



ASEAN Journal of Educational Research and Technology



Journal homepage: <https://ejournal.bumipublikasinusantara.id/index.php/ajert>

Teacher Technology Adoption and Pedagogical Integration: Digital Competence, Institutional Support, and Student Engagement

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ABSTRACT

Digital technology integration requires teachers to combine technological competence with pedagogical knowledge and supportive institutional conditions. This study reviews literature on teacher technology adoption, digital competence, pedagogical integration, institutional support, and student engagement in secondary education. The synthesis identifies teacher-level, technological, and institutional factors that shape technology adoption and influence the transition from basic digital use to pedagogically meaningful integration. An integrated framework is developed to explain how teacher competence, perceived usefulness, infrastructure, leadership support, professional development, and instructional alignment interact in technology-supported teaching. Student engagement is positioned as a potential educational outcome of purposeful pedagogical integration rather than a direct consequence of technology availability.

ARTICLE INFO

Article History:

Submitted/Received 12 Feb 2026

First Revised 17 Aug 2026

Accepted 26 Sep 2026

First Available online 28 Sep 2026

Publication Date 01 Dec 2026

Keywords:

Digital competence;

Educational technology;

Microsoft Office;

Student engagement;

Teacher technology adoption.

1. INTRODUCTION

Digital technology has become an important component of contemporary teaching and learning because teachers increasingly use digital tools to prepare instructional materials, organize assessment, communicate information, and support classroom activities. Effective technology integration, however, involves more than access to computers or software. Teachers must combine technological knowledge with pedagogical and subject-matter knowledge so that digital tools can be used for meaningful instructional purposes. The Technological Pedagogical Content Knowledge framework emphasizes that effective educational technology integration depends on the interaction among technological, pedagogical, and content knowledge rather than on technological skills alone (Koehler and Mishra, 2009; Koehler et al., 2013). Teacher adoption of educational technology is also influenced by perceptions of usefulness, ease of use, professional competence, access to resources, institutional expectations, and organizational support. Individual characteristics operate alongside technological and institutional conditions. Reviews of teacher technology integration identify digital skills, confidence, pedagogical training, access to appropriate technology, technical assistance, curriculum conditions, and school leadership as important determinants of classroom technology use (Buabeng-Andoh, 2012). Thus, technology integration should be understood as a multidimensional educational process rather than as the simple availability of hardware or software.

These considerations are particularly relevant in Cambodia, where the expansion of digital education has created opportunities as well as continuing challenges for secondary schools. Research involving Cambodian secondary-school teachers has shown generally positive perceptions of Information and Communications Technology (ICT)-integrated education while also identifying limitations related to infrastructure and insufficient teacher training. Positive attitudes toward ICT did not necessarily translate into extensive classroom use among Cambodian secondary-school teachers because implementation remained constrained by practical conditions (Shin et al., 2014). Research in rural upper-secondary schools has similarly highlighted the importance of teacher readiness for effective ICT adoption (Pang et al., 2022). More recent evidence from Cambodian schools continues to show that teacher perceptions, technological confidence, training opportunities, and multiple layers of barriers remain important in determining technology integration (Pen and Morrell, 2024). Digital transformation in Cambodian upper-secondary education also extends beyond basic technology access to broader digital competencies and curriculum-related preparation required for participation in increasingly digital learning environments (Un, 2025). Within this broader digital transformation, Microsoft Office applications provide a practical model for examining teacher technology adoption because they represent widely accessible digital tools used across instructional and administrative activities. Their use allows the broader processes of adoption, digital competence, institutional support, and pedagogical integration to be examined through familiar classroom and professional practices. Microsoft Word can support lesson preparation, worksheets, instructional documents, and administrative records. Microsoft Excel can facilitate the organization of assessment results, learner records, and classroom data. Microsoft PowerPoint can support presentation design, visualization, and multimedia-supported instruction. These applications therefore have potential value not only for administrative efficiency but also for instructional planning, classroom communication, assessment, and the preparation of learning materials. Their educational contribution, however, depends on how teachers use them and whether their technological use is aligned with pedagogical objectives.

The distinction between merely using software and integrating it pedagogically is important. Teachers may possess basic operational skills without being able to connect technology effectively with content and instructional strategies. TPACK provides a useful theoretical basis for examining this distinction because it conceptualizes technology integration as an interaction among different domains of professional teacher knowledge (Koehler and Mishra, 2009). At the same time, technology-acceptance perspectives help explain why teachers may choose to adopt or avoid particular applications based on their perceived usefulness, ease of use, and surrounding conditions. Teacher adoption therefore depends on both professional competence and the educational environment in which technology is introduced.

Institutional conditions further shape technology integration. Limited access to reliable devices, technical support, professional development, leadership encouragement, and opportunities for teachers to experiment with technology can constrain meaningful classroom use. Teacher-level limitations should therefore be considered together with broader school-level and system-level conditions, since these dimensions interact in shaping technology adoption and instructional practice (Buabeng-Andoh, 2012). This multidimensional perspective is particularly relevant to Cambodian public schools, where differences in infrastructure, technological access, training opportunities, and teacher readiness may create uneven conditions for digital teaching.

