Effects of Digital Resources in Science Teaching and Learning in Secondary Schools: A Study in Siraha District

Rajeshwer Prasad Yadav

Office of the Dean, Faculty of Education, Tribhuvan University

rajeshweryadav@gmail.com

https://doi.org/10.3126/oas.v2i1.65620

Abstract

The availability of digital resources has increased dramatically in school setting. The main objective of the study is to find out the use of digital resources in the science classrooms and its pedagogical impact on school-level science teaching and learning. The study followed descriptive design. For the study, 12 secondary (community-6, institutional-6) among 17 secondary schools that run Class 11 and 12 in science stream were randomly selected. All science teacher including lab instructors were the participants of the study. Observation forms and questionnaires were used as research tool. Percentage and Spearman's correlation test were performed by using SPSS version 20. The results showed that digital resources were generally available in the classrooms but were not widely used. Furthermore, the science teachers who had excellent knowledge regarding digital resources and abilities had better performance than those with less knowledge and skill regarding digital resources as they work less aware of pedagogical implications of digital resources. Science teaching impacts were found to be significantly influenced by teachers' age, experience, information communication and technology certifications, and teaching strategies. In the end, it was discovered that competencies of digital resources directly improved science teaching and learning results, enabling a paradigm shift away from conventional teaching techniques.

Keywords: *competency, digital resources, paradigm shift, pedagogy, science teaching*

Introduction

Radio, television, computer, internet, blogs, wikis, social medias, e-books, mobiles, camera are digital learning resources ("Digital Teaching Learning Resources," n.d.). During the past decades, in schools, the availability of digital resources has increased dramatically. The way of knowledge construction in educational settings and by learners has been profoundly impacted by the computing environment. Digital resources are integrated in classroom for various purposes. However, the study related to effectiveness and impact of digital tools in teaching learning activities are seen less amount (Gupta & KPN, 2012). Therefore, the effects of digital facilities in Nepalese schools' teaching especially in the context of Science teaching, has become the main concern of the study which contribute to transform the traditional teaching environment into digital resource based pedagogy.

Additionally, our teaching-learning methods in Nepal have attempted to progressively alter the paradigm shift from the old pattern of scientific instruction to a digitally based approach (Yadav, 2019). The effects of modern digital learning tools in the fields of education have great impact in our modern education system.

Face book, YouTube, Twitter, Blogs and Wiki are different types of social medias which are particularly used in the every stage of human life. These are used for simple to advance task for every person such as students, teachers, officer, farmer, and business person.

Specially to be made effective and interactive learning that must be used to make the self-learning, sharing based learning, collaboration, and web based learning and virtually learning for teaching and learning. These learning ICT tools, which have played the most significant role for the student and teacher, which improve the learning procedure, technique and technology, and through which people can communicate, share information, and create new relationships. The term ICT tool is web-based and mobile technologies through which communication is turned into an interactive dialogue within class room teaching learning process (Karki, 2020).

In science teaching, digital tools arouse students' interest not only acquiring learning resources, but also on interacting and collaborating with their friends more freely. Learning paradigm in this age are undergoing with the progress of ICT each day. Science education imparts general knowledge and a broad-minded attitude to the learners & produce creative activities through digital tools. The use of digital tools are better way in motivating students when they use it, & this leads to better for science teaching-learning activities (Bansal, 2016).

Teaching science involves specific skills, intelligence, proper use of teaching methods, and the development of need-based and digitally-based educational materials. Understanding how the topics, scientific techniques, and technology relate to one another is essential for creating successful and efficient science lessons. Digital tools, virtual model, classroom teaching, science practical activities, can be obtained through the help of different visual tools. Among all learning of people, about 90% of learning is contributed by visual perception whereas the way of 8% and 2% of information to brain is ears and other sense organs, respectively (Karki, 2020). Existing situation of Information & Communication Technology (ICT) Development in Nepal, reported by (Sharma & Kim, 2016), Nepal is ranked 165th with a score of 0.234 in the e-government development index (United Nations, 2014). Nepal's other nine indexes, including network readiness, are all quite poor. With a score of 3.2 out of 7, Nepal is placed 118th out of 143 nations (World Economic Forum and INSTEAD, 2015).

