School Support Systems for Strengthening Technology Integration in Primary School Design and Technology Education: A Conceptual Paper

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ABSTRACT

This conceptual paper examines the role of school support systems in strengthening technology integration in primary school Design and Technology (RBT) education in Malaysia. Although national education policies emphasise digital transformation, classroom implementation remains uneven, particularly when teachers face limited infrastructure, inconsistent administrative support, insufficient technical assistance, and unequal access to professional development. This issue is particularly significant in RBT because the subject requires teachers to connect technological knowledge with hands-on learning, design activities, problem-solving, and practical classroom application. Guided by the Technological Pedagogical Content Knowledge (TPACK) framework, Self-Determination Theory (SDT), and Facilitating Conditions (FC) from the Unified Theory of Acceptance and Use of Technology (UTAUT), this paper positions technology integration as a school-supported process rather than an individual teacher responsibility alone. The proposed conceptual framework explains how school support systems function as an enabling and mediating mechanism that links teacher competency and teacher motivation with actual technology integration practices. This paper contributes to the literature by shifting the discussion from teacher readiness alone to the interaction between teacher capacity, teacher willingness, and school-level conditions in the specific context of primary school RBT education. The discussion offers practical implications for policymakers, school leaders, curriculum developers, and teacher education providers in strengthening sustainable technology integration in Malaysian primary schools.

Keywords: school support systems, technology integration, primary school RBT education, teacher competency, teacher motivation, facilitating conditions

INTRODUCTION

Technology integration has become an important concern in contemporary education as schools are expected to prepare pupils for a society shaped by rapid digital change. Globally, digital transformation in education is increasingly linked to technological literacy, creativity, adaptability, and future-ready learning (UNESCO, 2023; Voogt et al., 2013). In Malaysia, this agenda is reflected in national education policies that emphasise digital transformation, teacher capacity building, infrastructure improvement, and the meaningful use of technology in teaching and learning (MOE, 2013, 2023). Within this policy direction, primary school Design and Technology (RBT) education plays an important role in exposing pupils to practical technological knowledge, design thinking, creativity, problem-solving, and hands-on learning from an early stage (MOE, 2017).

Technology integration in RBT classrooms cannot be understood merely as the use of digital devices, online platforms, or presentation tools. The subject requires teachers to make informed instructional decisions on how technology can support content understanding, project-based learning, practical activities, and pupils' learning experiences. This is important because RBT involves product design, problem-solving tasks, technological applications, and hands-on project work that require both technical understanding and effective teaching strategies. Therefore, teachers need to integrate technological, pedagogical, and content knowledge in ways that are meaningful to classroom practice, as emphasised in the Technological Pedagogical Content Knowledge framework (Koehler & Mishra, 2009; Mishra & Koehler, 2006; Schmid et al., 2021).

However, technology integration in schools remains uneven. Some teachers may have the knowledge and willingness to use technology, yet their classroom practice is still shaped by the level of support available in their school environment. Limited technological resources, weak infrastructure, insufficient technical assistance, lack of continuous professional development, and inconsistent leadership support can restrict teachers' ability to apply technology effectively (Dong et al., 2020; Sailer et al., 2021; Tondeur et al., 2019). These constraints are especially important in RBT because the subject depends not only on teacher knowledge, but also on selected tools, practical resources, time, workspace, and school-level support. Previous studies have also shown that school-related conditions and teacher background can influence technology integration, particularly when teachers are required to teach outside their area of specialisation (Ibrahim & Husnin, 2025; Shafie & Jamaluddin, 2025).

This paper is guided by three complementary perspectives: the Technological Pedagogical Content Knowledge (TPACK) framework, Self-Determination Theory (SDT), and Facilitating Conditions (FC) from the Unified Theory of Acceptance and Use of Technology (UTAUT). TPACK explains the knowledge teachers need to integrate technology, pedagogy, and subject content in classroom practice (Mishra & Koehler, 2006). SDT provides a supporting lens for understanding teacher motivation, particularly how autonomy, competence, and relatedness influence teachers' willingness to engage in meaningful teaching practices (Deci & Ryan, 2000; Ryan & Deci, 2020). UTAUT facilitating conditions explain how institutional support, resources, and organisational readiness influence technology use (Venkatesh et al., 2003). Together, these perspectives show that technology integration is shaped not only by teacher competency, but also by motivation and school-level conditions that enable classroom implementation (Inan & Lowther, 2010; Tang et al., 2024; Teo, 2011).