Student engagement represents another important educational dimension of technology integration. Digital tools can potentially support clearer instructional presentation, more structured assessment, access to learning materials, and opportunities for interactive learning. Nevertheless, the availability of technology alone does not guarantee greater student engagement. Engagement is multidimensional and may involve behavioral participation, cognitive involvement, emotional responses, and active interaction with learning tasks. Consequently, the relationship between Microsoft Office use and student engagement should be interpreted through instructional practice rather than treated as a direct technological effect.

Although previous studies have examined teacher technology adoption, digital competence, ICT barriers, and technology-supported learning, these dimensions are frequently discussed separately. In the Cambodian context, existing studies provide important evidence concerning teacher perceptions, ICT readiness, training, and infrastructural barriers, but a clearer conceptual organization is still needed to explain how teacher-level factors, technological conditions, and institutional support interact with technology adoption, digital competence, and pedagogical integration and how these relationships may create opportunities for student engagement.

Therefore, this study aims to synthesize the literature on teacher technology adoption, digital competence, pedagogical integration, institutional support, and student engagement and to organize these dimensions within an integrated educational framework. Microsoft Office applications are used as a practical model to illustrate how technology adoption can progress from routine digital use toward pedagogically meaningful integration. Specifically, the study addresses the following questions:

- (i) What teacher-level, technological, and institutional factors shape teacher technology adoption?

- (ii) How does teacher digital competence contribute to pedagogically meaningful technology integration?
- (iii) How can the relationships among technology adoption, digital competence, institutional support, pedagogical integration, and student engagement be organized within an integrated conceptual framework?

The contribution of this study lies in integrating technology-adoption perspectives with teacher digital competence, pedagogical integration, institutional support, and student engagement within a unified educational framework. Microsoft Office applications are used as a practical model of commonly available digital tools to illustrate how these broader processes operate in everyday teaching and professional practice. Rather than treating technology availability or frequency of use as evidence of successful integration, the framework emphasizes the interaction among teacher competence, perceived usefulness, pedagogical compatibility, school leadership, infrastructure, professional development, and instructional application. This perspective provides a basis for understanding how digital tools can move from routine professional use toward more purposeful and pedagogically integrated teaching practice. The conceptual relationships examined in this study are illustrated in **Figure 1**. The framework connects teacher-level, technological, and institutional factors with teacher technology adoption, digital competence, demographic characteristics, pedagogical integration, and student engagement. These relationships are interpreted through TPACK, technology-adoption perspectives, and institutional-support literature.

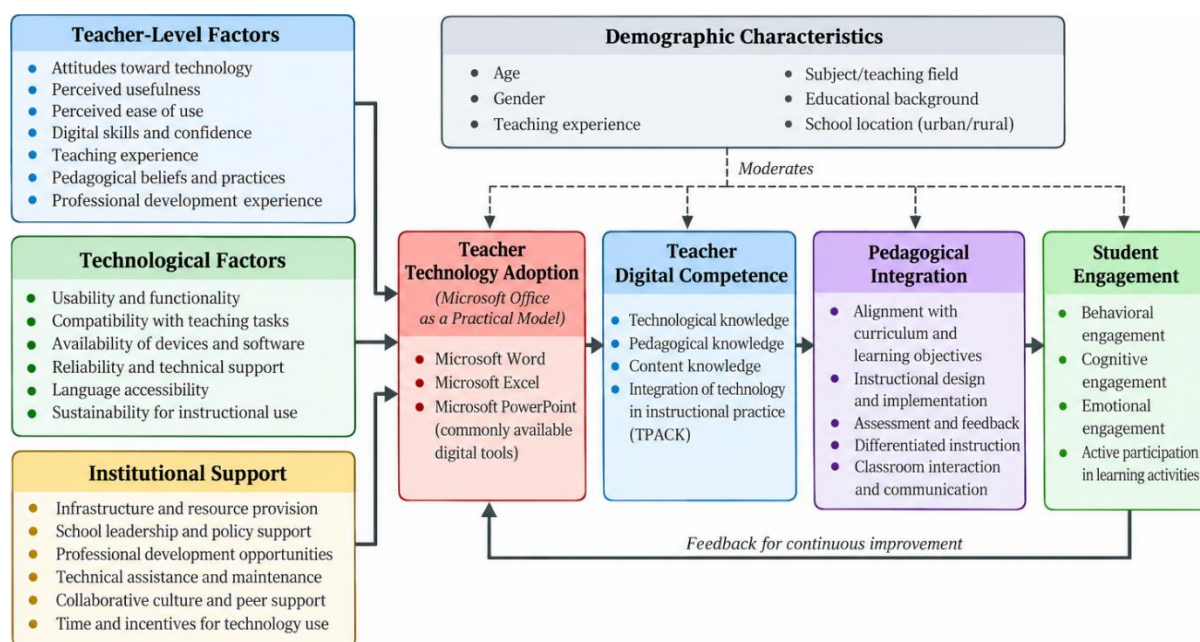


Figure 1. Conceptual framework.

