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Investigating Technology Acceptance: An Overview of Trainee Teachers' Potential Towards the Usage of Educational Robotics

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Abstract

At the beginning of past decade, rapid advancement of education focused on technological component such as robotics has become a trend that persist to the present day to meet the demanding needs of modern society. Despite this growth, questions remain regarding educators' preparedness and competency in mastering rapidly evolving technologies, particularly among trainee teachers. Therefore, this research aimed to assess trainee teachers' level of knowledge and skills in educational robotics. Employing a quantitative approach, a survey was administered to 92 trainee teachers from Bachelor of Teaching Degree Program (PISMP), June 2021 Intake, (Year 4, Semester II) majoring in Design and Technology (RBT). A set of questionnaires using 5-point Likert Scale was administered online using Google Form and the data obtained were analysed using descriptive statistics, specifically mean and standard deviation through Statistical Package for Social Science (SPSS) Version 30. The most obvious findings to emerge from the analysis is that the level of knowledge (M=3.80, SD=1.00) and skills (M=3.56, SD=1.20) are at high-level among trainee teachers at Institute of Teacher Education, Technical Education Campus (IPGKPT). Specifically, the results affirm the potential for continuous improvement in teacher training programs and curriculum development, which is essential to address identified digital competency gaps and ensure educators are equipped to integrate digital technology effectively. This aligns closely with the Malaysian Digital Education Policy (2023), advocating for comprehensive knowledge acquisition, creativity, and innovation to effectively navigate the digital transformation in education.

1. Introduction

In the contemporary global economy, digital technology has become a central focus especially in the field of education. A proper mechanism to utilize the use of technology in an integrated, creative and innovative way will facilitate the education system in Malaysia to remain competent and competitive towards a successful future in the context of real-world issues. This is in line with Ministry of Education's commitment to transform the

digital education landscape in order to produce a digitally literate generation that is competitive (Malaysia Education Blueprint 2013-2025). Evidence recognizes improving knowledge, skills and values of students, educators and educational leaders and making provisions for quality infrastructure, infostructure and content as well as the active participation of strategic partners in an integrated and cohesive manner from preschool through to post-secondary education will accelerate the transformation of education system to produce digitally fluent generation (Digital Education Policy, 2023).

Thus, the introduction of educational robotics into curriculum is understood to lead the transformation that has been forethought. It has been conclusively suggested that acceleration of digital education transformation in this country tends to narrow disparity between students' knowledge and skills to the demands of digital era (Aminamul et al., 2023). Some recent evidence suggests, the COVID-19 pandemic exposed that there is a digital divide in the country's education system and has led to a shift in schooling practices where drastic and immediate changes are needed in order to push forward revolutions in the nation's digital education landscape (Digital Education Policy, 2023). Collectively, the country's education system evolves in line with global technologies by producing knowledgeable, highly skilled, ethical and competitive human capital as has been emphasized in Sustainable Development Goal 4 in the United Nations' 2030 Agenda for Sustainable Development to ensure inclusive, efficient and equitable quality education opportunities for all.

Existing research recognizes the critical role played by educational robotics as it is believed to improve learning efficiency, foster creative and critical problem-solving skills, facilitate greater focus on the future professional needs of learners, develop computational thinking, promote social-emotional intelligence, enhance socio-cognitive skills, embodiment and focuses on interpersonal as well as meaningful interactions and nurture personality development in a digital society (Lampropoulos, 2025; Ching & Hsu, 2024; Bano et al., 2024; Seufert et al., 2021; Hamidah et al., 2021). Furthermore, a number of studies have postulated a convergence between the ability to bridge theoretical knowledge with practical applications to foster a deeper understanding of abstract concepts thus highlighting the importance of educational robotics (Eliza et al., 2025). To satisfy this emerging need, the research focus has shifted toward the realization of educational robotics and its introduction in curriculum design and classrooms (Lampropoulos, 2025). Therefore, the development and progress in curriculum require the knowledge and skills of the teaching staffs to be consistent in the field of robotics technology.

