

Interactive Digital Applications among Teachers: Issues and Challenges

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Abstract

The high pace of digital technology has led to the adoption of interactive digital applications (IDAs) like Google Classroom, Kahoot!, Quizizz, Padlet, Nearpod and DELIMa in the teaching and learning (T&L) in high schools. Access to technology however does not necessarily equate to effective and consistent usage among teachers. The key issues and challenges that impede the meaningful incorporation of IDAs into the pedagogical practice of teachers are discussed in this issue paper, including the urban-rural infrastructure gap, teacher digital competency, time constraints and workload, inconsistent school leadership support, teacher attitude and psychological readiness, including challenges unique to senior teachers, the pedagogy-technology gap, and technology-based assessment challenges. These problems are classified according to the first and second-order barriers framework provided by Ertmer (1999) and the discussion is also associated with the Technological Pedagogical Content Knowledge (TPACK) framework to clarify why the presence of technology is not enough to change the pedagogical practice of teachers. To respond to the identified challenges, the current issue paper advises the teacher professional development strategies and the school technology leadership and digital education policy to be more holistic and responsive to the local context, including the particular needs of specific groups of teachers.

Keywords: Interactive Digital Applications, Issues and Challenges, Teacher Pedagogical Practice, Tpack, Digital Education

Introduction

The advent of the Fourth Industrial Revolution has led to an overhaul of the education system around the world, with a change in teaching and learning (T&L) towards more dynamic and interactive, as well as student-centred, forms (Zou, Kuek, Feng and Cheng 2025). The use of interactive digital applications (IDAs) like Google Classroom, Kahoot!, Quizizz, Padlet, Nearpod and DELIMa have become standard tools in the basic toolkit of teachers to implement the curriculum, especially in Malaysia, which has introduced the Digital Education Policy (DEP) 2023 as a follow-up to the Malaysia Education Blueprint (MEB) 2013-2025 (Ministry of Education Malaysia 2013, 2023). This policy covers six strategic thrusts which are student digital fluency, teacher competency, digital leadership, infrastructure, quality digital content and strategic partnerships, and is to be implemented up to 2030.

But even the DEP 2023 situational analysis itself shows that most teachers are at a minimum level of digital competency, and only a small percentage of them is at a higher level (Ministry of Education Malaysia 2023). This result demonstrates that significant expenditure on infrastructure and digital platforms do not necessarily lead to the extensive and impactful use of IDA by teachers. Zou et al. (2025) also point out that despite the potential of digital learning, there is still a significant gap between the perceived advantages of technology and the reality of teachers, students and educational establishments.

Despite this growing body of research, existing studies have tended to treat first-order barriers (external, structural constraints such as infrastructure, time and institutional support) and second-order barriers (internal, attitudinal constraints such as teacher beliefs, confidence and psychological readiness) as largely separate lines of inquiry. Studies documenting infrastructural or resource constraints (e.g., Yap et al. 2024; Akram et al. 2022) rarely examine how such constraints shape teachers' underlying confidence or willingness to adopt IDAs, while studies on teacher attitude and psychological readiness (e.g., Ishak et al. 2022; Teo and Melor 2023) seldom trace these attitudes back to the structural conditions that may have produced or reinforced them. Ertmer (1999) herself cautioned that second-order barriers often persist even after first-order barriers have been resolved, implying that the two categories may interact rather than operate independently; however, this interaction remains underexplored empirically, particularly within the Malaysian secondary school context, where urban-rural infrastructural disparity coexists with considerable variation in teacher attitude and confidence. Moreover, while Ertmer's (1999) framework offers a structural account of what barriers exist, it does not by itself explain the pedagogical consequence of these barriers, namely why their presence results in superficial rather than transformative technology use. The TPACK framework (Mishra and Koehler 2006) addresses this explanatory gap by specifying the knowledge domains that must be integrated for meaningful instructional change. The distinct contribution of this issue paper, therefore, lies in using Ertmer's framework to categorise the structural and attitudinal barriers while using TPACK to explain the pedagogical mechanism through which these barriers translate into shallow, presentation-level technology use among Malaysian secondary school teachers, rather than genuine pedagogical transformation.

The purpose of this issue paper is thus to summarise the research results, both local and international, to determine the key problems and challenges to the successful implementation of IDAs in the pedagogical practice of secondary school teachers. The argument is also anchored in the Technological Pedagogical Content knowledge (TPACK) framework by Mishra and Koehler (2006) as a theoretical framework to articulate why the presence of technology is not enough to change the pedagogy of teachers without significant interaction of technological, pedagogical and content knowledge.

