USE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) BY TEACHERS WORKING ON HIGHER SECONDARY SCHOOLS

[1]Mrs Muni Sahu, [2]Dr. Basanta Kumar Mahakur & [3]Netramani Budhia
[1]Lecturer in Education, Dadhibman Collge, Bhatli
[2]Assistant Professor in Educational Studies, Dept. of Teacher Education, Govt. College Sundargarh
[3]Assistant Professor, Dept. of Education, Sambalpur University

Abstract

The study aimed to investigate teachers' ICT literacy, knowledge, and skills, their use of ICT in curriculum planning and delivery, and the problems they face in utilizing ICT in higher secondary schools. A sample of 80 teachers, 40 each from both Arts & Science stream from higher secondary schools were selected purposively. The investigator was used the questionnaire for the collection of data. The percentage statistical analysis using to analyse the data. Findings reveal that most teachers owned computers or laptops but rarely used desktops or tablets; they frequently used computers for tasks such as MS Word, PowerPoint, internet browsing, and email. ICT was primarily used for downloading learning materials, shopping, emails, and social media, but not for advanced tasks like video editing or teaching entire classes. Science teachers were more active in using ICT for internet research, online purchases, and ticket bookings than arts teachers. Teachers relied on search engines for information and saving web content but faced a lack of interactive whiteboards, computers, and technical support in schools. Few teachers taught ICT skills to students, and Science teachers encouraged students to explore educational sites and online communication tools more than their arts counterparts.

Keywords: Communication, Higher Secondary School, Information, Technology

Introduction

Literature Review

Research conducted in India indicates that there is still disparity in ICT understanding and use. For instance, Siddiqui (2012) showed that ICT use among higher secondary students in Jammu and Kashmir was low, with male students using it more frequently than female students, while Neeraj and Anitha (2010) found that many schoolchildren lacked appropriate awareness of computers and the internet. Perceptions among teachers, however, show complex trends. Panigrahi (2011) found no significant differences in perception of ICT use between urban and rural teachers, or between male and female teachers, whereas Manisha (2012) discovered that age, computer ownership, and prior experience influenced attitudes more than gender or professional experience.

Other scholars emphasize the importance of teacher preparedness. While Adegbenro et al. (2017) found that in-service teachers needed training in advanced ICT skills, such as database building and software use, despite displaying positive attitudes toward ICT, Wanjala et al. (2011) noted that teachers frequently depended on trial-and-error methods for ICT integration. These results are supported by international research. Rabah (2015) emphasized the advantages of ICT for student participation and globalization in Quebec schools, while Ahmed (2015) noted that school principals in Khartoum had positive opinions of ICT but faced challenges in its implementation.

Similarly, Aslan and Zhu (2016) revealed that pre-service teachers frequently limited their ICT use to simple demonstrations rather than revolutionary pedagogical applications. Several studies highlight the distinct benefits of ICT for topic learning. Sengamalaselvi et al. (2017) found that using Geogebra in mathematics helped students overcome learning hurdles and broaden conceptual comprehension. Gajek (2015) discovered that language teachers who had access to digital devices such as laptops and interactive whiteboards, saw themselves as competent users and respected their

pupils' ICT skills. Similarly, Meerza (2017) found that peer learning had a significant impact on undergraduates' attitudes toward ICT use in Kuwait, and Teeroovengadum et al. (2017) confirmed the TAM model's applicability in Mauritian schools, emphasizing the importance of perceived usefulness and ease of use in ICT adoption. Francis et al. (2017) pointed out that the high costs of ICT infrastructure, such as computers and internet installation, constituted significant challenges for schools, particularly those with limited resources. Gunduz (2017) also found that problematic internet use was more common among experienced male ICT teachers than among their female counterparts, raising concerns regarding balanced usage. Even in contexts where positive attitudes prevail, as noticed by Barnali Ghosh (2024) in rural and urban West Bengal, and Saputra et al. (2024) in post-COVID classroom practices, ICT remains underutilized for advanced, interactive, and collaborative learning.

Taken together, this body of research shows that ICT in education has immense potential for increasing student participation, global connectivity, and knowledge building. At the same time, its effectiveness depends on contextual elements such as infrastructure, training, and teacher readiness. Globally, ICT is regarded as an essential instrument for closing educational gaps and preparing students for 21st-century issues (Voogt & Knezek, 2008). To close the digital divide in India, policies such as the ICT in Schools Scheme (2004) and the National Education Policy (NEP 2020) placed an emphasis on digital literacy, smart classrooms, and teacher training. Despite these initiatives, ICT adoption in Indian schools remains limited, with most of its transformative potential in designing curriculum, instructional delivery, and student learning outcomes remaining unrealized. As a result, the current study aims to look into higher secondary school teachers' ICT literacy, skills, and practices, as well as the problems they experience when incorporating ICT into their instruction.

