

Acceptance of Digital Teaching Aids Among Design and Technology Teachers in Port Dickson Secondary Schools

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Abstract

The use of digital teaching aids (DTA) such as Arduino-based simulations is an effective approach to strengthening Design and Technology (RBT) education in line with 21st-century learning demands. Despite various initiatives, teachers' acceptance of DTA remains inconsistent. This study aimed to examine the acceptance of DTA among RBT teachers in secondary schools in Port Dickson, focusing on usability, capability, and attitude. A quantitative survey design was employed using a structured questionnaire, with 34 teachers selected as respondents. Data were analyzed through descriptive statistics and multiple regression analysis. The findings revealed that all three constructs recorded high levels, with capability identified as the most dominant factor influencing teachers' attitudes. These results indicate that teachers' technical competency and confidence are crucial in shaping positive attitudes towards the use of DTA. The study suggests that targeted professional training and continuous technical support are essential to enhance teachers' readiness and ensure effective integration of digital tools in RBT classrooms.

1. Introduction

The use of digital teaching aids (DTA), such as Arduino-based simulations, is becoming increasingly important in the teaching of Design and Technology (RBT), in line with the Digital Education Policy that emphasizes the mastery of 21st-century skills (Elman *et al.*, 2023). Digital resources provide opportunities for interactive, visual, and problem-solving-oriented instruction that can strengthen students' understanding of technical concepts. Despite these advantages, the level of teachers' acceptance of DTA remains inconsistent and is influenced by several factors, including usability, competency in technology-based teaching, and attitudes towards digital innovation (Sahaat & Mohamad Nasri, 2020).

Previous studies indicate that teachers' capability, defined as their knowledge, experience, and skills in applying DTA, is a dominant factor influencing positive attitudes towards the use of such tools (Mohamad Zaid *et al.*, 2021). Teachers with stronger technological capability tend to be more confident and prepared to use Arduino simulations effectively. In addition, the usability of DTA, including accessibility, interface clarity, and alignment with RBT content, also plays a significant role in encouraging adoption. User-friendly digital materials have been shown to foster creative and effective integration in Teaching and Learning (T&L) activities (Saidin *et al.*, 2023). Teachers' attitudes are further shaped by elements such as interest, motivation, comfort, and perceptions of teaching effectiveness. Positive attitudes are associated with greater engagement in digital approaches, which in turn enhance students' motivation and comprehension of technical concepts in RBT (Davis, 1989).

Although the integration of digital technology in education has been widely encouraged through initiatives such as the Malaysia Education Blueprint 2013–2025 and the Digital Educational Learning Initiative Malaysia (DELiMa), the implementation of DTA in schools remains uneven (Ministry of Education Malaysia, 2013). In the context of RBT, Arduino-based simulations are increasingly recognised as effective tools for enhancing students' understanding of electrical and programming concepts through interactive and visual learning experiences (Abdul Hadi & Mohamad, 2020). However, challenges such as limited training opportunities, inadequate access to technological facilities, and teachers' workload continue to hinder the effective integration of DTA in teaching and learning activities (Saidin et al., 2023).

Although many studies have examined technology acceptance in education, most have focused on general ICT integration or broader subject areas, with limited attention given specifically to RBT teachers in Malaysia. Furthermore, studies based on the Technology Acceptance Model (TAM) have primarily emphasised perceived usefulness and perceived ease of use as determinants of technology acceptance (Davis, 1989). Less attention has been given to teachers' capability, particularly their knowledge, skills, and confidence in using digital tools, and how these factors interact with usability to influence attitudes towards DTA. Consequently, a knowledge gap remains regarding the readiness and acceptance of Arduino-based DTA among RBT teachers, particularly in secondary schools within the Port Dickson district.

Given that RBT is a practical and skill-based subject, understanding teachers' acceptance of DTA is essential to support meaningful technology integration in classroom practice. Therefore, this study aims to examine the level of usability, capability, and attitudes of RBT teachers towards DTA and to identify the most dominant factor influencing their attitudes in secondary schools in Port Dickson.

The rapid development of digital technology has brought significant changes to T&L approaches in schools. In the context of the RBT subject, the use of DTA, such as Arduino simulation, is seen as an innovation that can strengthen students' understanding of technical concepts more interactively and practically. This approach not only aligns with the demands of 21st-century education but also supports the implementation of the National Digital Education Policy, which encourages the integration of technology in the classroom (Elman et al., 2023).

