INTEGRATION AND INSIGHT ON INFORMATION, COMMUNICATION AND TECHNOLOGY FOR SUSTAINABLE EDUCATION

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Abstract

This review based article has articulated ideas on integration and insight on ICT for sustainable education. In the field of education, a noteworthy paradigm shift is taking place through the usage of Information and Communication Technology (ICT), which serves as a transformative tool to shift into the neo-technology of teaching and learning. ICT in education refers to the integration of Information and Communication Technologies, including hardware, software, and networks, to advance teaching and learning by providing digital tools, facilitating online communication, supporting e-learning, and personalizing educational experiences for learners. It broadens the horizon of Information Technology (IT) to encompass all communication forms, using digital resources to make learning more engaging, accessible, and efficient for both learners and educators. Most of the nations have effectively incorporated ICT in their educational systems, understanding its potential to develop student engagement, enhance critical thinking skills, and prepare learners for technological advantage. ICT provides insights into the current condition of teachers' efficiency and technology use in teaching and recognizes pathways for further improvement in techno-based teaching and for promoting students' advancement. ICT integration in educational sectors seems much required. However, it depends on teachers' efficiency and the availability of required equipment. Teachers' proficiency in using ICT tools immensely impacts the learners' learning experiences and educational outcomes. The findings from the study will be beneficial not only to the policy framers but also to the teachers and researchers. Educational

strategies influence integration of ICT to promote active students' engagement, shifting their roles from passive listeners or observers to active participants in the learning process.

Keywords: *ICT, Integration, Insight, Sustainable education, Quality learning, Transformation*

Introduction

The term ICT indicates a wide array of electronic technologies, digital tools, devices, and applications used for creating, storing, processing, sharing, and providing access to information (Christensson, 2010). These encompass communication devices and mediums such as computers, the internet, local networks, multimedia, and cell phones. Michiels et al. (2001), cited by Cavas et al. (2009) introduce ICT as "technologies that enable electronic means for acquiring, storing, processing, transmitting, and disseminating information in various forms including voice, text, data, graphics, and video" (p. 21). This definition stresses the processes and outcomes of ICT but does not provide a comprehensive description of its components and functions, specifically multimedia details.

Tshewang (2019) presents ICT as technologies useful to access, gather, create, manipulate, present, store, share, or communicate information. This definition describes ICT as the hardware, software, and connectivity components and their functioning. Rouse (2023) presents that ICT is a diverse set of technological tools and resources used for accessing, gathering, manipulating, presenting, and communicating information. It embraces various hardware, software applications, and connectivity options, enabling communication, information management, and knowledge creation across multiple disciplines and contexts (Rouse, 2023).

In today's interconnected world, countries across the globe have known the vital role of ICT in education, respecting its role in improving learning quality and empowering human resources to address the dynamic requirements of the modern age (Thakur & Raghuwanshi, 2016; Yamamoto & Yamaguchi, 2016). As a result, many countries have implemented policies promoting the use of ICTs both as a medium of instruction and as a subject to be taught. Among them, initiatives undertaken by various nations, including the United States, South Korea, Singapore, Australia, and Britain, are examples that have instituted supportive policies targeted at cultivating the professional development of educators through the strategic usage of ICTs (Zhao et. al, 2016; Eshetu, 2015; Anderson, 2010; Kozma & Vota, 2014; UNESCO, 2012).

The School Sector Reformation Program (SSRP, 2009-2015) was implemented as a national-level educational project in Nepal. One of the main objectives of the SSRP was to develop teachers' professional competencies, including ICT skills, through Teacher Professional Development (TPD) training. After the completion of the School Sector Reform Program (SSRP), the Government of Nepal (GoN) introduced the School Sector Development Plan (SSDP), a comprehensive national-level educational strategy that spanned from 2016 to 2021. One of the key components of the SSDP was a consistent focus on teachers' capacity development through TPD training, aligned with the TPD framework prepared by the National Center for Educational Development, Nepal (NCED 2015a, 2015b). TPD framework in Nepal aims to enhance the efficiency of teachers in terms of curricular content, pedagogical process, and technological knowledge and skills to

address professional needs and competency gaps among teachers as set in the National Teacher Competency Framework. Such technological knowledge and skills include creating customized digital materials and implementing ICT-integrated learning strategies within the classroom (NCED 2015a, 2015b).

The National Curriculum Framework (NCF), serving as a guiding document for school-level curriculum and instruction, emphasizes the creation of digital materials and a supportive environment to enhance digital literacy and facilitate technology-based learning in schools (Curriculum Development Center, 2018).

Likewise, the Digital Nepal Framework (DNF), 2019, issued by the Ministry of Communication and Information Technology (MCIT), targets to use of ICT as a tool for enhancing teaching and learning across all levels of education, from pre-primary to grade 12. The DNF stresses on managing high-speed internet, essential equipment and infrastructure, and enhancing the teachers' capacity as well as the appropriate environment in school (MCIT, 2019).

The government has aimed to develop and use e-library, virtual labs, virtual classrooms, e-portfolios, ICT integrated curricula, specific subject teaching tools, podcasts, web seminars, Educast, Makerspace, Applets, and Educational-Apps for teaching and learning process (MOEST, 2019). Similarly, the development of virtual teachers, trainers, monitors, and supervisors, to increase the effectiveness of teaching, training, and monitoring are the policies of the federal government of Nepal (MOEST, 2019; MCIT, 2019). Similarly, the Information and Technology Policy (2015) of the government of Nepal encourages the use of ICTs in school education and provides training to teachers for its use. It also focuses on extending access to the ICT infrastructure through the implementation of the Master Plan on ICT in Education (Ministry of Information and Communication, 2015). In this line, The Digital Nepal Framework (2019) calls for providing ICT education in schools, developing capacities of ICT related education, and providing ICT literacy to all (MCIT, 2019).

