Journal of Education and Teaching Learning (JETL)
Volume 7, Issue 2, May 2025
Journal Homepage:
http://pusdikra-publishing.com/index.php/jetl

The Impact of Scientific Research Activities on the Development of Soft Skills Among University Students in Vietnam

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ARTICLE INFO
Article history:
Received
16 April 2025
Revised
19 April 2025
Accepted
20 April 2025

ABSTRACT

This study focuses on analyzing the impact of scientific research activities on the development of soft skills among university students in Vietnam, with particular emphasis on communication, teamwork, problem-solving, and critical thinking skills. A mixed-methods approach was employed, combining a quantitative survey of 480 students with in-depth interviews involving 20 students who had participated in scientific research, as well as 50 faculty members and administrative staff from various universities. Quantitative data were processed using SPSS software, while qualitative data were analyzed through content analysis. The findings indicate a clearly positive effect of engaging in scientific research on students' soft skills development: 78% of students reported significant improvement in communication skills; 72% enhanced their teamwork abilities; 69% demonstrated better problem-solving capacity; and 65% reported more logical and refined critical thinking. Based on these results, the study proposes several strategic directions to strengthen the integration of research activities into higher education curricula. These include expanding opportunities for students to participate in interdisciplinary research projects, developing digital platforms to support student-initiated research, and implementing structured mentoring programs between faculty and students. These initiatives are expected to contribute to the enhancement of human resource quality in the context of global integration.

Key Word *Scientific Research, Soft Skills, University Students, Skill Development, Higher Education.*

How to cite https://pusdikra-publishing.com/index.php/jetl

Doi 10.51178/jetl.v7i2.2420

INTRODUCTION

Scientific research activities (SRA) play a vital role in enhancing both students' academic knowledge and soft skills. Through participation in research projects, students not only expand their knowledge base but also cultivate essential skills such as teamwork, time management, effective communication, and critical thinking (Jenkins, T. , 2009). According to Seber (Seber, G. A., 2007),

research collaboration significantly improves students' ability to work in teams and solve problems efficiently.

Numerous studies have highlighted the positive impact of scientific research on students' soft-skill development. Research from Kennesaw State University (Kennesaw State University, 2016) found that involvement in research projects enhances students' communication, leadership, and teamwork skills. Similarly, Crede & Kuncel (Crede, M., & Kuncel, N. R. , 2008) emphasized that communication and problem-solving skills improve significantly when students engage in scientific research. Additionally, Lopatto (Lopatto, D. , 2004; Lopatto, D. , 2007) demonstrated that research activities not only enhance academic knowledge but also foster critical thinking, problem-solving abilities, and effective communication.

Russell, Hancock, and McCullough (Russell *et el.* , 2007) found that students involved in research projects had higher graduation rates and greater career success. Say Wah Lee et al. (Say Wah Lee, *et al.* , 2024) analyzed the development of university students' soft skills, particularly problem-solving and social competence, and proposed curriculum reforms integrating practical activities to enhance these skills. Likewise, John Smith et al. (John Smith *et al*. 2023) conducted a systematic review of the role of soft skills in IT education, affirming that competencies such as communication, teamwork, and problem-solving are as crucial as technical skills.

Emily Johnson et al. (Emily Johnson *et al.* , 2023) examined students' practice and application of soft skills in academic settings, revealing that many students are unaware of the significance of these skills, leading to inefficiencies in their development. Michael Brown et al. (Michael Brown *et al.* , 2022) suggested incorporating soft skills training into education curricula to equip students with essential competencies for their future careers. Additionally, the study by Abrami et al. (Abrami *et al.* , 2015) on students' critical thinking also indicates that engaging in research helps students enhance their analytical and problem-solving skills.

In Vietnam, Nguyen Minh Tuan (Nguyen Minh Tuan, 2018) investigated the impact of SRA on students' communication and teamwork skills at universities in Hanoi, demonstrating that students who participated in research exhibited significantly better communication and teamwork abilities. Nguyen Van Quy (Nguyen Van Quy, 2019) confirmed that SRA contributes to the development of leadership, teamwork, and problem-solving skills.

Furthermore, research by Nguyen Thi D et al. (Nguyen Thi D *et al.* , 2020) analyzed the influence of soft skills on students' academic performance, emphasizing the importance of time management, communication, and

teamwork skills. Similarly, Tran Thi B et al. (Tran Thi B et al. , 2021) found that students with well-developed soft skills have better job opportunities after graduation.