The central argument of this paper is that sustainable technology integration in primary school RBT depends on the interaction between teacher competency, teacher motivation, and school support systems. Although previous studies have recognised the importance of these factors, they are frequently examined in isolation. Less attention has been given to how these factors interact within subject-specific contexts such as primary school RBT, where successful technology integration depends on both teacher readiness and practical school-level support. Therefore, school support is positioned as a mediating mechanism that helps translate teacher competency and teacher motivation into actual classroom technology integration (Cabellos et al., 2024; Petko et al., 2018; Tang et al., 2024).

This conceptual paper proposes a context-specific framework that explains how school support systems mediate the relationships between teacher competency, teacher motivation, and technology integration in primary school RBT education.

Problem Background

Despite the strong emphasis on technology integration in education, its implementation in primary school RBT classrooms remains uneven. RBT is not a subject that depends only on explanation or textbook-based teaching. It requires pupils to engage in designing, building, testing, improving, and presenting project outcomes. Therefore, technology integration in RBT is not merely about using digital devices, but about helping pupils apply technological knowledge in meaningful and practical ways (MOE, 2017; Rashid et al., 2022; Schmid et al., 2021).

A key concern is that the expectations of the RBT curriculum are not always supported by adequate school-level conditions. Teachers may be expected to conduct practical and technology-based lessons, yet some schools still face limitations in equipment, workspace, internet access, technical assistance, teaching materials, and professional support. These constraints show that technology integration is not only related to teachers' knowledge or skills, but also to the extent to which the school environment enables teachers to apply those competencies in classroom practice (Dong et al., 2020; Tondeur et al., 2019; Yusof et al., 2023).

The issue becomes more complex because RBT teachers do not always share the same background, training, or readiness. Non-option teachers may face greater challenges because RBT requires practical demonstration, technical explanation, project supervision, and the ability to respond to pupils' mistakes during hands-on activities. Without sufficient support, teachers may simplify project tasks, avoid complex technology-based activities, or rely on safer teaching approaches that do not fully reflect the intended nature of RBT learning (Ibrahim & Husnin, 2025; Rashid et al., 2022; Shafie & Jamaluddin, 2025).

Teacher motivation is also important, but motivation alone may not be enough when teachers repeatedly face limited resources, weak technical support, insufficient training, lack of time, and unclear school-level guidance. Over time, these constraints may reduce teachers' confidence and willingness to integrate technology consistently. This suggests that teacher motivation needs to be supported by enabling school conditions so that willingness can be translated into actual classroom practice (Inan & Lowther, 2010; Ryan & Deci, 2020; Teo, 2011).

Previous studies have discussed teacher competency, motivation, and technology adoption as important factors in educational technology integration. However, these elements are often examined separately. This limits understanding of how teacher-related factors and school-level support work together in shaping actual technology integration practices. Therefore, this conceptual paper addresses the need to understand technology integration in primary school RBT as a school-supported process rather than an individual teacher responsibility alone (Batucan et al., 2022; Petko et al., 2018; Sailer et al., 2021; Venkatesh et al., 2003).

Technology Integration in Primary School RBT Education

Technology integration in primary school RBT education should not be viewed as the simple use of computers, presentation slides, online platforms, or digital applications. In RBT, technology integration refers to the purposeful use of technological knowledge, tools, materials, processes, and digital resources to support pupils' practical learning, design thinking, problem-solving, and project development (Endot et al., 2021; MOE, 2017; Rashid et al., 2022).

Technology in RBT functions as both subject content and learning process. Pupils are introduced to product design, basic electronics, programming, mechanical systems, invention, and practical problem-solving. Meaningful integration occurs when pupils are guided to explore ideas, construct products, troubleshoot errors, and explain how their project outcomes function (Dahari et al., 2024; Mohammad et al., 2015; Razali et al., 2022; Sahaat & Nasri, 2020).

This makes the role of RBT teachers more demanding than general digital tool use. Teachers need to understand RBT content, select suitable pedagogical strategies, demonstrate technical procedures, guide safe tool handling, support pupils during product construction, and respond to errors during testing. These tasks require teachers to connect technological knowledge, pedagogical decisions, and subject content in ways that support both technical understanding and classroom learning (Endot et al., 2021; Masingan & Sharif, 2019; Mishra & Koehler, 2006; Shafie & Jamaluddin, 2025).