The goals of the School Sector Development Plan (SSDP, 2016–2023) pertaining to ICT is to enhance instruction by utilizing digital technologies to create an ICT-enabled learning environment (Ministry of Education, 2016). The journal report focus to access digital learning materials, supporting and guidelines, to ensure adequate capacity only by the help of these facilities and, to use digital tools to improve and increase effectiveness and efficiency of overall in the fields of education. *SSDP (2016–2023),* a recent report focused on ICT-enabled teaching-learning for science, math and english. Due to restricted access, digital resources haven't been sufficiently utilized in Nepali schools to help students learn new information and skills (Dhital, 2018).

Timilsena (2017), this argued showed that schools have insufficient digital tools with suitable existing situation for the teaching and learning mathematics. The main opinions were positive thinking toward the digital based in teaching learning. All teachers and student are agreed that digital tools are very useful for the better achievement in teaching-learning. The dogmatic teaching-learning is problematic at present situation of classroom teaching in Nepal. It may cause low achievement scores, lack of scientific literacy or low performance of students in different examinations. So, digital based science education may contribute and solve to minimize such problems.

In such circumstances, the research tends to focus on the existing digital tools and their effects in teaching-learning of both community and institutional secondary schools. Science teachers enhance to use the digital tools but insufficient knowledge and skills of

handling these tools are practically challenging, which they face difficulty in implementation in teaching and learning. Therefore, in this present scenario, it is more significant to study the pedagogical effects of using digital tools in science teaching-learning in the schools of Nepal. In this regard, this paper aimed to examine the teachers' skills of digital tools and pedagogical effects of it in secondary-level science teaching.

Methods

The research from which this article stems was guided by descriptive quantitative survey design. Siraha district was selected purposefully for the study. Out of total 17 (Community-8, Institutional-9) science stream secondary schools of Siraha that conduct science in Class 11 and Class 12 (District Education Coordination Unit, B.S.2075), 12 (Community-6, Institutional-6) schools were randomly selected as a sample. Five teachers, one from each subject Physics, Chemistry, Botany, Zoology, and Math; and one Science lab instructor (hereafter called as teacher) from each selected school were selected as the participants of the study. So, the total numbers of participants were 72.

The primary sources of data were science teachers and instructors. Records from the district education office, schools, and other government papers were used as secondary sources. Questionnaire including checklist and observation form was the primary tool of data collection. Data was collected from teachers and instructors by using questionnaire whereas observation form and checklist were used to collect data regarding digital facilities available in the selected schools. To assess the reliability of the questionnaire, it was pre-tested outside of a selected group of school teachers and modified based on this pre-test.

After completion of the study tools, data were collected first after receiving permission of head of the institution. Later, science teachers, instructors, and administrators were gathered in staff room and informed about the study. After that, questionnaires were given to class teachers and instructors to collect data. Then, data related to digital resources such as computer/laptop, smart phone, Wi-Fi/internet, projector, photocopy/scanner, digital camera and virtual lab, and their pedagogical effects in teaching were collected by using observation sheet. The collected data were entered into SSPS version 20 for analysis. Descriptive statistical tool such as percentage and inferential statistics such Spearman's correlation was applied to analyze the data. The analyzed data is presented in table, figure and narrative.

Results and Discussion

Demographic Findings of Respondents

The demographic questionnaire was concentrated on the respondents' patterns of teaching competencies as well as their age, gender, ICT certification, and teaching experience. These elements directly or indirectly have an impact on teachers' abilities to effectively use digital technologies.