Scientific research activities not only enhance students' academic knowledge but also play a crucial role in developing essential soft skills for both academic success and future careers. However, the specific impact of research engagement on the development of soft skills among university students in Vietnam has yet to be systematically clarified. Additionally, there remains a lack of practical and appropriate solutions to effectively support students in cultivating and strengthening these skills through research activities. In this context, the present paper focuses on analyzing the relationship between scientific research participation and soft skill development among Vietnamese university students, while also proposing strategic solutions to optimize the role of research in fostering students' comprehensive competencies.

RESEARCH METHOD

This study utilizes a mixed-methods approach, combining both quantitative and qualitative techniques to assess the impact of scientific research on soft skills development among university students in Vietnam. The quantitative phase involved a survey of 480 students from various universities, including both those who had participated in research and those who had not. A stratified random sampling method ensured representation from different geographic regions (North, Central, and South), institutional types (public and non-public), and academic disciplines. The survey used a 5-point Likert (ranging from 1: Very Poor to 5: Very Good) scale to measure students' perceptions of their soft skills improvement. In the qualitative phase, in-depth interviews were conducted with 20 students involved in research and 50 faculty members and administrators from various institutions. These interviews aimed to explore how research activities contribute to soft skills development. The quantitative data were analyzed using SPSS for both descriptive and inferential statistics, while qualitative data were coded and analyzed through content analysis to identify key themes and patterns.

RESULT AND DISCUSSION

Result

Scientific research activities not only contribute to the enhancement of students' academic knowledge but also play a significant role in the development of essential soft skills, thereby equipping them with the necessary competencies for academic success and future careers. Based on data collected through

quantitative surveys and in-depth interviews, this study analyzes the improvement of key soft skill groups before and after students' participation in research activities. Specifically, communication skills were enhanced through the practice of presenting, academic discussion, and coherent expression of ideas; teamwork skills improved through collaboration, task sharing, and conflict resolution during project implementation; problem-solving abilities were strengthened via problem identification, data analysis, and decision-making processes; while critical thinking was reinforced through literature evaluation, formulation of research questions, and the ability to assess the reliability of information sources. The findings of this study help clarify the positive impact of research participation on each soft skill domain, thereby providing a foundation for strategic recommendations to effectively integrate soft skill development into higher education through scientific research activities.

Communication Skills

Communication skills play a crucial role in enhancing students' academic and professional effectiveness. Particularly in scientific research activities, communication proficiency influences not only presentation and persuasion but also teamwork, knowledge acquisition, and feedback processing. Engaging in research projects significantly improves students' communication skills in both academic and professional settings.

To evaluate changes in students' communication skills before and after engaging in scientific research, we surveyed with specific questions covering areas such as presentation and confidence in communication, communication within research teams and explaining results, communication through digital platforms, use of body language and constructive feedback, maintaining conversations, and adapting communication styles. Additionally, focus group discussions with students, faculty members, and administrators were conducted to gather qualitative insights. The survey results are presented in Table 1.

Table 1 .
Survey Results on Students' Communication Skills Before and After Engaging in Scientific Research

SN	Question	Mean Score Before Research	Mean Score After Research	Difference
1.1	I feel confident presenting ideas in group discussions or presentations.	3.2	4.5	+1.3
1.2	I can express my opinions confidently without feeling anxious.	3.0	4.3	+1.3

SN	Question	Mean Score Before Research	Mean Score After Research	Difference
1.3	When participating in research groups, I can explain research findings clearly.	3.1	4.2	+1.1
1.4	I can effectively convey information through different communication platforms (emails, video conferences, etc.).	3.5	4.4	+0.9
1.5	I can use body language effectively in communication.	3.4	4.6	+1.2
1.6	I am open to receiving and providing constructive feedback.	3.7	4.7	+1.0
1.7	I feel comfortable communicating with faculty and peers in academic settings.	3.0	4.3	+1.3
1.8	I can maintain conversations in both social and academic communication contexts.	3.3	4.5	+1.2
1.9	I frequently adjust my communication style to suit different audiences and situations.	3.2	4.4	+1.2

Before engaging in research, students' average scores for various communication aspects ranged from 3.0 to 3.7 but significantly increased to 4.2–4.7 after research participation. Faculty noted that research activities help train presentation skills, idea articulation, use of communication technology, body language, and adaptability to different communication styles. One student mentioned gaining more confidence in writing professional emails and participating in online meetings.