2. LITERATURE REVIEW

2.1. Microsoft Office Applications in Teaching and Professional Practice

Microsoft Office applications are among the most familiar general-purpose digital tools available to educators. Although they were not developed exclusively as educational technologies, their functions can be adapted to a broad range of professional and instructional activities. Word-processing applications can support lesson planning, worksheet preparation, instructional documentation, and the development of text-based learning

materials. Spreadsheet applications can assist teachers in organizing scores, monitoring assessment information, and managing classroom records. Presentation applications can support visual explanation, content organization, and multimedia-based classroom presentations. The educational value of these applications depends on the purpose for which they are used. Administrative use may increase efficiency in documentation or record management, whereas pedagogical use requires teachers to connect technological functions with instructional goals. A presentation, for example, does not become pedagogically effective merely because it is digital. Its educational value depends on content organization, visual design, interaction, explanation, and the way it is incorporated into classroom activity. Similarly, spreadsheets may support assessment more meaningfully when teachers use them to organize and interpret student performance information rather than merely store numerical records. This distinction is consistent with the TPACK perspective. Technological knowledge should interact with pedagogy and content knowledge (Koehler and Mishra, 2009; Koehler et al., 2013). For Cambodian public high schools, Microsoft Office may therefore be understood as a set of accessible technological resources whose educational value depends on teachers' competence, instructional objectives, contextual suitability, and institutional support.

To clarify the different roles of these applications, **Table 1** can be used to distinguish their professional and instructional functions. The table is conceptual and summarizes educational functions discussed in relation to teacher technology integration; it does not represent newly collected empirical data.

Table 1. Educational functions of microsoft office applications.

APPLICATION	PROFESSIONAL FUNCTION	INSTRUCTIONAL FUNCTION	POTENTIAL EDUCATIONAL CONTRIBUTION
Microsoft Word	Lesson plans, reports, documentation, worksheets	Preparation of reading materials, assignments, and structured learning documents	Supports organized instructional materials and teacher preparation
Microsoft Excel	Grade recording, attendance, classroom data organization	Assessment monitoring and organization of student performance information	Supports systematic assessment and data-informed instructional decisions
Microsoft PowerPoint	Presentation preparation and professional communication	Visual explanation, multimedia presentation, content sequencing	Supports visual communication and structured classroom presentation

2.2. Teacher Digital Competence and TPACK

Teacher digital competence involves more than the operational ability to use software. Teachers need to understand when technology is educationally appropriate, how it interacts with subject content, and how it can be incorporated into instructional strategies. This interaction can be conceptualized through TPACK, in which technological knowledge, pedagogical knowledge, and content knowledge overlap to form the knowledge required for effective technology-supported teaching (Koehler and Mishra, 2009). This framework is particularly relevant to Microsoft Office applications. A teacher may know how to create slides, calculate values in a spreadsheet, or format documents, but such technical knowledge does not necessarily indicate pedagogically meaningful technology integration. Effective use requires teachers to select functions that serve specific learning objectives. PowerPoint may be used to organize complex explanations visually; Excel may support assessment analysis;

and Word may facilitate structured learning materials. The educational significance of these tools therefore emerges from the interaction between technological capability and pedagogical decision-making. TPACK should not be understood as isolated technological expertise but as an integrated form of teacher knowledge that connects technological, pedagogical, and content-related competencies (Koehler et al., 2013). This perspective helps explain why one-time software training may be insufficient. Training that focuses only on menu commands and software operations may improve technical familiarity without necessarily improving teachers' ability to integrate technology into instruction. Evidence from Cambodia reinforces this need for pedagogically oriented digital competence. Cambodian secondary-school teachers may hold positive attitudes toward ICT while still demonstrating limited classroom use because of infrastructure and training constraints (Shin et al., 2014). Recent work with late-career teachers in Cambodia similarly identifies multiple barriers affecting technology integration, indicating that confidence, experience, support, and contextual conditions remain important in shaping teachers' technological practices (Pen and Morrell, 2024).

2.3. Teacher Adoption of Technology

Teacher adoption of technology is influenced by individual perceptions as well as environmental conditions. Technology-acceptance research emphasizes that users are more likely to adopt a system when they perceive it as useful and easy to use. Perceived usefulness reflects the extent to which users believe that a technology can improve their performance, whereas perceived ease of use concerns the effort required to operate the technology (Davis, 1989). In educational settings, these perceptions may influence whether teachers consider digital applications useful for lesson preparation, administrative tasks, assessment, and classroom instruction. However, teacher technology adoption cannot be explained solely by individual perceptions. Teachers' ICT knowledge, confidence, attitudes, experience, workload, pedagogical training, and access to resources are also important (Buabeng-Andoh, 2012). These factors interact. For example, a teacher may perceive Microsoft Excel as potentially useful but still avoid using it because of insufficient confidence or training. Conversely, readily available technology may remain underused when teachers do not perceive a meaningful instructional purpose. In the context of Microsoft Office, adoption can therefore be conceptualized through several interconnected factors: perceived usefulness, ease of use, teacher competence, pedagogical compatibility, resource availability, leadership support, and opportunities for professional learning. This broader interpretation avoids reducing adoption to a purely technical decision.

