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Technological competence of students in middle schools: a study in Ho Chi Minh City, Vietnam

Cao Thi Thuy Diem[1,2], Bui Van Hong[1]
[1]Institute of Technical Education, Ho Chi Minh City University of Technology and Engineering, Ho Chi Minh City, Vietnam
[2]Department of Training Management and Science and Technology, Institute of Educational Managers, Ho Chi Minh City, Vietnam

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ABSTRACT

With the development of the 4.0 revolution, technological competence is one of the specific competences that needs to be developed for students. In order to find out the perceptions of students and teachers on Technology and to assess the technological competence of students at the middle school level, quantitative (survey) and qualitative (interview) research methods were used in combination to collect data, with a total of 1,496 students and 33 Technology teachers participating in the survey. Quantitative data, which was statistically described and correlatedly analyzed, shows that Technology helped students had many possibilities, and at the same time, students' technological competence was also evaluated differently by teachers and students. The results of the qualitative survey have provided more information, showing that the technological competence of students was not really good, only at a normal level, and they still had difficulties in practice and design activities. The results of the research are an important basis for the proposed solutions that will be researched for the better development of students' technological competence in this subject.

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Corresponding Author:

Bui Van Hong
Institute of Technical Education, Ho Chi Minh City University of Technology and Engineering
No.1 Vo Van Ngan Street, Thu Duc, Ho Chi Minh City, Vietnam
Email: hongbv@hcmute.edu.vn

1. INTRODUCTION

The development of the 4.0 revolution requires education to create increasingly urgent high-quality human resources, especially high-quality human resources in engineering and technology. In the course of development, the industrial revolution 4.0 has impacted human resources [1], and changed "not only what we are doing, how we work, but also who we are at work" [2]. High-quality human resources create innovation, which is becoming "a key factor in building the competitiveness" of each business and the entire economy of a country [3] and is an invaluable asset of any organization [4]. In order to create high-quality human resources, education and training need to be adjusted in terms of curriculum at different levels of the education system [3]. In particular, technological competence is one of the specific competences required of high-quality human resources in the context of globalization and the development of the current 4.0 revolution. Technological competence is a person's ability to understand technology, physical or digital, to find information during tasks or connect with others, using technology to improve one's life [5]. At the same time, employers find new hired employees often lack technological competence [5]. Furthermore, these competences need to equip learners from the high school level to form and develop component technological competence for students, creating a foundation for students to further develop these competences when participating in the labor market after the end of the general education period. One study found a positive correlation between secondary school students' 21st-century learning skills and the educational technology

competencies they had developed. At the same time, the competence of technology education has made a significant contribution to the development of the skills of 21st century students [6], [7], as more and more jobs require technical skills from workers [8]. There are many studies by the authors on high-quality human resource development solutions to meet the requirements of the current trend such as competency-based development models, building skills and competency development programs or it may be necessary to improve the technical education program [3], [4]; and encourage the use of technology, fully integrate technology into the classroom, encourage students to participate and apply knowledge in practice to improve students' technological skills [9]. Integrating technology into traditional classrooms can enhance students' learning motivation by creating a more interactive and engaging learning environment [10]. This provides students with opportunities to become familiar with activities related to their future careers.

In the current educational context in Vietnam, the reform of general education has aimed at comprehensively developing the competence of students in order to create a high-quality human resource to meet the requirements of today's society. In particular, technological competence (including technological awareness competence, technological communication competence, technological use competence, technological evaluation competence, and technical design competence) [11] is one of the specific competences that the general education program aims to form and develop for students. This competence also helps to orient students' careers, helping them get acquainted with future professions right from the time they are in school. Furthermore, developing technology education in the curriculum from primary school onwards can increase students' interest in technology and science; technological skills and student engagement in technology and engineering subjects can help students connect existing knowledge with these subjects, enhancing their critical thinking and problem-solving abilities [12], [13]. Insufficient exposure to technology during the early years of schooling may hinder the development of students' competencies and subsequently influence their future career choices [13].

The general education program in Vietnam focuses on forming technological competence for students at each level through various educational activities [11]. In this study, the group of authors researches technological competence for students at the middle school level; this competence is formed and developed mainly through Technology, a subject with diverse content in many fields of engineering and technology. Up to now, there has been relatively little research on the technological competence of middle school students. Most existing studies have focused on the high school level and have primarily proposed interventions to develop individual components of technological competence, such as strategies for developing students' technical competence through technology instruction in high schools [14]. The renewal of the education program has been carried out synchronously at all levels, but there has been no specific research to assess the technological competence of middle school students. Therefore, this study conducted surveys of teachers and students to address the following research question: What is the level of technological competence of middle school students in the Technology subject?