Practical technology-based lessons also depend on school conditions. Suitable equipment, functional tools, workspace, teaching materials, technical assistance, and preparation time influence whether teachers can conduct meaningful RBT activities. When these conditions are limited, teachers may reduce project complexity, avoid certain activities, or rely on surface-level demonstrations. This may prevent pupils from fully experiencing the practical, exploratory, and problem-solving nature of RBT learning (Dahari et al., 2024; Masingan & Sharif, 2021; Sahaat & Nasri, 2020; Shafie & Jamaluddin, 2025).

RBT is especially relevant at the primary level because it provides early exposure to technical and vocational learning. Through RBT, pupils begin to develop technological awareness, practical skills, creativity, confidence, and real-life problem-solving ability. These learning experiences align with national and educational priorities on digital transformation, STEM learning, technical literacy, and future-ready skills (Dahari et al., 2024; MOE, 2013, 2017, 2023; Shafie & Jamaluddin, 2025; UNESCO, 2023).

Teacher Competency through TPACK

Teacher competency is central to technology integration in primary school RBT because the subject requires more than general digital literacy. RBT teachers are expected to interpret curriculum content, organise practical activities, guide pupils through project development, and use suitable technological tools to support learning. Competency is therefore understood as the ability to connect technological knowledge, pedagogical decisions, and RBT content in actual classroom practice (Mishra & Koehler, 2006; Schmid et al., 2021; Schmidt et al., 2009).

The TPACK framework is relevant because effective technology-based teaching depends on the interaction between technological knowledge, pedagogical knowledge, and content knowledge. In RBT, this interaction is important because teachers must know not only what to teach, but also how to teach it through demonstrations, project tasks, technical guidance, and problem-solving activities. Technology use may remain superficial if teachers cannot align tools with learning objectives, pupils' readiness, safety procedures, assessment requirements, and project outcomes (Chai et al., 2013; Mishra & Koehler, 2006; Sailer et al., 2021).

RBT teacher competency differs from general ICT competency. General ICT competency may involve using digital platforms or online resources, while RBT requires teachers to guide pupils in designing products, assembling components, using tools safely, troubleshooting project errors, and explaining how a product functions. This distinction is important, especially for non-option teachers who may require stronger school - based guidance, training, peer support, and teaching resources (Masingan & Sharif, 2019, 2021; MOE, 2017; Shafie & Jamaluddin, 2025).

Teacher competency also develops through continuous professional learning rather than one-off exposure to digital tools. Professional development should connect technology with RBT content, project-based pedagogy, classroom realities, and pupils' learning needs. Even teachers with strong TPACK may struggle to apply their knowledge if schools lack equipment, technical assistance, workspace, internet access, or leadership support. This shows that competency becomes meaningful only when supported by enabling school conditions (Dong et al., 2020; Petko et al., 2018; Tondeur et al., 2019; Yusof et al., 2023).

Teacher Motivation through SDT

Teacher motivation is important because technology integration in RBT requires sustained effort, confidence, and willingness to manage practical and sometimes uncertain classroom tasks. RBT teachers need to guide project-based learning, solve technical issues, support pupils during hands-on work, and respond to mistakes during testing or programming. Motivation is therefore treated as a psychological and professional condition that influences whether teachers are willing to engage with technology meaningfully (Deci & Ryan, 1985, 2000; Ryan & Deci, 2020).

Self-Determination Theory explains that teachers are more likely to engage in meaningful practice when autonomy, competence, and relatedness are supported. In RBT teaching, autonomy refers to teachers' professional control in selecting suitable strategies. Competence refers to their confidence in handling technology-based teaching tasks, while relatedness refers to support, collaboration, and belonging within the school environment (Deci & Ryan, 2000; Endot et al., 2021; Ryan & Deci, 2020).

Motivation and competency are closely connected. A teacher may have technological knowledge but may not apply it actively without motivation. At the same time, motivation without sufficient competency is also inadequate because RBT requires practical and technical decision-making. Teachers are more likely to sustain technology-based practices when they feel capable, trusted, and supported (Endot et al., 2021; Inan & Lowther, 2010; Shafie & Jamaluddin, 2025; Teo, 2011).

School-level conditions also shape teacher motivation. Even motivated teachers may become less willing to use technology when they repeatedly face limited equipment, lack of technical support, insufficient training, heavy workload, unclear guidance, or inadequate preparation time. This issue is especially relevant for non-option RBT teachers, who may experience greater uncertainty when teaching technical topics such as electronics, programming, product design, or project construction (Ibrahim & Husnin, 2025; Petko et al., 2018; Tondeur et al., 2019; Yusof et al., 2023).

