Teachers' Challenges in Integrating Technology and Pedagogy in Learning

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Abstract

The integration of technology in learning has become an important part of educational transformation. Digital devices, online learning platforms, educational applications, artificial intelligence, and digital learning resources let teachers create learning that is more flexible, interactive, and suited to learners' needs. The use of technology relates not only to the technical ability to use devices but also demands teachers' ability to integrate technology with pedagogy and material. This article aimed to describe the challenges teachers face in integrating technology and pedagogy in learning and to identify the factors that influence the success of that integration. The study used a qualitative method with a descriptive approach through library research. The data came from twenty scholarly articles addressing technology integration, teacher competence, techno-pedagogical skills, teacher education, professional development, and teachers' experience of using technology at various levels and fields. The analysis proceeded through the identification, grouping, comparison, and interpretation of the findings. The results show that the challenges of integrating technology and pedagogy include limited digital and pedagogical competence, a gap between the mastery of technology and its application in learning, limited infrastructure and resources, a lack of continuous training, varied teacher readiness, the changing role of the teacher, and difficulty in selecting technology suited to learning goals. The school context, learners' characteristics, institutional policy, and leadership support also influence the success of technology integration. The integration of technology in learning therefore needs to be directed toward strengthening teachers' techno-pedagogical competence through professional development that is continuous, collaborative, and contextual.

Keywords: *educational technology; pedagogy; technology integration; teacher competence; digital learning*

1. INTRODUCTION

The development of digital technology has brought significant changes to the world of education. Technology is no longer used only as an administrative aid but has developed into part of the process of planning, conducting, evaluating, communicating, and developing learning. Teachers can use various digital devices and platforms to present material, provide learning resources, assign tasks, carry out evaluation, communicate with learners, and give feedback. This change creates great opportunities for improving the quality of learning, but at the same time it also presents new challenges for teachers.

The integration of technology in learning is fundamentally not merely the process of bringing digital devices into the classroom. The presence of computers, projectors, the internet, learning applications, or smart devices does not automatically produce effective learning. Technology must be integrated with the learning goals, the characteristics of the material, learners' needs, pedagogical

strategy, and the learning context. Teachers are therefore required not only to possess technological skills but also to understand how technology can be used pedagogically.

This issue has been a concern of various studies. Work on the challenge of effective technology integration into teaching and learning has shown that technology integration is a complex process influenced by various interrelated factors; challenges arise not only from teachers' ability to use devices but also from environmental factors, institutional support, access to technology, and the fit between technology and learning practice ("Challenge of Effective Technology Integration," 2013).

Akram et al. (2022), through a systematic review of teachers' perceptions of technology integration, showed that teachers' perceptions and experiences are an important part of understanding the success of applying technology in learning. Teachers may view technology as an opportunity to improve learning, but they can also face barriers when technology is not supported by adequate training, facilities, or a working environment.

In the context of teacher education, the issue of technology integration becomes even more complex. So and Kim (2009) showed the importance of integrating technology, pedagogy, and content knowledge (TPACK) in the education of pre-service teachers, indicating that technological ability cannot be separated from pedagogical knowledge and the mastery of content; a teacher able to use digital devices is not necessarily able to select technology suited to the learning goals or to integrate it effectively into teaching strategy.

Kaminskienė, Järvelä, and Lehtinen (2022) positioned the development of technology as a challenge for teacher education. Rapid technological change requires teacher-education institutions to continually update their education and competence-development programs, so that teachers are prepared not only to use currently available technology but also to adapt to technological developments that will keep changing.

These challenges are visible in various learning contexts. Dinçer (2024), for example, examined the gap in technology integration through the competencies and needs of science teachers, showing the importance of considering teachers' needs specifically, since each field of learning has different material characteristics and pedagogical strategies; technology suited to science learning is not necessarily used in the same way in the learning of language, mathematics, or other subjects.

