Tribhuvan Journal Vol. 4 No.1.pp.64-73, December, 2025; Research Management Cell, Tribhuvan Multiple Campus, Tribhuvan University, Nepal
DOI: **https://doi.org/10.3126/tribj.v4i1.94705**

Integrating ICT in Teaching and Learning at School Level: A Systematic Review

Krishna Bahadur G.C.
krishna.gc@tmc.tu.edu.np
https://orcid.org/0009-0000-9157-5376
Tribhuvan Multiple Campus, Palpa
Shivlal Khanal
shivalkhanal17@gmail.com
Resunga Multiple Campus, Gulmi

Article History: *Received 12 May 2025; Reviewed 15 August 2025; Revised 22 October 2025; Accepted 21 November 2025*

Abstract

Introduction: *The effect of information and communication technology (ICT) integration in school education has continued to attract interest as a means of enhancing the effectiveness of student learning. However, as widely used as it is, there are still major gaps in how and how effectively ICT is applied across various settings. This paper will analyze the existing literature on the subject of integration of ICT in schools to understand the extent, the results and difficulties involved.*

Methods: *The review was conducted according to PRISMA guidelines of systematic reviews. Google Scholar, Scopus, ERIC and Web of Science were searched to find articles published between 2015 and 2025, including the terms: ICT integration, school education, teaching and learning, and digital pedagogy. Empirical and review studies (at the school level) were eligible, and non-English publications, abstracts of conferences, reports, and editorials were excluded. Among 1,245 records first located, 245 were eliminated as duplicates, 1,000 were filtered by title and abstract and 180 full texts analyzed. A total of 60 studies were finally included in the qualitative synthesis after meeting the inclusion criteria.*

Findings: *ICT integration was mostly related to increased student engagement, more interactive and learner-centred teaching, and better student performance. Digital learning platforms, multimedia resources, virtual simulations, and mobile applications were the most frequently reported tools and assisted in collaboration and critical thinking. Meanwhile, several obstacles were evident across the studies: a poorly developed infrastructure, insufficient teacher education, poor technical assistance, and socio-economic discrepancies that contribute to the digital divide. Such difficulties were particularly acute in the context of developing countries.*

Discussion: *ICT can truly transform school education, but this transformation requires a lot of planning about how it is done, how well teachers are trained and how institutions are ready to accommodate it. The support of policies, continuous professional training, and investment in the digital infrastructure have become prerequisites. Longitudinal research and context-specific models of integration should be prioritized in future work to aid the sustainable and equitable use.*

Keywords: Educational technology, ICT Integration in Education, E-learning, Technology, Digital Pedagogy

Introduction

Education in the world has been transformed by the fast-growing digital technology. The incorporation of information and communication technology (ICT) in teaching and learning is no longer viewed as an option in the learning process, but it is a necessity for effective, inclusive and student-centered learning. Here, ICT encompasses a wide area of tools and resources which include computers, the internet, mobile devices, multimedia applications and learning management systems, which are all useful in enhancing educational practice. With the changes in the education system to meet the needs of the twenty-first century, ICT integration has emerged as one of the most important tools of enhancing quality, access and equity.

ICT is transforming the classroom at the school level. The passivity and teacher-centred instruction are gradually being replaced by more technology-based teaching methods that require students to reflect, problem-solve and actively participate in the content. It has been observed by UNESCO and others that ICT can enhance innovative practice, broaden access to information, and serve to bridge educational gaps - especially in the developing world. To teachers, ICT opens up the possibilities of diversifying instruction, relying on multimedia, and responsively creating classrooms for various types of learners.

This is likely to be supported by empirical work. Tamim et al. (2011) meta-analysis established that a positive impact of technology on student achievement was consistent, as long as it is utilized effectively. As research suggests, in the case of intelligent integration of digital tools, gains in motivation and engagement have been observed. In particular, simulations, virtual laboratories, and interactive systems provide students with an opportunity to learn the intricate concepts that would otherwise be abstract.