School Support Systems through UTAUT Facilitating Conditions

School support systems are positioned as a central construct because technology integration in RBT cannot be sustained by teacher competency and motivation alone. Recent evidence shows that school facilitating conditions are closely linked to teachers' technology-related practices, suggesting that school-level conditions play an enabling role in translating teacher readiness into classroom implementation (Cabellos et al., 2024; Petko et al., 2018; Yusof et al., 2023).

UTAUT provides a useful theoretical basis for explaining school support through the lens of facilitating conditions. In UTAUT, facilitating conditions refer to organisational and technical infrastructure that supports technology use. In schools, these conditions include the resources, technical assistance, leadership practices, professional learning opportunities, and instructional supports that help teachers use technology effectively in classroom practice (Batucan et al., 2022; Tondeur et al., 2019; Venkatesh et al., 2003).

For future empirical testing, school support systems in primary school RBT education can be operationalised into four main dimensions: infrastructure support, technical support, leadership support, and professional development support. First, infrastructure support refers to the availability and functionality of internet access, digital devices, workshop facilities, tools, equipment, teaching materials, project materials, software, modules, funding, and preparation time needed for RBT activities. Second, technical support refers to assistance for troubleshooting, equipment maintenance, software use, and classroom technology problems. Third, leadership support refers to school leaders' encouragement, planning, resource allocation, time provision, and clear guidance for technology-based RBT teaching. Fourth, professional development support includes training, mentoring, peer collaboration, and professional learning communities that help teachers connect technology with RBT content and pedagogy.

These dimensions are important because RBT teaching requires more than ordinary classroom facilities. Teachers may possess TPACK-related knowledge and motivation to innovate, but this readiness may remain underused if the school lacks functional equipment, technical assistance, professional learning, leadership direction, teaching resources, or time for project preparation. In this sense, school support serves as the mechanism that connects teacher readiness to classroom enactment (Ertmer et al., 2012; Petko et al., 2018; Sailer et al., 2021).

This issue is also linked to educational inequality at the school level. Schools differ in infrastructure, resource availability, leadership culture, technical readiness, and professional development opportunities. These differences may create uneven technology integration practices across classrooms, even under the same curriculum. Such inequality is more visible in RBT because teachers need tools, materials, workspace, and technical support to conduct practical lessons effectively (Ibrahim & Husnin, 2025; Shafie & Jamaluddin, 2025; Yusof et al., 2023).

For this conceptual paper, school support systems through UTAUT facilitating conditions refer to organisational, technical, professional, leadership, and instructional supports that enable RBT teachers to carry out technology integration effectively. This framing supports the mediating role of school support systems: competency may prepare teachers to use technology, and motivation may encourage them to engage with it, but school support determines whether these teacher-level factors can be translated into sustainable classroom practice.

Knowledge Gap and Conceptual Contribution

Although technology integration has been widely examined in education, existing studies have produced mixed explanations regarding the factors that influence teachers' technology use. Some studies emphasise teacher-related factors such as technological competency and pedagogical readiness, while others highlight motivation, technology acceptance, organisational support, or school-level conditions as primary determinants of implementation. These differing perspectives suggest that technology integration cannot be adequately explained through a single factor alone (Inan & Lowther, 2010; Petko et al., 2018; Sailer et al., 2021; Tondeur et al., 2019).

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A key gap concerns the way teacher competency is conceptualised in technology integration research. TPACK-based studies consistently demonstrate the importance of technological, pedagogical, and content knowledge in supporting technology-enhanced teaching. However, evidence also suggests that teachers with adequate knowledge do not always translate this competency into classroom practice when contextual support is limited (Ertmer et al., 2012; Petko et al., 2018; Schmid et al., 2021). This indicates that teacher competency alone may be insufficient to explain sustained technology integration, particularly in practical subjects such as RBT (Endot et al., 2021; Masingan & Sharif, 2019; Mishra & Koehler, 2006; Schmidt et al., 2009; Shafie & Jamaluddin, 2025).

A second gap concerns teacher motivation. SDT explains why teachers engage in meaningful practice, but motivation is often treated as an individual psychological factor. In RBT, willingness alone does not guarantee implementation because teachers still need tools, materials, workspace, technical assistance, training opportunities, and time for preparation. Therefore, school-level support must be examined as the condition that enables motivation to become actual classroom practice (Deci & Ryan, 2000; Petko et al., 2018; Ryan & Deci, 2020; Yusof et al., 2023).

