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Examining the Relationship between Ubiquitous Technology Utilisation and Technology Competency: Implications for Digital Proficiency Development

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Abstract
The objectives of this study were to: (i) assess the level of Ubiquitous Technology (U-Tech) usage, (ii) evaluate undergraduates' competency in U-Tech, and (iii) examine the significance of the relationship between U-Tech usage and competency. A total of 400 undergraduates from four faculties were randomly selected as participants. The study utilized a survey method, collecting data through a 5-point Likert scale questionnaire. The questionnaire comprised 5 items on demographic information, 42 items on U-Tech usage, and 42 items on U-Tech competency, with reliability scores of 0.958 and 0.971, respectively. Data analysis was conducted using both descriptive statistics (mean, percentage, frequency, and standard deviation) and inferential statistics (Pearson correlation). The findings indicated that the majority of undergraduates exhibited a high level of U-Tech usage (mean = 4.39, SD = 0.895). However, the overall utilisation of U-Tech among undergraduates was found to be moderate, as was their competency in using U-Tech. Lastly, the results demonstrated a significant positive relationship ($r = 0.335$, $p < 0.01$) between U-Tech usage and undergraduates' competency level.
Keywords: Ubiquitous Technology, Technical Undergraduates, Technology Use, Technology Competency

Introduction
In today's digital era, with the rapid pace of technological innovation, ubiquitous technology (U-Tech) has emerged as a pivotal tool in transforming educational settings. U-Tech devices such as smartphones, laptops, and tablets (Lei, 2010; Saadiah, 2010; Levin & Bruce, 2001) are increasingly recognized not only for their primary functions in communication, entertainment, and organization but also as powerful mediators in education. These

technologies support learning by enhancing students' comprehension and engagement. A significant number of undergraduates integrate U-Tech into classroom and laboratory settings to facilitate more effective learning, as it provides a deeper understanding of the subject matter (Guetl, Chang, Edwards & Boruta, 2013). Several factors influence the utilisation of U-Tech, with competency being a key determinant in its effective use among undergraduates. Previous studies (Kadel, 2005; Mudasiru & Modupe, 2011) have explored these factors, highlighting the importance of competency in technology adoption. The successful integration of U-Tech relies heavily on students' ability to use and understand these digital tools for both academic and personal purposes. Simply possessing advanced U-Tech devices within institutions does not guarantee their effective utilisation. Regardless of the availability and quality of technology in classrooms, its impact ultimately depends on how students use these tools. Therefore, undergraduates must develop the necessary competencies and adopt a positive attitude towards technology (Kadel, 2005). Ahmad, Abdul Karim, and Albakri (2013) identified key technology competencies essential for effective U-Tech integration, including personal proficiency in using the tools, mastery of educational paradigms that incorporate technology, the ability to use technology as cognitive tools, competency in leveraging technology for learning, and an understanding of the fundamental standards governing U-Tech usage in education.

Utilisation of Technology in Technical University

The higher education system in Malaysia is designed to enable public higher education institutions to establish a strong reputation by being dynamic, competitive, and adaptable to emerging challenges. It aims to ensure that these institutions can anticipate and respond effectively to global trends while maintaining a high standard of excellence. Additionally, the system emphasizes enhancing universities' ability to perform their roles efficiently, transparently, and effectively, fostering an environment conducive to student success.

To date, the Ministry of Education (MoE) has designated 11 institutions as focused universities, including four Malaysian Technical Universities (MTUN), which specialize in technical and engineering fields and are dedicated to becoming innovation-driven centers of excellence. The four institutions under MTUN are Universiti Teknikal Malaysia Melaka (UTeM), Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Malaysia Pahang (UMP), and Universiti Malaysia Perlis (UniMAP). These universities are committed to producing highly skilled graduates to support Malaysia's industrial advancement, with a strong emphasis on technology competency to meet the evolving demands of the IT industry (Task Force on Meeting and Human Resource Challenge for IT and IT-Enabled Services, 2003).

Furthermore, the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET) has highlighted key competencies in their assessment of skill trends. These include technological proficiency, multi-tasking abilities, and the capability to identify, formulate, and solve engineering problems. These competencies align with the objectives of MTUN institutions in preparing graduates who are not only industry-ready but also equipped to contribute effectively to technological advancements and industrial innovation.

Benefits of Ubiquitous Technology Utilisation

Promoting Flexibility in Learning

In higher education, the integration of ubiquitous technology (U-Tech) as a learning tool offers authentic learning experiences, particularly for engineering and technical students who require clear, step-by-step guidance in tasks such as connecting electronic circuits—especially when hands-on practice is not immediately available (Amini, Ravindran & Lee, 2024).