Dockendorff, Merino, and Gómez Zaccarelli (2026) showed the challenges of using digital technology in mathematics learning from the perspective of teacher educators in Chile, indicating that technological challenges can relate to how teachers and teacher educators understand the use of technology in the learning of a particular discipline; the integration of technology cannot be separated from the characteristics of the field of study.

The issue of context is also raised by Ifinedo and Kankaanranta (2021), who showed the importance of understanding the influence of context on technology integration from the perspective of teacher educators. This shows that technology integration does not occur in a vacuum: the condition of the school, policy, organizational culture, access to resources, the support of colleagues, and teachers' experience can shape how technology is used.

In the context of pre-service teachers, Jamil, Aslam, and Shahzad (2024) showed that prospective teachers have their own perceptions, practices, and challenges in technology integration, indicating that teacher education holds a strategic position

because the competence developed during education will influence teachers' readiness when they enter the school environment.

In language learning, Taghizadeh (2020) showed that language teachers also face various issues when integrating technology into the young-learner classroom. Technology in language learning can open opportunities to use multimedia, digital communication, authentic sources, and interactive activities, but teachers need to understand how such technology supports the language goals to be achieved.

The issue of technology integration is also found in primary education. Paran, De Leon, and Pade (2024) discussed the challenges of technology integration for primary-school teachers, where teachers need to consider learners' level of development, the simplicity of device use, safety, and the fit of technology with learning activities. Taole (2024) showed that the challenge becomes more complex in the multigrade context, when a single teacher handles learners of different levels or needs within one learning environment.

In schools with particular conditions, limited resources can be a significant barrier. Mensah and Asafo-Adjei (2024) examined the challenges faced by primary-school teachers in integrating information and communication technology (ICT) in a developing country, and Thumbarayan, Kamaruzaman, and Omar (2023) discussed the issues and challenges of technology integration in National Type Tamil schools. These studies show that technology integration cannot be viewed only from the perspective of the individual teacher's readiness but must also consider the condition of the institution and the educational environment.

In higher education, Landa (2025) discussed the technological-pedagogical challenges associated with the integration of technology in learning, showing that even in higher-education environments, which generally have greater access to technology, the integration of technology with pedagogy still requires competence and careful planning. Panakaje et al. (2024) viewed technology integration in higher education as a process that can revolutionize pedagogy but also requires the ability to adjust technology to the learning process, teacher development, and performance improvement. Ngao, Sang, and Kihwele (2022) showed the importance of understanding teacher educators' perceptions and practices of ICT integration in teacher-education programs.

In the context of professional development, Napitupulu et al. (2024) emphasized the importance of strategies for teachers' professional development in the digital age in order to integrate technology and pedagogy. Technology integration cannot rely only on one-off technical training; teachers need a continuous process of development so that they can develop competence in line with changes in technology and learning needs. The increasingly rapid development of technology also gives rise to a new need for techno-pedagogical skills: Singh and Yadav (2026) positioned techno-pedagogical skills as an important factor in enhancing the learning process, since teachers need to understand technology and at the same time understand how to use it to create meaningful learning experiences.

Allonar and Medina (2026), through a study of teachers' lived experiences, showed the importance of teachers' direct experience in understanding technology integration, and MAEd et al. (2026) showed the experiences of public secondary-school science teachers in integrating technology into learning content and teaching strategy. On the basis of these various studies, the challenge of integrating technology and pedagogy is a multidimensional issue: the challenge lies not only in teachers' ability to use technology but also in the ability to combine technology with pedagogy, material, learners' characteristics, the school environment, and the learning goals.

This article therefore aims to analyze qualitatively the various challenges teachers face in integrating technology and pedagogy in learning on the basis of published research. Guided by this aim, the study addressed three research questions: (RQ1) What challenges do teachers face in integrating technology and pedagogy? (RQ2) How do these challenges vary across subjects, levels, and educational contexts? (RQ3) What factors influence the success of technology–pedagogy integration?

2. METHOD

Research Design

This study used a qualitative method with a descriptive approach through library research. This approach was chosen because the study aimed to obtain a deep understanding of teachers' challenges in integrating technology and pedagogy on the basis of various research findings produced by earlier researchers.