By addressing the research question, this study provides valuable empirical evidence on the current status of technological competence among middle school students following the implementation of the renewed general education program. It offers a more comprehensive understanding of students' technological competence by assessing five component dimensions, in contrast to previous studies that have mainly focused on individual components of technological competence. At the same time, the study contributes to addressing the research gap in technology education related to technological competence among students in middle schools. The findings provide useful information for educational managers and teachers in improving curriculum design and teaching practices, and serve as a reference for future studies proposing more practical solutions for developing students' technological competence.

2. METHOD

2.1. Research design

To clarify the research problem, the research used a mixed-methods research design, using a combination of quantitative research method (survey) and qualitative research method (interviews) [15], [16], where quantitative and qualitative data were collected concurrently and integrated during interpretation. Quantitative research (survey) was used in this research to collect data based on numerical measurements (numerical data), which were statistically analyzed, with the aim of finding out the opinions of students and teachers on the subject of technology in the general education program. At the same time, the assessment of students' technological competence in this subject was surveyed. Quantitative research has proven to be objective in the collection and processing of digital data. Qualitative research method (interviews) was used in this study to collect data through purposeful interaction between the researcher and participants (teachers and students), aiming to clarify information related to the research problem. Interviews enabled the collection of in-depth data, helped clarify complex issues, and complemented quantitative methods. This method facilitated a deeper understanding of the research problem through direct interaction with participants.

2.2. Participants and sampling procedure

This study employed a multistage sampling approach. In the first stage, cluster random sampling was applied to select nine public middle schools from the public school system in Ho Chi Minh City. The cluster sampling method ensured that the sample was representative of the whole and reliable [17] and this method of selecting samples has also proven to be superior in selecting a sample that is capable of representing the whole [18]. In the second stage, stratified random sampling was employed to ensure the representation of students from all grade levels in the survey. The samples included students and teachers selected from nine middle schools in wards under Ho Chi Minh City. The time to conduct the survey and interview was in the last 2 weeks of May 2025, at the time when students completed the end-of-semester examination and were preparing to have the annual summer vacation. This was very suitable for the survey because each grade level has completed the technology subject program according to the regulations of the Ministry of Education and Training, Vietnam. The survey was conducted with the approval of the school principals, who provided the necessary information and support for the research. According to this survey method, this research estimated number of surveys of 100 students and all teachers of the school's Technology subject to the survey. Due to the limited number of Technology teachers per school (typically 1–2), the sample was extended to include teachers from additional schools, resulting in an expected total of 30 Technology teachers from grades 6–9.

The study also expanded online surveys through Google Forms to collect data to be large enough to ensure reliability and feasibility. The online survey link, adapted from the paper-based questionnaire, was distributed to school principals to support further data collection. To enhance data reliability, the Google Forms survey was configured not to collect respondents' email addresses, and each participant was allowed to submit the questionnaire only once. A total of 1,496 students (both face-to-face and online via Google Forms) and 33 teachers participated in the survey. In particular, teachers participated in answering more interview questions. The number of students participating in the survey across all grade levels (both in-person and online) is compiled and described in Table 1.

The information of teachers participating in the survey and interview was summarized as: 78.8% of teachers were in the group of specialized training in technology pedagogy, industrial technical pedagogy, agricultural pedagogy, and home economics; the remaining 21.2% of teachers had other pedagogical expertise. Of the total 33 teachers, 66.7% were female, 33.3% were male. The seniority of teachers of 10 years or more accounted for 75.8% of the total and the teacher's work in charge of teaching grades was statistically shown in Table 2.

Table 1. Statistics on the number of students of all grades participating in the survey

Grade level	Frequency	Percentage (%)
6	258	17.2
7	466	31.1
8	353	23.6
9	389	26.0
No choice	30	2.0
Total	1,496	100.0

Table 2. Teaching information of teachers participated

Grade level	Frequency	Percentage (%)
No choice	3	9.1
6	4	12.1
6, 7	4	12.1
6, 7, 8	1	3.0
7	6	18.2
7, 8	1	3.0
7, 9	1	3.0
8	4	12.1
8, 9	4	12.1
9	5	15.2
Total	33	100.0

2.3. Instruments

Quantitative data collection instruments: using questionnaires with comments related to the subject of technology and students' technological competence. The questionnaire was designed according to the 5-point Likert scale to measure the level of awareness and technological competency of students achieved levels from "1=completely dislike/very bad" to "5=completely like/very good". At the same time, there is

one survey question with multiple options related to the student's proficiency to be imaged through the educational content of technology such as the competence to present the characteristics and uses of technology products; the competence to read, understand, and select symbols on devices and products to collect data to clarify teachers and students' opinions on Technology in the educational program. The component competences of technological competence are described in detail, used to survey and evaluate students' technological competence, as shown in Table 3.