However, this research addresses these critical gaps specifically evaluating lack of competency among teachers towards educational robotics (World Bank, 2024; Mazlan et al., 2023; Widiyatmoko et al., 2023; Setapa et al., 2023; Haslinda & Hafizah, 2022; Hamidah et al., 2021; Dorotea et al., 2021; Istenic et al., 2021; Intan et al., 2021; Seufert et al., 2021; Rosman & Hamid, 2020; Ummi & Fatimah, 2020; Ahmad Shakir & Adnan, 2020; Fanton & Essler-Petty, 2019; Acisli, 2016). The main limitations faced by the teachers are lack of professional competencies along with specialized nature of technical knowledge required scarcity of instructional and pedagogical materials that help to articulate the curriculum; the absence of curriculum guidelines; the shortage of specialized training for teachers to enhance their educational knowledge; and the high cost of majority robotics educational platforms (Silva et al., 2023). Unlike previous studies, this research offers empirical insights into actual competency levels, pinpointing precise areas requiring targeted intervention. Such contributions enable curriculum developers and policymakers to strategically integrate robotics into educational and training programs effectively.

Taken together, these findings suggest that it is undeniably important for training providers to prepare teachers with adequate training, interest, knowledge, skills and competency to integrate educational robotics into teaching and learning process that combines pedagogical principles with innovative technology to prioritize addressing the current competency gaps (Eliza et al., 2025). Teacher education program designers and professional development programs must address the lack of capacity building around the teaching and learning of educational robotics, given the urgent need to prepare human capital for the digital future (Yu et al., 2025; Yang, 2025). Consequently, trainee teachers will have the abilities to enhance teacher capacity, foster innovation, and ensure that learners are well-prepared for the digital age by integrating educational robotics that is a burgeoning field receiving worldwide interests. Thus this contributes to additional evidence that suggests the effectiveness of these technologies primarily relies on their integration by teachers to improve instructional practices (World Bank Report, 2024).

2. Objectives and Research Questions

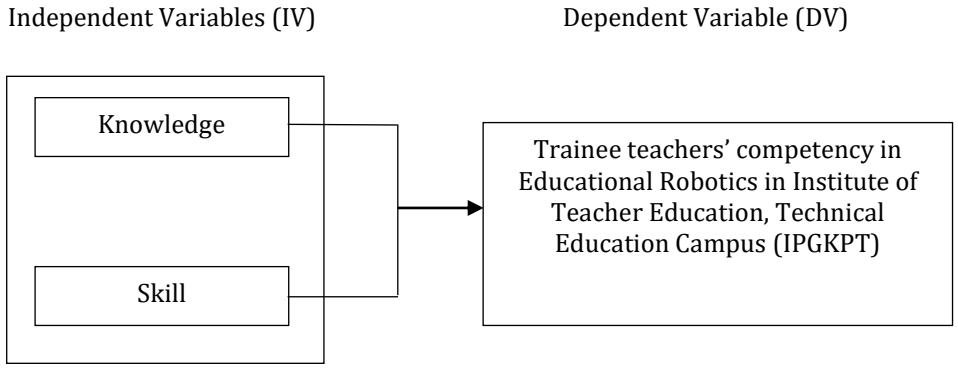
The specific objective of this study is to investigate the competency of educational robotics among trainee teachers in Institute of Teacher Education, Technical Education Campus. Information gained on trainee teachers' knowledge and skills pertaining to educational robotics is fundamental as trainee teachers' obligation to be competent to teach robotics. Moreover, the information obtained from this study could be useful for policy-makers, Design and Technology learning program designers and lecturers. In order to address the aforementioned research objective, this paper attempts to answer the following research questions:

i. What is the level of knowledge among trainee teachers in Institute of Teacher Education, Technical Education Campus pertaining to educational robotics?
ii. What is the level of skill among trainee teachers in Institute of Teacher Education, Technical Education Campus pertaining to educational robotics?

2.1 Conceptual Framework

The conceptual framework used as an establishment in this paper is to analyse the potential towards the usage of educational robotics among trainee teachers in Institute of Teacher Education, Technical Education Campus. The conceptual framework as illustrated in Figure 1 comprises of independent variables (IV) which consist of knowledge and skills meanwhile dependent variable (DV) measures trainee teachers' competency pertaining to educational robotics in Institute of Teacher Education, Technical Education Campus (IPGKPT). This conceptual framework serves as a purpose of clarifying concepts and illustrates the expected relationship between variables in this study.