Thus, the use of ICT in the education sector is tremendous. It helps to improve the effectiveness of learning. If it is not used in the classroom the result widens the digital divide and pushes marginalized groups far behind. In this backdrop, this study was conducted to provide a deeper understanding on integration and contribution on ICT in education. This study intends to explore the status of integration of information, communication and technology in education. Additionally, it intends to explore how teachers use ICT in their teaching and what factors that contribute or hinder to the use of ICTs in teaching.

Literature Review

The review of literature serves to uncover existing knowledge, scholars' contributions, and areas of knowledge gap. Specifically, it explores various facets including definitions of ICT, ingredients of ICT in education, ICT competence among school teachers, Teachers' Professional Development (TPD) training in Nepal, theoretical models of ICT integration, the utilization of ICT, technology integration practices in classroom instruction, and factors influencing these practices. The critical and thematic review of these topics is carried out within the framework of existing literature, providing valuable insights into the subject matter.

Ingredients of ICT in Education

The ingredients of ICT refer to a wide range of digital tools, technologies, and resources that enable effective communication, information processing, and interactive learning. They represent digital files and software, such as learning programs, simulation, and multimedia; data storage and management systems, including cloud services and databases; communication platforms, including email, messaging, and video conferencing; utilities for automation, including AI-driven learning tools and automated assessments; cybersecurity measures to be taken for created digital information; and Internet of Things (IoT) items, smart devices, and connected classroom tools.

These ICT elements are constantly evolving and play a vital role in developing innovative teaching and learning. They create more active and exploratory learning by providing opportunities for interacting among learners and their teachers, and also among learners and digital devices as well (Beauchamp & Kennewell, 2008). While this list includes essential ICT elements, they are ever-evolving technologies, so the technologies cannot be fully defined as new ones keep on emerging. With the constant evolution of ICT and applications in various aspects of life, it is necessary to look at all the pertinent constituents involved in the subject. Innovatively, Cavas et al., (2009) divided ICT elements into four types. They are ICT as an object, an assisting tool, a medium of communication, and a tool for organization or management in schools. In their view, the object represents something made and used in the computer such as an image, text, slides, graphics, audio, or video clip (Beauchamp & Kennewell, 2008).

Assisting tools are interactive tools that promote higher-order thinking skills, and provide creative and individualized options for students to express their understandings. For example, games, quizzes, simulation or applications, applets, animators, etc. are such tools that assist in quick interaction and provide immediate feedback while students play, communicate, create, disseminate, or manage information (Beauchamp & Kennewell, 2008; Tshewang, 2019; Hughes et al., 2006).

By using above interactive ICT tools, students can acquire the skills to deal with ongoing technological changes in society and workplaces (UNESCO, 2018). The medium of communication is the element that is used for connectivity and sharing ideas or objects. When the teacher uses one or more ICT devices for synchronous and asynchronous communication in audible, visual, or symbolic form, it promotes students' cooperation for their benefit.

Moreover, it contributes by displacing inflexible linear and limited teaching activities and establishes motivational, creative, dynamic, and productive technology that empowers students to be active and collaborative. Similarly, ICT can also help in the effective management of schools which can lead to general improvements in whole school development. It is also usable in planning, budgeting, recording, controlling, supervising, and organizing as well (Cavas et al., 2009).

The expansion and evolution in the field of ICT are influencing the meaning and examples of its elements, leading to changes in the way people learn, communicate, work, and even live their lives. While a particular scholar's statement may not cover the entire range of evolving ICT elements, my study is specifically linked to the elements stated by Cavas et al. in 2009.

ICT Use in School Education in Nepal

MoE (2021) shows that "61.1 percent of the 27,890 community schools that were operating had electricity supplies, 42.3 percent of them (nearly 12,000 schools) had computer facilities, and 21.6 percent (nearly 5,400) had an internet connection" (p.98). After federalization came into effect in the education sector in 2017, federal, provincial, and local governments have been funding schools for ICT facilities. For example, in the year 2022 AD, CEHRD of the federal government had subsided Rs. 650,000 per school to 1200 schools, and the Bagmati Provincial government had subsided Rs 1500,000 per school to 300 schools of the province for the ICT lab program (Notices: CEHRD, 2078/12/03 BS; Education Development Directorate-EDD, 2078/12/03 BS). Noteworthy contributions to the use of technology in teaching and learning have been made by organizations such as Nepal Online School (NOS), OLE Nepal, and MiDas e-class.

Thus, after the 2000s, academic organizations, NGOs, and the private sector have contributed to increasing access to digital literacy in Nepal. During the implementation of SSRP and SSDP, the GoN funded the schools for some computers and ICT accessories. Therefore, in 2018 AD, almost 10,000 schools had computers in Nepal (MOEST, 2018), these have been used in teaching and official work. On the other side, by the 2000s, smartphones were penetrated in Nepal. The widespread expansion of mobile services has significantly increased the access of telecommunication and internet services to the general public. Mobile phones have expanded to reach more than 90 percent of the population in the country. The density of telephones including both landline and cellular mobile in 2010, 2017, and 2020 was 22.94%, 96%, and 126.72% respectively.