Nevertheless, the image is not entirely rosy. The integration of ICT in low- and middle-income countries is faced with real challenges. The first one is often infrastructure: poor internet connectivity, inaccessible computers, and unresponsive technical support. These gaps on their own can cripple ICT initiatives in rural and under-resourced schools. Second is teacher capacity: despite the availability of devices, teachers might not have the training or confidence to effectively use them in a meaningful manner, and resources go to waste.

The third problem, the digital divide, crosscuts the other two. Less wealthy students will be less likely to have devices or a consistent internet connection at home, which restricts the potential technology has to benefit them. This gap became especially noticeable during the COVID-19 pandemic, when online and blended learning were being transitioned to. According to Hodges et al. (2020), remotely teaching an emergency situation at the time revealed the disparate nature of school and learner preparation to digital instruction.

In addition to the infrastructure and equity, the institutional and policy environment is also important. Incorporation of ICT requires policy support, sufficient investments and national and school coordination. Even the best initiatives are likely to be ineffective without that support, investment in infrastructure, professional development of teachers, and good instructions on how to use the classroom.

A large body of literature exists on ICT in schools; however, the results are often fragmented and largely context-dependent. Some studies report strong positive effects and mixed or inconsistent effects, depending on local conditions, such as the level of teacher training and the availability of resources in different schools. Such a synthesis of this literature helps to understand what works, as well as identify where open questions lie.

This paper is a systematic review of the literature on the ICT integration in teaching and learning in schools. It has three objectives: (i) to explore the level and nature of ICT integration in schools, (ii) to determine the effect of ICT integration on teaching and learning outcomes of students, and (iii) to determine various challenges and barriers to implementation. Comprising the findings of the recent studies, the review aims to add to the existing literature and to provide evidence-based advice to educators, policymakers, and researchers.

This review is particularly relevant for developing countries like Nepal, where ICT has been integrated into the school system despite real resource constraints. The Government of Nepal has already launched various programs to promote digital learning, such as specific ICT policies and e-learning programs. However, there is still much debate about how well these programs are working. To come up with solutions that work in these scenarios, it is important to understand the factors that affect the use of ICT.

In brief, ICT integration is a huge potential to enhance teaching and learning in the digital era - but to take advantage of that potential is to take into account the issues of infrastructure, teacher capacity and equity. The proposed study will be a systematic review of the literature in the field to give a grounded, evidence-based perspective on where ICT integration is and where it is yet to be.

Methodology

Research Design

This paper uses a systematic review research design to synthesize the available empirical data on the implementation of ICT in teaching and learning at the school level. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines will guide the review procedure to make the process of identification, screening and synthesizing research transparent and reproducible.

Search Strategy

Four electronic databases were searched systematically to determine the literature published in 2015-2025: Google Scholar, Scopus, ERIC (Educational Resources Information Center), and Web of Science. Relevant keywords and synonyms were used with the help of Boolean operators (AND, OR) to retrieve as much of the relevant literature as possible.

Search Strings

The search strings used were the following:

1. (ICT integration, Information and communication technology or Educational technology) and (Teaching or Learning or Pedagogy) and (School education or primary education or secondary education).

2. (Digital learning" OR e-learning) AND (Classroom teaching) OR instructional practices) AND (School students).
3. (ICT use in education) OR (Student achievement) OR (Learning outcomes) AND (Schools).
4. ("Technology integration) AND (Teacher practices OR Instructional methods) AND (K-12 education).

Search filters were used to narrow the results to peer-reviewed journals, English-language sources and publications published in the year 2015 and beyond.

Eligibility Criteria

The following criteria were used to make sure the information was relevant and of quality.

Inclusion criteria:

1. SESE studies on ICT integration at the school-level (primary and secondary) education.
2. Empirical research (quantitative, qualitative, or mixed-methods) and systematic reviews.
3. Peer-reviewed journal articles
4. Studies that provide results in terms of teaching practices, student learning, or learning effectiveness.