However, the implementation of DTA in the teaching of RBT still faces various challenges. One of the main issues identified is the level of teachers' acceptance of the use of this technology. According to the TAM, acceptance of educational technology is influenced by perceived usefulness and perceived ease of use (Davis, 1989). Later extensions of the model emphasize additional factors such as system usability, user capability, and attitudes towards technology (Antonietti et al., 2022). If teachers lack the necessary skills or confidence, or if the DTA is difficult to use and not aligned with instructional needs, the full potential of the technology cannot be effectively realized.

Therefore, this study was conducted to examine the level of teacher acceptance towards the use of Arduino simulation in the teaching of RBT, with a focus on the aspects of usability, capability, and attitude. This study is essential to identify the need for professional support, training development, and improvements to user-friendly digital teaching aids to enhance teaching practices among teachers. While previous studies have investigated the acceptance of digital technology in education, most have focused on general ICT tools or broader subjects, with limited emphasis on RBT teachers in Malaysia. This study offers a novel contribution by concentrating on Arduino-based DTA within the RBT context, a subject that is both practical and skill-oriented.

Furthermore, the research extends the application of the TAM by incorporating teachers' knowledge, skills, and confidence as a central construct alongside usability and attitude. This approach moves beyond the traditional focus on perceived usefulness and provides new insights into how teacher competence interacts with technology usability to shape positive attitudes towards digital integration (Lin et al., 2023). By focusing on secondary schools in Port Dickson, the study generates context-specific evidence that is directly relevant to the journal's audience in technical and vocational education and training (TVET), offering practical implications for teacher training, policy, and classroom innovation. Digital tools such as Arduino simulations support teaching electricity and programming safely and interactively. Studies show simulations to improve conceptual understanding and encourage independent learning, though challenges remain in terms of training, infrastructure, and institutional support.

The integration of DTA enhances lesson engagement, flexibility, and systematic planning. However, issues such as internet access, limited resources, and teachers' digital literacy affect effective implementation. TAM (Davis, 1989) explains that perceived ease of use and perceived usefulness shape users' attitudes and acceptance of technology. Its simplicity and empirical support make it suitable for examining teachers' acceptance of digital tools in education. Usability relates to how easily teachers can operate the tools, while capability refers to their effectiveness in supporting teaching and learning. Together, these factors influence teachers' attitudes. Prior research suggests that capability often plays a stronger role in shaping positive acceptance compared to usability.

2. Methodology

This study employed a quantitative survey design using a structured questionnaire as the primary research instrument. The target population consisted of all 34 RBT teachers from secondary schools in the Port Dickson district. Due to the small population size, a census sampling technique was used, whereby all teachers were invited and agreed to participate in the study. The questionnaire comprised 24 items organized into four sections: (i) demographic information, (ii) usability, (iii) capability, and (iv) attitude towards the use of digital teaching aids (DTA). All constructs were measured using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Content validity was established through expert review. Four validators were involved: one Bahasa Melayu teacher with 8 years of teaching experience, who examined the clarity and linguistic accuracy of the items, and three lecturers specializing in Educational Technology and Technical and Vocational Education and Training (TVET), with 12, 17, and 25 years of experience respectively. Their review ensured that the items were linguistically appropriate, content relevant, and aligned with the study objectives. Feedback from the validators was used to refine the questionnaire before administration. A pilot test was conducted with 31 RBT teachers from secondary schools in the Seremban district. The results demonstrated high internal consistency across all constructs, with Cronbach's alpha values exceeding 0.90. This confirmed the reliability of the instrument for use in the main study. Data were collected using the validated questionnaire from all 34 RBT teachers in Port Dickson. The responses were analyzed with SPSS Version 27. Descriptive statistics (mean, standard deviation, and frequency) were used to examine the levels of usability, capability, and attitude. Multiple regression analysis was applied to identify the most dominant factor influencing teachers' attitudes towards DTA. The significance level was set at $p < 0.05$, and the assumptions of regression (normality, linearity, homoscedasticity, and multicollinearity) were checked to confirm the validity of the model.

3. Results and Discussion

The results show that the three main constructs, usability, capability, and teachers' attitude towards DTA, are all rated at a high level. This suggests that RBT teachers generally have a positive acceptance of Arduino-based DTA in their teaching.