The survey results show that research participation significantly improves students' communication skills, both verbal and non-verbal, as well as digital. These findings confirm the crucial role of research in developing students' soft skills, enabling them to communicate more effectively in academic and professional environments.

Teamwork skills

Teamwork skills play a crucial role in scientific research, enabling students to collaborate effectively to achieve common objectives. The research process requires a rational allocation of tasks, shared responsibility, and mutual support

to optimize overall performance. Additionally, students must learn to resolve conflicts and maintain positive relationships within their teams to ensure cohesion and sustainable collaboration. Contributing creative ideas and fostering a collaborative spirit help sustain team motivation and facilitate the development of innovative solutions. Furthermore, team support plays a vital role in encouraging individuals to feel motivated and willing to contribute.

To assess changes in students' teamwork skills before and after participating in scientific research, we conducted a survey based on these criteria. The results are presented in Table 2, along with a detailed analysis derived from students' feedback, faculty evaluations, and administrative perspectives.

Table 2.
Survey Results on Students' Teamwork Skills Before and After Engaging in Scientific Research

SN	Question	Mean Score Before Research	Mean Score After Research	Difference
2.1	I can effectively collaborate with team members in research projects.	3.6	4.3	+0.7
2.2	I take the initiative in sharing tasks and information within the team.	3.4	4.0	+0.6
2.3	I feel comfortable working in a team with individuals who have different viewpoints and work styles.	3.3	4.0	+0.7
2.4	When conflicts arise, I strive to find a harmonious solution and maintain good relationships within the team.	3.8	4.5	+0.7
2.5	I know how to listen and respect the opinions of others in the team.	3.7	4.2	+0.5
2.6	I actively contribute ideas to help the team complete tasks more effectively.	3.9	4.6	+0.7
2.7	I am willing to assist team members when they face difficulties in group tasks.	4.0	4.6	+0.6
2.8	I can motivate my team and help achieve collective goals.	3.8	4.5	+0.7

Survey results reveal significant improvements in students' teamwork skills after participating in scientific research. Task coordination scores (Questions 2.1–2.3) rose from an average of 3.3–3.6 to 4.0–4.3, indicating better communication

and efficiency in role allocation. Students reported becoming more proactive, with one noting, "*Research taught me to collaborate effectively and delegate tasks.*" Faculty also observed enhanced adaptability in complex situations.

Conflict resolution and idea contribution saw notable progress, with scores (Questions 2.4–2.6) increasing from 3.7–3.9 to 4.2–4.6. Students learned to navigate disagreements while maintaining team harmony, with one stating, "*I now resolve conflicts without damaging relationships.*" Additionally, they grew more confident in sharing ideas, as faculty highlighted their increased engagement in discussions.

Team spirit and peer support improved substantially, with scores (Questions 2.7–2.8) rising from 3.8–4.0 to 4.5–4.6. Administrators noted stronger camaraderie, with students actively supporting peers. Overall, research participation bolstered by faculty guidance developed critical teamwork skills, preparing students for future academic and professional success.

Problem-Solving Skills

Problem-solving skills play a crucial role in enhancing students' academic and research capacities in a university environment. Particularly in scientific research activities, students frequently encounter challenges that require the ability to identify problems and propose appropriate solutions. This process not only demands keen insight in recognizing root causes but also necessitates the ability to suggest feasible solutions. Furthermore, analyzing, making decisions, and evaluating solutions are essential components of students' critical thinking when engaging in research. They must consider multiple factors, assess risks, and select the optimal approach based on empirical data and scientific reasoning.

Moreover, scientific research cultivates adaptability and the ability to work under pressure. Students need to be flexible in adjusting their methods when encountering obstacles while maintaining perseverance to complete their research on schedule. To evaluate the changes in students' problem-solving skills before and after participating in scientific research, we surveyed with specific questions assessing their abilities in problem identification, solution development, analysis, evaluation, adaptability, and working in high-pressure environments. The survey results are presented in Table 3.