Inclusion criteria: Journal articles published in English since 2015.

Exclusion criteria:

1. Research concentrated on tertiary or tertiary level.
2. Conference papers, dissertations, reports and editorials.
3. Non-English publications
4. Research with no clear methodology or empirical evidence.
5. Duplicates across databases

Study Selection Process

The process of selection was based on the four-stage PRISMA flow:

1. Identification. Database searches yielded a total of 1,245 records.
2. Screening. One thousand records were filtered by title and abstract after the elimination of 245 duplicates. Out of them, 820 were eliminated as irrelevant to the topic.
3. Eligibility. The rest of the 180 full-text articles were evaluated on the basis of the eligibility criteria. Others (n=120) were excluded due to the following reasons: failed to concentrate on school education (n=45), poor or vague methodology (n=30), conceptual or non-empirical papers (n=25), inaccessible or duplicated full texts (n=20).
4. Inclusion. Sixty studies were put through all qualitative criteria and were incorporated in the qualitative synthesis.

Data Extraction

To ensure that the data in each of the studies covered by the study is captured in a uniform manner, a structured data extraction form was created. The fields that were extracted were:

1. Name(s) of author/s and the date of publication.
2. Study location

3. Research design and methodology.
4. Sample characteristics
5. ICT interventions and tools applied.
6. Key findings

Quality Assessment

In order to justify the quality of the synthesis, every included study was evaluated in accordance with a list of quality criteria:

1. Clearness of research objectives.
2. Appropriateness of methodology
3. Validity and reliability of data collection tools.
4. Data analysis transparency.
5. Applicability to the research questions.

At the eligibility stage, the studies were filtered out that failed to meet the minimum quality threshold.

Data Synthesis

The findings were synthesized in a thematic analysis approach. It was done in four steps: familiarization with the data, coding of major results, grouping of the codes into themes and generalization into bigger categories. This process has resulted in five themes:

1. Educational practice of ICT.
2. Student learning outcomes.
3. Teacher competencies and attitudes.
4. Obstacles to ICT integration.
5. Policy and institutional support.

Ethical Considerations

Since the study relies on published literature only, it does not entail the use of human subjects. Ethics were, however upheld by the observance of citing all sources, avoiding plagiarism and reporting original results correctly.

Results and Discussion

This review is a synthesis of sixty peer-reviewed research papers published in the past four years (2015-2025) regarding the inclusion of ICT in teaching and learning in schools. The research is based on a variety of geographic settings, both developed and developing nations, and a large portion of such is low- and middle-income environment. In terms of methodology, they range across quantitative, qualitative and mixed-methods designs, which, when combined, provide a fairly broad perspective on ICT integration.

Many common themes go through the studies included: (i) ICT in educational practice, (ii) effect on student learning outcomes, (iii) teacher capacity and attitudes, (iv) infrastructural and

institutional issues, (v) the digital divide and equity, and (vi) policy and systemic support. A discussion of each of them is given below with a special regard to the implications of the findings to Nepal.

ICT in Education

The overviewed studies indicate, to some extent, a change towards less teacher-centered and more interactive and learner-centered approaches. Multimedia presentation tools, interactive white boards, simulation programs, and learning management systems are providing educators with the means of providing complex concepts in forms that can be understood by the students.

One similarity is that active learning is facilitated by ICT. Students engage in discussions, problem solving activities and group activities in ways that were more difficult to arrange in the traditional classrooms. A virtual science simulation, such as one that allows students to test their ideas otherwise-abstract concepts, allows them space to develop creative and expressive abilities, whereas digital storytelling and multimedia projects do not.

ICT-informed pedagogy is gradually emerging in Nepal especially in urban schools. ICT is explicitly mandated to be integrated in teaching and learning in national efforts like the School Sector Development Plan (SSDP). In practice, however, classroom practices, particularly in rural communities, continue to be quite traditional, and the explanations are well known: a lack of access to digital technologies and enough chances of meaningful teacher education.