The demographic background of the research participants, including six science instructors from community and six from institutional secondary schools, has been displayed in Table 1. Among 72 respondents who answered the questions in total, 55.6% were up to 40 years old, and 44.4% were above 40 years old. Merely 22.2% of them were female, with 77.8% of them being men; yet, there were more female teachers in institutional schools than they were in community schools. Additionally, 41.7% of the teachers had less than five years of teaching experience, while 58.3% of the teachers had more than five years of teaching experience.

Table 1 *Demographic Findings of Science Teachers*

Factors	Description	no.	%
Type of Schools	Community	36	50.0
	Institutional	36	50.0
Age	Under 30 years	22	30.5
	31-40 years	18	25.0
	41-50 years	20	27.8
	Above 50 years	12	16.7
Gender	Male	56	77.8
	Female	16	22.2
Qualification	Diploma with ICT literacy	9	12.5
	Diploma without ICT literacy	7	9.7
	Degree with ICT literacy	25	34.7
	Degree without ICT literacy	31	43.1
Teaching Experiences	Up to 5 years	30	41.7
	More than 5 years	42	58.3
Pattern of Teaching	Traditional (Chalk & Talk)	49	68.1
	Modern (With ICT)	23	31.9

According to Table 1, almost about 52.8% science teachers were qualified in separate specialized subject but not trended in ICT competency. Only 47.2% respondents had qualified with ICT competency. The result showed that most of the secondary level (11 and 12 class) science teachers had adequate qualifications (Masters' degree) in science but majority (52.8%) of them were without pedagogical and ICT qualification. The table has also highlighted that only 47.2% science teachers were ICT literate but quite a few of them had academic qualification academically. Similarly, about 49 (68.1%) were teaching traditionally with chalk and talk pattern.

The results has also showed that the effects of the teaching-learning process with modern technological teaching were directly impacted by school type, age groups, ICT qualifications, ICT teaching experience, and ICT skills.

Availability of Digital Resources at School and Home

The figure 1 shows that both community and institutional schools had facility of digital resources. Almost all secondary schools science teachers had access mobiles, computers/laptops and internet/Wi-Fi common tools at home but only two-third teachers had these facilities at schools. Similarly, only 11% teachers had access of virtual lab facilities in

the schools. Majority of teachers (89%) were out of reached from virtual lab facilities in the schools due to lack of ICT competency.

Figure1 *Digital Resources Available at School and Home*
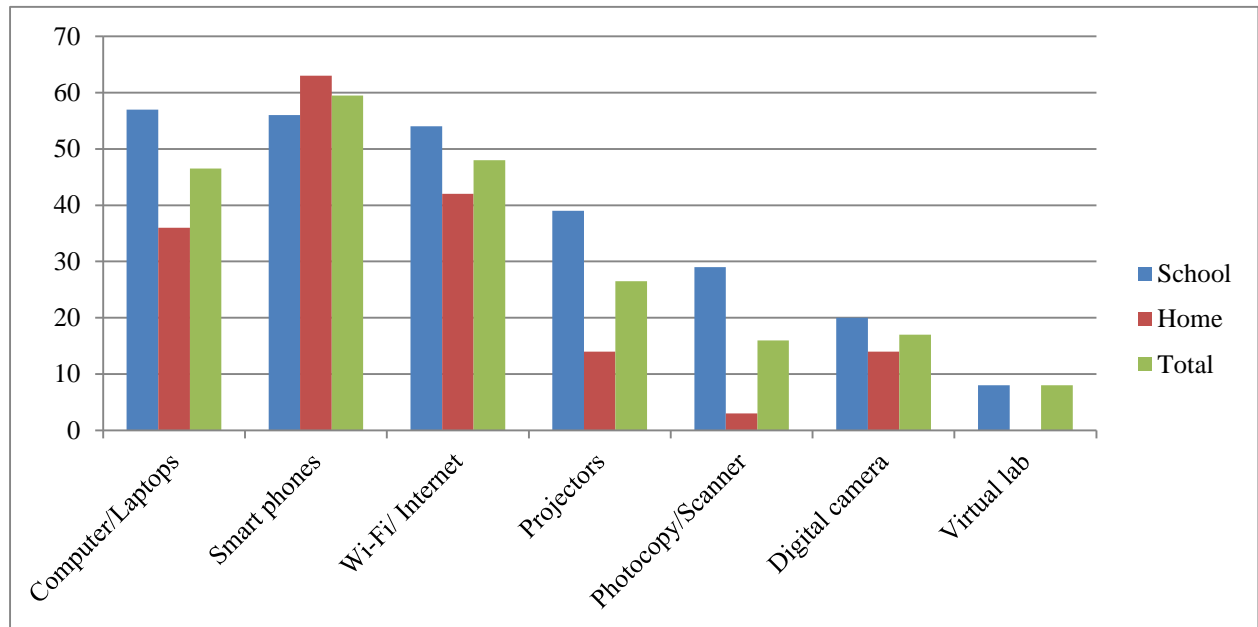
The above data analysis expresses the poor use of digital resources by science teachers in the school. Also the rate of utilization was lower in community school than in institutional school due to inadequacy of digital resources friendly environment.