Research Objectives

This issue paper is prepared to achieve the following objectives:

1. To identify the main issues and challenges faced by secondary school teachers in using Interactive Digital Applications (IDAs) during the implementation of teaching and learning.
2. To analyse the causes and effects of these issues and challenges on teachers' pedagogical practice based on the TPACK framework and Ertmer's (1999) barriers framework.

3. To propose strategies for addressing the issues and challenges of IDA use among secondary school teachers.

Literature Review

This issue paper adopts a narrative synthesis approach, drawing primarily on peer-reviewed journal articles and official Malaysian policy documents identified through targeted searches of Scopus, Google Scholar and local institutional repositories using combinations of the terms 'interactive digital application', 'ICT integration', 'teacher barriers', 'TPACK' and 'Ertmer framework'. Priority was given to studies situated in Malaysian secondary education, supplemented by international studies where local evidence was limited or where cross-context comparison strengthened the argument. The literature is synthesised thematically according to Ertmer's (1999) first- and second-order barriers framework rather than through a systematic or meta-analytic protocol, consistent with the scope of an issue paper intended to map the problem space rather than exhaustively catalogue all available evidence.

Online learning platforms that facilitate a two-way interaction of users with both learning content and each other and the difference between online learning and passive one-way digital technology is basically interactive digital applications. Their success is justified by strong empirical data: in a meta-analysis of 43 studies that included 1,706 students, Özdemir (2025) discovered that Kahoot! had a significant positive impact on academic performance (effect size = 0.772) and knowledge retention (effect size = 1.492). This is also facilitated by local literature like Zulkifli, Nordin and Hassan (2023) in Geography, and Nordin and Swanto (2023) who discovered better vocabulary performance in secondary school students in Lahad Datu, Sabah, after the application of Quizizz.

However, this effectiveness does not come automatically. In a quasi experimental study which included 141 Form 4 Chemistry students in rural Sabah, Fung Ah Chon, Sharif, Chan, Shaafi and Norwen (2026) discovered that Kahoot! significantly enhanced student motivation, although the difference in academic performance between experimental and control groups was not statistically significant. This discrepancy between a large affective effect and a small cognitive effect is a significant clue that the effects of IDAs are heavily influenced by how teachers combine them in the pedagogical use, rather than by the frequency of use.

The identified issues and challenges in this issue paper are arranged based on the classic technology-integration barriers framework by Ertmer (1999) where first-order barriers are external and structural in nature (infrastructure, time and institutional support) and second-order barriers are internal and based on the pedagogical beliefs and attitudes of teachers. The same categorisation is further substantiated by the fact that Bingimlas (2009) has found lack of confidence, lack of competence and lack of access to resources three interconnected critical elements that influence barriers to the use of technology among teachers.

A closer reading of this literature, however, reveals that most studies adopt a single-lens approach, examining either first-order or second-order barriers rather than both together as interacting forces. For example, infrastructure-focused studies (Yap et al. 2024; Mastam et al. 2024; Akram et al. 2022) document access and resource constraints without examining their influence on teachers' confidence or motivation, while attitude-focused studies (Sulaiman et al. 2024; Ishak et al. 2022) document psychological resistance without tracing it back to the

structural conditions that may have produced it. This issue paper addresses this limitation by explicitly discussing, in the following sections, how first-order and second-order barriers co-occur within the same teacher population in the Malaysian secondary school context — for instance, how senior teachers' psychological resistance to digital approaches (Rubathey Muniyandi et al. 2023) is compounded by, rather than independent of, the infrastructural and institutional constraints documented elsewhere in this review. Combining Ertmer's (1999) barriers framework with TPACK (Mishra and Koehler 2006) further allows this issue paper to move beyond a descriptive cataloguing of which barriers exist towards an explanatory account of why these barriers translate into shallow, presenter-type technology use (Antonietti et al. 2024) rather than deep pedagogical transformation. Whereas prior studies have tended to apply either Ertmer's barriers typology (e.g., Bingimlas 2009, in a broader international context) or TPACK alone (e.g., Azhar and Hashim 2022; Tzafilkou et al. 2023) to describe digital competency, few have systematically integrated both to explain how structural and attitudinal barriers specifically obstruct TPACK integration among Malaysian secondary school teachers, which is a gap this issue paper aims to narrow.