2.4. Teacher-Level Factors

Teacher-level factors include knowledge, experience, beliefs, confidence, attitudes toward technology, perceived usefulness, and perceived ease of use. Teacher attitudes, ICT competence, confidence, teaching experience, workload, and professional development are among the factors influencing technology integration (Buabeng-Andoh, 2012). These factors are important because teachers determine how available technologies are translated into instructional practice. Even when software and equipment are accessible, low confidence or weak pedagogical understanding may discourage meaningful integration. Teachers who view technology as relevant to their professional tasks are more likely to devote time to developing the competencies necessary for effective use. Cambodian evidence supports this interpretation. Positive perceptions of ICT among Cambodian secondary-school teachers can coexist with comparatively limited classroom implementation (Shin et al., 2014). ICT

readiness among rural upper-secondary-school teachers highlights the importance of teacher preparedness in educational environments where digital integration may be affected by contextual limitations ([Pang et al., 2022](#)).

2.5. Technological Factors

Technological factors concern the characteristics and accessibility of the tools themselves. These may include ease of operation, compatibility with teachers' tasks, availability of appropriate devices, language accessibility, reliability, and suitability for instructional purposes. Technology that is technically available may nevertheless remain underused if it does not fit teachers' existing practices or if its use requires resources that schools cannot consistently provide. Microsoft Office applications may have an advantage in this regard because they can support multiple professional activities with relatively familiar interfaces. Nevertheless, familiarity should not be equated with pedagogical effectiveness. Teachers still require knowledge of how specific software functions can be matched with curriculum objectives and classroom needs. Technological compatibility is also contextual. Applications that function effectively in one school may be less practical in another because of differences in access to computers, projection equipment, electricity, internet connectivity, technical maintenance, or student access. Technology adoption should therefore be interpreted relative to the school environment rather than as an individual teacher characteristic alone.

2.6. Institutional Support and Enabling Conditions

Institutional support plays a central role in sustaining teacher technology use. School leadership can influence access to resources, opportunities for training, expectations for technology use, technical assistance, collaboration, and the time available for professional development. School-level and system-level conditions can either support or constrain teachers' ability to integrate ICT into teaching ([Buabeng-Andoh, 2012](#)). In Cambodia, infrastructure and teacher-training limitations have repeatedly been identified as barriers to educational technology integration. Inadequate ICT-related infrastructure and insufficient teacher training can restrict teachers' ability to translate positive attitudes toward technology into regular classroom practice ([Shin et al., 2014](#)). Multiple technological, professional, and contextual barriers also continue to influence teachers' use of digital technologies in Cambodian educational settings ([Pen and Morrell, 2024](#); [Ourn and Chhorn, 2025](#)). Institutional support should therefore extend beyond equipment provision. Effective integration requires a combination of physical resources, pedagogical professional development, leadership encouragement, opportunities for peer learning, and continuing technical assistance. These elements create an enabling environment in which teachers can move from basic software operation toward purposeful educational use. Technology integration can be organized into four interrelated phases consisting of contextual assessment, infrastructure and digital foundation development, capacity building and digital pedagogy, and implementation with continuous monitoring and refinement. These phases provide a structured basis for understanding how schools can move from initial technological readiness toward sustained educational technology integration. The four implementation phases are summarized in **Table 2**.

2.7. Student Engagement and Technology-Supported Instruction

Student engagement should not be treated as an automatic consequence of technology use. Digital technologies can support behavioral, cognitive, and emotional dimensions of

engagement, but their contribution varies according to the type of technology, instructional activity, and manner of classroom implementation (Schindler et al., 2017). Technology can support varied instructional presentation, structured materials, feedback, and classroom interaction, but it does not automatically increase student engagement. PowerPoint and Excel may support engagement when they are used interactively and pedagogically to guide instruction, assessment, and feedback. Therefore, Microsoft Office should be viewed as creating conditions that may support student engagement when its use is aligned with pedagogy, teacher competence, and institutional support, rather than as a direct cause of engagement.

Table 2. Phase, strategic focus, and core action.

PHASE	STRATEGIC FOCUS	CORE ACTION
1. Contextual assessment and strategy	Readiness evaluation	Diagnostic assessment of existing technological infrastructure, teacher digital competence, institutional conditions, and alignment with educational priorities.
2. Infrastructure and digital foundations	Physical and technological readiness	Provision and maintenance of essential digital infrastructure, including computers, supporting devices, reliable connectivity, and appropriate software access.
3. Capacity building and digital pedagogy	Human capital development	Continuous professional development focusing on digital competence, pedagogical technology integration, instructional material development, and practical use of Microsoft Office applications.
4. Implementation, monitoring, and refinement	Continuous implementation and feedback	Classroom application of digital tools, monitoring of instructional practices, evaluation of implementation challenges, peer support, and continuous improvement of technology-supported teaching.