Spearman's Correlations

Spearman's rho rank-order correlation coefficient of bivariate analysis was followed to further analyze and interpret the data. This method analyses the correlation coefficient values of rho and significance was denoted by the p. The value of p signifies the significance as:

p>0.5 = Not significant

p<0.5 = Significant

Further value of Spearman's rho that shows correlation is interpreted by the rules of thumb on effect sizes are as:

<0. +/- 1 = Weak

<0. +/- 3 = Modest

<0. +/- .5 = Moderate

<0. +/- .8 = Strong

>=+/- 0.8 = Very Strong (Muijs, 2014)

Correlation of Teachers' ICT Knowledge with Different Factors

The researcher examined teachers' ICT expertise in relation to the Ms Office application package, social sites, learning management systems, and social media platforms, as well as their component replies on 3-point Likert scales, reporting both frequency and

proportion of responses. With the use of the statistical program SSPS 20 version, the qualitative Likert-scale data were computed and converted into the sum of the total score using the mean, standard deviation, and non-parametric test analysis. Utilize Spearman's bivariate correlation to determine the correlation coefficient and significant values (Muijs, 2014).

Table 2 *Correlation of Teachers' Knowledge with Different Factors*

Different factors	*Rho*	*P*	N
Types of schools	.189	.111	72
Age of teachers	-.639**	.000	72
Teachers' qualification	-.697**	.000	72
Experience of teaching	-.587**	.000	72
Teachers teaching style	.678**	.000	72

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2 presents the relationship between teachers' ICT knowledge (an independent variable) and five dependent factors such as school type, age, experience, qualification, and teaching style.

The study found that the ICT proficiency of teachers had significant strong negative correlation with their age (-0.639), qualification (-0.697) and experience of teaching (-0.587). However, ICT proficiency of teacher had strong significant correlation with their teaching style (0.678).

The findings therefore explained why instructors of younger ages with ICT qualifications, experience using ICT, and current teaching methods were strongly associated with understanding of ICT. Therefore, it is necessary to improve the conventional pattern of instructional practice.

Teachers' ICT Skills Association with Independents Variables

Teachers' responses for the level of computer based 7 skills which are software applications, internet, file management, text note, students' assignments, presentation slides and search e-sources parameters ware measured with 3-point Likert's rating scale. The investigator mentioned that majority of teachers of school thought about using ICT based teaching learning activities. However, they had inadequate ICT based skills. Some senior teachers had not updated themselves timely and they did not use ICT based skills in classroom and lab works of science. So they were unable to find the positive effects as recognized by them. The table 3 also found the correlation and level of significant by following the same process of table 2.