Significance of the Study

This issue paper has a lot of practical and theoretical implications on different stakeholders in the Malaysian education system. In the case of secondary school teachers, this discussion of problems and difficulties can assist them in recognizing and introspecting on the obstacles that they might encounter when incorporating IDAs into their everyday pedagogical routine, and, thus, allow them to design the adaptation strategies that will be more appropriate to the school environment in which they will be working. To school administrators and department heads, the results of this issue paper highlight the need to have a proactive technology leadership (Ghavifekr and Wong 2022) that will offer a long-term support to teachers, but not just to offer infrastructure.

To policymakers, especially the Ministry of Education Malaysia, this issue paper will provide empirical evidence to support the need to keep on improving the strategies of implementing the Digital Education Policy (DEP) 2023 especially in ensuring that teacher professional development strategies, are responsive to the diversity of the contexts of urban, rural and industrial schools (Ministry of Education Malaysia 2023). In theory, the issue paper adds to the body of existing literature by combining the Ertmer (1999) framework of technology-integration barriers with the TPACK framework (Mishra and Koehler 2006), which provides a more comprehensive analytical prism than earlier research which has tended to apply either of these frameworks in isolation.

Issues and Challenges of Ida Use among Teachers

Infrastructure Gap and Technology Access

The most basic problem of teachers is the disparity in access to digital infrastructure based on the location of the school. In a survey of 395 Malaysian secondary school teachers, Yap, Moses, Cheah, Md. Khambari, Wong and Fu-Yun Yu (2024) determined that the facilitating conditions (namely infrastructure and ICT support) were the primary factor in determining the level of Google Classroom use with a large disparity between urban and rural school teachers. Mastam, Mokhtar and Zaharudin (2024) also note that the disparity in access to technology between urban and rural schools is still a significant issue in Malaysia, although the DEP 2023 aims to ensure that all students and teachers are provided with digital skills.

This is not a Malaysian problem; in a systematic review of the Pakistani situation, Akram, Abdelrady, Al-Adwan and Ramzan (2022) found insufficient infrastructure, disruptions in internet connections and power supply to be key obstacles to the adoption of technology in T&L by teachers.

This digital divide is not restricted to the lack of devices or the internet connection alone but also includes digital literacy and readiness of the environment in general (Ina Murni Hashim 2024). In the student level, Sarimah Suriashah (2021) discovered that indigenous students in rural Sabah were unable to maintain digital learning regularly because of the unreliability of the internet connections and the absence of appropriate digital devices. Though this paper is about the experiences of students, not teachers per se, the result is pertinent to the debate over teacher-related problems since teachers in the same schools are working within the same limited infrastructure, which further supports the argument that the digital divide is a systemic problem that requires solutions at the infrastructure, training and ongoing support level, and not an individual teacher or student problem.

Uneven Teacher Digital Competency

There is also significant variability in teacher digital competency based on school context and teacher profile. Omar and Mohmad (2023) discovered that the general digital competency of SMK teachers in the Klang Valley was high in the dimensions of digital pedagogy, ICT skills and readiness to online teaching; nevertheless, this positive result does not always reflect the situation in other regions with other socioeconomic and infrastructural characteristics. Even the DEP 2023 report itself shows that most of the teachers in the country are at the lowest level of digital competence, and only a minor percentage of them can be considered at a higher level (Ministry of Education Malaysia 2023). Further supporting the claims of the competency gap being a systemic issue, Msambwa, Daniel and Cai (2024) conduct a systematic review of 54 internationally indexed studies and conclude that effective ICT implementation in secondary schools needs to involve simultaneous focus on teacher professional development, enhanced ICT skills and systemic issues like infrastructure, policy and school collaborative culture, so the competency gap is not an individual teacher problem, but also a systemic provision.