Table 3. Expressive descriptions of technological competences

No.	Students' technological competence reflected in the descriptions	Scale 1 (Very bad)	2 (Bad)	3 (Normal)	4 (Good)	5 (Very good)
1	Describe the product, know the use/meaning/impact of the technology product on the family and yourself; Describe the process of creating technology products by what method/methods, including what steps/stages?					
2	Draw product descriptions, read and understand parameter symbols, and use processes, ... technology products in life					
3	Use technological equipment and products properly and effectively; not damaged; can handle some simple techniques for technological devices in life					
4	Comment on the use, durability of technology products and know how to choose the right product for your needs.					
5	Interpret drawings of simple technology products, design implementation steps, or describe model assembly steps.					
6	The overall assessment of students' competence in Technology shown in the above descriptions					

Qualitative data collection instruments (interviews): a semi-structured interview protocol was employed to guide the interviews with teachers. Initially, the research team only interviewed Technology teachers in all grades of the chosen schools for the survey. As a result, 31/33 teachers answered interview questions (93.9%). The content of the interview had open-ended questions, in order to collect information shared by teachers about students' competence in Technology, specifically "please indicate the level of students' competence in Technology (describe in detail what students have done and not done when they finish learning Technology in grade level that you teach)?" In the final stage of the survey, the research randomly interviewed five students of grade 9 in one school unit, using the same teacher's interview questions to find out more about the students' technological capabilities through qualitative data from the collected information, which was recorded and synthesized.

Before conducting the interviews, teachers and students were informed about the research objectives and the intended use of the collected data. Participation was voluntary, and teachers could withdraw from the study at any time. For information security, personally identifiable information was removed, and encryption (GV1 or HS1) was used when compiling and presenting results. The validity of the research instruments was established through a review of the relevant theoretical literature and expert evaluation in the field. Prior to the collection of quantitative and qualitative data, the researchers refined the instruments based on expert feedback and conducted a pilot study to evaluate the feasibility of the data collection instruments. The instruments were subsequently revised and finalized before the official data collection process was conducted.

2.4. Data analysis

The quantitative data was processed using a descriptive statistical method through SPSS statistics 20 software. The Cronbach's alpha values of the observational variables (surveys of students' technological competence) in teachers (0.908) and students (0.895) were quite high, confirming a very good reliability value. The observed variables all had a variable correlation - the sum was greater than 0.3 to ensure the reliability of the survey data [19]. The value range of the Likert scale is defined as: i) 1.00–1.80: completely dislike/very bad; ii) 1.81–2.60: dislike/bad; iii) 2.61–3.40: neutral/normal; iv) 3.41–4.20: like/good; and v) 4.21–5.00: completely like/very good.

The qualitative data collected during the survey process were documented, organized, and analyzed according to the interview themes. The qualitative data analysis process involved data preparation, thematic coding, and interpretation of the data. This process was iterative and required continuous interaction between the researchers and the data [20]. Qualitative data analysis is a systematic process aimed at exploring and interpreting issues requiring further clarification. It also complemented the quantitative findings by providing deeper insights into students' technological competence that could not be fully captured through quantitative data alone [21].

The findings from the document analysis were used to establish the study's conceptual framework and identify key aspects of technological competence. This informed the development of the survey and interview instruments and provided a basis for data analysis and interpretation. On the basis of the results of qualitative and quantitative data analysis, the paper assessed the perception of students and teachers towards the subject of technology and the level of technological competence of students in this subject.

3. RESULTS AND DISCUSSION

3.1. Theoretical framework

3.1.1. Research context

Previous study indicated that the rapid advancement of the fourth industrial revolution has created significant demands for educational reform in Vietnam to better meet contemporary societal needs and labor market expectations. In particular, teaching and learning activities require innovation in instructional methods, learning approaches, curriculum content, and assessment practices in order to increase the proportion of highly qualified human resources in the future [22], [23]. With the aim of fostering students' competencies and qualities comprehensively, the new general education program in Vietnam has been implemented since the 2020–2021 academic year. Within this curriculum, technological competence is identified as one of the seven subject-specific competencies prioritized for student development. At the middle school level, this competence is primarily fostered through technology education, a subject encompassing diverse technical and technological domains, including industry, agriculture, forestry, fisheries, and services. During this period of educational reform, science, technology, engineering, and mathematics (STEM) education has also been increasingly integrated into teaching practices to support the development of students' general competencies and technological competence in particular. Previous research has shown that integrated STEM instruction positively affects students' academic achievement, creativity, critical thinking, and problem-solving abilities [24]–[26], while also promoting student engagement in research-related activities [27]. Furthermore, the systematic integration of soft skills development and STEM education has been regarded as an effective strategy for enhancing the professional and social adaptability of future professionals [28].