Data Sources

The research data came from twenty scholarly articles relevant to the theme of technology and pedagogy integration. All the references provided were used as the principal sources in the analysis. This literature covered research on teachers' perceptions, teachers' experiences, technological competence, techno-pedagogical skills, teacher education, professional development, ICT integration, learning in various subjects, and the contexts of primary, secondary, and higher education.

Data Collection

Data were collected through documentation. Each article was examined in terms of its research focus, research context, teachers' experience or perception, the form of technology used, the challenges found, and the implications for the integration of technology and pedagogy. The information obtained was then grouped by related theme.

Data Analysis

Data were analyzed descriptively and interpretively in several stages. The first stage identified the main ideas of each reference. The second stage grouped the findings into themes related to technological competence, pedagogical competence, the integration of technology and material, infrastructure, professional development, institutional context, teacher readiness, and the changing role of the teacher. The third stage compared findings across references to identify similarities, differences, and connections. The final stage interpreted the various findings as a whole to obtain a picture of teachers' challenges in integrating technology and pedagogy. To maintain breadth of perspective, the study used references from various educational contexts and levels, so that the results describe not the challenges of teachers in a single type of school or a single subject but the broader complexity of technology and pedagogy integration.

Trustworthiness

The validity of the interpretation was supported through the comparison of sources, so that conclusions were built on the tendencies emerging across the literature rather than on a single source, and drew on references from diverse contexts and levels of education.

Ethical Considerations

Because the study analyzed publicly available scholarly literature and did not involve human participants or personal data, the ethical requirements centred on academic integrity, the accurate representation of sources, and proper attribution.

3. RESULTS

The analysis produced eight interrelated themes that together address the three research questions, as summarized in Table 1. The themes were derived from the reviewed sources and are presented below with their supporting evidence.

Table 1

Themes, Core Focus, and Supporting Sources Derived from the Analysis

Theme	Core focus / analytic codes	RQ	Key supporting sources
Integration is more than using devices	Pedagogical, not merely technical, use of technology	RQ1	So & Kim (2009); Akram et al. (2022)
The technology–pedagogy competence gap	Digital vs pedagogical competence; techno-pedagogical skills	RQ1	Dinçer (2024); Singh & Yadav (2026); Landa (2025)
Limited infrastructure and resources	Devices, connectivity, technical support, settings	RQ3	Mensah & Asafo-Adjei (2024); Thumbarayan et al. (2023); Taole (2024)
Limited training and professional development	One-off vs continuous, pedagogy-integrated development	RQ3	Napitupulu et al. (2024); Kaminskienė et al. (2022); Ngao et al. (2022)
Differences in teacher readiness	Experience, perception, pre-service preparation	RQ1	Akram et al. (2022); Allonar & Medina (2026); Jamil et al. (2024)
Matching technology to subject content	Discipline-specific fit; science, mathematics, language	RQ2	Dinçer (2024); Dockendorff et al. (2026); Taghizadeh (2020)
School and institutional context	Policy, leadership, culture, level-specific conditions	RQ3	Ifinedo & Kankaanranta (2021); Paran et al. (2024)
Changing role of the teacher and teacher education	Facilitator and designer; teacher educators; TPACK	RQ1, RQ2	Panakaje et al. (2024); Landa (2025); So & Kim (2009)

Note. RQ = research question; ICT = information and communication technology; TPACK = technology, pedagogy, and content knowledge. The themes and codes were derived from the reviewed scholarly sources.

3.1 Integration Is More Than the Ability to Use Devices

The analysis showed that the principal challenge in technology integration lies in the difference between the ability to use technology technically and the ability to use it for pedagogical purposes. Teachers may be able to operate applications, digital devices, or learning platforms, but this does not yet show that technology has been integrated meaningfully into learning.