This disparity is also eminent in subjects taught. Nor Farahin Abdul Manaf, Nur Athirah Hamizah Yahya, Nur Sabrina Aiman Mohd Rosszi and Jing (2024) discovered that the majority of Malay Language teachers are struggling to incorporate technology in their teaching because their understanding of more recent digitalisation elements, especially online platforms, is moderate. This observation is supported by Noormarizan Mohamed Nawi and Ariff Mohamad (2024) who found that the information and digital technology literacy of Malay Language teachers is at the weak level with the majority of teachers being only familiar with the basic and traditional software like Microsoft Word and PowerPoint as opposed to more modern online systems, which means that digital competency development planning must consider the subject diversity and not just use a one-size-fits-all approach to all teachers. The impact on students is also associated with this problem of low digital literacy; Nur Syawal Syazwani Ibrahim and Norfatiha Othman (2022) have found that low digital literacy among students contributed to their increased difficulty in adapting to and using new technology during the Covid-19 pandemic, which is also indicative of the digital literacy gap as a problem that cuts across both the teacher and student populations in the same school environment.

Time Constraints and Workload

The issue of time due to workload and the load of curriculum is always cited as a challenge in a variety of research. Sulaiman, Shaifuddin and Samsudan (2024) discovered that the primary barriers that affect the implementation of digital information literacy competency among secondary school teachers in Malaysia are limited access to technology, time constraints caused by workload and curriculum demands, resistance to change, high rate of technological change, and assessment challenges. An overload of administrative tasks and curriculum requirements among teachers usually leaves them insufficient time to investigate, plan and systematize the use of IDAs within their daily T&L, thus restricting the use of IDAs to a superficial level only.

Inconsistent School Leadership and Institutional Support

The institutional variables, especially the technology leadership of principals are a key determinant of how meaningfully teachers use IDAs. In a survey of 310 teachers in secondary schools in Selangor, Ghavifekr and Wong (2022) discovered that the technology leadership of principals had a significant and positive correlation with the effectiveness of ICT use among teachers, including technology vision, strategic planning, resource support and development of a digital school culture. Without this kind of leadership, the competency of individual teachers is hard to put into digital pedagogical practice across the school. Abdullah and Abdul Kadir (2023) also support this finding by observing that in secondary schools in the Klang District, there is a significant correlation between digital leadership by principals and digital competency of teachers, with teachers having higher levels of digital literacy being more likely to plan interactive technology-based T&L when supported by strong digital leadership at the school level.

Ping, Tahir, Rosli, Atan and Ali (2024) also identified various challenges and barriers to e-leadership participation among Malaysian secondary school teachers, showing that the issue of digital leadership is not confined to school administrators but also involves teachers' own capacity to take on digital leadership roles at the classroom level.

Teacher Attitude and Psychological Readiness towards Change

The problem is not entirely structural but encompasses psychological and attitudinal aspects in teachers. Sulaiman, Shaifuddin and Samsudan (2024) discovered that educators who lacked confidence in using and teaching ICT tools could lower their initiative to use technology, thus limiting the exposure of students to the advantages of ICT-based learning; this result indicates that resistance to change is also caused by the self-confidence of teachers, rather than by a deficiency in technical competence. The latter psychological issue was especially acute during the COVID-19 pandemic, as Ishak, Din and Othman (2022) discovered that educators in Malaysia encountered multiple psychological and technical obstacles when the sudden transition to online T&L took place. Similarly, Teo Woon Chun and Melor Md Yunus (2023) discovered that attitude and perceived ease of use were significant factors that affected the behavioural intentions of Malaysian ESL teachers to persist technology use in the post-COVID-19 period, rather than the exposure to the technology during the crisis period.

This psychological preparedness challenge is identified to be more acute in the case of senior teachers. Rubathey Muniyandi, Norliza Abdul Majid and Nurulhuda Md Hassan (2023) discovered that despite welcoming the technological advances in education, senior teachers

were reported to be more familiar with the traditional approach to pedagogy than with digital approaches, with age, physical health factors due to long-term screen exposure, and low self-confidence being cited as the primary reasons. This research also discovered that a proportion of older teachers believed that an impending retirement decreases the urgency to enhance their digital proficiency in an opinion that threatens to increase the generational divide in the use of ICTs in schools unless an intervention is undertaken to address their requirements through a more accommodating training strategy.

The Pedagogy-Technology Gap: Surface-Level Use versus Meaningful Transformation

The greatest challenge that was found in the literature is the disjuncture between superficial technology application and real pedagogical change. In a latent profile of 2,088 upper secondary school teachers in Switzerland, Antonietti, Consoli, Schmitz, Cattaneo, Gonon and Petko (2024) discovered that 43.5 per cent of the teachers were digital presenters, who merely used technology to deliver content but did not alter their pedagogical framework, 47.3 per cent were digital activators, who provided limited student engagement, and only 10.3 per cent were digital constructivists, who actively engaged students in constructing new knowledge with technology. The result that nearly nine out of ten teachers failed to make any significant pedagogical change even with the use of technology is solid empirical evidence that the gap is structural in nature, not simply due to incompetence in technology.