Table 3 *Teachers Total Score of ICT Skills Correlations with Independent Factors*

Different factors	Rho	P	N
Types of schools	.148	.214	72
Age of teachers	-.694**	.000	72
Teachers' qualification	-.682**	.000	72
Experience of teaching	-.613**	.000	72
Teachers teaching style	.678**	.000	72

**. Correlation is significant at the 0.01 level (2-tailed).

The significant of impact of Teachers ICT skills are correlated with its affected variables. The arithmetic average mean was 6.819 with standard deviation of 4.303. According to table 5 result, the value of rho for teachers ICT skills on types of school was 0.148 which showed modest correlation. Also the value of P obtained was 0.214 explaining no significant result.

Similarly, the values of rho for Teachers ICT skills on the age of teachers, qualification and experience of teacher were -0.694, -0.682, and -0.619, respectively, show a strong negative correlation. However, the result of rho with teachers' teaching pattern was 0.627 which showed strong positive correlation. The results obtained were strongly significant as p was 0.000.

The findings have explained why instructors of younger ages with ICT qualifications, experience using ICT, and current teaching methods were strongly associated with understanding of ICT. Therefore, it is necessary to improve the conventional pattern of instructional practice. Better confidence of ICT based skills has significant positive impacts on science teaching. Teachers with strong ICT skills are more likely to engage in continuous professional development.

ICT Impacts Spearman's Correlation with Dependent and Independents variables

The title covers total 11 statements related to pedagogical impacts of using ICT perceived by science teachers of Class 11 and 12. The covered statements like use of Internet/ Website in teaching, effective class presentation, impacts of E-leaning resources, improving class note preparation than previous time, alternate way of learning and paradigm shift into modern teaching were more positive impacts in teaching than others. Similarly creative learning environments, improve autonomous learning and impact on virtual learning were moderate impacts in the fields. But monitoring of classroom works, cooperative and collaborative works had least pedagogical impacts in teaching learning sectors. Three-point Likert scale ranging from o (Do not know), 1 (least agree) to 3 (agree) was used to measure these statements.

The analysis has focused on investigating the separate elements of the different independent variables such type school, age, qualification and experience of teachers. The study has also been focused on the relationship between patterns of teaching practice of the school science teachers. For this, the analysis examined each of the major Likert scale responses including the questionnaire and Spearman's rho correlation with value of significance (p).

Table 4 *Teachers Total Score of ICT Impacts Correlations with Independent Variables*

Different factors	Rho	P	N
Types of schools	.223	.060	72
Age of teachers	-.653**	.000	72
Teachers' qualification	-.601**	.000	72
Experience of teaching	-.459**	.000	72
Teachers teaching style	.530**	.000	72

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 shows modest correlation between teachers ICT impacts and types of school though it is not significant (p > 0.5). Similarly, strong negative correlations were obtained for age of teachers and qualification with value of rho as -0.653 and -0.601 respectively. Moderate negative correlation with rho = 0.459 was observed for experience of teachers. Also, the value of rho was 0.530 for teachers teaching pattern. So, the correlation was concluded as strong positive. The above results were strongly significant as p was 0.000.

The result has indicates that age, qualification, and teaching experience and teaching style of teachers were positive with impacts of ICT in the teaching-learning process. Thus, the above factors had positive roles to deliver significance of impacts on teaching leaning.

Discussions

The present study aimed to use of available ICT resources and their impact of science teaching on pedagogical aspects. Altogether 72 science teachers were participated in the study with both six community and six constitutional secondary schools of Siraha District. In this study with mean age ± 40 years old and all had to teach secondary level (class 11 and 12) that were not significant relationship with types of school but significant relationship with their age, qualifications, experiences and teaching style. The report of Kerzic et al. (2021) reported correlation between use of ICT and age of teachers. Therefore, younger teachers had more ICT practice for teaching-learning and individual purpose than older ones. Studies (Inan & Lowther, 2010; Braak et al., 2004) claimed that practice of ICT decreases as working year experiences increases because younger teachers feel more comfortable to use ICT tools compared to older ones. A study (Krumsvik et al., 2016) among teachers of Morocco upper school found that teachers of 50 years and above had less digital competencies due to an inadequate ICT environment.