This study was conducted as a case study in Ho Chi Minh City, a major economic, cultural, educational, and technological center in southern Vietnam. As of September 2024, the city had 289 public middle schools with 486,621 students, accounting for nearly half of the lower secondary student population in the southeast region of Vietnam [29]. Differences in students' competencies may exist between urban and rural areas and across population groups. Although Ho Chi Minh City has a relatively high proportion of formally trained workers aged 15 years and above (37.5%), exceeding the national average, the unemployment rate among the working-age population remained at 3.42% in 2024, which was still higher than the national average [29]. Upon completing lower secondary education, students may pursue vocational education and training in preparation for future participation in the labor market. Therefore, fostering students' competencies at this stage is essential to meet societal and workforce demands. In this context, examining students' technological competence in Ho Chi Minh City is of considerable educational significance, as it provides insights into the current state of students' technological competence and serves as a basis for future educational research and improvement.

3.1.2. Characteristics of students' technological competence in Technology

The subject of Technology in Vietnam's general education program contributes to the formation and development of the main qualities and general competences for students at levels suitable for the subject. In addition, through the content of Technology, teaching also helps to form and develop technological competence in students. With diverse subject curriculum content, in many different fields and professions, students' technological competence is also developed in those fields, and the lower secondary level is the level that continues to develop the technological competence of students accumulated at the primary level. At the stage of general education, students' technological competence is formed and developed through diverse educational contents, associated with real life including fields such as technology in life, agriculture, forestry, industry, fisheries and engineering design. For each field, students' technological competence is focused on forming five component competences such as technology awareness competence, technology communication competence, technology use competence, technology evaluation competence, and technical design competence [11].

At the end of the middle school level, students have achieved a certain technological competence and can apply that competence in practice such as reading technical specifications, identifying and properly using some technology products in the family. Furthermore, the students can exchange information about products and technological processes through making and reading simple technical drawings; evaluate and

design simple technology products. Also, they can acquire knowledge and experience in choosing a career in the field of technology, contributing to choosing the right direction after middle school and training students to be careful and persistent in technical and technological activities.

3.1.3. Technological competence structure

The general education program has been determined through the subject of Technology, in which the technological competence of students is formed and developed. At each level of education, each component of technological competence has different manifestations of achievement. The general structure of technological competence includes components as [11]: i) technological awareness competence is the competence to master the core general knowledge of technology in the essence of technology, the relationship between technology, people and society, some popular technologies and production processes mainly impacting on the economy and society in the present and future, technological development and innovation; and career orientation in the main technical and technological fields; ii) technological communication competence: means the competence to make, read and exchange technical documents on products, processes and services of technology in the use and evaluation of technological and technical design; iii) technological use competence: means the competence to exploit technological products, processes and services with the right functions, techniques, safety and efficiency, creating technological products; iv) technological evaluation competence: is the competence to make judgments about a technological product, process or service with a multi-dimensional perspective on the role, function, quality, economy-finance, environmental impact and downsides of engineering and technology; and v) technical design competence: is the competence to detect demands and problems that need to be innovated in practice, to propose technical and technological solutions to meet needs and problems needed to be solved, to realize technical and technological solutions, and to assess the level of meeting the needs and problems posed.

Figure 1 illustrates the structure of the components of students' technological competences [11]. Thus, in technological competences, the highest level of expression is the competence to engineering design, which is the competence that students are able to propose solutions to improve and manufacture a certain product to solve the problem posed. The competence with the lowest level of manifestation is the competence to recognize technology.