Additionally, the CEHRD has conducted virtual classes utilizing digital materials developed collaboratively by the CDC, CEHRD, and OLE Nepal. Along with the global context, the method of teaching and learning activities is gradually being transformed into online and blended modes also in Nepal. The use of e-library, virtual lab, virtual classroom, online exams, e-portfolios, textbooks including ICT, subject-specific teaching tools, Podcasts, Webinars, Makerspace, and Teaching-learning Apps has started to grow (MOEST, 2018). In comparison to the advent of technology, its use in community school classrooms seems to be weaker. Though computer education is taught as a compulsory subject in grades 6, 7, and 8 and as an optional subject at the secondary level, it has not been established as a means of teaching and learning activities in some schools due to the lack of adequate physical infrastructure and skilled manpower (MOEST, 2018).

Joshi (2017) conducted a study in Nepal and concluded that ICT makes teaching more meaningful, creative, attractive, and joyful, encouraging learners towards self-guided learning as it "opens all the doors of learning evidence" (p. 414). The study also noted that private schools are actively integrating ICT into their pedagogical practices, while community schools have limited access to such resources.

Chaudhary (2020) explored teachers' perceptions of digital literacy and implementation practices. The data were collected through a semi-structured interview with six non-native English teachers

from different schools in Nepal. The results indicated that English language teachers are becoming digitally literate by educating themselves in digital technology, which they can then use to teach English and digital skills. However, the report lacks information about the background of the participants, the study site, and the types of schools they were affiliated with.

In 2020, due to the global COVID pandemic, schools could not be operated for some months (March to November) in Nepal and the government directed schools and teachers to adopt alternative learning methods (CEHRD, 2020). Therefore, in that pandemic time, the use of radio, television, and online had increased significantly for the distance, virtual, and e-learning process. Through the endeavors of CEHRD, OLE Nepal, and MiDas Education Pvt. Ltd., different e-learning platforms have been launched. Likewise, for school-level students, plenty of grade-wise and subject-wise learning materials are also available on YouTube channels (CEHRD, 2020).

ICT Competence and Acquiring Measures of Teachers

UNESCO's ICT competency framework for teachers emphasizes several key skills that are:

> (a) articulating alignment with institutional and/or national policies, (b) analyzing curriculum standards and integrating ICTs pedagogically, (c) making suitable ICT choices for teaching methods, (d) identifying hardware and software functions and using them, (e) creating an inclusive tech-friendly environment, and (f) using ICTs for professional development (UNESCO, 2018, p. 27).

This list of ICT competencies might benefit from further specification, particularly in terms of computer and multimedia usage in teaching and assessment.

Nepal's Teachers' Competency Framework (TCF) covers certain ICT skills. According to the TCF (2015), techno-friendly teaching skills include:

> (a) selecting and using ICT-integrated learning strategies, (b) developing tailored digital content, adapting devices, and enhancing communication, (c) using ICT for learner self-awareness and effective collaboration, (d) evaluating learning, and (e) understanding ICT education policies and demonstrating professional behavior (p. 2). These skills provide a comprehensive overview of the areas where teachers should be efficient in utilizing technology, however, they lack detailed outlining, potentially leaving space for varied specifications and interpretations (NCED, 2015a).

According to the Program for International Student Assessment (PISA) 2021 ICT framework, the core competencies of applying digital tools inside and outside the classroom include accessing, managing, integrating, and assessing information; constructing knowledge, and communicating efficiently. This includes competencies associated with adapting communication to various contexts and media, managing ICT-based platforms related to communication, problem-solving, and computational thinking (OECD, 2019).

In the field of education, a noteworthy paradigm shift is taking place through the usage of Information and Communication Technology (ICT), which serves as a transformative tool to shift into the

neo-technology of teaching and learning (Kozma & Vota, 2014; UNESCO, 2012; Yamamoto & Yamaguchi, 2016). Most of the nations have effectively incorporated ICT in their educational systems, recognizing its potential to enhance student engagement, foster critical thinking skills, and prepare learners for technological benefit. Such as policies for teachers' professional development through the integration of ICT in school education have been implemented in the United States, Singapore, Australia, South Korea, China, Britain, and Malaysia, etc. (Ng, 2010; Zainal & Zainuddin, 2020; Zhao et. al, (2016).

Nepal has taken initiatives by implementing national-level educational plans and policies, including the ICT in Education Master Plan (2013), the School Sector Development Plan (2016-2022), the National Education Policy (2019), and the Teachers' Professional Development Framework (Ministry of Education [MOE], 2013, 2016; National Centre for Education Development [NCED], 2015). To ensure the success of these efforts, the Government of Nepal (GoN) regularly conducts Teacher Professional Development (TPD) training, using the baseline of the TPD framework to develop teachers' ICT capacity. Consequently, a substantial number of teachers who have been serving in Nepal for more than a decade have completed this training (MOE, 2013, 2016; Ministry of Education Science and Technology [MOEST], 2021).

Teachers' Professional Development through Training

Teacher Professional Development (TPD) is a widely extensive and diverse field of knowledge, and it can be defined as the entire process of developing knowledge, skills, and the teachers' dispositions. Professional development can adopt different forms in different contexts. Not only a single professional development model is effective and applicable to all countries (Marcelo, 2009). The TPD program, in Nepal, was initiated under SSRP in 2010 to deliver short-term in-service teacher training programs based on teachers' competency gaps (Ministry of Education, 2009).

One of the targets of TPD in the past and present is the development of teachers' ICT skills for techno-friendly teaching in classrooms (NCED, 2015). It is a certification program, mandatory to complete for all teachers, and was structured as a 30-days course. This one-month program was divided into three ten-day modules; each module consisted of five days at the training center, followed by a school-based project work (PW) period for 45- days, which was considered equivalent to five days of interactive training at the center. Teachers were expected to complete one module annually, with the requirement to finish all three modules within five years, establishing a comprehensive foundation for professional development aligned with the TPD framework and curriculum.