The bigger picture of the literature is that ICT integration cannot be successful only because of the availability of technology. Tools must be linked well with the goals of instruction; otherwise, they can become ends of their own. This is consistent with constructivist perspectives of learning, in which technology is viewed as an aid to build knowledge by engaging in active learning, but not instead of active learning.

Student Learning Outcomes

Among the more intuitive results of the review, it is evident that ICT integration in its quality does help in enhancing learning outcomes. The majority of the studies included indicate academic performance, motivation, engagement, and digital literacy improvement.

This is in part because of personalization. Adaptive platforms and educational applications enable students to learn at their speed, provide immediate feedback, and assist students in understanding where they are performing poorly. The multimedia resources, in their turn, appear to aid in understanding and memorizing.

Other studies also bring out the importance of ICT in helping to promote higher-order thinking - critical analysis, problem solving, and creativity. Digital-based project-based learning (such as) tends to lead students towards real-life questions and open-ended solutions, as opposed to one-shot answers.

These advantages are not uniformly spread, though. The effect is enhanced in well-prepared teachers and good infrastructure environments. The situation is much more inequitable

in such nations as Nepal: in certain schools, the gains are significant, whereas in others, it is hard to achieve the same results due to the lack of resources. ICT adoption was accelerated, and these gaps were revealed by the COVID-19 pandemic. In Nepal, the switch to online education created an indisputable digital access gap as a significant number of students were unable to attend virtual classes due to the lack of equipment or a reliable internet connection. The episode highlighted the firm connection between equity and effectiveness.

Teacher Knowledge and Disposition to ICT

Teacher capacity, always, again and again, is a determining element. The studies reviewed emphasize that technological, pedagogical and content knowledge of teachers influence, to a great degree, the actual implementation of ICT into the classroom.

Remarkably, educators in the majority of studies have quite positive attitudes towards ICT and see its potential. This disconnect is more likely to manifest between belief and practice - classrooms are not necessarily reflective of what teachers claim to desire. A lot of this is a question of training: single workshops, with little follow-up, are seldom sufficient.

The case example is Nepal. Other training programs have been implemented, although not extensively, and the applied aspects of ICT integration, in most cases, do not get the necessary attention they deserve. Educators in rural schools, especially, encounter actual challenges in connecting to continuous training and assistance.

This is because the literature supports the idea of constant professional improvement. Technology is fast evolving, and one training session cannot match that. More effective is long-term support - mentoring, collaboration with peers and frequent chances to review and perfect practice. The attitude of teachers towards change and their beliefs is also a factor. ICT may seem like an additional burden to some teachers, and not a helpful tool, particularly when they lack confidence. To change that, there has to be an institutional culture which, in effect, rewards experimentation.

Infrastructural and Institutional Challenges

Despite all the potential that ICT has, it is infrastructural and institutional issues that continue to hinder the implementation. The reviewed studies recurrently raise the same concerns, namely: inadequate equipment, poor internet connectivity, ineffective tech support, and underinvestment. These issues are particularly acute in most developing nations, where Nepal is no exception. Not only are computers missing in rural schools, but also the electricity and network connections are typically unreliable. The hardware is not always available, even in cities where it is not used; maintenance and technical support is often lacking.

Institutional aspects are important as well. What can be seen to be the difference between schools that meaningfully integrate ICT and those that do not is the backing of school leadership and administration? Where there is involvement of leadership and policy is clear, implementation is likely to occur; whereas planning and coordination are weak, initiatives get stuck. Related is the funding model. The launch of many ICT projects is accompanied by external funding and fades away when the money runs out; a trend that suggests the necessity of investing over a period of time and investing in ICT as a national education expenditure, rather than as an addition.