Figure 1 *Conceptual Framework*



3. Methodology

The research design chosen in this study is quantitative approach as the researchers intend to ask specific narrow questions in order to measure competency defined by knowledge and skill pertaining to educational robotics among trainee teachers in Institute of Teacher Education, Technical Education Campus (Creswell, 2008). As a result, survey is carried out to gather quantifiable data from respondents. Several studies have documented, survey is the most practical approach to administer a set of questionnaires to a small group of people (sample) to identify trends in attitudes, opinions, behaviours or characteristics of a large group of people (population) (Ghazali & Sufean, 2018; Creswell, 2008; Wiersma, 1991). In addition, it is considered advantageous since it lessens the labour load and expenses associated with examining the entire target group (Malhotra & Birks, 2007). The data collected from survey was then analyzed using statistics in a neutral and unbiased manner.

Therefore, a survey is administered to observe the competency of trainee teachers at Institute of Teacher Education, Technical Education Campus (IPGKPT) in educational robotics. The population of this study comprised of 120 trainee teachers from Bachelor of Teaching Degree Program (PISMP) (June 2021 Intake, Year 4, Semester II) majoring in Design and Technology (RBT). The sample size in this study was determined using Krejie and Morgan (1970) sampling table. Therefore, 92 randomly selected respondents, achieving a response rate of 100% to participate in this study. A set of questionnaires were then administered to 92 respondents and the survey was conducted online using Google Forms. This is based on the fact that digitally collected data has been shown to be more efficient than pen-and-paper methods in the matter of speedy data handling, less lost or incorrect data and general feasibility (Drummond et al.,1995).

A set of questionnaire was used in this study. According to Christopher and Bruce (1985), questionnaires are the easiest way to obtain information from a big group of respondents and are able to collect valid and reliable data for analyzing a research problem to obtain computable information. Specifically, the questionnaire in this study consist of Section A, B and C. Section A requires respondents' demographic information, meanwhile section B and C consist of items on knowledge (11 items) and skills (9 items) variables. Total items administered in this questionnaire was 20 items altogether. The questionnaire was tested using 5-point Likert Scale as it is established that the accuracy of statistics calculated is not compromised (Rasmussen, 1989). The interpretation of mean score by Tschannen-Moran and Gareis (2004), was used to determine level of

knowledge and skills among trainee teachers at Institute of Teacher Education, Technical Education Campus (IPGKPT) towards educational robotics as demonstrated in Table 1. Thenceforth, data were analysed by descriptive statistics namely mean and standard deviation (SD) using Statistical Package for Social Science (SPSS) version 30. In general, this study was conducted with a focus on obtaining descriptive information to answer aforementioned research questions.

Table 1 *Interpretation of mean value*

Mean Value	Interpretation of Mean Value
1.00 - 1.80	Very Low
1.81 - 2.60	Low
2.61 - 3.40	Average
3.41 - 4.20	High
4.21 - 5.00	Very High

4. Result and Findings

This study was conducted among 92 trainee teachers from Bachelor of Teaching Degree Program (PISMP) (June 2021 Intake, Year 4, Semester II) majoring in Design and Technology (RBT) at Institute of Teacher Education, Technical Education Campus (IPGKPT). The respondents of this study were selected randomly. Table 1 lists the information on the respondents' background with 40 (43.5%) respondents are male meanwhile 52 (56.5%) are female. Based on the overall analysis of the respondents' demographic, it can be said that most of the respondents were female compared to male.

Table 2 *Respondents' demographic information (n=92)*

Variables	Category	Frequency	Percentage (%)
Gender	Male	40	43.5%
	Female	52	56.5%

4.1 Knowledge pertaining to Educational Robotics among Trainee Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 3 demonstrates the mean value and level of trainee teachers' knowledge pertaining to educational robotics in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at high level (M=3.80, SD=1.00). Findings revealed, most respondents agreed that they have heard of Micro:bit Programming Design (M=4.35) and know that Micro:bit Programming Design is in Design and Technology's Curriculum Document (DSKP) (M=4.35). The lowest mean recorded in item B7 which is they know about the Micro:bit pseudocode (M=3.29). Based on Table 3 as shown below, the descriptive analysis found that the overall mean of trainee teachers' level of knowledge regarding educational robotics is high. Therefore, this finding suggests that the level of knowledge regarding educational robotics among trainee teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at high level.