A study conducted among engineering educators and students found that technology enables educators to utilize applications that simulate real-world environments, allowing students to engage in realistic experimental settings. Through technology, students can undertake authentic tasks that mirror real-world work, explore new environments, interact with individuals from diverse cultural backgrounds, and leverage various digital tools to collect information and solve problems (Rodríguez, Granados & Muñoz, 2013).

Promoting Engagement in Learning

Student engagement is defined as students' willingness to participate in routine learning activities, including attending classes, completing assignments, and adhering to instructors' guidance (Manuguerra & Petocz, 2011). Various strategies have been explored to enhance student engagement, with research suggesting that educators can foster higher levels of engagement by encouraging students to take an active role in their learning. This can be achieved by creating collaborative opportunities that involve students in educational research, lesson planning, teaching, and evaluation processes (Martin et al., 2013).

Promoting Collaborative Learning

Collaborative learning takes place in an environment where learners actively engage in a task, relying on and being accountable to one another. This approach includes both face-to-face interactions and digital discussions, such as online forums, chat rooms, and video conferencing (Alzubi, Nazim, & Ahmad, 2024).

At its core, collaborative learning emphasizes working together, allowing knowledge to be constructed through shared experiences and reciprocal roles (Wali et al., 2014). In the digital age, collaboration has become a key element of online learning. Instead of traditional one-to-one interactions, technology facilitates collective learning experiences, enabling students to engage with a variety of interactive and instructional resources while collaborating with peers.

Promoting Personalised Learning

In the 21st century, students learn most effectively when lessons are personalized to their interests, strengths, and challenges (Arshad & Scott-Ladd, 2010). A study conducted in Malaysia by Sedek and Mohd (2025) found that wireless classrooms and digital instruction allow students to learn at their own pace, enhancing flexibility and autonomy in the learning process.

Personalized learning adapts to individual needs, making education more responsive and efficient. By integrating ubiquitous technology (U-Tech), educators can shift their focus from routine tasks such as manual grading to serving as instructional coaches, offering targeted guidance and support. U-Tech places learners at the center of the educational experience, where learning activities are customized based on their specific needs. Students can engage in learning one-on-one or in small groups, ensuring a more tailored approach. Additionally, technology enables educators to track student progress in real time, providing immediate feedback and fostering continuous improvement.

Promoting Speed in Information Accessibility

A continuous flow of information among users is widely recognized as a key feature of ubiquitous technology (U-Tech) (Gupta, 2013). Through U-Tech, students gain access to multiple input and output channels, enhancing their learning efficiency. According to Hwang et al. (2008), technology facilitates five key types of interaction: learner-content, learner-teacher, learner-learner, learner-interface, and learner-community. Students can engage with digital databases, communicate with peers, send messages to lecturers, navigate learning platforms, and participate in broader community discussions. Additionally, they can utilize social networking platforms such as Facebook® and Twitter to stay updated with current information and expand their knowledge base.

Promoting 21st Century Skills

In Malaysia, in regard to a review of the relationship between technology and 21st century skills, Sedek and Mohd (2025) reported that with the utilisation of new technology, students were able to produce high- calibre work with a range of technology providing opportunities for creativity. The researchers found that students utilised u-tech to exhibit creative thinking, increase knowledge and develop innovative products.

Technology Competency

Rasool et. al., (2025) define technology competency as the ability to effectively use a wide range of computer applications for various purposes, which can be developed through learning, knowledge acquisition, and skill enhancement. In the context of engineering and technical education, technology competency encompasses students' perceived skills, abilities, and knowledge, along with other key attributes necessary for their academic and professional growth (Parsons, Dewey & Niedringhaus, 2024).

Technology competency is regarded as one of the most critical skills for engineering graduates as they transition into the workforce. Given the demands of technical professions, graduates are expected to manage, operate, and troubleshoot a diverse range of technological tools, machinery, and digital systems (Sedek & Hassan, 2019). Recognizing the significance of technology competency, the International Society for Technology in Education (ISTE) has established the National Educational Technology Standards for Students (NETS.S), which outline a framework for cultivating technology-driven skills from school to university levels. These standards serve as a guideline to enhance students' proficiency in digital tools, equipping them with the 21st-century competencies necessary for academic and professional success.

A study conducted among engineering students in India by Goel (2006) found that technology competency significantly influenced the adoption and use of technology in learning. The study revealed that while most undergraduates demonstrated strong technical skills, their application of technology remained largely limited to lower-order cognitive tasks, such as using digital tools for specific subjects or as general utilities. The full potential of technology was underutilized, particularly for higher-order thinking skills such as analysis, synthesis, and evaluation. Goel attributed this gap to limited exposure and insufficient opportunities for students to engage in advanced, critical, and problem-solving tasks using technology.

