

Enhancing Research Competence of University Students in the Context of Industry 4.0

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ABSTRACT: This study aims to investigate the current research competence of university students in Vietnam and explore factors affecting their development within the context of Industry 4.0. A total of 320 undergraduate students and 12 academic staff members from four universities participated in the study. Data were collected through a structured questionnaire for students and semi-structured interviews with lecturers and advisors. A mixed-methods approach was employed, combining quantitative analysis of survey responses using SPSS and qualitative thematic analysis of interview transcripts. The findings reveal that students possess a moderate level of research competence, with strengths in academic writing but weaknesses in data analysis and digital tool usage. Additionally, disparities in digital literacy across disciplines and insufficient institutional support were identified as major challenges. The study underscores the need for early integration of research training, enhanced mentorship, and systematic incorporation of digital technologies to better prepare students for research demands in the digital era.

KEYWORDS: research competence, university students, Industry 4.0, higher education, pedagogical innovation.

1. INTRODUCTION

In the context of the rapid global transformation driven by the Fourth Industrial Revolution (Industry 4.0), higher education is no longer limited to the transmission of knowledge. It must also equip learners with the capacity for self-directed learning, independent research, and adaptability to an ever-changing society and labor market (Nguyen Van Hoa, 2020). Among the core competencies required of university students today, research competence stands out as essential—it involves the ability to identify problems, formulate hypotheses, collect and process information, analyze data, and present scientific results in a logical and convincing manner (Nguyen Thi Thu & Tran Minh Duc, 2021).

However, many Vietnamese students still face considerable challenges in accessing and engaging in academic research. These limitations stem from various factors, including theory-heavy teaching methods, a lack of dynamic academic environments, limited technological skills, and insufficient integration between theoretical learning and practical application (Tran Quang Huy, 2019).

In the digital era, research competence is not only a tool for academic success but also a key to thriving in the knowledge-based society, where information changes rapidly and innovation becomes a core value (World Economic Forum, 2020). Integrating Industry 4.0 technologies into teaching and research is not merely a trend—it is a practical and effective solution that empowers students to develop independent, creative academic thinking (Pham & Nguyen, 2022).

Based on the aforementioned context, this paper aims to clarify the role and current state of university students' research competence, and to propose solutions for enhancing this competence in the context of digital transformation and higher education reform.

2. LITERATURE REVIEW

2.1. Research Competence in Higher Education

Research competence is widely regarded as a core academic skill essential for university students, particularly in the context of knowledge-based societies. According to Tynjälä (2008), research competence encompasses the ability to ask relevant questions, design appropriate methodologies, collect and analyze data, interpret results, and communicate findings effectively. Nguyen Thi Thu and Tran Minh Duc (2021) emphasize that research competence also includes critical thinking, creativity, and the ethical use of scientific information.

In the Vietnamese context, research competence among students is still developing. Many students struggle with research design, data analysis, and academic writing due to insufficient training and limited exposure to research activities during their

Enhancing Research Competence of University Students in the Context of Industry 4.0

undergraduate studies (Tran Quang Huy, 2019). The development of research competence is not only a matter of individual skill-building but also depends on institutional support and the integration of research into the curriculum.

2.2. Industry 4.0 and Its Impact on Higher Education

The Fourth Industrial Revolution, characterized by advances in artificial intelligence, big data, cloud computing, and the Internet of Things, has significantly transformed education systems worldwide (Schwab, 2016). In higher education, Industry 4.0 technologies provide new opportunities for student learning and academic research. Platforms such as online learning management systems (LMS), academic databases, reference management software (e.g., Mendeley, Zotero), and AI-powered tools (e.g., ChatGPT, Grammarly) offer students easier access to information, enhanced research efficiency, and more personalized support (Pham & Nguyen, 2022).

These technologies also redefine the skills students need to succeed. The World Economic Forum (2020) lists analytical thinking, innovation, and complex problem-solving as top future skills—all of which are nurtured through research engagement. Thus, equipping students with research competence aligned with digital tools is essential in preparing them for the demands of the Industry 4.0 era.

2.3. Pedagogical Approaches to Enhancing Research Competence

Various pedagogical models have been proposed to foster research competence in higher education. One widely supported approach is inquiry-based learning, which engages students in exploring real-world problems and developing research skills through active investigation (Healey & Jenkins, 2009). Project-based learning (PBL) and problem-based learning (PBL) are also effective in enhancing research abilities by immersing students in collaborative, interdisciplinary research tasks.

Moreover, the integration of research into undergraduate curricula—sometimes referred to as "research-based learning"—has proven to positively influence students' academic performance, motivation, and self-efficacy (Brew, 2013). However, the effectiveness of these approaches depends on several factors, including faculty support, institutional policies, technological infrastructure, and students' attitudes toward research (Nguyen Van Hoa, 2020).

3. METHODOLOGY

This study employed a mixed-methods research design, combining both quantitative and qualitative approaches to provide a comprehensive understanding of the current state of university students' research competence and the factors influencing its development in the context of Industry 4.0. The participants consisted of 320 undergraduate students from four major universities in Vietnam. In addition, 12 lecturers and academic advisors with experience in guiding student research were selected for in-depth interviews. Participants were selected through purposive sampling, ensuring representation from universities with varying levels of digital infrastructure and student research engagement.

In this study, a structured questionnaire was developed to assess students' self-perceived research competence, exposure to research activities, use of technology in research, and challenges faced. The questionnaire included both closed-ended (Likert-scale) and open-ended items. Also, conducted with selected faculty members and academic advisors to gather insights into institutional support mechanisms, challenges in supervising student research, and the impact of Industry 4.0 technologies on research training.