So and Kim (2009) showed the importance of integrating technology, pedagogy, and content knowledge. This concept shows that the effective use of technology requires the connection of these three components: teachers must understand the material taught, know the appropriate pedagogical strategy, and determine the technology that can support that strategy and material. The findings of Akram et al.

(2022) likewise showed that teachers' perception of technology is an important part of determining its application; teachers who view technology as relevant to learning needs tend to have a different orientation from teachers who use technology only because of institutional demands. The challenge of technology integration is therefore not merely the question of whether teachers can use technology but whether they can use it appropriately to achieve learning goals ("Challenge of Effective Technology Integration," 2013).

3.2 The Gap between Technological and Pedagogical Competence

The findings showed a gap between technological competence and pedagogical competence. Teachers may have good digital skills but still experience difficulty in determining how technology is used in the learning process; conversely, teachers with strong pedagogical ability do not necessarily have the confidence or skill to use technology.

Dinçer (2024) emphasized the importance of attending to teachers' competencies and needs in technology integration, since teachers' competence needs to be developed in a balanced way so that the use of technology is not separated from learning strategy. Singh and Yadav (2026) likewise positioned techno-pedagogical skills as an important ability for enhancing learning, connecting technological ability with pedagogical ability so that teachers can determine technology relevant to the learning goals. Landa (2025) showed that technological-pedagogical challenges still occur in higher education, indicating that a high level of education or the availability of technology does not automatically remove the gap between technology and pedagogy.

3.3 Limited Infrastructure and Resources

The analysis showed that limited infrastructure is one important barrier to technology integration. Infrastructure includes the availability of devices, internet connectivity, electricity, software, supportive learning spaces, and technical support. Mensah and Asafo-Adjei (2024) showed that teachers in developing countries face various challenges in ICT integration, so that the condition of the school environment can limit the use of technology even where teachers have the desire and ability to use it.

Thumbarayan et al. (2023) also showed various issues in technology integration in schools, which indicates that the success of integration is closely related to the support of the school environment. Taole (2024) showed that the multigrade context has its own challenges, since teachers need to manage learners with different needs, so that the use of technology must be adjusted to a complex learning situation.

3.4 Limited Training and Professional Development

The findings showed that a lack of continuous training is one of the principal challenges. The development of technology proceeds very rapidly, so that training conducted only once is not enough to ensure that teachers can keep up with change. Napitupulu et al. (2024) showed the importance of teacher professional development in the digital age, which needs to be directed not only at the mastery of devices but also at the integration of technology with pedagogical strategy.

Kaminskienė et al. (2022) showed that the development of technology presents a challenge for teacher education; education and professional-development programs need to adjust to technological developments so that both prospective and in-service teachers can face a changing educational environment. Ngao et al. (2022) also showed the importance of understanding teacher educators' perceptions and

practices of ICT, indicating that the development of teachers' competence needs to begin with the institutions that prepare and develop teachers.

3.5 Differences in Teacher Readiness

Teachers do not have the same level of technological readiness. Some teachers can quickly adopt new technology, while others need more time, training, and support, a difference that can be influenced by experience, professional age, educational background, experience of using technology, and the working environment. Akram et al. (2022) showed the importance of teachers' perception in technology integration, since perception can influence readiness and willingness to use technology.

Allonar and Medina (2026), through a study of teachers' lived experiences, showed the importance of teachers' direct experience in understanding technology integration, which is not always uniform because each teacher faces different classroom conditions, learner needs, and school support. Jamil et al. (2024) also showed that pre-service teachers have perceptions and challenges in technology integration, indicating that technological readiness needs to be built from the stage of teacher education.

3.6 Difficulty Matching Technology to Subject Content

The analysis showed that the selection of technology must consider the characteristics of the learning material; not all technology is suited to every subject or learning goal. Dinçer (2024) showed the importance of science teachers' competence in integrating technology, while Dockendorff et al. (2026) showed the challenges of technology integration in mathematics learning. Both contexts show that technology integration is closely related to the characteristics of the field of study.