Research indicates that younger teachers tend to be more adept at adopting and incorporating ICT tools into their teaching methodologies (Ertmer et al., 2012). These teachers often possess a greater familiarity with digital technologies due to their exposure during their formative years (Russell et al., 2009). Their comfort with technology may result in a more seamless integration of ICT tools in the classroom, and foster a dynamic and interactive learning environment. Younger educators may be more in line with constructivist teaching methods, which inherently use technology to support student-centered learning (Koehler & Mishra, 2009). According to Etiubon and Akpan (2017), there was no correlation found between the age of instructors and digital supported teaching activities. However, teachers' ICT qualifications and their experiences of using ICT facilities substantially and significantly correlated.

According to the research's findings, the majority of schools lack basic ICT resources such computers, software, and extra hardware, as reported by a related study (Dhital, 2018).

Even many attempts are made to provide computers to more schools as possible by governmental agencies, private citizens, businesses, and non-governmental groups.

The findings shows that teaches' knowledge of ICT is strongly correlated with age, qualification regarding ICT, experience and teaching pattern. It indicates the need of improvement in traditional pattern to teaching.

The study claimed that knowledge of digital tools is significantly correlated with teachers' way of ICT integrated teaching in the classroom. The result also advocated that younger age of teachers, ICT qualification, digital integrated pattern of teaching and newly teachers were familiar association with the use of Spearman's Correlations. The integration of ICT in science education carries potentiality to upgrade the quality of teaching-learning by providing innovative tools and resources. A study by He et al. (2020) found that adaptive learning technologies improved students' performance in science courses. Arguing this result, Fahadi et al. (2022) indicated the need of knowledge of technology and pedagogy for the successful enhancement of ICT in improvement of education. ICT is useful for entrepreneurship in education (Iqbal et al., 2022).

In the twenty-first century, teaching-learning needs to the more learner-centered as opposed to the traditional teacher-centered pedagogy. Opportunities to change education and enhance learning are presented by new technology. The conventional balance between instructor and student is altered when ICT is included into classrooms (Mahboob,2020).

The research also discovered that the use of digital technology has enhanced their instruction by providing students greater access to a broad range of digital resources and increasing the degree of individualization of instruction (Walan, 2020).

Teacher's preparedness and perception on information and communication technology utilization for classroom instruction in secondary schools Katsina Metropolis, a study by Ahmad et al. (2020), sought to evaluate teachers' preparedness for incorporating ICT into lessons in the Katsina State educational context. Their results showed that most of the participating teachers had a general lack of IT proficiency, indicating insufficient IT understanding. Furthermore, the research demonstrated a marked deficiency in the level of readiness among teachers to use ICT for basic teaching and learning tasks. These findings are consistent with earlier research by Isaboke (2014), which showed that instructors' lack of confidence in using ICT across a range of instructional domains affected their readiness to incorporate them into teaching practices.

This study indicated that several factors also had correlated with effects about pedagogical impacts of ICT in science teaching-learning. The finding reveals that only one third teachers found about use of ICT and their positive impacts in classroom teaching. According to finding of report majority of senior science teachers had inadequate ICT knowledge and skills and without having pedagogical background.

Kolb (2014) in the book Experiential Learning describes about four steps (Figure 2) that engage learners during use of information technology.

Figure 2 *Steps of Engaging while Using Information Technology*

Watching ⟶ Thinking (Mind) ⟶ Feeling (Emotions) ⟶ Doing (Muscle)

Different tools such as networks, image enhancements, software packages, stimulations, animations, music, and speech provide virtual realities and experiences for learners that make learning more direct, applicable, and joyful. Further, self-engagement of learners is considered as the heart of better education (Bhasin, 2012). In addition, ICT positively impacts on the achievements of students in subjects like geography, history, music, and arts (Chauhan, 2017; Condie & Munro, 2007), and design and technology (Balanskat et al., 2006).