Table 1: Mean and Standard Deviation for the Constructs of Usability, Capability, and Teachers' Attitudes Towards DTA

Construct	Mean	Standard Deviation
Usability	4.15	0.52
Capability	4.10	0.48
Attitude	4.22	0.50

To examine the influence of usability and capability on teachers' attitudes towards the use of DTA, a multiple regression analysis was conducted. The results indicated that both independent variables significantly contributed to teachers' attitudes, which served as the dependent variable in this study. This suggests that usability and capability play a crucial role in shaping teachers' attitudes towards the integration of DTA, such as Arduino simulations, in the teaching of RBT.

Table 2: Multiple Regression Analysis-Influence of DTA Usability and Capability on RBT Teachers' Attitudes

Variable	B	Std Error	Beta	Sig.
(Constant)	0.49	0.21	—	0.003
Usability	0.23	0.11	0.25	0.004
Capability	0.68	0.11	0.73	0.000

Summary: $R^2 = 0.920$ | $F = 178.583$ | $\text{Sig.} = 0.000$

This result demonstrates a very strong explanatory power of the model, suggesting that teachers' attitudes towards the use of DTA are largely shaped by their perceptions of usability and their capability in applying such tools. The high R^2 value (92.0%) implies that only a small proportion of the variance is influenced by other factors not included in the model. Furthermore, the significant F-value ($p < 0.001$) provides strong statistical evidence that the predictors jointly contribute meaningfully to explaining the variance, thereby confirming the robustness and validity of the model.

The descriptive analysis showed that the levels of usability, capability, and attitude towards the use of DTA were high (Saidin *et al.*, 2023). Furthermore, the multiple regression analysis revealed that both independent variables, usability and capability, had a significant influence on teachers' attitudes. However, capability was identified as the most dominant factor, as indicated by the highest beta coefficient ($\beta = 0.73$). The R^2 value of 0.92 suggests that 92% of the variance in teachers' attitudes could be explained by the combination of these two

variables (Ahmad & Ariffin, 2021). These findings indicate that teachers' capability in mastering digital instructional technology plays a crucial role in shaping positive attitudes toward the integration of such tools in teaching, which is consistent with previous studies highlighting the importance of teacher competence in adopting innovations (Latif *et al.*, 2020).

These findings suggest that RBT teachers are generally receptive to the use of Arduino-based DTA in teaching and learning activities. The high level of usability indicates that teachers perceive DTA as accessible, practical, and relevant to the delivery of RBT content. This may be attributed to the increasing exposure of teachers to digital technologies through professional development programmes and the growing emphasis on technology integration in Malaysian schools. The findings also imply that teachers recognise the potential of Arduino simulations to support the teaching of electrical and programming concepts in a more interactive and engaging manner.

The results further highlight the importance of teachers' capability in influencing attitudes towards DTA. As capability emerged as the strongest predictor, the findings suggest that teachers who possess greater technological knowledge, skills, and confidence are more likely to develop positive attitudes towards the use of digital teaching aids. This supports the argument that successful technology integration depends not only on the availability of digital tools but also on teachers' readiness and competence to utilise them effectively. Therefore, continuous training and hands-on exposure to Arduino-based applications are essential to strengthen teachers' capability and sustain the implementation of DTA in RBT classrooms.

4. Conclusion

This study provides relevant insights into the acceptance of DTA, particularly Arduino-based simulations, among RBT teachers in Port Dickson. By applying the TAM and extending it with the construct of capability, the paper makes a meaningful contribution to understanding how usability and teacher competence shape attitudes toward digital integration. The findings revealed that both usability and capability significantly affect teachers' attitudes, with capability emerging as the most dominant factor. These findings suggest that strengthening teachers' technological knowledge, skills, and confidence is essential for promoting the effective implementation of DTA in RBT classrooms. Therefore, continuous professional development programmes, hands-on training, and adequate technological support should be prioritised to enhance teachers' readiness for digital teaching practices. Future research may expand the scope of the study by involving a larger sample from different regions and examining additional factors that may influence teachers' acceptance of digital teaching aids.

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Conflict of interest

There is no conflict of interest regarding the publication of the paper.

Author Contribution

*The authors confirm contribution to the paper as follows: **study conception and design:** Nurul Fazillah Zainan, Nurul Hidayah Liew Abdullah; **data collection:** Nurul Fazillah Zainan; **analysis and interpretation of results:** Nurul Fazillah Zainan; **draft manuscript preparation:** Nurul Fazillah Zainan, Nurul Hidayah Liew Abdullah. All authors reviewed the results and approved the final version of the manuscript.*

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