2.8. Integrated Conceptual Perspective

Teacher adoption of Microsoft Office applications should be understood as an interaction among multiple levels of influence. Teacher-level factors include competence, confidence, attitudes, experience, and perceived usefulness. Technological factors include accessibility, usability, compatibility, and reliability. Institutional factors include infrastructure, leadership, professional development, technical assistance, and organizational support. These factors influence how teachers use Microsoft Office for professional and instructional purposes. Teacher digital competence occupies a central position within this relationship because access and acceptance alone are insufficient for pedagogical integration. TPACK provides the conceptual basis for understanding how teachers connect technological functionality with pedagogy and subject content (Koehler and Mishra, 2009; Koehler et al., 2013). The framework consequently treats student engagement as an educational implication of instructional use rather than as a direct consequence of software adoption. This integrated perspective provides the conceptual basis for interpreting Microsoft Office adoption in Cambodian public high schools and for identifying areas in which teacher professional development, infrastructure, and school-level support may be strengthened.

3. METHOD

3.1. Research Design

This study employed a conceptual narrative review to synthesize theoretical and empirical literature concerning teacher technology adoption, digital competence, pedagogical integration, institutional support, and student engagement. Microsoft Office applications

were used as a practical model of commonly available digital tools through which these relationships could be examined in everyday educational practice. The study seeks to organize existing knowledge and develop an integrated conceptual interpretation rather than test an intervention or estimate a quantitative effect. The review was structured around five interconnected constructs: teacher technology adoption, teacher digital competence, technological conditions, institutional support, and pedagogical integration, with student engagement examined as a potential educational outcome. The analysis also incorporated theoretical perspectives on technological-pedagogical competence and technology adoption to provide a more coherent explanation of the relationships among these constructs.

3.2. Conceptual Domains

The literature synthesis was organized into four principal domains. The first domain concerned teacher-level factors, including digital competence, attitudes, confidence, perceived usefulness, experience, and pedagogical readiness. The second domain concerned technological factors, including usability, accessibility, compatibility, and the instructional functions of Microsoft Office applications. The third domain examined institutional conditions, including leadership support, infrastructure, professional development, technical assistance, and resource availability. The fourth domain concerned educational outcomes and implications, particularly teacher digital competence, instructional practice, and student engagement. These domains were selected because they represent the central relationships among technology adoption, teacher competence, institutional conditions, instructional practice, and student engagement identified in the reviewed literature.

3.3. Theoretical Basis

Two complementary theoretical perspectives were used to organize the synthesis. First, the Technological Pedagogical Content Knowledge framework was used to interpret teacher digital competence and the pedagogical integration of digital tools. TPACK conceptualizes effective technology-supported teaching as an interaction among technological, pedagogical, and content knowledge (Koehler and Mishra, 2009; Koehler *et al.*, 2013). Second, technology-adoption perspectives were used to interpret factors affecting teachers' willingness and ability to use digital applications in professional and instructional contexts. These perspectives were complemented by research examining teacher-level, technological, and institutional conditions affecting ICT integration (Buabeng-Andoh, 2012). The Cambodian educational context was interpreted using empirical journal studies addressing technology integration, teacher readiness, teacher perceptions, and barriers in Cambodian secondary education (Shin *et al.*, 2014; Pang *et al.*, 2022; Pen and Morrell, 2024).

3.4. Literature Synthesis

The literature was analyzed conceptually by identifying recurring relationships among teacher characteristics, technological conditions, institutional support, professional competence, and educational use. The synthesis did not treat individual studies as equivalent evidence; instead, findings were interpreted according to their relevance to the conceptual domains of the review. The analysis proceeded through three stages. First, literature was grouped according to teacher-level, technological, institutional, and educational dimensions. Second, relationships among the dimensions were mapped to identify connections among technology adoption, digital competence, institutional support, pedagogical integration, and student engagement. Third, the findings were integrated to explain how Microsoft Office

applications may move from basic professional tools toward pedagogically meaningful educational technologies when supported by teacher competence and appropriate institutional conditions. This synthesis establishes a coherent theoretical basis for explaining technology adoption and its educational implications in Cambodian public high schools.