Consoli, Schmitz, Antonietti, Gonon, Cattaneo and Petko (2024) have also discovered that the quality of technology integration, as opposed to the number of times it was used, was significantly related to behavioural engagement and digital competencies among students. This gap is indicative of the failure of some teachers to combine technological knowledge (TK) meaningfully and simultaneously with their pedagogical knowledge (PK) and content knowledge (CK) in the TPACK framework (Mishra and Koehler 2006; Koehler and Mishra 2009). Tzafilkou, Perifanou and Economides (2023) and Azhar and Hashim (2022) also confirm that Technological Pedagogical Knowledge (TPK) component is the most strongly correlated with overall teacher digital competency as compared to other TPACK constructs, with Küng and Brovelli (2025) also showing that the level of training directly affects the ability of teachers to assess and choose pedagogically appropriate IDAs.

Technology-Based Assessment Challenges

Lastly, there is a unique challenge of teachers in terms of IDA-based assessment. One of the key obstacles to the implementation of ICT in T&L by the Malaysian secondary school teachers according to Sulaiman et al. (2024) is the assessment challenges, especially in the context of ensuring that the technology-based formative assessment is a valid and reliable measure of learning achievement by students. In a research of 338 ESL teachers in Selangor, Razak, Mat Yusoff, Chin and Marzaini (2023) discovered that pedagogical knowledge (PK) and pedagogical content knowledge (PCK) and not content knowledge (CK) alone was significantly linked to classroom-based assessment practice, and it was important to note that the success of digital assessment relies on the depth of the teachers pedagogical knowledge and not just their familiarity with the technology tools.

Conclusion

There is a great potential in interactive digital applications to enhance T&L in secondary schools, but this potential does not manifest itself spontaneously. The analysis of problems

and difficulties in this issue paper indicates that the infrastructure gaps, imbalanced digital competency, time, teacher attitude, inconsistent institutional support, pedagogy-technology gap and assessment problems are all a complex obstacle to meaningful integration of IDA, which involves structural, individual, and pedagogical factors. The TPACK framework explains that the answer to these issues is not just to introduce technology like the DELIMa platform, but to have the education system able to assist teachers in the simultaneous and meaningful integration of technological, pedagogical and content knowledge (Mishra and Koehler 2006; Antonietti et al. 2024).

A number of solutions are proposed in order to cope with these problems. To begin with, the teacher professional development programmes in urban, rural, and industrial schools should be different in design depending on school context (Yap et al. 2024; Mastam et al. 2024). Secondly, schools should enhance the technological leadership of administrators and heads-of-department to offer long-term assistance to teachers, and not just access to digital platforms (Ghavifekr and Wong 2022; Abdullah and Abdul Kadir 2023). Third, teacher education is to be oriented at the concurrent development of the three TPACK areas of knowledge, but not only technical proficiency in the working with IDA platforms (Küng and Brovelli 2025). Fourth, specific support plans must be tailored to groups of teachers who are more likely to be left behind, such as senior teachers and teachers of specific subjects like Malay Language, who are identified to be less digital-ready (Rubathey Muniyandi et al. 2023; Nor Farahin Abdul Manaf et al. 2024). Fifth, more empirical studies are required to specifically investigate the connection between the degree of utilization of particular IDA platforms and the aspects of pedagogical practice of teachers in a variety of local settings, including industrial regions that are under-researched. It takes long-term commitment on the part of policymakers, school leaders and educators themselves to make sure that the investment in digital education can be translated into the actual pedagogical change, as opposed to the superficial application of technology.

This issue paper is not without limitations. As a narrative synthesis rather than a systematic review, it does not apply a formal protocol for study selection or quality appraisal, and the literature discussed, while broad, is not exhaustive. The discussion also draws predominantly on studies situated in Malaysian secondary schools, which may limit the generalisability of the findings to other educational levels or national contexts, although comparable issues reported in non-Malaysian studies (e.g., Akram et al. 2022) suggest that the challenges identified are not unique to Malaysia. Future empirical research, particularly studies that directly test the interaction between first-order and second-order barriers proposed in this paper, would help validate and extend the arguments presented here.

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