In language learning, Taghizadeh (2020) showed that language teachers face their own challenges when integrating technology into the young-learner classroom. Technology can support language learning, but teachers must ensure that its use genuinely supports the development of language ability, so that teachers' challenge is not merely to select popular technology but to select technology relevant to the goals, material, method, and characteristics of learners.

3.7 The Influence of School and Institutional Context

The findings showed that technology integration is strongly influenced by context. Ifinedo and Kankaanranta (2021) emphasized the importance of context in understanding technology integration from the perspective of teacher educators. Context includes school policy, leadership, technical support, organizational culture, collaboration among teachers, access to devices, and institutional expectations; teachers who work in an environment with strong support are in a different position from teachers who must develop technology integration individually.

Paran et al. (2024) showed that the challenges of primary-school teachers in technology integration relate to specific learning conditions, and Taole (2024) showed that the multigrade condition also requires a different strategy. This indicates that policy on technology integration needs to consider the real context in which teachers work.

3.8 The Changing Role of the Teacher and Teacher Education

Technology integration also brings a change in the role of the teacher. Teachers are no longer only the principal source of information but develop into facilitators, directors, managers of learning resources, providers of feedback, and designers of learning experiences. Panakaje et al. (2024) showed that technology integration in

higher education can change pedagogical practice and support the improvement of learning, but such change requires teachers' ability to adjust their professional role. Landa (2025) showed that pedagogical challenges still arise when technology is used in higher education, so that the change in the role of the teacher does not occur automatically simply because technology is available.

Teacher education is one strategic space for addressing the challenges of technology integration. So and Kim (2009) emphasized the importance of the experience of integrating technology, pedagogy, and content knowledge in the education of pre-service teachers, and Jamil et al. (2024) showed that prospective teachers face challenges in integrating technology, so that teacher-education programs need to provide the experience of designing learning that combines technology, pedagogy, and material. MAEd et al. (2026) showed the experiences of public secondary-school science teachers in integrating technology into learning content and teaching strategy, confirming that technology integration occurs in the day-to-day process of planning and practising learning, in which teachers decide when technology is used, for what purpose, how learners interact with it, and how the results are evaluated.

4. DISCUSSION

The integration of technology in learning needs to be understood as a pedagogical process rather than merely a technological one. It is not enough for teachers to have the ability to use digital devices or applications; what is more important is the ability to determine the relationship among technology, learning material, teaching strategy, and learners' needs. So and Kim (2009) showed that the integration of technology, pedagogy, and content knowledge is an important basis for building technology-based learning practice. The principal challenge for teachers therefore lies in the ability to change technology from a mere tool into a part with a pedagogical function in the learning process.

This explains why the presence of technology in schools does not always produce significant change in learning. If technology is used only to replace old media without a change in learning strategy, the transformation that occurs is more technical than pedagogical. Teachers may use digital presentations as a replacement for the blackboard or a digital platform as a replacement for collecting assignments, but the pattern of learning remains the same. Meaningful technology integration requires change in the design of activities, the pattern of interaction, the giving of feedback, and the way learners build knowledge.

Akram et al. (2022) showed that teachers' perception of technology is an important part of understanding technology integration. Such perception is formed through experience, knowledge, institutional support, and the experience of success or failure in using technology; teachers with positive experience tend to have a different understanding of the benefits of technology from teachers who face various constraints without obtaining adequate support. Policy on technology integration therefore needs to attend to teachers' real experience and not merely impose an obligation to use digital devices.

The gap between technological and pedagogical competence is a very important issue. Teachers may know how to use a particular application but not necessarily know which learning activity is most suited to it; conversely, teachers may have a good learning strategy but find it difficult to translate that strategy into a digital environment. Singh and Yadav (2026) showed the importance of techno-pedagogical skills as the ability that connects technology with learning practice, a competence

that needs to be developed through real experience of designing, conducting, evaluating, and reflecting on technology-based learning.