4. RESULTS AND DISCUSSION

4.1. Teacher-Level Factors Influencing Technology Adoption

The synthesis identifies teacher-level factors as an important foundation for teacher technology adoption in educational practice. Microsoft Office applications provide a practical illustration of how these factors operate in teachers' routine professional and instructional activities. These factors include attitudes toward technology, perceived usefulness, perceived ease of use, digital skills, confidence, teaching experience, workload, and professional development experience. Teachers are more likely to integrate technology when they perceive clear professional and instructional benefits and possess sufficient competence to use digital applications confidently and appropriately (Buabeng-Andoh, 2012). Perceived usefulness is particularly relevant because teachers generally need practical reasons for incorporating technology into established professional routines. Microsoft Word can facilitate lesson planning, preparation of learning materials, worksheet development, and documentation. Microsoft Excel can assist with student records, assessment organization, and classroom data management. Microsoft PowerPoint can support visual explanation, multimedia presentation, and structured delivery of instructional content. Microsoft Office applications can serve both administrative and pedagogical purposes when they are aligned with teachers' professional needs. Teacher confidence and digital competence also influence whether available applications are used only for routine administrative purposes or extended into instructional practice. Basic operational knowledge does not necessarily indicate meaningful technology integration. Teachers need to understand how particular technological functions can support curriculum content, instructional strategies, and learning objectives, which is consistent with the integration of technological, pedagogical, and content knowledge described in the TPACK framework (Koehler and Mishra, 2009; Koehler et al., 2013). This issue is particularly relevant in Cambodia. Teachers may hold positive attitudes toward digital technology while still experiencing limitations in classroom integration because of insufficient training, infrastructure, or sustained technological support (Shin et al., 2014). Teacher readiness is therefore important, particularly in school contexts where opportunities for technology-supported teaching vary according to available resources and professional support (Pang et al., 2022).

4.2. Technological Factors and Pedagogical Compatibility

Technological factors determine whether Microsoft Office applications are sufficiently accessible, reliable, and suitable for teachers' professional and instructional activities. Important considerations include usability, availability of devices and software, technical reliability, language accessibility, compatibility with teaching tasks, and technical support. These conditions interact with teachers' competence because access to software alone cannot ensure educationally meaningful use. Microsoft Office applications provide a practical model for examining how general technology-adoption processes are translated into everyday professional and instructional practice. Their functions can be incorporated into familiar teacher activities, allowing the distinction between basic technological use and pedagogical integration to be examined more clearly. Word can support the preparation of

lesson plans and instructional documents, Excel can organize assessment information, and PowerPoint can assist with classroom presentation. However, technological familiarity should not be interpreted as evidence of pedagogical effectiveness. Educational value depends on how teachers connect application functions with instructional purposes. For example, PowerPoint can be used simply to reproduce text-based lectures, or it can be used to organize visual explanations, questions, examples, and learning activities. Excel can function only as an electronic score sheet, or it can help teachers organize and interpret student performance information for instructional decision-making. Word can be used solely for administrative documentation or as a tool for producing structured worksheets, assignments, reading materials, and differentiated learning resources. Technological adoption and pedagogical integration are related but distinct processes. The major professional and instructional functions of the three Microsoft Office applications examined in this study are summarized in **Table 1**. The applications support different but complementary aspects of teachers' work, including instructional preparation, assessment management, learning-material development, and classroom communication. Microsoft Office applications should not be viewed as a single technological category with identical educational purposes. Each application provides different affordances, and its contribution depends on the teacher's ability to select an appropriate tool for a particular instructional or professional task.

4.3. Institutional Support and Enabling Conditions

Teacher technology adoption and pedagogical integration are also shaped by institutional conditions. School leadership, infrastructure, resource availability, professional development, technical assistance, peer collaboration, and organizational expectations can either facilitate or constrain technology-supported teaching. Educational technology integration should therefore be understood as both an individual and institutional process rather than as the responsibility of teachers alone ([Buabeng-Andoh, 2012](#)). Infrastructure provides the basic conditions for technology use, but access to equipment is insufficient when teachers lack continuing professional and technical support. Professional development is especially important because teachers need opportunities to connect software functions with authentic classroom tasks. Training in Microsoft Word can be linked to lesson planning and learning-material preparation, Excel training can focus on assessment and student-performance organization, and PowerPoint training can address visual communication and instructional presentation. Leadership support can strengthen implementation by encouraging experimentation, allocating resources, facilitating professional development, and creating opportunities for teachers to collaborate. Peer support is also important because teachers with greater digital competence can share practical strategies, provide informal technical assistance, and demonstrate how applications can be incorporated into different subject areas. The implementation stages presented in **Table 2** emphasize the importance of progressing from contextual assessment and infrastructure development to capacity building, implementation, monitoring, and refinement. Sustainable technology integration requires coordinated attention to both technological resources and human capacity. Cambodian studies similarly indicate that infrastructure, teacher preparation, and institutional support remain important conditions for technology integration in secondary education ([Shin et al., 2014](#); [Pen and Morrell, 2024](#)). Providing software or hardware without corresponding pedagogical support is unlikely to produce sustained instructional integration.

