness of methods for training technical communication skills and problem-solving skills for students majoring in Electrical Engineering Technology.

4.3.2 Content and Audience

- Content

The experimental approach involves applying the illustrated teaching design from Chapter 4 into teaching. The assessment includes measuring students' technical communication skills through Lesson 1, Chapter 2 of the "Electrical Supply Practice" course, as well as measuring problem-solving skills through Lesson 5, Chapter 3 of the "Learning Skills" course.

- Participants

The experimental group consists of 160 students majoring in Electrical Engineering Technology at Ho Chi Minh City University of Technology and Education. The experiment takes place in normal learning conditions. The experimental group and the control group have an equal number of students, with relatively similar learning abilities and conditions. The teachers in both groups possess similar qualifications and experience. The experimentation involves implementing skill development methods in Electrical Engineering Technology for students taking the "Electricity Supply Practice" course and the "Learning Skills" course in the second semester of the academic year 2021 - 2022 at Ho Chi Minh City University of Technology and Education.

4.3.3 Methods and Tools

- Method: Controlled experiment.
- Tools: Tests, pre-and post-experiment quality skills measurement sheets.

4.3.4 Evaluation Methods

Qualitative evaluation, quantitative analysis, and statistical hypothesis testing for H0 and H1.

4.3.5 Analyzing Experimental Results

4.3.5.1 Analysis of Experimental Results for the Specialized Subject "Electricity Supply Practice"

- Quantitative assessment of results for the control class and the experimental class before pedagogical impact

A test was designed for both the experimental and control groups, covering the content of knowledge from Lesson 1, Chapter 2, titled "Model of High-Voltage Transmission Line." In the experimental Group 2, the highest achieved score was 6 (frequency 12), and the lowest score was 2, with the highest score being 8. For the control Group 2, the maximum score was 6 (frequency 13), while the lowest SV score was 3, and the highest score was 8. The statistical hypothesis test indicates that $t < t\alpha$, implying that the difference between $\bar{X}$experimental and $\bar{X}$control is not significant. Therefore, hypothesis H0 is accepted, and hypothesis H1 is rejected. This demonstrates that the learning outcomes of both experimental Group 2 and control Group 2 are comparable. The average technical communication skills score for experimental Class 2 and control Class 2 falls within the range of 2.7 - 3.4, indicating an average "skill" level. Consequently, the skill level of students from both groups is similar before the experiment.

- Quantitative assessment of results for the control class and the experimental class after pedagogical impact

The end-of-experiment student learning results test was conducted using the knowledge content from Lesson 1, Chapter 2, "Model of High-Voltage Transmission Line." The scores were normalized to a 10-point scale. This test was administered to both experimental Group 2 and control Group 2, with identical answers, scales, and assessment methods. The experimental Group 2 had the highest frequency output score of 6, the lowest score was 3, and the highest was 9. In the control Group, the maximum score was 6, the lowest score was 3 points, and the highest score was 8. The mean output score of the experimental Group 2 test (6.0) is higher than the input score (5.52). Statistical hypothesis testing reveals that $t > t\alpha$, suggesting that the difference between $\bar{X}$experimental and $\bar{X}$control is significant. Thus, hypothesis H1 is accepted, and hypothesis H0 is rejected. Consequently, the learning outcomes of students in experimental Group 2 exceeded those of control Group 2. Post-experiment, some skills of experimental Group 2 surpassed the control Group by one level. The technical communication skills of students in experimental Group 2 were more advanced compared to those in control Group 2.

- Analyzing Observation Results

Observation of teaching hours after the pedagogical impact in experimental Class 2, in terms of all component skills necessary for practicing technical communication skills, the number of students who require no instruction increases, the times of skill training

later, and the number of students needing regular guidance decreases. Consequently, after skill training, the number of students completing learning tasks increased, while the number of students unable to complete tasks decreased significantly.

4.3.5.2 Analysis of Experimental Results for the Elective Subject "Learning Skills"

- Quantitative assessment of results for the control class and the experimental class before pedagogical impact

Results of the entrance test for students' creative problem solving skills. A test was created for both the experimental and control groups, focusing on the content of knowledge from Lesson 5, Chapter 3 of the subject "University Study Skills." The aim was to evaluate students' problem-solving skills prior to the experiment. In the experimental Group 1, the highest input score was 7 (frequency 14). For the control Group 1, the highest score was 6 (frequency 16). Neither group obtained scores of 4 (lowest frequency) or 9 (highest frequency). Statistical hypothesis testing indicates that $t < t\alpha$, leading to the conclusion that the difference between $\bar{X}$experimental and $\bar{X}$control is not significant. Therefore, hypothesis H0 is accepted, and hypothesis H1 is rejected. This implies that the learning outcomes of both experimental Group 1 and control Group 1 are comparable. The average scores of the experimental Group 1 and control Group 1 fall within the range of 2.7 - 3.4, representing an average "skill" level. Consequently, the skill level of students from both groups is similar before the experiment.