Table 3.
Survey Results on Students' Problem-Solving Skills Before and After Participating in Scientific Research

SN	Question	Mean Score	Mean Score	Difference

		Before Research	After Research	
3.1	I can quickly and accurately identify and clarify research problems.	3.6	4.4	+0.8
3.2	I can propose creative solutions to problems in a research group.	3.7	4.3	+0.6
3.3	When faced with research problems, I can develop practical and feasible solutions.	3.8	4.5	+0.7
3.4	I can adjust my research plan when encountering difficulties or changes in requirements.	3.5	4.2	+0.7
3.5	I know how to analyze relevant factors and make rational decisions to solve problems.	3.9	4.6	+0.7
3.6	I can work under pressure to solve problems within a short time frame.	3.8	4.5	+0.7
3.7	I can detect and resolve problems during data collection and analysis.	3.7	4.4	+0.7
3.8	I can address research problems in a logical and scientifically grounded manner.	3.6	4.3	+0.7
3.9	I always evaluate the effectiveness of solutions before implementation.	3.8	4.5	+0.7
3.10	I can make problem-solving decisions even when information is incomplete.	3.7	4.4	+0.7

Survey results demonstrate significant improvements in students' problem-solving abilities after participating in scientific research. Problem identification skills (Question 3.1) improved from 3.6 to 4.4, while solution development (Questions 3.2–3.3) rose from 3.7–3.8 to 4.3–4.5. Students reported transitioning from intuitive approaches to analytical thinking, with one noting, "*Research taught me to clarify issues systematically.*" Faculty observed more logical, real-world applicable solution proposals.

Analytical and decision-making skills showed marked progress, with scores (Questions 3.5, 3.8–3.9) increasing from 3.7–3.9 to 4.3–4.6. Students shifted from intuition-based to evidence-based decisions, as one shared, "*I now use data to evaluate options.*" Faculty noted deeper risk analysis and flexibility in uncertain scenarios, with administrators emphasizing these skills' workplace relevance.

Adaptability and pressure management also improved, with scores (Questions 3.4, 3.6–3.7) rising from 3.5–3.8 to 4.2–4.5. Students reported better stress resilience, with one stating, "*I've learned to adapt when plans change.*" Faculty highlighted enhanced time management and crisis-resolution skills, underscoring research's role in preparing students for dynamic professional environments.

Critical Thinking Skills

Critical thinking skills are fundamental in enhancing students' scientific research quality and logical problem-solving abilities. Throughout the research process, students cultivate their ability to analyze issues, identify root causes, and propose appropriate solutions. They also learn to evaluate information from multiple perspectives, avoiding biased thinking and approaching problems objectively. More importantly, students develop the habit of demanding clear evidence and distinguishing reliable information from sources lacking scientific credibility. To assess the changes in critical thinking before and after engaging in scientific research, we surveyed with specific criteria. The results are presented in Table 4.

Table 4.
Survey Results on Students' Critical Thinking Skills Before and After Engaging in Scientific Research

SN	Question	Mean Score Before Research	Mean Score After Research	Difference
4.1	I can analyze issues in depth and identify root causes.	3.2	4.5	+1.3
4.2	I alwaYs evaluate information from multiple perspectives before drawing conclusions.	3.5	4.3	+0.8
4.3	I know how to formulate systematic questions to clarify research problems.	3.1	4.3	+1.2
4.4	I can identify weaknesses in a theory or research method.	3.3	4.4	+1.1
4.5	I always require concrete evidence to support viewpoints or theories.	3.6	4.7	+1.1
4.6	I can differentiate between reliable and scientifically unsupported information.	3.4	4.6	+1.2
4.7	I can identify flaws in scientific reasoning.	3.2	4.5	+1.3

4.8	I seek and consider opposing viewpoints before making decisions.	3.5	4.4	+0.9
4.9	I can propose hypotheses or alternative solutions to address problems.	3.3	4.6	+1.3
4.10	I frequently question and challenge assumptions in research.	3.0	4.5	+1.5

Scientific research participation significantly enhanced students' critical thinking abilities across multiple dimensions. Root cause analysis skills (Question 4.1) improved from 3.2 to 4.5, as students shifted from superficial observation to systematic problem deconstruction. Similarly, multi-perspective evaluation (Question 4.2) rose from 3.5 to 4.3, with students moving beyond confirmation bias to actively consider opposing viewpoints. Faculty noted this transformation, with one student remarking, "*Research taught me to value counterarguments for stronger reasoning.*"

The development of systematic questioning showed particularly strong gains, with question formulation (Question 4.3) improving from 3.1 to 4.3 and assumption-challenging (Question 4.10) jumping from 3.0 to 4.5. Students transitioned from passive learning to active inquiry, as faculty observed their increased ability to "*pose essential questions and systematically seek answers.*" Evidence evaluation skills demonstrated the most dramatic progress, with source reliability assessment (Question 4.6) increasing from 3.4 to 4.6, reflecting new habits of cross-referencing and rigorous verification.