These challenges also show that technology training for teachers needs a change of approach. Training that teaches only the technical functions of devices or applications has limitations, because teachers need more than operational ability. Napitupulu et al. (2024) showed the importance of teachers' professional development in the digital age, integrating technology with pedagogy; training should begin from the learning problems teachers face and then seek technology that can help resolve them, so that technology is placed as a means of achieving learning goals rather than as a goal in itself.

The rapid development of technology further strengthens the need for continuous professional development. Educational technology used several years ago can change or be replaced by new technology. Kaminskienė et al. (2022) showed that the development of technology presents a challenge for teacher education; teachers need the capacity for adaptation so as not to depend on a single device or application, and the more important competence is the ability to understand the principles of technology use and transfer that knowledge to various contexts.

The factor of context also cannot be ignored. Ifinedo and Kankaanranta (2021) showed that context influences technology integration from the perspective of teacher educators. A teacher may have adequate digital competence, but its application can be hindered when the internet connection is unstable, devices are limited, technical support is unavailable, or school policy gives no room for experiment. This shows that technology integration is a shared responsibility involving teachers, schools, educational institutions, education managers, and providers of technological support.

Limited infrastructure is more visible in educational contexts with limited resources. Mensah and Asafo-Adjei (2024) showed that teachers in developing countries face particular challenges in ICT integration; in such situations, the strategy for technology integration cannot rely entirely on high-technology devices, and teachers need a realistic approach that considers the available devices, network conditions, learners' ability, and school resources. Thumbarayan et al. (2023) also showed that particular school conditions can give rise to their own challenges in the use of technology, and the multigrade context examined by Taole (2024) requires teachers to manage several groups of learners with different needs, so that technology can be a solution for providing varied learning resources but also needs to be managed so as not to add to the complexity of learning.

Challenges also cannot be equated across fields of study. Dinçer (2024) showed the needs of science teachers in technology integration, while Dockendorff et al. (2026) showed the challenges of using technology in mathematics learning. The characteristics of each subject influence how technology can be used: in science, technology can be used for simulation, visualization, experiment, or data processing; in mathematics, for the visualization of concepts, modelling, and exploration; teachers therefore need sufficient pedagogical understanding to choose technology use suited to the characteristics of the material. Language learning also has its own characteristics, and Taghizadeh (2020) showed that technology integration in the young-learner classroom requires special consideration, so that teachers need to ensure that technology provides learners with the opportunity to use language meaningfully rather than only increasing its entertainment aspect.

Teacher education is one important point for addressing the challenges of technology integration. If prospective teachers experience technology only as users,

they may not have enough experience to design technology-based learning. Jamil et al. (2024) showed the challenges in prospective teachers' perceptions and practices, so that teacher-education programs need to provide the experience of designing learning that combines technology, pedagogy, and material. Teacher educators hold a strategic role in this process: Ngao et al. (2022) showed the importance of understanding teacher educators' perceptions and practices of ICT integration, and teacher educators need digital and pedagogical competence in order to provide a model of practice that prospective teachers can emulate, since the development of teachers' competence cannot run optimally if those who prepare prospective teachers do not themselves obtain the opportunity to keep developing their competence.

Technological change also brings a change in teachers' professional identity. Teachers who previously acted as providers of information must now act more as designers of learning experiences, facilitators, directors, and evaluators of learning resources. Panakaje et al. (2024) showed that technology integration can bring change to pedagogy in higher education, but such a change of role requires support and the opportunity for teachers to reflect on their practice. In higher education, Landa (2025) showed that the challenges of technology integration still relate to pedagogical issues: students with access to technology do not automatically become active learners, so that teachers need to design activities that allow technology to be used for collaboration, problem-solving, information-seeking, the production of knowledge, and reflection, integrating technology into the overall design of learning.

The development of technology also requires teachers to keep evaluating the effectiveness of the technology used. Not all new or popular technology is suited to every learning need; teachers need to consider whether technology helps learners understand material, increases interaction, strengthens skills, provides better feedback, or instead adds cognitive load. In this context, teachers' technological literacy must run together with their pedagogical ability and reflective ability. Effective professional development therefore needs to be carried out collaboratively: teachers can learn through professional communities, share practice, conduct lesson study, discuss their experience of using technology, and reflect together. Real experience becomes an important source of learning because the challenges of technology integration often differ from one school to another, so that a contextual model of professional development makes it more possible for teachers to develop solutions suited to their needs.