The most significant conceptual gap concerns the role of school support systems. Existing literature acknowledges that infrastructure, leadership, professional development, technical assistance, and teaching resources influence technology integration. However, these factors are commonly treated as contextual or background variables rather than as mechanisms that explain how teacher competency and teacher motivation shape actual classroom practice (Batucan et al., 2022; Cabellos et al., 2024; Petko et al., 2018; Venkatesh et al., 2003). This limitation is particularly important in primary school RBT education because successful technology integration depends not only on teacher readiness but also on access to tools, workspace, technical guidance, project materials, and practical teaching support.

This conceptual paper contributes to the literature in three ways. First, it extends technology integration research into the underexplored context of primary school RBT education, where teaching involves project-based, practical, and design-oriented learning activities. Second, it integrates TPACK, SDT, and UTAUT facilitating conditions (FC) into a unified explanatory framework that links teacher capability, teacher willingness and enabling school conditions. Third, it positions school support systems as a mediating mechanism through which teacher competency and teacher motivation are translated into technology integration practices. Unlike previous studies that frequently examine teacher-related and school-related factors separately, the proposed framework explains how these factors interact to support sustainable technology integration in primary school RBT classrooms.

PROPOSED CONCEPTUAL FRAMEWORK

This conceptual paper proposes a framework for understanding technology integration in primary school RBT education as a school-supported process. The framework is developed by synthesising three theoretical perspectives: TPACK, SDT, and UTAUT. TPACK explains the teacher competency needed to integrate technological knowledge, pedagogical strategies, and RBT content. SDT explains the motivational conditions that influence teachers' willingness to engage in technology-based teaching. UTAUT facilitating conditions explain the school-level support required to enable actual classroom implementation (Deci & Ryan, 2000; Mishra & Koehler, 2006; Ryan & Deci, 2020; Schmidt et al., 2009; Venkatesh et al., 2003).

Table 1. Theoretical Constructs and Conceptual Roles in the Proposed Framework

Construct	Theoretical Lens	Conceptual Role in the Proposed Framework
Teacher Competency	TPACK	Provides the conceptual basis for understanding and assessing teacher competency in integrating technological knowledge, pedagogical strategies, and RBT content in project-based classroom practice.