To bridge this gap, educators and institutions must focus on fostering deeper engagement with technology by integrating activities that promote problem-solving, innovation, and critical thinking. This includes project-based learning, simulations, coding, automation, and interdisciplinary applications that challenge students to apply their technical skills in real-world contexts. Additionally, institutions should provide structured training and hands-on experiences to ensure that students not only develop competency in using technology but also maximize its potential for complex problem-solving and innovation in their respective fields.

Problem Statements

Despite numerous efforts to explore undergraduates' U-Tech usage in higher education globally, existing literature remains largely superficial (Sedek & Mohd, 2025)). Many studies have primarily focused on ICT literacy among lecturers and students rather than specifically examining the use of U-Tech in learning environments (Ahmad & Bakhtiari, 2007). Furthermore, there is limited research on how technical undergraduates integrate U-Tech into their academic experiences. The field also lacks comprehensive data on the actual level of U-Tech usage and competency among undergraduates, particularly in technical education settings. This study aims to bridge this gap by assessing U-Tech usage and competency levels among undergraduates in one of the Malaysian Technical University Networks (MTUN). Additionally, it evaluates U-Tech usage in alignment with the National Educational Technology Standards for Students (NETS.S), providing a structured framework to understand how undergraduates are engaging with U-Tech for learning and skill development.

Objectives

The study attempts to achieve the following objectives:

1. To identify the level of U-Tech usage among technical undergraduates.
2. To examine the competency level of technical undergraduates in the use of U-Tech.
3. To determine whether there is any significant relationship between technical undergraduates’ use of U-Tech and competency level.

Methodology

This research deployed a survey method using a questionnaire to investigate the level of U-Tech usage among engineering students and their competency level. The questionnaire consisted of Section A (eight items on socio- demographic information), Section B (42 items on U-Tech usage and 42 items on ICT competency). The instrument was validated by a panel of experts and pilot tested. Based on the pilot study the obtained reliability was 0.96 for U-Tech usage and 0.97 for U-Tech competency. Data were analyzed descriptively (mean, percentage, frequency and standard deviation), and inferentially (Pearson correlation) using SPSS version 17. All items in the section B were measured on a five-point Likert scale.

Findings

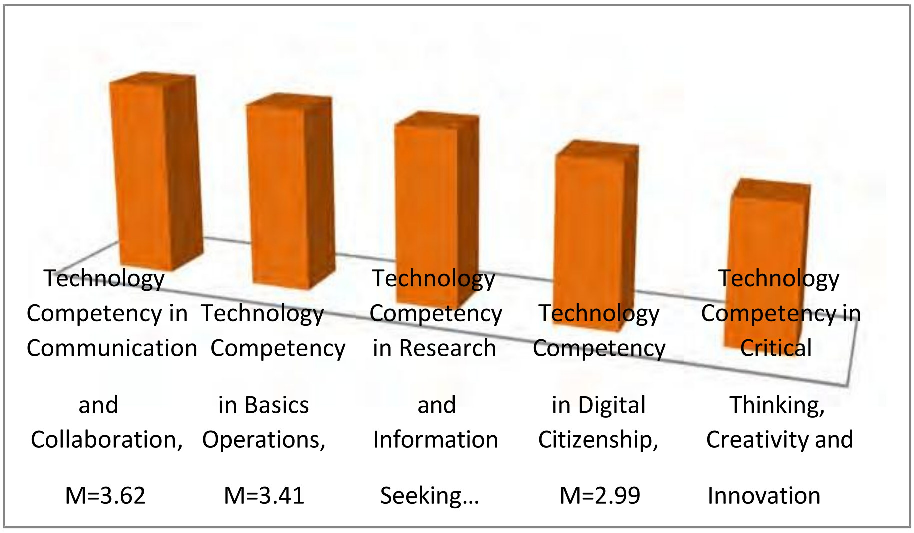
Demographic Information

A total of 400 undergraduates from four universities participated in this study. Most undergraduates were from UTeM (n=175, 44%), followed by UTHM (n=154, 38%) and UniMAP (n=42, 11%). The least number of undergraduates was from UMP (n=29, 7%). The gender distribution was almost equal among undergraduates; male (n=208, 52%) and female (n=192, 48%). The age of undergraduates varied from 22 to 25 years old. Many of the undergraduates were around 23 years (n=165, 41%). Those, of 22 years (n=113, 28%). Undergraduates of age 24 (n=79, 20%) and the fewest undergraduates were at the age of 25 (n=43, 11%).

Undergraduates' Level of U-Tech Usage

Results revealed that the overall level of u-tech utilisation was moderate. A majority of undergraduates (n=229, 58%) perceived their utilisation level as moderate, 168 (41%) undergraduates high with a maximum score of 223, and 3 (1%) undergraduates perceived their utilisation level as low with a minimum score of 98. From 229 (58%) undergraduates who perceived their utilisation level as moderate, 110 (28%) were males and 119 (30%) were females. From 168 (41%) undergraduates who perceived their utilisation as high, 95 (24%) were males and 73 (17%) were females. Finally, 3 (1%) undergraduates who perceived their utilisation as low, were all males.