During the past SSRP period (2009–2015), the TPD training program was intensively conducted, focusing on individual and institutional needs. Such needs were collected from every teacher and the headteacher by using interviews, focus group discussions, and field observation. Collected needs were recorded in the 'need profile' in the local training hub. Twenty-nine educational training centers (ETCs) in Nepal, under the NCED, were responsible for preparing training packages, forming teachers' cohorts for TPD training based on analyzed needs profiles, and conducting the training sections. Subject-specific roster trainers (RTs) were also invited in for specific days

to support in-house trainers in developing training schedules and conducting sessions (NCED, 2015a).

In 2016, the SSDP was introduced, during which the 30-day TPD program was restructured into two 15-day phases. Each phase operates based on the TPD curriculum prepared by CEHRD, consisting of ten days at the training center followed by school-based project work equivalent to five days of participation in the training center (NCED, 2015a). This school-based project work must be completed by teachers participating in the center-based training workshops.

The TPD framework (2015) has envisioned for constructing, collecting, and supplying study materials based on ICT in the teacher's professional development training. The framework has also focused on integrating ICT skills in the subject teacher training, enriching the use of ICT in all teacher training programs, and broadening basic teacher training on communication technology (NCED, 2015).

Bharati and Chalise (2017) explored the perceptions of English language teachers in Nepal and found that teachers were aware of what Teachers' Professional Development (TPD) meant; however, they were unsuccessful in converting the knowledge into practice. This study concluded that TPD has been targeted to provide pedagogical and technical skills and content knowledge; however, teachers are reluctant to apply the skills and ideas in their real classroom situations. Senior and skilled teachers of some schools assist novice teachers, but there is no formal collaborative learning activity and sharing culture among the teachers regarding technical, pedagogical, and content knowledge.

International Practice of Technology Integration in Classroom Instruction

There are different views and definitions of technology integration in teaching. According to Foon and Brush (2007), ICT in teaching is the utilization of technology tools, generally in content areas in classrooms and educational activities to permit learners to use computers and multimedia in learning and problem-solving. "One of the basic advantages of integrating technology into the classes is that when they are applied suitably, they can make learning more fun for the learners"(Gilakjani, 2017, p. 96).

Among all the resources for ICT use, human resources are the most important because skilled and confident teachers are more important than the equipment for delivering digital skills and knowledge. Thus, teachers play a crucial role in improving the quality of education by acquiring different knowledge and skills and applying it in teaching.

When learners get enjoyable materials, they will be engaged in the lesson and this will help them better understand the subject matter. Technology helps learners and teachers with easy and quick learning, however, the effectiveness of technology in classrooms mostly depends on teachers' efforts and skills (Gilakjani, 2017).

There are various research reports about teachers' ICT skills and techno-friendly teaching. Foon and Thomas (2007) classify ICT user teachers into, low-level users and high-level users in their study, each participant teacher appeared to have a minimum knowledge of ICT.

Johnson (2014) explored whether professional development was effective for increasing teachers' capacity and integrating technology into the instructional process. The study was qualitative explorative, underpinned by Prensky's transformation and Siemen's connectedness theories. Data was gathered from 15 participant teachers from five different high schools using two sets of questionnaires. Her findings indicated that professional development moderately increased technology integration and changes were occurring in slow motion.

Tshewang (2019) researched in Bhutan to investigate the ICT knowledge, skills, perceptions, and attitudes of teachers and patterns of ICT use. A mixed-method study has covered the patterns of ICT use in daily life, confidence in using ICT, and its application in science teaching. The research found that teachers possessed moderate levels of ICT knowledge and skills. Some ICT elements were used in the teachers' daily lives, but only a few were employed in teaching due to the lack of confidence. Although teachers had positive perceptions and attitudes regarding the use of ICT in teaching, many could not fully utilize ICT due to personal and institutional constraints.

Similarly, Baek et al. (2008) found that teachers with the experience of short teaching tenures used technology in their classrooms more frequently than those with longer overall professional experience. Likewise, Byrd (2017) explored teachers' experiences with technology integration in daily classroom activities, their self-perceived competency level, and attitudes regarding technology use. Mixed method research was conducted taking a purposive sample of 35 teachers of Georgia. This descriptive study concluded teachers use technology for different purposes and in a variety of ways. When technology is available, teachers attempt to use it. As teachers become more comfortable using technology, they are more likely to use it for teaching and learning.

Salavati (2016) conducted an ethnographic study on the use of digital technologies in education to illuminate and identify the understanding of the complexity of compulsory school teachers' everyday work practices using digital technologies. The results of the study indicated that teachers' everyday practices regarding the use of digital technologies are influenced by their knowledge, experience, values, beliefs, and the passage of time. Those teachers who have a 'traditional' teacher-centered worldview, are also concerned with students' needs and tend to use digital technologies in a limited way. Research further showed that in-service training was inadequate for convincing teachers to use digital technology.

Models of ICT Integration

Different models of technology integration in teaching have been developed by scholars. For example, Substitution–Augmentation–Modification–Redefinition (SAMR), Levels of Technology Integration (LoTI), Technology-Pedagogy and Content Knowledge (TPACK), Replacement-Amplification -Transformation (RAT), Passive-Interactive-Creative-Replacement-Amplification-Transformation (PICRAT), etc. are some of the models of technology integration in teaching. Among these models related to ICT knowledge and use, my study links to the TPACK and PICRAT.

TPACK Model

TPACK, introduced by Mishra and Koehler (2006) as a theoretical framework for educational research, focuses on teachers' ICT knowledge and its effective use in teaching. It identifies three

essential domains of knowledge that teachers must possess: content, pedagogy, and technology. Each of these components is equally important for the enhancement efficiency of teachers. Among these, the overlap of these knowledge domains leads to three important concepts: pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK), and the complete overlap of all these domains is referred to as TPACK (Schmidt et al., 2009). (Schmidt et al., 2009).