The qualitative investigation has improved our comprehension of how digital technologies affect learning environments and clarified positive results. In addition, it has clarified the implications, recommendations, and future directions for research pertaining to digital technology. In particular, researchers like Çelik (2022), Schmid et al. (2014), and Tamim et al. (2015) emphasized the value of learning environments and instructional practices to support the incorporation of ICT into pedagogy. Furthermore, it has shown critical components that moderate the effects of digital technology on education, highlighting their interdependence and critical function in the process of transformation.

Conclusions

This finding of the study covers effectiveness of science classroom by using digital resources. The study mainly focused to examine pedagogical impacts of using digital resources in secondary school science teaching-learning among both community and institutional school teachers. The study had explored the impact of digital resources in education, the concept of science teachers regarding ICT infrastructure, the facilities and its uses, and the role to enhance quality of teachers. Digital resources helps to achieve the learning outcomes for the improvement of teaching-learning. Therefore, traditional pattern of teaching should be minimized in new age science teachers. Conversely, those ICT integrated pattern of teaching learning are more applicable with 21th century pedagogical impacts. The study concludes that promoting digital resources in science teaching and learning facilitate and enhance both the teachers' teaching and students' learning.

References

Ahmad, U. M., Torpev, T. F., & Yahaya, S. (2020). *Teacher's preparedness and perception on information and communications technology utilization for classroom instruction in secondary schools Katsina Metropolis,* Katsina State. UMYU. *https://dx.doi.org/10.2139/ssrn.4068413*

Bansal, P. (2016). *Fostering ICT competency in prospective teachers: issues and recommendations*. Govt. College of Education, Chandigarh, India. *https://www.academia.edu/7191736/*

Balanskat, A., Blamire, R., & Kefala, S. (2006). *The ICT impact report*. European School net. Retrieved from: http://colcc ti.colfinder.org/sites/default/files/ict_impact_report_0.pdf

Bhasin, B. (2012). Integration of information and communication technology in enhancing teaching and learning. *Contemporary Educational Technology, 3*(2), 130-140. https://doi.org/10.30935/cedtech/6073

Çelik, B. (2022). The effects of computer simulations on students' science process skills: Literature review. *Canadian Journal of Educational and Social Studies*, *2*(1), 16–28. https://doi.org/10. 53103/cjess.v2i1. 17

Chauhan, S. (2017). A meta-analysis of the impact of technology on learning effectiveness of elementary students. *Computers & Education*, *105*, 14–30. https://doi.org/10.1016/j.compedu.2016.11.005

Condie, R., & Munro, R. K. (2007). The impact of ICT in schools-a landscape review. Retrieved June 30, 2022, from:https://oei.org.ar/ibertic/evaluacion/sites/default/files/biblioteca/33_impact_ict _in_ schools.pdf

Dhital, H. (2018*). Opportunities and challenges to use ICT in government school education of Nepal. *International Journal of Innovative Research in Computer and Communication Engineering, 6*(4). https:/doi.org/10.15680/IJIRCCE.2018.0604004

Digital Teaching Learning Resources. (n.d.). https://egyankosh.ac.in/bitstream/123456789/46307/1/Unit-6.pdf

Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, *59*(2), 423-435.

Etiubon, R.U., & Akpan, O. A. (2017). Science teachers' perception of ICT capacity building workshop in Akwa Ibom State Secondary School, Nigeria. *African Research Review*, *11*(2), 201-215. https://doi.org/10.4314/afrrev.v11i2.15

Gupta, C.D., & KPN, H. (2012). Role of ICT in improving the quality of school education in Bihar (pp.1-8). *International Growth Centre, India*.

Ministry of Education. (2016). School sector development plan 2016 – 2023. Government of Nepal.

He, W., Lajoie, S. P., & Wiseman, J. (2020). The effects of adaptive learning technologies on students' motivation and performance: A meta-analysis. *Educational Research Review*, *30*, 100322.

Fahadi, M., Khan, M., &Hossain, S. (2022). Technology-enhanced teaching in engineering education: Teachers' knowledge construction using TPACK framework. *International Journal of Instruction*, *15*(2), 519-542.