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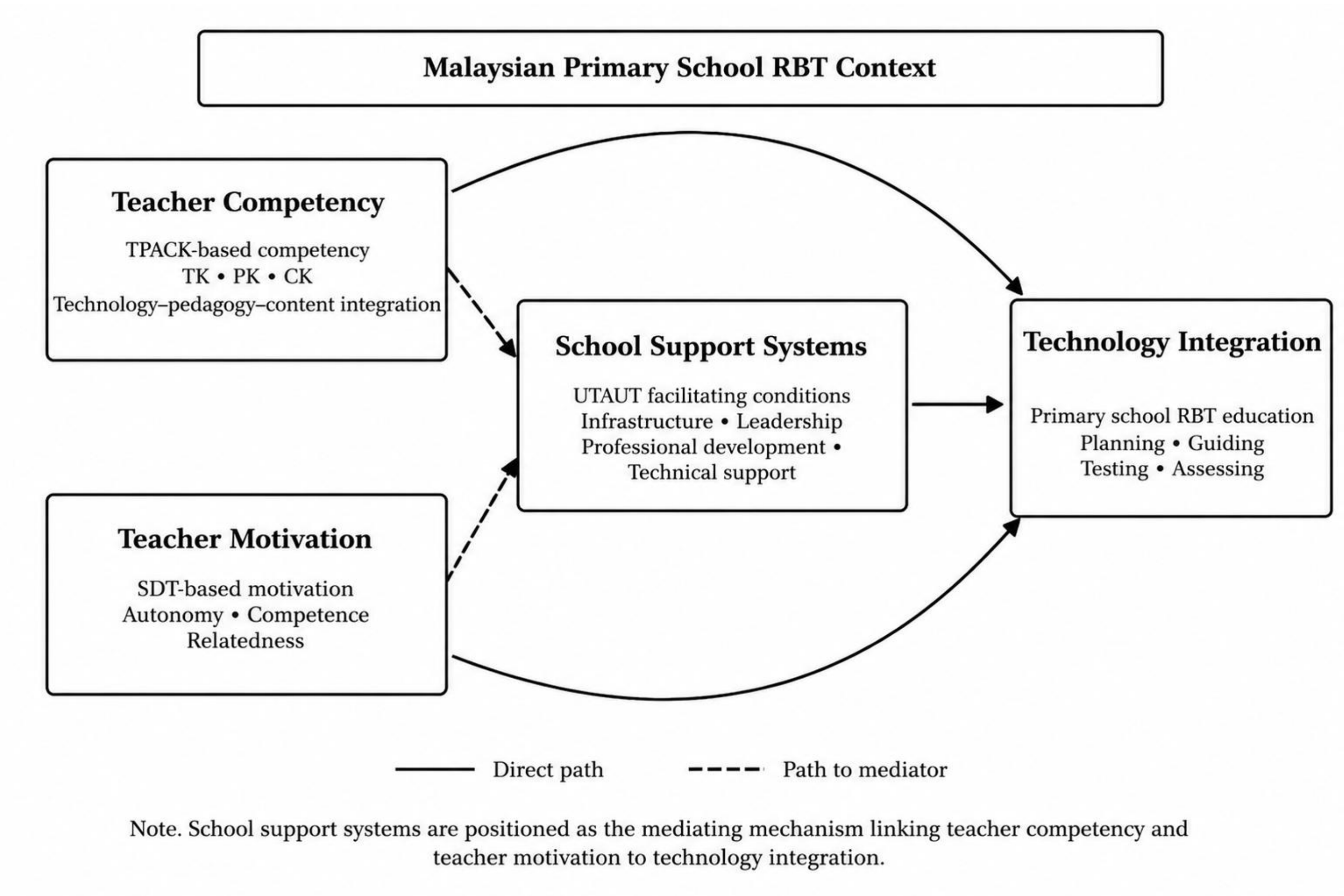
Teacher Motivation	SDT	Provides the conceptual basis for understanding teacher motivation to engage in technology-based teaching when autonomy, competence, and relatedness are supported.
School Support Systems	UTAUT Facilitating Conditions	Provides the conceptual basis for explaining the enabling school conditions that support the translation of teacher competency and teacher motivation into actual classroom implementation.
Technology Integration	RBT Classroom Practice	Refers to the actual use of technology in planning, guiding, testing, troubleshooting, and assessing pupils' RBT project-based learning.

Figure 1. Proposed Conceptual Framework for School-Supported Technology Integration in Primary School RBT Education



Note. TPACK = Technological Pedagogical Content Knowledge, SDT = Self-Determination Theory, UTAUT = Unified Theory of Acceptance and Use of Technology. Solid arrows indicate direct paths, while dashed arrows indicate paths to the mediating construct.

This paper conceptualises school support systems as a mediator because teacher competency and teacher motivation may not directly become classroom practice unless school-level conditions enable implementation. This position is consistent with studies showing that school readiness, facilitating conditions, and institutional support influence whether teacher-level readiness is translated into technology integration practices (Petko et al., 2018; Tondeur et al., 2019; Cabellos et al., 2024). However, school support may also operate as a moderator in other contexts by strengthening or weakening the relationship between teacher-level factors and technology integration. Therefore, future empirical studies may compare mediation, moderation, and reciprocal models to determine which explanation best reflects technology integration in primary school RBT classrooms.

As shown in Figure 1, teacher competency and teacher motivation are positioned as teacher-level factors that may directly influence technology integration in primary school RBT education. Competency enables teachers to plan, guide, demonstrate, troubleshoot, and assess technology-based learning activities, while motivation supports their willingness to sustain these practices despite classroom challenges. However, these teacher-level factors may not be sufficient when school conditions are weak or inconsistent (Inan & Lowther, 2010; Petko et al., 2018; Sailer et al., 2021; Shafie & Jamaluddin, 2025).

The framework positions school support systems as the mediating mechanism between teacher-level readiness and technology integration practices. School support systems include infrastructure, leadership support, professional development, technical assistance, teaching resources, and time allocation. These facilitating conditions determine whether teachers' competency and motivation can be translated into actual RBT classroom practice. In this sense, school support is not treated as a background factor, but as an enabling condition that supports the movement from teacher readiness to sustainable implementation (Ertmer & Ottenbreit-Leftwich, 2010; Tondeur et al., 2019; Venkatesh et al., 2003; Yusof et al., 2023).