These comprehensive improvements highlight research's role in fostering academic rigor. Students developed stronger analytical frameworks, evidence-based reasoning, and healthy skepticism - moving from uncritical acceptance of sources to thorough scrutiny. Faculty confirmed these behavioral changes, underscoring how research participation cultivates essential critical thinking skills for academic and professional success. The findings demonstrate research's unique capacity to transform cognitive approaches beyond traditional classroom learning.

DISCUSSION

Soft skills play a crucial role in the holistic development of university students. They not only enable students to adapt effectively to academic and

professional environments but also contribute to enhancing individual capacities and increasing competitiveness in an increasingly demanding labor market. Based on the analysis of survey and interview data, this study reveals that students demonstrated significant improvement in key soft skill domains—namely, communication, teamwork, problem-solving, and critical thinking—after participating in scientific research activities. These advancements highlight the positive influence of research engagement in shaping and developing students' comprehensive competencies. However, to optimize the impact of research activities on soft skill development, it is necessary to implement specific, systematic, and context-sensitive solutions tailored to the characteristics of each academic institution. Accordingly, this study proposes several strategic approaches to effectively integrate soft skill training into the design and implementation of student research programs.

Implementing Interdisciplinary Research

Objective:

To help students expand their perspectives, improve communication skills, and collaborate with different professional groups, thereby developing multidimensional problem-solving abilities.

Content:

Interdisciplinary research integrates different fields of science to address a common issue. Participating in interdisciplinary research allows students to learn from various disciplines, fostering cooperation and creative thinking.

Implementation methods:

Promoting interdisciplinary scientific research activities is one of the key solutions to enhance the effectiveness of soft skill development for students. First, it is essential to organize interdisciplinary research groups involving students from various faculties, providing them with opportunities to develop teamwork, professional communication, and problem-solving skills in a multi-disciplinary context. For example, a research project on air pollution could include students from environmental science (analyzing air quality), medicine (assessing health impacts), and information technology (developing forecasting models). In addition, organizing interdisciplinary scientific workshops would create an academic forum where students can present their research findings and receive feedback from experts in various fields, thereby improving their critical thinking and presentation skills. Finally, institutional support, such as encouraging students to register for interdisciplinary research topics and providing necessary funding and research resources, plays a crucial role in realizing and sustaining these integrated academic activities.

Implementation conditions:

The development of interdisciplinary research topics requires close collaboration between departments and institutes within the university to fully utilize existing expertise and resources. To facilitate this, the university needs to provide support in terms of funding, infrastructure, and mechanisms that encourage student participation, thus creating favorable conditions for research implementation. Additionally, having a diverse team of faculty members with various areas of expertise is essential to ensure the quality of interdisciplinary research topics. These faculty members should be willing to actively participate in and offer in-depth guidance, not only in their own fields of expertise but also in integrating knowledge from different disciplines, thereby contributing to the comprehensive development of students' research capabilities.

Developing Digital Platforms to Support Scientific Research

Objective:

To enhance students' technological proficiency, information management, and research efficiency while improving their online communication and teamwork skills.

Content:

Digital technology facilitates access to extensive resources, efficient scientific data management, and effective remote collaboration. Digital platforms also support students in presenting, sharing, and analyzing research data professionally.

Implementation methods:

Integrating technology into research activities is a crucial strategy to enhance students' research competencies and align their skills with the demands of contemporary academic and professional contexts. Universities should prioritize training students in the use of essential software tools, including Mendeley and Zotero for reference management, SPSS, R, and Python for data analysis, as well as collaborative platforms such as Microsoft Teams, Slack, and Zoom for virtual teamwork. These tools enable students to manage data efficiently, collaborate effectively, and develop strong digital research capabilities. In addition, the development of internal digital platforms—such as research management systems—can support document storage, facilitate the sharing of research findings, and provide a structured mechanism for faculty feedback. To further strengthen digital proficiency, universities should organize specialized training programs focused on Big Data and Artificial Intelligence (AI) applications in research. For instance, a student group studying sustainable consumer behavior could collect social media data through Big Data analytics, analyze it using statistical software, and share their results online to obtain instructor feedback. This integrated approach not only enhances students'

technological skills but also equips them to conduct innovative, data-driven research in a digitally connected environment.