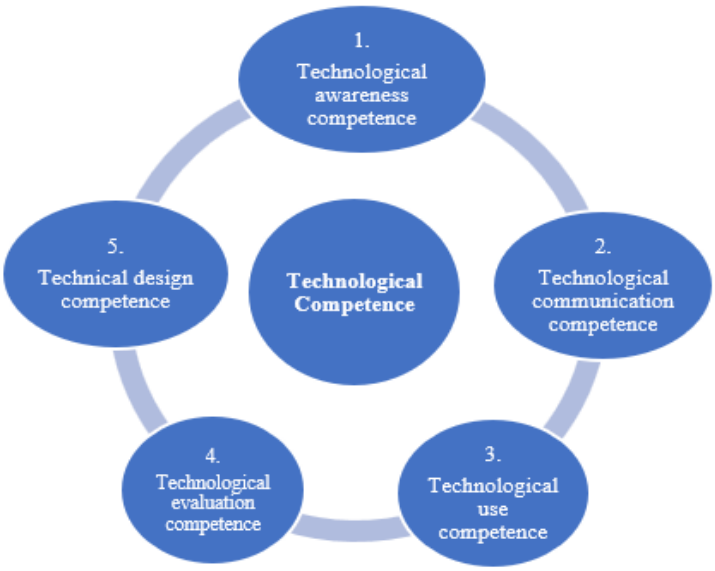


Figure 1. Diagram of the components of the technological competences

At the lower secondary level, based on the objectives and content of the program of Technology, the technological competence of students at this level is formed and has specific manifestations in each component of technological competence [11]. Table 4 presents the specific manifestations of each component of technological competence in the Technology subject, reflecting the competencies students achieve through the subject curriculum. This serves as a basis for teachers and students to assess students' technological competences.

Table 4 shows that the components of technological competence are studied and arranged according to the gradual increase in students' competence [11]. The highest manifestation of technological competence is technical design competence which is the sum of the previous component competences to create the engineering design capability. Although Technological awareness is a primitive competence that manifests itself at the lowest level in the table, it is the basis and premise for the next competences. The use of teaching methods and evaluation criteria must be based on the development goals of the competence components and other factors to choose accordingly.

Table 4. Components of technological competence

No.	Components of technological competence	Specific manifestations
1	Technological awareness competence	Describe the product, know the use/meaning/impact of the technology product on the family and self, what method the process of creating technology products is, and what steps/stages include.
2	Technological communication competence	Draw product descriptions, read and understand parameter symbols, usage processes, and technology products in life
3	Technological use competence	Use technological equipment and products properly and effectively; not damaged; can handle some simple techniques for technological devices in life.
4	Technological evaluation competence	Comment on the use, durability of technology products and know how to choose the right product for their needs.
5	Technical design competence	Read drawings of simple technology products, design implementation steps, or describe model assembly steps.

3.1.4. Overview of research on technological competence and technological competences development for students

A number of previous studies have found that the increase in technological competence begins at the high school stage and continues to develop further in college and technological competence is the foundation for human development, including components: technological knowledge, technological skills, and technological attitudes/actions related to technology. This is the basis for further studies to analyze and clarify the structure of technological competences. Next, when discussing the role of students' technological competence, there has been a study on the correlation between learning competences in the 21st century and the technological education competences of high school students [7]. At the same time, technology education competences have made a significant contribution to the development of 21st century students' skills and sub-aspects of the 21st century learning skills scale such as active learning, learning how to learn, problem-solving, collaboration, and communication [5]. In another study, 82.2% of grade 8 students expressed a favorable attitude towards integrating technology into the education sector but still struggled to use technology tools (48%) and the internet to support learning (35%) [9]. Research has proven that the integration of educational technology into the teaching process has a significant impact on student learning outcomes. This study shows that the competence to communicate technology has an impact on students' learning process. Meanwhile, teachers' technological competence also needs to be improved to integrate technology into lesson plans to create an engaging learning experience and create interaction for students in the teaching process [30]. Other studies by multiple authors have also shown that technological competence has a positive relationship with the competence of educators in the 4.0 era [31]. Simultaneously, research also shows that after high school, students have an interest in science and technology, and the importance of science and technology also increases compared to other subjects as students make academic progress [32].

In Vietnam, students' technological competence is formed and developed through the content of technology education in the general education program, helping students work effectively in the technological environment at home, school and society [11], thereby contributing to career orientation for students, preparing the foundation for students to continue vocational training or participate in working life. This is also one of the necessary competences of high-quality human resources that society needs in the current development period. In addition, the Organisation for Economic Co-operation and Development (OECD) noted that the majority of Vietnam's workforce remains concentrated in the low- and medium-skilled groups, while the demand for highly skilled technical workers across various sectors continues to increase [33]. This suggests that education has not sufficiently emphasized practical training or maintained close alignment with industry needs, resulting in a mismatch between acquired skills and labor market requirements. In the face of the strong development of the 4.0 revolution, the role of technical and technological thinking is increasingly important, and concurrently a number of ways to develop scientific and technical thinking in high school such as through game activities, intellectual play for children, and through educational activities in Technology as well as activities to experience science, technology, and creativity [34].