Table 3 *Trainee teachers' knowledge regarding educational robotics*

	Item	Mean	SD	Level
B01	I know about Micro:bit Programming Design.	3.90	0.85	High
B02	I have heard of Micro:bit Programming Design.	4.35	0.71	Very High
B03	I understand about Micro:bit.	3.83	1.06	High
B04	I know that Micro:bit Programming Design is integrated in Design and Technology's Curriculum Document (DSKP).	4.35	0.65	Very High
B05	I understand the terminologies used in Micro:bit.	3.67	1.06	High
B06	I have studied Micro:bit settings.	3.88	0.98	High
B07	I know about the Micro:bit pseudocode.	3.29	1.16	Average
B08	I know how to design Micro:bit pseudocode in flowchart form.	3.27	1.22	Average
B09	I know how to use Micro:bit interface features.	3.38	1.25	Average
B10	I feel it is important for me to learn how to use Micro:bit.	4.21	0.87	Very High
B11	I know the uses of hardware in Micro:bit.	3.62	1.25	High
		3.80	**1.00**	**High**

4.2 Skills pertaining to Educational Robotics among Trainee Teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT)

Table 4 demonstrates the mean value and level of trainee teachers' skill pertaining to educational robotics in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at high level (M=3.56, SD=1.20). Findings revealed, most respondents agreed that Micro:bit programming facilitates task in Design and Technology subject (M=3.98). The lowest mean recorded in item C12 which is they have skills and ability to be able to use Micro:bit programming (M=3.33). Based on Table 4 as shown below, the descriptive analysis found that the overall mean of trainee teachers' level of skill regarding educational robotics is high. Therefore, this finding suggests that the level of skill regarding educational robotics among trainee teachers in Institute of Teacher Education, Technical Education Campus (IPGKPT) is at high level.

Table 4 *Trainee teachers' skills regarding educational robotics*

	Item	Mean	SD	Level
C12	I have skills and ability to be able to use Micro:bit.	3.33	1.15	High
C13	Micro:bit facilitates task in Design and Technology subject.	3.98	0.90	High
C14	I master the ability to use Micro:bit.	3.37	1.22	Average
C15	I am confident using Micro:bit while in the classroom.	3.60	1.24	High
C16	I am confident using Micro:bit outside of the classroom, e.g for exhibition and roadshows.	3.56	1.22	High
C17	I have the ability to program using Micro:bit for the electronic components I have installed.	3.60	1.20	High
C18	I can create and produce teaching aids using Micro:bit.	3.60	1.22	High
C19	I am proficient in using the Micro:bit interface features.	3.56	1.39	High
C20	I am skilled in designing based on flowcharts using Micro:bit.	3.48	1.29	High
		3.56	**1.20**	**High**

5. Discussion

The existing literature underscores that trainee teachers' potential towards using educational robotics is significantly influenced by their knowledge, skills, attitudes, interest and self-confidence. Studies have shown that emotional engagement in teaching and learning process through educational robotics can positively impact behavioral and cognitive engagement, suggesting that positive initial experiences are vital for future adoption. This aligns with international findings, as a Portuguese study revealed very positive levels of knowledge, interest, and self-efficacy among computer science teachers regarding educational robotics for teaching purposes (Dorotea et al., 2021). Similarly, early childhood education teachers in Turkey expressed positive attitudes towards robotics education, believing it should be integrated into the curriculum (Ugur-Erdogmus, 2021). Pre-service science teachers in Turkey also reported high satisfaction with robotic applications and a desire to stay updated with innovations (Fenton & Essler-Petty, 2019). These consistent findings across different countries highlight the universal importance of these foundational attributes for successful educational robotics integration. Effective teacher preparation programs play a pivotal role in fostering this acceptance by providing adequate pedagogical and technical support to build confidence and self-efficacy. These programs should emphasize not just the technical aspects of robotics but also how to integrate robots meaningfully into the curriculum to enhance learning. Furthermore, offering opportunities for hands-on experimentation and collaborative learning can increase trainee teachers' comfort and willingness to use educational robotics. However, it is important to acknowledge potential barriers such as discomfort with technology or a lack of perceived utility, which teacher training providers must address.