The concept of TPACK was first developed as a conceptual framework by Mishra and Koehler in 2006 overlapping the technological knowledge of Lee Shulman's model of pedagogical content knowledge (PCK) developed in 1986 (Koehler & Mishra, 2006). In this age of information technology, expected learning outcomes can only be achieved through the effective implementation of ICT.

Pedagogical content knowledge (PCK) that lacks a technological component results in a gap in technology-friendly pedagogical skills, making it difficult to meet the demands of the modern educational landscape. Therefore, the TPACK model is widely used to study the use of ICT in teaching (Koehler et al., 2013). In this regard, some previous researchers have used the TPACK frame to measure and analyze the teachers' technological knowledge quantitatively, such as studies by Al Harbi, 2014, and Tshewang, 2019.

Some others, such as Passos (2009) and Schmidt et al. (2009), have used it to describe and explore qualitatively the teachers' ICT competence and their classroom pedagogical practices. Therefore, this theoretical model of the use of ICT has become a guiding tool for exploring teachers' ICT knowledge and pathways adopted for it. However, this TPACK does not highlight the passive and active role of teachers and students while using ICTs. Therefore, the PICRAT model, developed by Kimmons et al. (2020) is also utilized in the discussion in this research project.

PICRAT Model

The PICRAT model, developed by Kimmons et al. (2020), provides an advanced framework for understanding and enhancing the interaction between students and technology. It addresses the roles of both teachers and students in the learning process, focusing on the spectrum from passive to active engagement.

This model categorizes ICT use into six distinct terminologies: Passive (P), Interactive (I), Creative (C), Replacement (R), Amplification (A), and Transformation (T). The 'Passive' category refers to digital tools that allow students to receive information passively, such as videos, slides, or podcasts. The 'Interactive' category includes tools that enable students to actively engage with curricular content, such as simulations, online discussions, interactive applications, gamified learning Apps, and web pages.

The 'Creative' category represents a higher level of engagement, where students use technology to produce new content or artifacts. This includes processes involving text, data, audio, video, and image editing tools. 'Replacement' (R) denotes the substitution of older technology with newer versions, 'Amplification' (A) stands for maximizing the use of existing tools and resources using neo accessories, ideas, and approaches, and 'Transformation' (T) signifies changes in situations of ICT usage in instructional activities.

The PICRAT model underscores the importance of students taking ownership of their learning by interacting with devices or peers (Kimmons et al., 2020). By emphasizing interactive and creative uses of technology, the model encourages educators to reflect on how technology can be leveraged not just to support learning but to transform it in ways that foster active student engagement.

This model aligns with the objectives of this study by highlighting the need to provide students with opportunities for interactive and creative use of ICTs. It offers a practical and clear framework for analyzing and enhancing the role of technology in teaching and learning, making it a valuable tool for exploring students' active or passive roles in the classroom.

Contributing Factors to the Use of ICT in Teaching

The factors that have a positive impact on the integration of ICT in educational practice are considered promoting factors. According to Flores et al. (2018), the availability of various resources (mainly computers and wireless networks), teacher training, leadership role, and the effectiveness of teachers play a motivational role in the use of ICT in teaching. as well as in the integration of technology in teaching. In Olaore's (2014) exploration of the role of ICT in education, a neutral standpoint is taken to consider both its positive and negative effects.

On the positive side, Olaore advocates that ICT can greatly benefit the educational system in areas of collection, storing, editing, retrieving, and sharing of information, and enhancing learning to be more interactive and exciting. With this, Trucano, 2005 asserts that for the integration of ICT into teaching to be effective, there needs to be an ICT integrating policy, appropriate environment availability of resources and time as well as teacher efficiency.

Similarly, Malik and Shanwal (2017) highlight that ICT itself fosters motivation for its use in teaching due to its pivotal role and attributes. Applying ICT in teaching and learning not only enhances student engagement but also promotes critical thinking and problem-solving skills, preparing students to navigate an increasingly technology-driven world.

Koirala et al. (2016) emphasize that the successful integration of ICT in schools relies heavily on stakeholders' awareness, interest, and positive attitudes. Other motivating factors that promote successful integration of ICT include teachers' willingness, availability of ICT materials in the classroom, low work pressure, incentives for those using ICT, and well-guided training.

Previous research findings have shown that the functional use of ICT in the classroom has been quite different between the teachers of different subjects and conditions of schools. Therefore, a thorough analysis of their conceptions of ICT in education can provide insights into the prerequisites for teachers' successful preparation for the effective application of ICT in their classroom (Jimoyiannis & Komis, 2008).

Factors influencing the use of ICT can be divided into external and internal factors and these two types of factors are related to each other and determine ICT usage level (Tezci, 2011). Varieties of external factors have been found to influence the effectiveness of technology integration in schools. These include the availability of ICT equipment, time to plan for instruction, technical and administrative support, school curriculum, school environment and culture, and teaching load

or pressure to prepare students for national-level standardized tests (Flores et al.,2018).

Aforementioned literature claims that the use of technology has rendered a significant contribution to the quality of education (Malik & Shanwal, 2017; Tshewang, 2019). Focusing on the importance of technology in teaching, UNESCO (2012) mentions that technical knowledge can best facilitate and enhance teachers' efficiency, and teaching effectiveness, and improve education administration and governance as well. Supporting this argument, Raboca and Carbunarean (2014) state that "ICT tools in education should not be regarded as a simple attempt to innovate educational process but rather a starting point regarding the new paradigms, models, and theories that should govern the educational process of the 21st century" (p. 59).