Digital Divide and Equity

The digital divide is a unified theme in the literature. It is an embodiment of uneven access to ICT resources and is determined by the socio-economic status, geography, sex, and disability. This is most evident in Nepal in the urban-rural divide. The urban students have a great chance of being provided with some devices and access to the internet, whereas their rural peers are confronted with real obstacles. The consequence is that ICT, which ought to increase educational opportunity, runs the risk of decreasing it.

There are still gender gaps. Various factors combine to influence girls to have less access to technology compared to boys, including a team of socio-cultural and economic factors. The sealing of these gaps requires specific interventions, as opposed to general rollouts. The literature, in general, has a very simple and direct message: equity and inclusion should guide ICT integration. The policies should also be made in such a way that technology closes the gaps that exist and not strengthen them.

Systemic support and policy

Good policy and systemic support, both country-wide and within institutions, are critical to successful ICT integration. The studies reviewed put emphasis on the impact of government policies, curriculum frameworks, strategic plans and how they contribute to what schools actually do with technology. This front has actually been moved in Nepal. The ICT Master Plan in Education and School Sector Development Plan are policies that directly focus on ICT integration, training of teachers and development of infrastructure.

It is not evenly implemented, however. Well-designed policies are usually dulled by resource constraints, lack of co-ordination, and weak monitoring systems. The literature indicates that policy on paper must be supported by clear execution guidelines, sustained funding, as well as monitoring and evaluation systems which are, in fact, functional. It is also necessary to work together with stakeholders, including government, schools, teachers and communities, and partnerships between government and the business community can be of some use in terms of resource and technical capacity expansion.

Synthesis and Implications to Nepal

Collectively, the results indicate that ICT integration has the potential to enhance teaching and learning in a real way, that is, when pedagogy, teacher capacity, infrastructure and policy support are in place. In the case of Nepal, it has tangible consequences. It has progressed, yet there are still true challenges. Their solution demands a comprehensive strategy: a strategy that links technology and pedagogy, enhances the capacity of teachers and challenges towards equal access to resources.

Key recommendations include:

1. Enhancing teacher training and development to develop hands-on ICT skills.
2. Investing in the digital infrastructure and especially in rural regions.
3. Going forward with policies of inclusion to reduce the digital divide.
4. Promoting new pedagogical strategies that purposefully use ICT.
5. Setting up monitoring and evaluation to monitor the effects of ICT initiatives.

Conclusion

There are definite opportunities to enhance teaching and learning through ICT integration in school education. This review indicates that the benefits are genuine: improved engagement, improved learning, and increased flexibility in practice, but that they are context-specific: the quality of infrastructure provision, teacher preparation, and policy support. In the case of Nepal, it will still require a long-term commitment to overcome the current obstacles and employ ICT as a real driver of education change. An all-inclusive and holistic strategy - one that places equity at the heart of it will be central to ensuring that ICT assists in the provision of quality education and a smaller disparity between learners.

References

Baako, I., Osei, E. O., & Abroampa, W. K. (2025). Mapping the landscape of ICT integration in education: A systematic review. Indonesian Journal of Education and Social Science, 4(2), 254–275. https://doi.org/10.56916/ijess.v4i2.1096

Bond, M., Zawacki-Richter, O., & Nichols, M. (2019). Revisiting five decades of educational technology research. Educational Technology Research and Development, 67, 1025–1056. https://doi.org/10.1007/s11423-019-09619-2

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. IEEE Access, 8, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2988510

Crompton, H., Burke, D., & Gregory, K. (2017). The use of mobile learning in PK–12 education: A systematic review. Computers & Education, 110, 51–63. https://doi.org/10.1016/j.compedu.2017.03.013

Crompton, H., Jones, M. V., & Burke, D. (2022). Affordances and challenges of artificial intelligence in K–12 education: A systematic review. Journal of Research on Technology in Education, 56(3), 248–268. https://doi.org/10.1080/15391523.2022.2121344

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. Journal of Research on Technology in Education, 42(3), 255–284. https://doi.org/10.1080/15391523.2010.10782551