4. FINDINGS AND DISCUSSION

4.1. Students' Self-Assessment of Research Competence

A total of 320 valid responses were collected from undergraduate students. Based on a 5-point Likert scale (1 = Very Poor, 5 = Excellent), the overall mean score for students' self-assessed research competence was 3.01 (SD = 0.72), indicating a moderate level of competence.

Table 1. Self-Assessment of Research Competence by Components

Research Competence Component	Mean	SD	Level
Formulating research questions	2.85		
Conducting literature review	3.12		
Applying research methods	2.91		
Analyzing and interpreting data	2.76		
Academic writing and presentation	3.40		
Using digital tools in research	2.98		
Overall	3.01		

As shown in Table 1, the highest mean score was in academic writing and presentation (M = 3.40), suggesting that students are more confident in presenting findings than in designing or analyzing research. The lowest competence was found in data analysis

Enhancing Research Competence of University Students in the Context of Industry 4.0

and interpretation ($M = 2.76$), which aligns with prior findings by Tran Quang Huy (2019), who noted that students often lack quantitative reasoning skills.

4.2. Use of Digital Tools in Research

Only 37% of students reported regularly using academic software or digital platforms (e.g., Google Scholar, Mendeley, SPSS). Students from technology-related majors showed higher usage rates (52%) compared to those in social sciences (28%). Furthermore, most students (61%) reported using AI tools like ChatGPT mainly for idea generation or grammar checking, but only 18% used them for literature support or research framing.

Table 2. Frequency of Digital Tool Usage by Discipline

Discipline	Regular Users (%)	Occasional Users (%)	Non-users (%)
Education	34	50	16
Social Sciences	28	49	23
Engineering	52	41	7
Business	39	44	17

These findings suggest a **discipline gap** in digital research literacy, supporting previous studies (Pham & Nguyen, 2022) that highlight unequal digital readiness among students.

4.3. Challenges in Developing Research Competence

From both survey and interview data, the following challenges were identified as follows:

In term of Lack of guidance, 72% of students agreed that they received limited mentoring during research activities. Regarding Insufficient training, 68% reported not receiving formal instruction in research methodology until their third or fourth year. With regard to technology-related barriers, 55% lacked training in research software/tools. With reference to language proficiency, Especially for students using English literature, 47% indicated difficulty understanding academic texts.

Lecturers also noted that institutional research culture remains weak: “Students are often assigned research tasks but are not taught how to think like researchers,” said one senior lecturer at University X.

4.4. Comparison with Previous Research

Compared with the findings of Nguyen Thi Thu and Tran Minh Duc (2021), who observed low engagement and confidence in research among undergraduates, this study shows slight improvements in some components (e.g., literature review and academic writing). However, core competencies such as formulating research questions and data analysis remain problematic.

Moreover, while digital tools are more accessible now than in the past, their effective integration into student research remains limited. This reinforces Schwab’s (2016) argument that technological availability alone does not guarantee competence without systemic support and training.

4.5. DISCUSSION

These findings reveal a disconnect between students' interest in research and their actual capabilities, especially in analytical thinking and digital literacy. While most students express a willingness to conduct research, they lack the foundational skills and institutional support to do so effectively.

In the context of Industry 4.0, this gap is particularly critical. As the World Economic Forum (2020) notes, skills such as critical thinking, research, and digital collaboration are central to the future workforce. If universities fail to prepare students accordingly, they risk falling behind in global innovation and competitiveness.

Thus, enhancing students’ research competence should be approached not only as an academic priority but also as a strategic response to digital transformation in higher education.

5. CONCLUSION

5.1. Conclusion

This study has explored the current state of research competence among university students in Vietnam within the context of the Fourth Industrial Revolution. The findings suggest that students generally perceive their research competence to be moderate, with strengths in academic writing and literature review, but notable weaknesses in data analysis, research design, and use of digital tools.

Despite increased access to technology, the effective integration of digital platforms and AI tools into research activities remains limited. Institutional constraints, such as lack of systematic training, insufficient mentorship, and uneven digital readiness across disciplines, continue to hinder the development of robust research competence.

Enhancing Research Competence of University Students in the Context of Industry 4.0

These findings reaffirm previous studies while highlighting new challenges emerging from the rapid digital transformation of higher education. Enhancing students' research capacity is no longer optional but a critical requirement for building a future-ready workforce that can engage in innovation and problem-solving in a data-driven world.

5.2. Recommendations

To bridge the gap between research expectations and student capacity, the following recommendations are proposed.

First, Universities should introduce compulsory courses on research methodology and digital literacy from the first or second year, rather than delaying them to senior years.

Second, Institutions should provide incentives and reduced teaching loads for faculty members who actively mentor student research. Establishing research clubs and peer mentoring programs can also be beneficial.

Third, training sessions on academic databases, citation tools (e.g., Zotero, Mendeley), data analysis software (e.g., SPSS, Excel, NVivo), and AI tools (e.g., ChatGPT, Grammarly) should be made part of research skills courses.

Fourth, Universities should organize student research conferences, journals, and innovation competitions to build a community of practice that values inquiry, creativity, and interdisciplinary collaboration.

Finally, Policymakers should invest in digital infrastructure and promote policies that prioritize undergraduate research as a strategic goal of higher education in the Industry 4.0 era

By implementing these recommendations, higher education institutions can cultivate research-literate graduates who are capable of contributing meaningfully to scientific knowledge, technological development, and sustainable innovation in a digital society.

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