This framework is particularly relevant to the Malaysian primary school RBT context because RBT involves practical, technical, and project-based learning. Teachers are expected to guide pupils in design tasks, product development, programming, electronics-related activities, testing, improvement, and assessment of project outcomes. These requirements demand more than teacher knowledge or willingness alone; they require school-level conditions that allow technology-based teaching to be planned and carried out effectively (Dahari et al., 2024; Endot et al., 2021; MOE, 2017; Rashid et al., 2022).

The main conceptual contribution of this framework is its positioning of school support systems as the mechanism that connects teacher competency and teacher motivation with actual technology integration practices. Rather than combining TPACK, SDT, and UTAUT as separate theories, this framework gives each theory a specific role in explaining RBT technology integration. TPACK explains teacher capability, SDT explains teacher willingness, and UTAUT facilitating conditions explain the school-level support needed to convert readiness into classroom implementation. This synthesis addresses a limitation in previous technology integration studies, where teacher-related factors and school-level conditions are often discussed separately. It reframes technology integration in primary school RBT as a coordinated process shaped by teacher capability, teacher willingness, and enabling school conditions.

CONCEPTUAL PROPOSITIONS

Based on the proposed framework, this paper presents five conceptual propositions that explain the expected relationships among teacher competency, teacher motivation, school support systems, and technology integration in primary school RBT education.

Proposition 1: Teacher competency strengthens technology integration in primary school RBT education.

Teacher competency is expected to strengthen technology integration because RBT teaching requires teachers to connect technological knowledge, pedagogical strategies, and subject content in practical classroom situations. Applied TPACK enables teachers to align technology with pupils' readiness, project tasks, safety procedures, and learning outcomes (Mishra & Koehler, 2006; MOE, 2017; Schmid et al., 2021; Schmidt et al., 2009; Shafie & Jamaluddin, 2025).

Proposition 2: Teacher motivation strengthens technology integration in primary school RBT education.

Teacher motivation is expected to support technology integration because RBT teaching requires sustained effort, confidence, and willingness to engage with practical classroom tasks. Teachers are more likely to engage meaningfully when autonomy, competence, and relatedness are supported from the SDT perspective (Deci & Ryan, 2000; Endot et al., 2021; Inan & Lowther, 2010; Ryan & Deci, 2020).

Proposition 3: School Support Systems Strengthen Technology Integration in Primary School RBT education.

School support systems are expected to strengthen technology integration because practical technology-based teaching depends on enabling school conditions. RBT teachers need appropriate tools, functional equipment, workspace, technical support, leadership encouragement, teaching resources, and professional development opportunities. Technology integration may remain limited to simplified tasks or basic demonstrations without these supports (Ibrahim & Husnin, 2025; Petko et al., 2018; Tondeur et al., 2019; Venkatesh et al., 2003; Yusof et al., 2023).

Proposition 4: School Support Systems Mediate the Relationship between Teacher Competency and Technology Integration in primary school RBT Education.

School support systems are proposed to mediate the relationship between teacher competency and technology integration because competency alone may not lead to classroom implementation. Teachers may have strong technological, pedagogical, and content knowledge, but this competency may remain underused if the school lacks equipment, teaching materials, technical assistance, leadership support, or time for project preparation. School support therefore enables teacher competency to be translated into actual RBT classroom practice (Ertmer & Ottenbreit-Leftwich, 2010; Petko et al., 2018; Sailer et al., 2021; Shafie & Jamaluddin, 2025; Venkatesh et al., 2003).

Proposition 5: School Support Systems Mediate the Relationship between Teacher Motivation and Technology Integration in primary school RBT Education.

School support systems are also proposed to mediate the relationship between teacher motivation and technology integration. Motivated teachers may be willing to use technology, but willingness alone does not ensure meaningful implementation when school conditions are weak. In RBT, teachers still require tools, materials, workspace, guidance, and technical support to manage project-based learning effectively. School support therefore helps convert teacher motivation into sustained technology integration practice (Deci & Ryan, 2000; Endot et al., 2021; Ryan & Deci, 2020; Venkatesh et al., 2003; Yusof et al., 2023).

Together, these propositions support the central argument that technology integration in primary school RBT education should not be explained through teacher factors alone. Teacher competency and teacher motivation remain important, but their effects on classroom practice depend on whether schools provide the enabling conditions needed for implementation.