Regarding teaching and developing technological competence for students, active teaching methods such as hands-on, project teaching, STEM education, and experiential learning were proposed to develop technological competence for students [35]. The process of evaluating students through the evaluation criteria for each technological competency and evaluating the process of creating products, the progress of students' cognition, and practical skills after each learning task [35]. The organization of action-oriented teaching in the subject has also helped develop technological competences and general competences for grade 6 students in Technology [36]. For the component competences of technological competence, one of the manifestations of technological competence, the application of group and project teaching methods in teaching will develop those technological competence components such as technological communication competence, and technical design competence. Whilst, the study also affirms the role of components of technological competence, including the important role of technological communication competence in the subject which needs to be focused when teaching [14].

The studies share the same opinion on the important role of technological competence and proposed solutions to develop general technological competence and component technological competences for students in the learning process through Technology or other technology education activities. Other studies are mainly on digital technology competence, with little or no research on technological competence in technological fields such as electrical engineering, mechanical engineering, and construction. To the best of our knowledge, no previous studies in Vietnam have investigated the technological competence of middle school students within the general education program. From the relevant research results, in order to better understand the research problem, this research conducted a survey to learn about the awareness and technological competence of middle school students through Technology in Ho Chi Minh City, a case study from which the overall assessment of the technological competence of students in this subject has been achieved.

3.2. Students' opinions when learning content in technology subjects

First, the authors conducted a survey of teachers and students about students' attitudes when participating in learning the content of the Technology curriculum. Quantitative data was synthesized for statistical analysis to answer research questions (using the Likert scale from 1=completely dislike to 5=completely liked) [15]. With the survey results, as shown in Table 5, teachers said that students liked to learn the content in the Technology curriculum with an average score of mean=4.03, SD=0.585, but students judged that the results were at a neutral level mean=3.39; SD=0.929, which shows that students still did not really feel interested in learning Technology content in high school. In particular, there were still a small number of students who did not participate in voting for this survey content. The results of the study depict that it is necessary to study methods or ways to create learning interest for students in this subject. For example, activities that engage students in applying subject knowledge to real-world problem solving or developing products through assigned tasks may benefit from the integration of STEM-based instruction, which has been shown to enhance students' interest in learning [27]. Next, to find out students' perceptions about the role of Technology, the research team developed a survey question, with orientations on the role of technological competence to continue surveying teachers and students, as shown in Table 5.

Table 5. Results of the survey on students' attitudes when learning the contents of the Technology curriculum

Respondents	N	Mean	Std. deviation	Variance
Teachers	33	4.03	0.585	0.343
Students (students who do not choose: 13)	1483	3.39	0.929	0.864

Table 6 describes 56.8% of students said that Technology helped students have four abilities such as the competence to present characteristics, uses and read and understand symbols on technology products used in real life, besides students could also choose devices or products to serve their individual needs and families as well as suggest ideas to improve those products. This statement of students is similar to that of teachers, accounting for 84.8% of teachers' survey results, saying that the content of Technology assisted students in having many different component technological competences. The survey results also express that the second most chosen content by students and teachers was the content in Technology that supported students to have at least 1 possibility of presenting the characteristics and uses of the product (student=13.1%; teacher=6.1%). The survey results reveal that both teachers and students identified the important role of subject program content towards forming and developing students' technological abilities. At the middle school level, the content of the Technology curriculum as presented is very diverse, in many different fields and professions, through teaching activities; this helps students form and develop certain technological competences in different fields and professions.

Table 6. Students' and teachers' assessment of the competences achieved through the content of Technology

Statistical items	Students		Teachers	
	Frequency	Percent (%)	Frequency	Percent (%)
N	1,496	100.0	33	100
No choice	32	2.2	0	0
1. Describe the characteristics and uses of products used in real life	196	13.1	2	6.1
2. Read and understand the technical symbols on the products.	120	8.0		
3. Selection of equipment and products. Serving personal and family needs	162	10.8	1	3
4. Propose ideas to improve products according to needs	42	2.8		
5. All possibilities in items 1, 2, 3, 4	850	56.8	28	84.8
6. Other possibilities	19	1.3		
7. Students/teachers' chose from 2 to 3 skills	75	5	2	6

3.3. Students' technological competences in Technology

Table 7 shows that the teacher thought that the student had a good level of technological competence in Technology, but the average value of the assessment result was also not really high, mean=3.84; SD=0.638, in which the competence to use technology products properly and effectively (or the competence to use technology) was evaluated by the teachers at the highest average score in the manifestations of component technological competence (mean=3.94; SD=0.609). Meanwhile, most students rated their technological abilities as normal, neutral, and not really good (mean=3.38; SD=0.836). Similarly, students also shared that they only had the competence to use technology products properly and effectively, which is at a good level mean=3.55; SD=0.913. The standard deviation had the 2nd highest value in the evaluation table, showing that the data dispersion was quite high compared to the rest of the component technological competence. The differences in the evaluation of technological competence between students and teachers may be attributable to differing assessment standards and expectations regarding students' technological competence.