Similarly, Cener et al., (2015) conclude that ICT brings real-life issues into classrooms that were impossible before in a traditional classroom setting. Agreeing with this statement, Herlo (2017) adds ICT links people to communicate in the global network crossing over the narrow boundaries of traditional learning theories and providing the opportunity to learn by creating, recording, searching, and using any of the text, image, audio, video, software and other forms of digital materials.

In this connection, Malik & Shanwal (2017) state that ICT brings richer material to the classrooms and libraries for teachers and students. It provides opportunities for learners to use maximum senses to get new and updated information. It ends the monotony and introduces a variety of teaching-learning situations, easing remedial teaching, evaluation processes, the development of virtual laboratories, digital libraries, and the means of self-guided learning (Sharma, 2018). The flexible nature of ICT and the internet provides opportunities for learners to interact, cooperate, collaborate, and revise in learning processes.

Factors Hinder to the Use of ICT in Teaching

Hindering factors in educational technology usage are internal or external factors that can impede its effectiveness. These factors may include insufficient ICT capacity among teachers, unsuitable school environments, inadequate infrastructure, and insufficient ICT equipment or materials. Olaore (2014) has also noted that ICT can contribute to the digital divide and promote academic dishonesty, which can negatively impact attitudes toward its use. This may lead to instances of plagiarism by students and teachers, reducing the perceived value of ICT in education. The use of social media platforms, including YouTube, Facebook, TikTok, messaging apps, games, and Instagram, can distract students from learning.

Olaore has observed that incorporating ICT into teaching may require significant time investments, and teachers who rely heavily on ICT may not always prepare thoroughly. Furthermore, technical glitches can frustrate students, while relying exclusively on the Internet for study materials may encourage dependence rather than fostering self-sufficiency (Olaore, 2014). Various internal and external factors can also impede the effective use of technology in education. Insufficient ICT capacity among teachers, inappropriate school environments, weak infrastructure, and inadequate ICT equipment or materials can impede technology-integrated educational practices. On a negative note, Olaore (2014) suggests that ICT can contribute to the digital divide and promote

academic laziness, as students and teachers sometimes resort to plagiarism instead of producing original work. Social media platforms such as YouTube, Facebook, messaging apps, Instagram, and games can also distract students, hindering their concentration and engagement.

Furthermore, Olaore argues that utilizing ICT in teaching demands significant time investments. Teachers who rely on ICT may use information obtained online without proper preparation, and students may become frustrated when they encounter technical issues or have to wait to use the ICT lab. Nevertheless, Olaore ultimately concludes that the benefits of ICT in education exceed its disadvantages, indicating a positive impact of ICT on teaching and learning.

Several obstacles can impede the effective use of technology in education, including insufficient time, lack of technical support, inadequate training opportunities, low-quality training, lack of teacher interest, and lack of managerial support. Among these hindering factors, the insufficiency of ICT competence and confidence among teachers is a major barrier to technology integration in the classroom (Ndibalema, 2014). Gutierrez (2019) argues that inadequate knowledge, training, and managerial support can negatively influence the integration of technology in education. Bingimlas (2009) also notes that a lack of confidence and competence are teacher-related hindering factors, but his finding reports that teachers are enthusiastic about using ICT. Özdemir (2017) found that the lack of ICT competence was a significant obstacle to integrating ICT into education.

In the East African context, Mukhari (2014) identifies a range of inhibiting factors for ICT integration, including unrealistic policies, poor infrastructure, lack of teachers' confidence and competence, poor incentives, negative perceptions and beliefs, imposed curriculum, lack of political stability, lack of public awareness and participation, poor school leadership, and lack of motivational factors.

Demetriou (2020) found that internal factors, such as inspiring and influential leadership, school-based in-service training on ICT, a capable ICT instructor, involvement of primary stakeholders in the integration process, and teacher competence in ICT, play a crucial role in determining the impact of ICT on education. On the other hand, challenges such as lack of effective training, limited time for ICT integration, inadequate technical support, and lack of teachers' confidence and competence can hinder the successful application of ICT in teaching.

Methods of a Study

The study is on integration and contribution of ICT for sustainable education. This study is based on qualitative method. An intensive in-depth information and insight have been reviewed (Bogdan & Biklen, 2007) on integration and contribution of ICT in education. The techniques that are used in this study are document review and reviewing theoretical knowledge. Relevant literature has been reviewed to make the study conceptually and theoretically reliable and authentic (Pandey, 2025).

The study is based on secondary sources. The researcher has googled and visited the website to obtain information related to the themes of the study. Data are presented from books, journals and articles. The writer has presented his own personal and professional knowledge and experiences

to explore ideas and strategies on critical thinking. Research design is an overall plan of the study which helps the researcher to complete the work perfectly (Pandey, 2024). It is a framework of the study. According to Kumar (2005), a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. A research design is a fixed set of procedure for conducting a research.

Findings

Nepal has been actively struggling, striving and thriving to leverage technology for teaching and learning purposes. The nation's educational blueprints, information technology (IT) policies, and periodic action plans consistently emphasize the integration of ICT into education. Noteworthy examples include the School Sector Reformation Project (2009-2016), The ICT in Education Master Plan (2013), the School Sector Development Plan (2016-2022), and the National Education Policy (2019). These national level plans and policies, are endorsed and enacted by the Government of Nepal (GoN). These plans holistically outline critical components such as infrastructure improvement, connectivity establishment, human resource development, and digital learning resource creation, all pivotal for effective ICT incorporation in education. One of the common goals of unifying these initiatives is to provide schools with ICT infrastructure and empower educators with the necessary knowledge and skills.