Rationale of the Study

This study will explore the use of ICT in teaching and learning at higher secondary school to help us to deepen into the role of teaching - learning facilities in a classroom. Digital technology or ICT can be implemented its different revolutionary techniques in the field of education for creating effective teaching and learning environment to achieve the maximize desired goals in the higher secondary schools. This present study of will help to extend the theoretical knowledge innovative ideas, implementation procedure and its use in higher secondary school which will help to fulfil the desired objectives of sponsor schemes in a particular place. Access to ICT also gains relevance in the newly adopted sustainable development goals (SDGs) for 2030 in developing countries like India. ICT offers a lot of potential for improving the quality of education. Educational systems around the world are under increasing pressure to use the new technologies to reach students to knowledge and skills they need in the 21st century for quality education programme. ICT can be used with various tools and techniques effectively such as Television, Computers, Multimedia Software, Internet and teleconferencing. Teacher could make best use of ICT, which is the contemporary mantra of quality education, also it aids in web-based learning, online learning.

Objectives of the Study

1. To study the ICT literacy, knowledge and skills of teacher in higher secondary schools.
2. To study the uses of ICT in planning and delivering curriculum by teachers in higher secondary school.
3. To study the problems of ICTs facing by the teachers in higher secondary school.

Hypotheses of the Study

1. The teachers possess ICT literacy, knowledge and skills of using ICT tools in higher secondary schools.
2. The teachers use ICT tools in planning and delivering curriculum at higher secondary schools.
3. The teacher face problems and difficulties in using ICT tools at higher secondary schools.

Materials and Methods
Design of the Study
Since the main objectives was to investigate the availability and uses of ICT tools in higher secondary schools, so that descriptive survey method was used.

Sample

Five higher secondary school teachers (80 teachers form both Arts & science stream) 100 students from both streams was selected purposively.

Tools and Techniques

Since the present study was designed to explore the present status of use of ICT by higher secondary school teachers so that questionnaire developed by the investigator with the help of research guide and subject experts.

Statistical Technique used

As per the objectives of the present study, the researcher applied a simple percentage technique to analyse the collected data of working of higher secondary school teachers.

Results

Table 1
Summary of possession of ICT resources and ICT knowledge by teacher (Arts & Science stream) in higher secondary school (N=80)

Sl. No.	Description of the items		Higher Secondary School Teachers (Arts) N=40		Higher Secondary School Teacher (Science) N=40	
			Yes	%	Yes	%
1	Teacher having computer of its own		32	80%	36	90%
2	Teachers having types of computer like	Desktop	16	40%	18	45%
		Laptop	24	60%	28	70%
		Tablet	Nil	00%	Nil	00%
3	Types of training by teachers	Training on ICT	24	60%	28	70%
		DCA	36	90%	38	95%
		PGDCA	32	80%	34	85%
		Others	Nil	00%	Nil	00%
4	How often teachers used computer at school	Everyday	Nil	00%	Nil	00%
		Once a week	8	20%	26%	65%
		Rarely	24	60%	14	35%
		Never	Nil	00%	Nil	00%
5	Teachers having basic operational knowledge	MS word	40	100%	40	100%
		MS Excel	40	100%	40	100%
		MS Power Point	40	100%	40	100%

		E-mail	40	100%	40	100%
		Others	Nil	00%	Nil	00%
6	For which purpose do the teachers use the ICTs?	Downloading learning materials	40	100%	40	100%
		Shopping	36	90%	38	95%
		E-mail	40	100%	40	100%
		Movie	05	12.5%	07	17.5%
		Game	08	20%	12	30%
		Course work	36	90%	38	95%
		Face book	30	75%	37	92.5%
		Local News	40	100%	40	100%
		Instant Chat	40	100%	40	100%
		Music	32	80%	36	90%
		Banking	35	87.5%	38	95%
		Video editing	Nil	00%	Nil	00%
		Others	Nil	00%	Nil	00%
7	Teachers possess knowledge of internet and its access		40	100%	40	100%
8	Do the teacher think that technology has made a different to our life?		40	100%	40	100%