Table 7. Assessing students' technological competences in technology

No.	Students' competences in Technology reflected in the descriptions	N		Mean	Std. deviation	Variance
1	Describe, recognize, and present the products.	Students	1,496	3.39	0.844	0.713
		Teachers	33	3.88	0.650	0.422
2	Draw and interpret technology products in life	Students	1,496	3.35	0.912	0.831
		Teachers	33	3.85	0.712	0.508
3	Use technology products properly and effectively	Students	1,496	3.55	0.913	0.834
		Teachers	33	3.94	0.609	0.371
4	Comment on the use, durability of technology products and know how to choose the right products for their needs	Students	1,496	3.40	0.897	0.805
		Teachers	33	3.70	0.728	0.530
5	Read drawings of simple technology products, design implementation steps, or describe model assembly steps	Students	1,496	3.36	0.948	0.899
		Teachers	33	3.76	0.792	0.627
6	The overall assessment of students' competence in Technology shown in the above descriptions	Students	1,496	3.38	0.836	0.700
		Teachers	31	3.84	0.638	0.406

Thus, in general, the technological competence of students in the subject of technology at the middle school level was not really good. The average evaluation score of this component technological competence was only at the level of mean=3.38, SD=0.836. This finding is consistent with the OECD's observation that Vietnam's workforce remains concentrated at a moderate competency level and has not yet fully met practical labor market demands. It is also consistent with Mori research [37], who identified a "skill mismatch" in Vietnam's manufacturing sector. Unlike previous studies reviewed in the literature, which focused only on specific dimensions of technological competence, the present study examined the full range of component competencies constituting students' technological competence.

In addition, the t-test results indicated a statistically significant difference between teachers and students in their evaluations of students' technological competence based on the mean of the component scales (p=0.001). This result was consistent with the analysis of the overall evaluation variable (p overall assessment=0.003), suggesting that the differences observed between the two groups were stable and reliable. This is consistent with principles in quantitative research, in which composite scales are generally considered more reliable than single indicators [19]. The consistency of these results strengthens the credibility of the findings and highlights the need for further examination of teaching and learning practices in order to propose appropriate measures for improving students' technological competence.

At the same time, the content described in Table 7 (from content 1 to 5) corresponded to the component competences of the students' technological competence. This research restructured the content and analyzed the results of determining the correlation between the component competences with each other,

showing that the competences were closely correlated and supported each other. The component competences in the technological competence structure were also closely correlated with the overall technological competence of students; the correlation coefficient (r) ranged from 0.584 to 0.642, as described in Table 8.

Table 8. Correlation between components of technological competence

Components of technological competence	Correlation statistics	Technological awareness competence	Technological communication competence	Technological use competence	Technological evaluation competence	Technical design competence	General assessment of students' competence in Technology
Technological awareness competence	Pearson correlation	1	0.582**	0.584**	0.609**	0.566**	0.642**
	Sig. (2-tailed)		0.000	0.000	0.000	0.000	0.000
Technological communication competence	Pearson correlation	0.582**	1	0.512**	0.546**	0.633**	0.602**
	Sig. (2-tailed)	0.000		0.000	0.000	0.000	0.000
Technological use competence	Pearson correlation	0.584**	0.512**	1	0.621**	0.540**	0.584**
	Sig. (2-tailed)	0.000	0.000		0.000	0.000	0.000
Technological evaluation competence	Pearson correlation	0.609**	0.546**	0.621**	1	0.582**	0.609**
	Sig. (2-tailed)	0.000	0.000	0.000		0.000	0.000
Technical design capabilities	Pearson correlation	0.566**	0.633**	0.540**	0.582**	1	0.625**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000		0.000
General assessment of students' competence in Technology	Pearson correlation	0.642**	0.602**	0.584**	0.609**	0.625**	1
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	

**. Correlation is significant at the 0.01 level (2-tailed).

To find out more about the technological competence of students, this study conducted interviews with teachers and randomly interviews about five students during the survey. The results display that there were also quite a number of comments from teachers that the technological competence of students was "not good", "at an average level", or teachers assessed students only at the level of "recognition and understanding". There was also a teacher's opinion that students could only perform simple activities, not proficient in activities such as designing and assembling technology products. These findings indicate that technical design competence may reflect the higher-order nature of this skill, which requires integration of multiple lower-level competencies.

Another observation noted by teachers was the uneven development of students' technological competence. While some students were able to apply their knowledge and demonstrate creativity in activities involving technological products, many others still faced difficulties in translating theoretical knowledge into practical activities. This coincided with self-assessment of students in Table 7.