4.4. Teacher Digital Competence and Instructional Integration

Teacher digital competence occupies a central position between technology adoption and educational application. A teacher may use Microsoft Office frequently for administrative tasks without integrating the applications into instruction. Frequency of use therefore does not necessarily represent pedagogical competence. Digital competence becomes educationally meaningful when teachers can connect technological knowledge with pedagogy and subject content. Teachers need to determine which application is appropriate for a particular learning objective, how information should be presented, how students will interact with the material, and how technology can support assessment or feedback. This integrated understanding is consistent with the TPACK framework, which conceptualizes effective technology integration through the interaction of technological, pedagogical, and content knowledge (Koehler and Mishra, 2009; Koehler et al., 2013). The relationships among teacher-level factors, technological factors, institutional support, Microsoft Office adoption, teacher digital competence, demographic characteristics, and student engagement are represented in **Figure 1**. The framework positions technology adoption as a process influenced by multiple enabling conditions rather than as an isolated individual decision. Demographic characteristics are treated as contextual or moderating conditions. Age, gender, teaching experience, subject area, educational background, and school location may influence how teachers experience technological demands and available support. These characteristics should not be interpreted as deterministic predictors but as contextual factors that may alter the conditions under which technology integration occurs. The framework also distinguishes teacher adoption from teacher digital competence. Adoption represents teachers' willingness and opportunity to use Microsoft Office applications, whereas digital competence concerns their capacity to integrate these applications appropriately into professional and instructional practice. This distinction helps explain why access and frequent use alone may not result in educationally meaningful technology integration.

The progression from basic software operation to pedagogically integrated use is illustrated in **Figure 2**. At the initial level, Microsoft Office applications may primarily support routine tasks such as document preparation, score recording, and slide presentation. Professional integration extends these functions to lesson planning, assessment management, and instructional-material development. At a more advanced level, teachers align technological functions with content, pedagogy, feedback, and classroom interaction. Learning-oriented integration therefore represents not simply more frequent technology use but a qualitative shift toward purposeful instructional application.

4.5. Student Engagement in Technology-Supported Instruction

Student engagement represents an important educational consideration in the integration of Microsoft Office applications. Engagement can involve behavioral participation, cognitive involvement, emotional engagement, and active participation in learning activities. Digital technologies may create opportunities to support behavioral, cognitive, and emotional dimensions of engagement, although their educational contribution depends strongly on instructional design and the manner in which technology is incorporated into learning activities (Schindler et al., 2017; Bond et al., 2020; Nkomo et al., 2021). Microsoft PowerPoint may support engagement when teachers combine visual explanations with questions, examples, discussions, and student activities. Microsoft Word may contribute through well-structured worksheets, assignments, and learning materials that help students interact systematically with instructional content. Microsoft Excel may contribute indirectly when

teachers use assessment information to provide feedback or modify instructional strategies according to student learning needs.

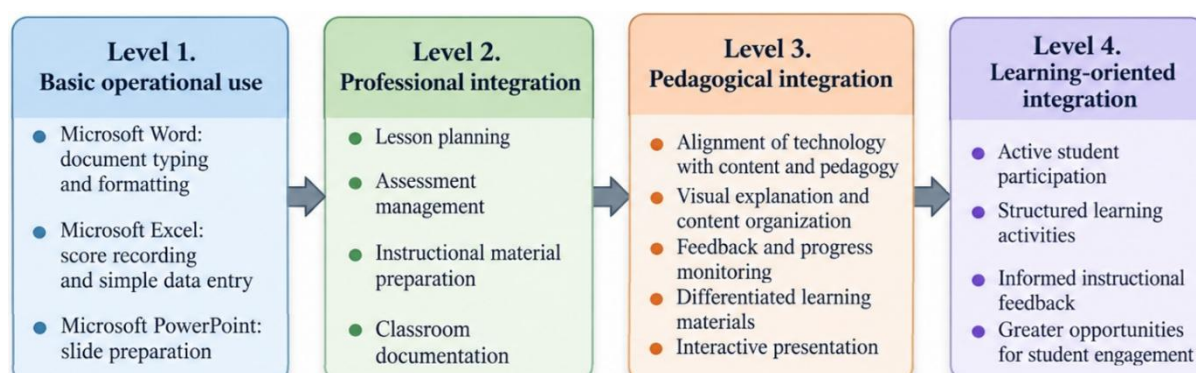


Figure 2. Progression from basic Microsoft Office use to pedagogically integrated educational practice.

The potential relationships between instructional uses of Microsoft Office applications and dimensions of student engagement are summarized in **Table 3**. These relationships should be interpreted as pedagogical pathways rather than direct effects of the software itself.

Table 3. Potential relationships between Microsoft Office applications and student engagement.