Inan, F., & Lowther, D. (2010). Factors affecting technology integration in K-12 classrooms: A path model. *Educational Technology Research and Development,* 58(2), 137-154.

Iqbal, J., Yi, X., Ashraf, M. A., Chen, R., Ning, J., Perveen, S., & Imran, Z. (2022). How curriculum delivery translates into entrepreneurial skills: The mediating role of knowledge of information and communication technology. *Plos one*, *17*(5), e0265880.

Isaboke, H. G. (2014). Teacher-preparedness in integrating information and communications technology in instruction in lower primary schools in Nyamira County, Kenya. [Master's thesis, Kenyatta University]. https://ir-library.ku.ac.ke › bitstream ›

Karki, S. (2020). *Attitudes of teachers towards use of social media in teaching learning.* [Unpublished master's thesis]. Tribhuvan University.

Kerzic, D.; Danko, M.; Zorko, V., & Decman, M. (2021). The effects of age on higher education teachers ICT use. *Knowledge, Management & e- Learning, 13*(2,) 182-193.

Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60-70.

Kolb, D. A. (2014). Experimental learning: Experience as the source of learning and development (2nd ed.). Pearson Education.

Krumsvik, R. J., Jones, L. O., Ofstegaard, M., & Eikeland, O. J. (2016). Upper secondary school teachers' digital competence: Analysed by demographic, personal and professional characteristics. *Nordic Journal of Digital Literacy*, 11(3), 143-164 https://doi.org/10.18261/issn.1891-943x-2016-03-02

Mahboob, A. (2020). Education in the time of COVID -19. http://flcgroup.Net/courses/education 101-intro/

Muijs, D. (2014). *Doing quantitative research in education with SPSS.* Sage Publications.

Russell, M., Bebell, D., O'Dwyer, L., & O'Connor, K. (2003). Examining teacher technology use: Implications for preservice and inservice teacher preparation. *Journal of Teacher Education*, *54*(4), 297-310.

Schmid, R. F., Bernard, R. M., Borokhovski, E., Tamim, R. M., Abrami, P. C., Surkes, M. A., Wade, C. A., & Woods, J. (2014). The effects of technology use in postsecondary education: A meta-analysis of classroom applications. *Computers & Education*, *72*, 271–291. https://doi.org/10.1016/j.compe du.2013.11.002

Sharma, A. & Kim, Y. (2016). Information communication technology development in Nepal.   http://dx.doi.org/10.18350/ipaid.2016.25.1.10

Tamim, R. M., Borokhovski, E., Pickup, D., Bernard, R. M., & El Saadi, L. (2015). Tablets for teaching and learning: A systematic review and meta-analysis. *Commonwealth of Learning*. http:// oasis. col. org/ bitst ream/ handle/ 11599/ 1012/ 2015_ Tamim- et-al_ Table ts- for- Teach ing- and- Learning.pdf

Timilsena, T.R. (2017). *Attitudes of teachers towards ICT in teaching and learning* [Unpublished master's thesis]. Tribhuvan University.

United Nations. (2014). United Nations E-Government Survey 2014. https://publicadministration.un.org/egovkb/en-us/Reports/UN-E-Government-Survey-2014.

Braak, J. V., Tondeur, J., & Valcke, M. (2004). Explaining different types of computer use among primary school teachers. *European Journal of Psychology of Education*, *19*, 407-422. https://link.springer.com/article/10.1007/BF03173218

Walan, S. (2020). Embracing digital technology in science classroom: Secondary school teachers' enacted teaching and reflections on practice. https://doi.org/10.1007/s10956-020-09828-6

World Economic Forum and INSEAD. (2015). *The global information technology report 2015.* http://www3.weforum.org/docs/WEF_Global_IT_Report_2015.pdf

Yadav, R. P. (2019). *Perspectives of teachers on the use of ICT tools in teaching biology in secondary schools* [Mini-research report]. Faculty of Education, Tribhuvan University.