The literature constantly focuses on the importance of techno-friendly teaching and claims that if teachers have the right environment and they are working responsibly, some improvement in teaching seems inevitable. On the other hand, stakeholders have raised concerns that community school teachers still adopt traditional teaching methods, fail to apply modern technology in the classroom, and are causing the poor performance of public school. The low attraction of students to these types of schools in urban areas is also bolstering such concerns.

Conclusion

To integrate ICT in Nepal's education system, a multi-faceted approach is needed, focusing on developing robust infrastructure, providing comprehensive teacher training on ICT tools and digital pedagogy, creating relevant digital learning resources, and establishing strong school-home-community links through ICT. The process requires a clear vision, consistent funding, and a shift in traditional teaching methods to embrace technology for a more engaging, accessible, and effective learning environment.

Information and Communication Technology (ICT) enhances education by increasing accessibility, promoting student engagement through interactive multimedia, developing personalized learning, and preparing students for future careers. It provides diverse online resources, supports global collaboration, systematizes administrative tasks for teachers, and enables more effective, engaging, and flexible learning environments for all students.

Thus, ICT covers all those technologies at the core of information and communications handling and processing, including telecommunication, computer hardware and software, satellite systems, and other services and applications related to them, like videoconferencing and distance learning.

Reference

Baek, Y., Jung, J., & Kim, B. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting the facilitation of technology with a Korean sample. *Computers & Education,* 50(1), 224–234.

Beauchamp, G., & Kennewell, S. (2008). The influence of ICT on the interactivity of teaching. *Springer*, 13(1), 305–315.

Bharati, P. L., & Chalise, S. (2017). Teacher development: Strategies and perception. *Saptagandaki Journal*, 8(February), 69–78.

Bingimlas, K. A. (2009). Barriers to the successful integration of ICT in teaching and learning environments. *Eurasia Journal of Mathematics, Science & Technology Education*, 5(3), 235–245.

Bogdan, R.C. & Biklen, S.K. (2007). Qualitative research for education: *An Introduction to Theory and Methods*. 5th Edition, Allyn & Bacon, Boston.

Byrd, N. (2017). *Technology-based professional development for teaching and learning in K-12 classrooms* [Doctoral dissertation, Walden University]. https://scholarworks.waldenu.edu/dissertations/4047/

Cavas, B., Cavas, P., Karaoglan, B., & Kisla, T. (2009). A study on science teachers' attitudes toward information and communication technologies in education. *The Turkish Online Journal of Educational Technology*, *8*(2), 20–32.

Center for education and human resource development. (2020), *Learning Continuity Campaign (Alternative Education Framework.* Government of Nepal, Ministry of Education, Science and Technology, Kathmandu.

Cener, E., Acun, I., & Demirhan, G. (2015). The impact of ICT on pupils' achievement and attitudes in social studies. *Journal of Social Studies Education Research, 6*(1), 190–207.

Chaudhary, P. (2020). Perceptions on digital literacies and implementation practices: Perspectives of English teachers. ELT Chautari. http://eltchoutari.com/?s=puskar

Christensson, P. (2023, January 4). *ICT Definition*. Retrieved 2023, Aug 1, from https://techterms.com

Curriculum Development Centre. (2018). *National curriculum framework*. Ministry of Education, Curriculum Development Center.

Demetriou, K. (2020). Factors that impact the use of educational technology by Cypriot teachers: an alternative training opportunity. *Int. J. Learning Technology,* 15(4), 277-308.

Flores, P., Flores, A., & Ramos, A. (2018). Factors that inhibit or promote the integration of ICT in education. Iated Digital Library. https://doi.org/10.21125/inted.2018.1908

Foon, K., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: current knowledge gaps and recommendations for future research. *Education Technology Research Development*, *55*(1), 223–252. https://doi.org/10.1007/s11423-006-9022-5

Gilakjani, A. P. (2017). A review of the literature on the integration of technology into the learning and teaching of English language skills. *International Journal of English Linguistics*, *7*(5), 95–106. http://doi.org/10.5539/ijel.v7n5p95

Herlo, D. (2017). Connectivism, a new learning theory. *The European Proceedings of Social & Behavioural Sciences*, November. https://doi.org/10.15405/epsbs.2017.05.02.41

Hughes, J., Thomas, R., & Scharber, C. (2006). Assessing technology integration: The RAT – replacement, amplification, and transformation – framework. In proceedings of SITE 2006: *Society for Information Technology & Teacher Education International Conference* (pp. 1616–1620).

Jimoyiannis, A., & Komis, V. (2008). Examining teachers' beliefs about ICT in education: Implications of a teacher preparation program. *Teacher Development,* 11(2), 149–173. https://doi.

org/10.1080/13664530701414779

Joshi, D. R. (2017). Policies practices and barriers of ICT utilization in school education in Nepal. *International Journal of Research in Social Sciences*, *7*(2), 408–417.

Johnson, P. B. (2014). *Technology strategies in the classroom after completing professional development* (Issue UMI 3628756) [Doctoral dissertation, Walden University]. ProQuest LLC.

Kimmons, R., Graham, C. R., & West, R. E. (2020). The PICRAT model for technology integration in teacher preparation. *Contemporary Issues in Technology and Teacher Education* (CITE Journal), 20(1), 176-198.