As can be seen in Table 1 80% of higher secondary school arts teachers and 90% of higher secondary school science teachers were having computer of their own. Further, it was found out that 40% of arts teacher and 45% of science teachers were having desktop of their own and 60% arts teacher and 70% of science teachers were having like laptop and both Arts and Science teacher were not having like tablet of their own, 60% Arts teachers and 70% science teachers were training on ICT 90% Arts teacher and 95 % Science teachers were training on DCA programme. 80% Arts teacher and 85% science teachers were training on PGDCA programme. Further it was found out that both Arts and Science teachers did not use computer at school every day. Whereas 20% Arts teacher and 65% science teacher used computer once a week at school 60% Arts and 35% science teacher used computer rarely at school. 20% Arts teacher and none of the science teacher never used computer at school. It was found out that 100% Arts and Science teachers were having knowledge and skill of Ms Word.62.5% Arts teacher and 100% science teacher were having the knowledge and skill of Ms Excel. However, 100% Arts and science teachers were having the knowledge of power –point, internet and E-mail. It was revealed that 100% Arts and science teacher used ICT for downloading learning materials. 90% Arts teacher and 95% science teachers used ICT for shopping different materials.100% Arts and science teachers used. ICT for E-mail getting local news and instant chat. It was found out that 20% Arts teacher and 30% science teachers used ICT for playing game .90% Arts teacher and 95% science teachers used ICT for doing course work. 75% Arts teacher and 92.5% science teachers used ICT for face book. Further it was found out that 80% Arts teacher and 90% science teachers used ICT for listening music purposes. 87.5% Arts teachers and 95% science teacher used ICT for banking. None of the Arts and science teachers used ICT for video editing and other purposes. Further it was revealed that 100% Arts and science teacher possessed knowledge of internet access and thought that technology had made a positive different to their life.
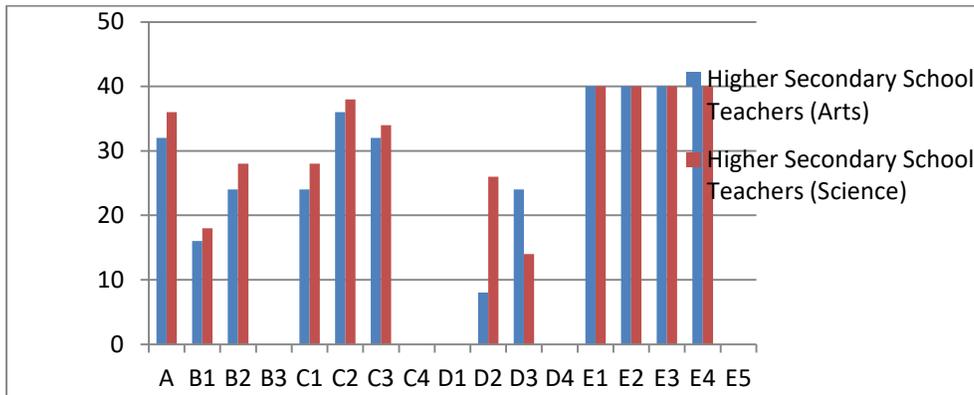
Figure 1 Number of ICT resources and ICT Knowledge b y teachers (Arts & Science Stream) in Higher Secondary Schools

A- Teacher having computer of its own

B- Teacher having types of computer
B_1- Desktop
B_2 – Laptop
B_3 Tablet

C- Teachers having types of training
C_1- Training on ICT
C_2-DCA
C_3-PGDCA
C_4-Others

D- Teachers having types of school
D_1-Everyday
D_2-Once a week
D_3-Rarely
D_4-Never

E- Teacher having basic operational knowledge
E_1-Ms Word
E_2-Ms Excel
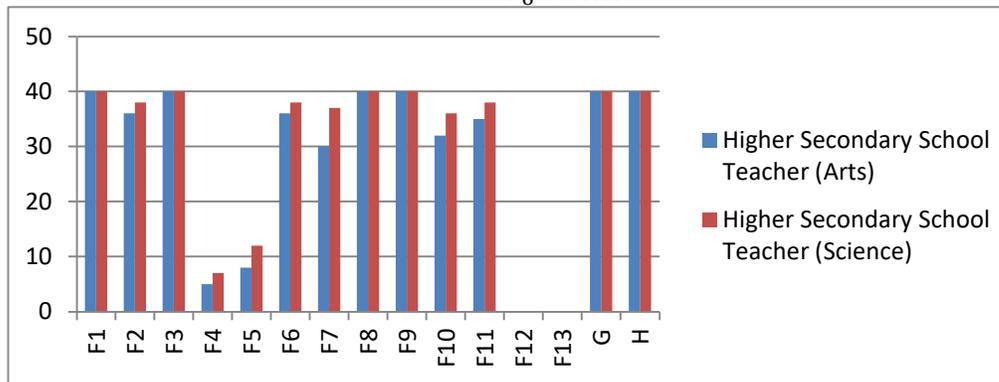E_3-Ms Power point
E_4-Internet
E_5-E-mail
E_6-Others

Figure 2 Number of ICT resources and ICT Knowledge by teachers (Arts & Science Stream) in Higher Secondary Schools

F-Teacher uses ICI for different purposes

F_1-Downloading learning Materials
F_2-Shopping
F_3-E-mail
F_4-Movie
F_5-Game
F_6-Course work
F_7-Face book
F_8-Local News
F_9-Instant chat
F_{10}-Music
F_{11}-Banking
F_{12}-Video editing
F_{13}-Others

F- Teacher possess knowledge of Internet and its access
G- Do the teacher think that technology has made a different to our life.