- Quantitative assessment of results for the experimental and control classes after pedagogical impact

The end-of-experiment test for student learning outcomes was conducted using the knowledge content from Lesson 5, Chapter 3, "Study Skills." Scores were scaled down to a 10-point system. This test was administered to both the experimental group and the control class, with identical answers, scales, and assessment methods. The experimental Group 1 achieved the highest score of 7 (frequency 26), with 4 students scoring 9 points, and no students scoring 6 or lower. In the control Group 1, the highest frequency score was 7 (22), with 17 students scoring 6, and no students scoring 9. Statistical hypothesis testing demonstrates that $t > t\alpha$, indicating a significant difference between $\bar{X}$experimental and $\bar{X}$control. Thus, hypothesis H1 is accepted, and hypothesis H0 is rejected. Consequently, the learning outcomes of students in experimental Group 1 surpassed those in control Group 1. Post-experiment, the skill level of experimental Group 1 exceeded that of control Group 1. Problem-solving skills of students in experimental Group 1 are more proficient compared to those in control Group 1.

- Evaluation through Observation and Time Attendance

In experimental Group 1, teachers utilized quality skill training methods during teaching, incorporating project-based and group-based teaching techniques involving problem scenarios to stimulate students' critical thinking. This approach prompted students' active

engagement in technical learning projects, fostering interaction between students and teachers as well as within peer groups.

- Evaluation through Expert Consultation

Regarding the necessity of employing quality skill training methods in teaching engineering students, the evaluation from experts revealed that 100% of them deemed this method necessary. However, two experts noted its limited feasibility. These experts further explained that the method may require teachers to invest more time in lesson planning and developing learning materials for incorporating quality skill training activities. This could potentially lead to teachers hesitating to embrace this method due to concerns about increased workload.

- Experimental Conclusion

Before the pedagogical intervention, the measurement outcomes of core skills for students in both experimental and control classes were similar. Teaching lacked a connection to fostering quality skills, with teachers primarily presenting theoretical content and practical activities being assessed based on theoretical knowledge rather than practical application. Students followed standardized patterns, lacking creativity.

Following the pedagogical intervention, teachers actively applied quality skill training methods in teaching, resulting in dynamic content compilation and well-prepared teaching activities designed to enhance students' quality skills. These activities were designed to provide numerous opportunities for creative and positive engagement in practical tasks. The classroom atmosphere became more vibrant, with increased student participation and not just cognitive thinking but also hands-on technical manipulation. Teachers also felt less pressured when preparing lessons using this quality skill training method, as it was found to suit the learning content and conditions of engineering students without excessive complexity.

CONCLUSION - CHAPTER 4

The implementation of a 3-stage process - Design, Organization Implementation, and Evaluation - facilitates the training of core skills among engineering students using logical teaching methods and project-based teaching methods. This approach assists both teachers and students in meeting subject output standards while gradually mastering core skills. Teaching methods to practice core skills are selected based on lesson objectives and content, ensuring students have ample opportunities to practice these skills.

To validate the reliability and effectiveness of this method in practice, the training of core skills was experimentally applied to the subjects "Electrical Supply Practice" and "Learning Skills" at the Ho Chi Minh City University of Technology and Education.

Results from expert opinion polls support the proposed method of training core skills through teaching. The method's practicality, scientific grounding, and feasibility were highly rated by experts. This outcome underscores unanimous agreement among experts on the importance and applicability of this method in training core skills for engineering students.

CONCLUSIONS AND RECOMMENDATIONS

1. Conclusion

Practicing core skills in engineering students stands as a crucial task for both educators and learners, aiming to fulfill training program output standards and cultivate future engineers' capabilities. To establish a clear theoretical basis for core skill training in engineering students, it is imperative to draw on domestic and foreign research and publications directly related to the topic. However, the overview study revealed limited works in this area, lacking a solid scientific foundation for selecting core skills in the engineering sector and suitable teaching methods. This research gap prompted the need to develop a theoretical framework for the topic, thereby identifying specific core skills for engineering students: problem-solving skills, technical communication skills, and technical support thinking skills. Sixteen corresponding teaching activities, including 5 for practicing problem-solving skills, 5 for technical communication skills, and 6 for technical support thinking skills, were proposed to foster these skills. These activities collectively contribute to the development of 16 indicator skills.

2. Recommendations

2.1. For Educational Institutions

Encourage teachers and students to prioritize core skill training, enhancing teaching core and aligning with output standards.

Invest in modern and adequate facilities to optimize the organization of skill-based learning.

2.2. For Lecturers

Foster an understanding of core skills, their role, and designing teaching activities that align with core skill objectives.

Prioritize the development of core skills.

Incorporate the method of training core skills into teaching strategies.

Regularly evaluate the progress of core skills, offering positive feedback to students.

Apply the method of training core skills in lesson planning and teaching organization for improved effectiveness and enhanced learning core.

2.3. For Curriculum Development and Learning Materials

Integrate technical skills and core skills into learning materials.

Clearly define objectives for developing core skills.

Provide guidance for teachers on assessing core skills.
Advance the training of core skills for educators.
2.4. For Students
Heighten awareness and skills in implementing core skills.
Cultivate knowledge, perseverance, and dedication to practicing core skills.
Express challenges and cooperation in the learning process openly with peers and instructors to facilitate timely adjustments and refinement of core skills.

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