Interestingly, some studies suggest that trainee teachers might exhibit different levels of acceptance compared to in-service teachers and even skepticism towards social robots that overly mimic human characteristics. This observation is notably consistent with findings from a Slovenian study, which evidenced a strong rejection among pre-service teachers concerning the integration of embodied human-like social robots into the teaching process (Istenic et al.,2021). The core of this rejection stemmed from the perceived social dimension of the robots, as participants believed the robots' social abilities were insufficient and unsuitable for children's well-being and upbringing (Istenic, 2021). This contrasts with some in-service teacher populations, where positive reactions and acceptance towards socially assistive humanoid robots in preschool and elementary classrooms have been reported (Aminamul et al.,2023). However, it is also suggested that in-service teachers' caution might be influenced by a lack of expectation that they would actually experience such robots in the future (Papadakis et al.,2021). Furthermore, a study in Greece highlighted a generational dichotomy, with older and more experienced teachers expressing more intense worries and negative feelings about educational

robotics use in the formal curriculum compared to younger teachers, indicating differing perspectives within the teaching profession itself. Teacher education programs should therefore consider these varied perspectives and potential anxieties. Providing learning environments where trainee teachers can experiment and design with robotics, alongside opportunities to observe effective integration strategies, could be beneficial. Therefore, future research should continue to explore these nuances in technology acceptance among trainee teachers, considering factors like ICT familiarity, and focus on developing teacher education strategies that effectively bridge the gap between technological potential and practical classroom implementation. This has been reiterated in the Malaysian Digital Education Policy (2023) that a significant digital literacy gap across the teaching profession, with a large percentage of teachers at a "basic level" of digital competency, underscoring the urgent need for targeted training. This policy also prioritizes enhancing the digital competence of educators, highlighting a national commitment to this area. Consequently, teacher training programs should aim to enhance both technical skills and pedagogical understanding of how educational robotics can be meaningfully used to advance teaching and learning. This comprehensive approach, starting at the initial teacher education stage and continuing through professional development, is vital for fostering a positive and effective integration of educational robotics in future classrooms.

6. Conclusion

In conclusion, this overview of trainee teachers' potential towards the usage of educational robotics underscores the multifaceted nature of technology acceptance in the pedagogical context. The literature consistently highlights that trainee teachers' knowledge, skills, interest, self-confidence and attitudes are fundamental determinants of their willingness to integrate educational robotics. Effective pre-service teacher education plays a pivotal role in nurturing this acceptance by providing comprehensive pedagogical and technical support. Training initiatives should prioritize hands-on experiences, collaborative learning opportunities, and exposure to practical integration strategies to bolster confidence and self-efficacy. It is crucial to acknowledge and address potential barriers, including discomfort with technology. Furthermore, research suggests a divergence in acceptance levels between pre-service and in-service teachers, with younger, digitally native trainees often exhibiting more positive views than older, more experienced educators who may express greater anxieties.

Considering factors such as ICT familiarity and tailoring training to address varied needs and concerns are essential for successful adoption. Ultimately, by focusing on developing both the technical skills and the pedagogical understanding of educational robotics within robust teacher preparation programs, educators can be better equipped to harness the potential of this innovative technology to enhance classroom engagement and improve learning outcomes as well as to prepare the next generation of human beings for the future. The emphasis should be on how to use robots for actual teaching purposes rather than just building them, and training programs should provide the necessary support to build teachers' confidence and self-efficacy as well as to ensure that teachers remain competent and confident in integrating educational robotics into their daily practice. Teachers should be enabled and supported to sit in the driver's seat to shape their classrooms during this current major transitional phase—to quote Kay's (1971) well-known remark: "The best way to predict the future is to invent it."

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Conflict of Interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Author Contribution

The authors confirm contribution to the paper as follows: ***Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing – original draft:*** *Anusuya Kaliappan,* ***Methodology, Formal analysis, Data curation, Writing – original draft:*** *Khu Eian Chun,* ***Literature review, Writing – original draft:*** *Asmah Bohari,* ***Literature review, Data curation, Writing – review & editing:*** *Azhar Hashim,* ***Literature review, Validation, Writing – review & editing:*** *Mohamed Shariff Salehuadin. All authors reviewed the results and approved the final version of the manuscript.*

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