Koehler, M. J., Mishra, P., & Cain, W. (2013). What is technological pedagogical content (TPACK)? *Journal of Education*, *193*(3). https://doi.org/10.1177/002205741319300303

Koirala, B. N., Bhandari, A. B., Lingthep, P. R., & Shrestha, S. (2016). *A study on the use of ICT and its sustainability in school education*. Department of Education. https://www.doe.gov.np/category/research-reports

Kozma, R. B., & Vota, W. S. (2014). ICT in developing countries: Policies, implementation, and impact. In J. M. Spector, M. D. Merrill, J. Elen, & M. J. Bishop (Eds.), *Handbook of research on educational communications and technology* (4th ed., pp. 885–894). Springer. https://doi.org/10.1007/978-1-4614-3185-5

Kumar, R. (2011). Research Methodology. SAGE Publication Ltd. www.sagepublications.com

Kumar, S., & Phrommathed, P. (2005). Research methodology. In S. Kumar & P. Phrommathed (Eds.), *New product development* (pp. 43–50). Springer. https://doi.org/10.1007/0-387-23273-7_3

Malik, N., & Shanwal, V. K. (2017). A comparative study of academic achievement of traditional classroom and smart classrooms in relation to their creativity and academic achievement. *Integrated Journal of Social Science,* 4(1), 15–19.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record,* 108(6), 1017-1054.

Ministry of Communication and Information Technology. (2019). *Digital Nepal framework.* Government of Nepal.

Ministry of Information and Communication. (2015). *National information and communication technology policy.* Government of Nepal.

Ministry of education. (2009). *School sector reform plan*. Ministry of Education. www.moe.gov.np

Ministry of education. (2013). Information & communication technology (ICT) in education master plan. Ministry of Education. www.moe.gov.np

Ministry of Education. (2016). School sector development programme. www.moe.gov.np

Ministry of Education, Science and Technology. (2018). Report of high-level *national education commission-2075.* Ministry of Education, Science and Technology, Nepal

Ministry of Education Science and Technology. (2019). *National education policy.* Ministry of Education Science and Technology, Nepal

Ministry of Education Science and Technology. (2021). *School education sector plan,* 2021-2030. Nepal

Ministry of Information and Communication. (2015). *IT Policy of the GoN.* https://mocit.gov.np/detail/policy

Mukhari, S. (2014). Teacher factors influencing the use of ICT in teaching and learning in South African Urban Schools. *Mediterranean Journal of Social Science,* 5(23), 1213–1220.

National Center for Educational Development. (2015a). *Teachers' competency framework.*

National Center for Educational Development. (2015b). *Teachers' professional development framework.* National Center of Educational Development, Gov. of Nepal.

Ng, P. T. (2010). Educational Technology Management Approach: The Case of Singapore's ICT Masterplan Three. *Human Systems Management,* 29(3), 177-187.

OECD. (2019). PISA 2021 ICT Framework. In OECD Publishing (pp. 1–59).

Olaore, A. (2014). The challenges and prospects of using ICTs in higher education: The case of a Nigerian university. *International Journal of Education and Development using Information and Communication Technology,* 10(4), 4-18.

Özdemir, S. (2017). Barriers to the integration of information and communication technologies into teaching and learning processes. *International Journal of Educational Technology in Higher Education,* 14(1), 22.

Pandey, S. R. (2024). Rummaging on a research method. *Journal of NELTA Koshi (JoNK),* 2(1), 100–110. https://doi.org/10.3126/jonk.v2i1.69661

Pandey, S. R. (2025). Creating collaborative learning environment for quality education. *Journal of Social Work and Science Education,* 6(1), 1 11.https://doi.org/10.52690/jswse.v6i1.1039

Passos, A. F. J. (2009). *A comparative analysis of teacher competence and Its effect on pupil performance in upper primary schools in Mozambique and other SACMEQ countries (issue july)* [Ph.D. dissertation, University of Pretoria]. University of Pretoria.

Raboca, H. M., & Carbunarean, F. (2014). ICT in education: Exploratory analysis of students' perceptions regarding ICT impact in the educational process. *Managerial Challenges of the Contemporary Society. Proceedings,* 7(2), 59.

Rouse, M. (2023). *Information and communication technology.* Retrieved Aug 2, 2023, from https://www.techopedia.com/definition/24152/information-and-communications-technology-ict.

Salavati, S. (2016). *Use of digital technologies in education:* The complexity of teachers' everyday practice. [Doctoral dissertation, Linnaeus University]. Linnaeus University Press. ISBN: 978-91-88357-39-7

Schmidt, D. A., Baran, E., & Thompson, A. D. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education,* 42(2), 123–149. https://files.eric.ed.gov/fulltext/EJ868626.pdf

Sharma, S. (2018). ICT in education: Catalyst for effective teaching-learning. *American International Journal of Research in Humanities, Arts and Social Sciences,* April, 19–25. https://doi.org/10.13140/RG.2.2.34044.64641

Tezci, E. (2011). Factors that influence pre-service teachers' ICT usage in education. *European Journal of Teacher Education* ISSN, 34(4), 483–499. https://doi.org/10.1080/02619768.2011.587116

Thakur, V., & Raghuwanshi, P. (2016). ICT Transforming teaching & learning system. *International journal of scientific research and management,* 4(07), 2321–3418. https://doi.org/10.18535/ijsrm/v4i7.02

Tshewang, S. (2019). *The use of ICT by science teachers in middle secondary science education in the himalayan kingdom of Bhutan* [Doctoral dissertation, Edith Cowan University]. https://ro.ecu.edu.au/theses

UNESCO. (2018). *UNESCO ICT competency framework for teachers.* https://unesdoc.unesco.org/ark:/48223/pf0000265721

Zhao, J., Yao, P., & Kon, J. (2016). Comparative study on international policies for teachers' ICT capacity-building. In Huang, R. K. & Price, J. K. (Eds.), *ICT in education in global context.* Springer.