Allonar and Medina (2026), examining teachers' lived experiences, showed the importance of understanding technology integration from teachers' direct experience, which can reveal that teachers face not only technical issues but also issues of time, workload, classroom management, learner readiness, and administrative demands. The success of technology integration therefore needs to be judged more comprehensively than merely by the number of devices or applications used. MAEd et al. (2026) also showed that the integration of technology into learning content and teaching strategy is part of teachers' professional experience, confirming that technology integration occurs in the day-to-day process of planning and practising learning. The challenge of integrating technology and pedagogy can thus be understood as an issue of balance: teachers need to balance technological ability with pedagogy, learners' needs with the characteristics of the material, innovation with the readiness of the school, and the use of technology with the learning goals. Effective integration is not the use of as much technology as possible but the use of technology appropriately, in a planned, contextual way oriented toward improving the quality of the learning process.

Implications. The findings suggest that teacher preparation and professional development should strengthen techno-pedagogical competence rather than device operation alone, beginning from real learning problems and the characteristics of each subject; that teacher educators themselves need continuous development so as to model pedagogical technology use; that institutions should provide infrastructure, technical support, leadership, and a collaborative professional culture; and that the success of integration should be judged by the quality of learning rather than by the quantity of devices used.

Limitations and Suggestions. This study was based on a qualitative synthesis of twenty scholarly sources rather than on primary fieldwork; its findings therefore reflect the analyzed literature and are not derived from direct observation of teachers or classrooms. Future research could examine teachers' challenges empirically, through case studies, interviews, classroom observation, and lesson study in Indonesian schools and universities, and could compare challenges across subjects, levels, and conditions of infrastructure and institutional support.

5. CONCLUSION

On the basis of the review above, it can be concluded that the integration of technology and pedagogy in learning is a complex process that presents various challenges for teachers. These challenges relate not only to the technical ability to use devices or applications but above all to the ability to connect technology with pedagogy, learning material, learners' characteristics, and the learning goals.

The findings show that one of the principal challenges is the gap between technological competence and pedagogical competence. A teacher able to operate technology is not necessarily able to use it effectively for learning, so that the development of techno-pedagogical skills becomes an important need. Teachers need the ability to select, use, evaluate, and integrate technology on the basis of learning needs.

Limited infrastructure is also an important challenge, particularly in schools and regions with limited resources, since the availability of devices, the quality of the internet connection, technical support, and learning resources affect teachers' opportunity to integrate technology. In addition, differences of context—primary, secondary, and higher education, multigrade learning, and the learning of science, mathematics, and language—show that technology integration requires a contextual approach.

A further challenge relates to teachers' professional development. The rapid change of technology makes one-off training no longer adequate; teachers need professional development that is continuous, collaborative, based on real needs, and integrates technology with pedagogy. The education of prospective teachers also needs to provide sufficient experience of integrating technology, pedagogy, and content knowledge.

The role of the institution is also very important: teachers need leadership support, supportive policy, infrastructure, access to resources, opportunities for collaboration, and technical support, so that the responsibility for technology integration cannot be placed on teachers as individuals alone. Technology should therefore not be seen as the goal of learning but as a means of strengthening the pedagogical process. Effective technology integration occurs when teachers are able to select and use technology on the basis of learners' needs, the characteristics of the material, the learning goals, and the context of the educational environment. The enhancement of teachers' techno-pedagogical competence, continuous professional development, the strengthening of teacher education, and the

provision of institutional support are therefore important parts of building learning that can make meaningful use of technological developments.

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Author Contributions.

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Data Availability.

This study analyzed publicly available published literature; no new empirical data were generated, and all sources analyzed are listed in the References.

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