Implementation conditions*:*

To effectively integrate technology into research, universities must prioritize investing in robust technological infrastructure, including servers, research-support software, and internal digital platforms. These investments provide the necessary foundation for students to engage in research activities efficiently and effectively. Additionally, a dedicated technical support team should be readily available to assist students in accessing and utilizing digital tools, ensuring that students can overcome any technical challenges they may encounter during their research processes. This support helps foster a seamless research experience and ensures that students can fully utilize the technological resources at their disposal. Furthermore, universities must provide fundamental digital literacy training to students, equipping them with the essential skills to navigate and maximize the use of technological platforms in research. By offering such training, universities can enhance students' confidence and competence in using digital tools, thereby improving their research capabilities and preparing them for the demands of the modern research landscape. This comprehensive approach to technology infrastructure, support, and training is essential for empowering students to succeed in a digitally-driven academic environment.

Establishing a Mentorship Program Between Students and Faculty/Researchers

Objective:

To enhance students' professional communication, critical thinking, and career orientation through mentorship from experienced researchers and faculty members.

Content:

Mentorship programs connect students with faculty members or researchers, enabling them to gain practical experience, improve scientific reasoning, critique arguments, and develop academic thinking skills.

Implementation methods:

To strengthen students’ research competencies, universities should develop comprehensive mentorship frameworks that actively link students with faculty members and researchers. Each student or research team should be assigned a faculty mentor responsible for providing structured guidance on research methodologies, data analysis, and academic writing. This mentoring relationship

plays a pivotal role in equipping students with the skills necessary to conduct rigorous and methodologically sound research. Beyond individualized support, institutions should also facilitate regular mentorship sessions where students present research progress, receive expert feedback, and enhance their critical thinking and analytical abilities. In parallel, implementing peer mentorship models—by pairing senior students with first-year counterparts—can further promote collaborative learning and experience-based knowledge sharing. A notable example is the "Young Research Mentorship Program" at Vietnam National University, which has successfully connected students with emerging researchers. This initiative not only improved research capabilities but also advanced students' academic communication, presentation, and teamwork skills.

Implementation conditions:

Strong collaboration between faculty members and students is essential for the success of mentorship programs, as it ensures active faculty engagement in guiding students through their research journey. To facilitate this collaboration, institutional policies should be established to encourage faculty participation in student mentorship. These policies can include incentive mechanisms such as bonus points, financial support, or recognition, which serve to motivate faculty members to dedicate time and effort to mentoring students. In turn, these incentives can help foster a culture of mentorship within academic institutions. Equally important is the active participation of students in these mentorship programs. By fully engaging with their mentors, students can maximize the benefits of the guidance and support offered. This active participation enhances students' learning experiences, helping them refine their research skills, critical thinking, and academic writing. Ultimately, a well-structured mentorship system, supported by institutional policies and student engagement, contributes to the development of competent researchers and fosters a collaborative academic environment that benefits both faculty and students.

CONCLUSION

Scientific research activities hold a pivotal role in fostering the comprehensive development of soft skills among university students in Vietnam. Prior to participation in such activities, many students exhibit limitations in core competencies such as communication, teamwork, problem-solving, and critical thinking. However, engagement in the research process has been shown to substantially enhance these skills. To optimize the developmental impact of research on students' soft skills, three strategic approaches should be prioritized. First, the promotion of interdisciplinary research encourages broader intellectual

perspectives and strengthens the ability to collaborate across diverse academic domains. Second, the development of digital platforms facilitates more efficient research workflows and enhances students' proficiency in online collaboration. Third, the establishment of structured mentorship programs connecting students with faculty members or experienced researchers provides essential guidance in research methodology and supports academic skill development. Beyond disciplinary knowledge acquisition, scientific research serves as a dynamic vehicle for cultivating transferable skills necessary for professional success. Nonetheless, students may face several barriers throughout their research engagement, including limited time, insufficient practical experience, and restricted access to academic resources or expert consultation. If not effectively addressed, these challenges may diminish the potential benefits of research activities in promoting soft skill growth. This research was supported by the Thai Nguyen University of Technology, Viet Nam, under grant number T2023-B12.

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