Implications

The proposed framework offers theoretical, policy, leadership, teacher education, and future research implications. Theoretically, it reframes technology integration in primary school RBT education as a school-supported process. By synthesising TPACK, SDT, and UTAUT facilitating conditions, the paper shows that meaningful technology integration depends on teacher capability, teacher willingness, and enabling institutional support (Deci & Ryan, 2000; Mishra & Koehler, 2006; Ryan & Deci, 2020; Schmidt et al., 2009; Venkatesh et al., 2003).

The framework also strengthens the conceptual role of school support systems as a mediating mechanism. In RBT, practical and project-based technology lessons require tools, materials, technical assistance, workspace, leadership support, professional development, and time allocation. Teacher competency may remain underused and teacher motivation may gradually weaken without these conditions (Ertmer & Ottenbreit-Leftwich, 2010; Petko et al., 2018; Tondeur et al., 2019; Yusof et al., 2023).

For policymakers and curriculum developers, the framework highlights the need to align curriculum expectations with realistic school-level support. Policy direction alone does not guarantee classroom implementation. RBT curriculum planning should therefore consider equipment, technical facilities, teacher training, resource allocation, and instructional guidance needed for practical technology-based learning (MOE, 2013, 2017, 2023; Rashid et al., 2022).

For school leaders, the framework suggests that support must move beyond general encouragement. School leaders need to provide practical conditions such as time for project preparation, access to tools and materials, peer collaboration, professional learning opportunities, and technical assistance. These supports can influence whether RBT teachers are able to conduct design tasks, electronics-related activities, programming, testing, troubleshooting, and project assessment with confidence (Ibrahim & Husnin, 2025; Petko et al., 2018; Shafie & Jamaluddin, 2025; Venkatesh et al., 2003).

Teacher education and professional development should not focus only on general digital skills or tool operation. RBT teachers need professional learning that connects technology with subject content, project-based pedagogy, pupil readiness, safety considerations, troubleshooting, and classroom assessment. This is especially important for non-option teachers, who may require stronger support to build technical confidence and pedagogical content knowledge (Endot et al., 2021; Masingan & Sharif, 2019, 2021; Mishra & Koehler, 2006; Schmidt et al., 2009).

Future studies may examine the proposed framework using survey-based research involving primary school RBT teachers. Structural equation modelling, particularly PLS-SEM, may be useful for testing the direct and mediating relationships among teacher competency, teacher motivation, school support systems, and technology integration. Comparisons between option and non-option RBT teachers may also provide further insights into differences in technology integration practices. To strengthen understanding of the proposed relationships, future researchers may consider combining survey data with interviews or classroom observations. Established instruments based on TPACK, SDT, UTAUT, facilitating conditions (FC) and technology integration practices can also be adapted to suit the context of primary school RBT education.

CONCLUSION

This conceptual paper argues that technology integration in primary school RBT education should be understood as a school-supported process rather than an individual teacher's responsibility alone. Although teacher competency and teacher motivation remain important, both may not automatically lead to meaningful classroom implementation when school-level support is weak or inconsistent. This issue is particularly significant in RBT because the subject involves practical teaching, project-based learning, technical demonstration, problem-solving, testing, troubleshooting, and assessment of pupils' project outcomes (MOE, 2017).

By synthesising TPACK, SDT, and UTAUT facilitating conditions, this paper provides a focused conceptual explanation of technology integration in RBT. TPACK explains teacher capability, SDT explains teacher willingness, and UTAUT facilitating conditions explain the school support systems that enable readiness to become actual classroom practice (Deci & Ryan, 2000; Mishra & Koehler, 2006; Ryan & Deci, 2020; Venkatesh et al., 2003).

The main contribution of this paper is the positioning of school support systems as a mediating mechanism between teacher-level readiness and technology integration practices. Infrastructure, leadership support, technical assistance, professional development, teaching resources, workspace, and time allocation function as enabling conditions that determine whether teacher competency and motivation can be translated into sustainable classroom implementation (Petko et al., 2018; Tondeur et al., 2019).

Overall, this paper contributes to the discussion on sustainable technology integration by reframing technology integration in primary school RBT education as the outcome of the interaction among teacher competency, teacher motivation, and school support systems. Future empirical studies may use the proposed framework to examine how these constructs operate in real classroom settings, including differences between option and non-option RBT teachers and variations in school-level support.

Conflict of Interest

The author declares that there is no conflict of interest related to the publication of this paper.

Data Availability Statement

Data sharing is not apply to this conceptual paper as no datasets were generated or analysed.

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