MICROSOFT OFFICE APPLICATION	INSTRUCTIONAL USE	POTENTIAL ENGAGEMENT DIMENSION	PEDAGOGICAL MECHANISM
Microsoft Word	Worksheets, assignments, reading materials, and structured learning documents	Cognitive and behavioral engagement	Provides organized tasks that require students to read, respond, complete activities, and interact systematically with learning content
Microsoft Excel	Assessment records, progress monitoring, and organization of student performance information	Cognitive and behavioral engagement	Enables teachers to identify learning needs, adjust instruction, and provide more targeted feedback
Microsoft PowerPoint	Visual explanation, multimedia presentation, questioning, and content sequencing	Behavioral, cognitive, and emotional engagement	Supports visualization, attention, discussion, questioning, and structured interaction when incorporated into active instruction
Integrated use of Word, Excel, and PowerPoint	Coordinated preparation, assessment, feedback, and classroom presentation	Multiple dimensions of engagement	Connects instructional materials, assessment information, feedback, and classroom communication within a coherent teaching process

The contribution of each application depends on instructional design, teacher digital competence, classroom implementation, and the opportunities provided for students to interact with learning activities. The relationships reinforce the distinction between technology availability and pedagogical integration. Microsoft Office applications provide technological affordances, but student engagement emerges from the instructional activities built around those affordances. Consequently, the same application can support active participation in one classroom while remaining largely passive in another, depending on how teachers structure learning tasks, feedback, interaction, and opportunities for student

response. The educational effect therefore depends primarily on instructional design rather than on the application itself. A PowerPoint presentation may remain teacher-centred when students only observe slides passively. In contrast, the same application can support greater participation when it is integrated with questioning, discussion, problem solving, or collaborative activities. Technology should consequently be treated as an instructional resource whose contribution depends on pedagogical application. This distinction is particularly important because student engagement should not be represented as an automatic outcome of Microsoft Office adoption. Technology adoption can contribute to teacher digital competence, which may support more purposeful instructional practices and create conditions that encourage student engagement.

4.6. Implications for Cambodian Public High Schools

Strengthening the educational use of Microsoft Office applications in Cambodian public high schools requires coordinated development of teacher competence, technological resources, institutional support, and pedagogical practice. Professional development should focus on authentic teaching tasks, with Word supporting lesson preparation, Excel supporting assessment and progress monitoring, and PowerPoint supporting visual and interactive instruction. School-based peer support can complement formal training by enabling teachers to share materials, strategies, and technical assistance. Implementation should also reflect differences in school readiness, with well-equipped schools advancing toward deeper pedagogical integration while schools with limited infrastructure first strengthen basic technological conditions. The resulting priorities for school-level implementation are summarized in **Table 4**.

Table 4. Priority areas for technology integration in Cambodian public high schools.

PRIORITY AREA	IDENTIFIED NEED	RECOMMENDED EDUCATIONAL ACTION	EXPECTED CONTRIBUTION
Digital infrastructure	Limited or unreliable access to devices, software, connectivity, or technical services	Strengthen essential digital facilities and establish continuing technical support	Provides basic enabling conditions for regular technology use
Teacher digital competence	Uneven operational and pedagogical competence	Provide task-based professional development using Word, Excel, and PowerPoint in authentic teaching activities	Strengthens the transition from basic software operation to instructional integration
Pedagogical integration	Technology used mainly for administrative or presentation purposes	Connect software functions with lesson objectives, assessment, feedback, and student activities	Promotes purposeful and curriculum-aligned technology use
School leadership	Limited coordination or support for technology integration	Establish leadership support, resource allocation, monitoring, and opportunities for experimentation	Creates an institutional environment that sustains technology-supported teaching
Peer professional support	Unequal digital competence among teachers	Develop peer mentoring, collaborative material development, and school-based knowledge sharing	Supports continuous professional learning and reduces dependence on one-time training
Monitoring and refinement	Limited information on implementation challenges	Review classroom use, teacher needs, and implementation barriers periodically	Enables continuous adjustment of technology-integration strategies

Rather than proposing a uniform intervention, the framework links different implementation needs with corresponding forms of institutional and professional support. Technology integration should be differentiated according to school readiness rather than implemented through a single standardized approach. Infrastructure establishes the enabling environment, whereas professional development and pedagogical integration determine how available technology is translated into instructional practice. Leadership, peer support, and monitoring are therefore necessary to sustain the process beyond initial technology provision. This variation supports the phased strategy presented in **Table 2**, in which readiness assessment precedes infrastructure development, capacity building, and continuous implementation. The conceptual framework therefore positions Microsoft Office applications as accessible entry points for educational technology integration rather than as educational solutions in themselves. Their contribution to teaching and learning depends on teachers' digital competence, pedagogical alignment, school leadership, resource availability, professional development, and continuing technical support.

5. CONCLUSION

Teacher technology adoption and pedagogical integration are shaped by interacting teacher-level, technological, and institutional conditions. Meaningful integration requires digital competence, perceived usefulness, pedagogical compatibility, adequate infrastructure, leadership support, professional development, and technical assistance. Using Microsoft Office applications as a practical model, the study illustrates how commonly available digital tools can move from routine professional use toward more purposeful instructional integration. Student engagement should be understood as a potential outcome of pedagogically aligned technology use rather than technology availability alone. The framework provides a conceptual basis for strengthening teacher digital competence, institutional support, and sustainable technology-supported teaching in secondary education.

6. ACKNOWLEDGMENTS

We gratefully acknowledge the researchers whose scholarly works contributed to the theoretical and empirical foundation of this study.

7. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper is free from plagiarism.

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