Falloon, G. (2020). From digital literacy to digital competence: The teacher digital competency framework. Educational Technology Research and Development, 68, 2449–2472. https://doi.org/10.1007/s11423-020-09767-4

Gil-Flores, J., Rodríguez-Santero, J., & Torres-Gordillo, J. J. (2017). Factors influencing teachers' use of ICT in classrooms. Computers & Education, 110, 1–11. https://doi.org/10.1016/j.compedu.2017.02.012

Hew, K. F., & Brush, T. (2007). Integrating technology into K–12 teaching and learning: Current knowledge gaps and recommendations for future research. Educational Technology Research and Development, 55, 223–252. https://doi.org/10.1007/s11423-006-9022-5

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. Educational Technology Research and Development, 68(5), 1–12. https://doi.org/10.1007/s10639-020-10378-7

Kozma, R. B. (2005). National policies that connect ICT-based education reform to economic and social development. Human Technology, 1(2), 117–156. https://doi.org/10.17011/ht/urn.2005355

Law, N., Pelgrum, W. J., & Plomp, T. (2008). Pedagogy and ICT use in schools around the world. Computers & Education, 50(2), 641–662. https://doi.org/10.1016/j.compedu.2006.07.003

Ottenbreit-Leftwich, A., Glazewski, K., Newby, T., & Ertmer, P. (2010). Teacher value beliefs associated with using technology. Computers & Education, *55*(3), 1321–1335. https://doi.org/10.1016/j.compedu.2010.06.002

Petko, D. (2012). Teachers' pedagogical beliefs and their use of digital media in classrooms. Computers & Education, 58(4), 1351–1359. https://doi.org/10.1016/j.compedu.2011.12.023

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. International Journal of Educational Technology in Higher Education, 14, 25. https://doi.org/10.1186/s41239-017-0063-0

Silva, H. T., & Arancibia, M. L. (2025). Research on ICT in teacher education: A systematic review. Revista Digital de Investigación en Docencia Universitaria. https://doi.org/10.19083/ridu.2025.2142

Sosa-Díaz, M. J., Sierra-Daza, M. C., Arriazu-Muñoz, R., Llamas-Salguero, F., & Durán-Rodríguez, N. (2022). EdTech integration framework in schools: A systematic review of the literature. Frontiers in Education, *7*, 895042. https://doi.org/10.3389/feduc.2022.895042

Sung, Y. T., Chang, K. E., & Liu, T. C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis. Computers & Education, 94, 252–275. https://doi.org/10.1016/j.compedu.2015.11.008

Tamim, R. M., Bernard, R. M., Borokhovski, E., Abrami, P. C., & Schmid, R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. Review of Educational Research, 81(1), 4–28. https://doi.org/10.3102/0034654310393361

Tondeur, J., van Braak, J., Ertmer, P. A., & Ottenbreit-Leftwich, A. (2017). Understanding the relationship between teachers' pedagogical beliefs and technology use in education. Computers & Education, 117, 1–15. https://doi.org/10.1016/j.compedu.2017.10.010

Van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2017). The relation between 21st-century skills and digital skills: A systematic review. Computers in Human Behavior, *72*, *577–588*. https://doi.org/10.1016/j.chb.2017.03.010

Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world. Journal of Computer Assisted Learning, 29(5), 403–413. https://doi.org/10.1111/jcal.12029

Yu, H., & Guo, Y. (2024). Generative artificial intelligence in education: Current status and prospects. Frontiers in Education, 8, 1183162. https://doi.org/10.3389/feduc.2023.1183162

Zheng, B., Warschauer, M., Lin, C. H., & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis. Review of Educational Research, 86(4), 1052–1084. https://doi.org/10.3102/0034654316628645

binti Mohd, R. F., Zulkifli, H., Hamzah, M. I., & Tamur, A. H. (2024). Systematic literature review of ICT integration in teaching and learning. *TEM Journal*, *13*(4), 3146.