Particularly for students, the research team randomly interviewed five students in grade 9 (the grade level preparing to complete the middle school education program) during the process of distributing the survey with the question "What abilities do you have after completing the Technology curriculum?". The result most of the students described was to recognize and use technological products in the family (rice cookers, electric fans, and blenders) and describe electrical appliances. However, it was still difficult for students to comment on the characteristics of technology products or read and understand technical parameters and simple technology drawings. Students also expressed a desire for more learning opportunities involving hands-on experiences and the creation of technological products. These qualitative findings help explain why technical design competence was rated lower than the other component competencies of technological competence. This suggests that higher-order component competencies of technological competence require more complex learning experiences, as well as greater opportunities for hands-on practice and real-world problem solving, than those provided through conventional knowledge acquisition and routine learning tasks. From a theoretical perspective, these findings reinforce the view that technological competence is a multi-component construct whose components do not develop uniformly through the same

instructional activities. This implies that the development of technological competence should be supported through learning activities that engage students in designing, testing, evaluating, and solving real-world problems. From a practical perspective, the findings highlight the importance of strengthening STEM education, project-based learning, and experiential learning activities to promote the comprehensive development of all component competencies of technological competence.

4. CONCLUSION

Technological competence is one of the specific competences that need to be focused on and developed for students in general education. Students with good technological competence not only contribute to their career orientation but also help them acquire the necessary skills to meet the requirements of the profession when participating in the labor market in the future. Research found that students did not really enjoy learning Technology. However, students were aware that Technology in the program helped them from many different technological competences (including at least 1 competence).

The study represents one of the few studies examining technological competence at the middle school level in Vietnam, thereby contributing to the limited empirical evidence available in this field. The results show that the technological competence of students was not really good, only at an average level. They also had difficulties in practicing learning tasks to achieve a higher level of technological competency such as product evaluation or basic design practices. The findings suggest that students may have limited opportunities to engage in practical activities or apply acquired knowledge in real-world contexts to develop their technological competence, particularly higher-order competencies such as evaluative competence and engineering design competence. The findings provide an important basis for designing instructional approaches, such as the integration of STEM-based lessons and project-based learning, to create more opportunities for students to practice, gain hands-on experience, and apply knowledge to solving real-world problems, thereby supporting the development of students' technological competence.

This study also has several limitations that should be considered. First, the data were collected only in Ho Chi Minh City; therefore, caution should be exercised when generalizing the findings to other contexts. Second, the number of teachers and students participating in the interviews was relatively limited because only a small number of teachers teach this subject in each school. Third, this study has not yet had the opportunity to comprehensively assess all the factors affecting the formation and development of students' technological competence in the Technology subject. Despite these limitations, the research findings serve as a foundation for identifying practical solutions for organizing teaching and learning activities that are suitable for students and the subject curriculum to further develop the technological competence of middle school students in Vietnam. The article also hopes that more scientists will continue to research on orientations and solutions to develop students' technological competence based on these findings.

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Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Cao Thi Thuy Diem	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Bui Van Hong	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors claim there is no conflict of interest.

INFORMED CONSENT

The authors obtained the consent of all individuals involved in this study.

ETHICAL APPROVAL

The research involving the use of human resources complied with all national regulations and organizational policies in accordance with the principles of the Helsinki Declaration and was accepted by the authoring organization conducting the research.

DATA AVAILABILITY

The data of this study may be provided by the authors if there is a reasonable request.

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BIOGRAPHIES OF AUTHORS



Cao Thi Thuy Diem is currently a Ph.D. candidate at Ho Chi Minh City University of Technology and Engineering. She also teaches in-service training courses for general education teachers to improve their competence and skills. She has served as a member or scientific secretary of science and technology research projects funded by the Ministry of Education and Training, including projects that have been completed and those currently being implemented. Her main research areas include teaching and learning theory, teaching methods for developing learners' competence, STEM education, educational management, vocational education, and educational science. She can be contacted at email: diemctt.ncs@hcmute.edu.vn; caothuydiem@gmail.com.



Bui Van Hong is working at Ho Chi Minh City University of Technology and Engineering (HCM-UTE), Viet Nam, as a lecturer and researcher. He is a (co-)author of many journal papers and publications in both local and international conference proceedings. He has had teaching experience for many years. He has organized and managed many projects to improve the teaching quality at various levels, from primary to high school, and higher education. He is also the chair of the committee of many thesis defense sessions. His areas of interest include the application of the STEM approach, project-based learning, blended learning, and vocational education. He can be contacted at email: hongbv@hcmute.edu.vn.