Patterns in Competency in Using Ubiquitous Technology According to Categories



The findings on patterns in competency in using ubiquitous technology (U-Tech) according to categories reveal varying levels of proficiency among undergraduates. The highest competency was observed in communication and collaboration tools (M=3.62, SD=0.95), indicating that students are most proficient in using technology for interaction and teamwork, likely through online platforms, messaging applications, and collaborative workspaces. This was followed by basic operations tools (M=3.41, SD=0.92) and research and information-seeking tools (M=3.28, SD=0.95), suggesting that students are fairly skilled in fundamental digital tasks and in leveraging technology to gather and process information. Additionally, the competency in using digital citizenship tools (M=2.99, SD=0.93) was found to be moderate, indicating that while students have some understanding of responsible digital engagement, there may still be gaps in areas such as online security and ethical considerations.

On the other hand, the lowest competency was found in the use of U-Tech for critical thinking, creativity, and innovation (M=2.57, SD=0.99), highlighting a significant challenge in applying technology for higher-order cognitive skills. This suggests that while students are comfortable using technology for communication and basic tasks, they may struggle with utilizing it for problem-solving, innovation, and creative exploration. The findings indicate a need for educational strategies that integrate technology-driven critical thinking activities, such as simulations, coding, design thinking, and project-based learning, to enhance students' ability to use technology for innovation. Strengthening these competencies would help ensure that students are not only passive users of technology but also active and innovative contributors in their respective fields.

Relationship between technical undergraduates' U-Tech usage and competency level

Correlation Analysis between Relationships of technical undergraduates of U-Tech usage and U-Tech Competency Level

		U-Tech usage	U-Tech competency
U-Tech_usage	Pearson Correlation	1	.335**
	N	400	400
U-Tech competency	Pearson Correlation	.335**	1
	N	148	148

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

The correlation analysis between U-Tech usage and U-Tech competency revealed a significant positive relationship ($r = 0.335$, $p < 0.01$), indicating that students who frequently use U-Tech tend to develop higher competency in utilizing it effectively. With a sample size of 400 for U-Tech usage and 148 for U-Tech competency, the findings suggest that increased exposure to technology enhances students' proficiency, reinforcing the idea that regular engagement with digital tools leads to improved skills. This relationship highlights the importance of integrating technology into learning environments, as students who actively use U-Tech are more likely to develop essential digital competencies. The results further emphasize the need for structured technology-based learning activities that not only encourage frequent usage but also foster deeper critical thinking, problem-solving, and innovation skills through technology.

Discussion and Conclusion

The study also shows that there is a significant and positive correlation ($r = 0.335$, $p < .01$) between undergraduates' U-Tech usage with their competency level. Hence, it is assumed that when undergraduates have high competency, there is a relative advantage in using U-Tech fully, perhaps for the higher level of thinking, such as in expressing complex concepts. This finding is consistent with those of Abdullah Abdullah, Wan Mohd Amin, Mansor, Mohammad Noor and Amirudin (2011) and Ahmad, Abdul Karim, Din and Albakri (2013) in which competency was the most influential factor related to technology use. Both studies reported that many users were in agreement that having sufficient technology competency and skills were primary importance in the successful and effective utilisation of technology.

Theoretical and Contextual Contribution

This research provides both theoretical and contextual contributions to the field of educational technology, particularly in the domain of technical and engineering education. Theoretically, the study reinforces the Technology Acceptance Model (TAM) and the TPACK framework by highlighting the importance of competency in influencing the adoption and effective use of ubiquitous technology (U-Tech). It further validates the notion that technological integration in education is not merely a function of access, but heavily reliant on users' perceived competencies and attitudes. By establishing a positive and significant correlation between U-Tech usage and competency, this study supports existing theoretical assertions that competency enhances the effectiveness and depth of technology adoption in educational environments.

Contextually, the research offers valuable insights into the Malaysian Technical University Network (MTUN), a context that has received limited attention in existing literature. The findings underscore the need for targeted interventions in technical universities to enhance not only access to U-Tech but also structured training that cultivates higher-order digital skills such as creativity, innovation, and critical thinking. This focus is particularly relevant in Malaysia's push toward IR4.0 and national goals for digital transformation in education. The study addresses a critical gap by presenting empirical data on undergraduates' current usage and competency levels and providing a clear roadmap for institutional improvements. In doing so, it contributes to the development of more nuanced and effective educational strategies, policies, and practices aligned with national and global standards.

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