The finding revealed also have been presented through histogram in figure 2

Table 2
Summary of knowledge of using internet by higher secondary school teachers (Arts & science stream) N=80

Sl. No	Description of the items	Higher secondary school teachers (Arts) N=40		Higher secondary school teachers (science) N=40	
		Yes	%	Yes	%
1	Accessing an internet site in its website address	32	80%	40	100%
2	Using search engines to find information	40	100%	40	100%
3	Downloading files from the internet	37	92.5%	38	95%
4	Saving text and images from web pages	30	75%	32	80%
5	Sending and receiving e-mail message	40	100%	40	100%
6	Giving orders to purchase materials online	25	62.5%	38	95%
7	Booking tickets online	30	75%	37	92.5%

As can be seen in Table 2 revealed that 80% higher secondary Arts teacher were accessed on internet site in its website address and 100% science teacher were accessed and internet site in its website address. It was found out that

100% Arts and science teachers were used search engines to find information for different purpose. 92.5% Arts teacher were download files from the internet and 95% science teachers were download files from the internet. Most of the science teachers were download files from the internet for practical purposes. It was revealed that 75% Arts teacher saved text and images from web pages and 80% science teacher saved text and image from web pages. It can be interpreted that 100% both Arts and science teachers were send and receive e-mail message from college website 62.5% Arts teachers were gave order to purchase material online and 95% science teacher were gave order to purchase material online. It was revealed that 75% Arts teachers were booked ticket online and 92.5% science teacher were booked ticket online. They were booked ticket of different types such as railway, airway hotel etc.
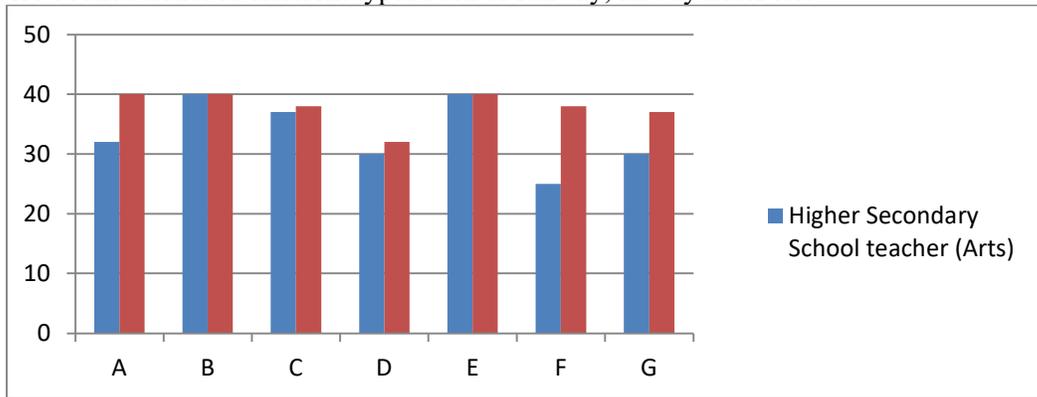

Figure 3 Number of using Internet by higher secondary School teachers (Arts & science stream)
Accessing an internet site in its website address
- A- Using search engines to find information
- B- Downloading files from the internet
- C- Saving text and images from web pages
- D- Sending and receiving e-mail massage
- E- Giving order to purchase materials online
- F- Booking tickets online

The finding revealed also have been presented through histogram in figure 3

Table 3
Summary if ICT curriculum planning and delivery by higher secondary school teachers (Arts & Science stream)   N=80

Sl No	Description of the items	Higher secondary school teachers (Arts) N=40		Higher secondary school teachers (science) N=40	
		Yes	%	Yes	%
1	Teaching ICT Skills to Students	05	12.5%	10	25%
2	Organizing and managing the use of ICT in the Classroom	Nil	00%	8	20%
3	Teaching whole class lesson using ICT	Nil	00%	Nil	00%

4	Extending student learning in a subject through the use of ICT	Nil	00%	Nil	00%
5	Encouraging student to go to different educational site	25	62.5%	34	85%
6	Encouraging student to use e-mail/twitter/Face book	35	87.5%	37	92.5%
7	Using data projector for content delivery	5	12.5%	12	30%

As can be seen in Table 3 revealed that 12.5% higher secondary school teachers (Arts) and 25% sciences teacher were having teaching ICT skills to students. No higher secondary school teachers of Arts stream were managed and organized teaching and learning activities in the class using ICT. Whereas, 20% science teachers managed and organized teaching and learning activities in the class using ICT. It was found out that no arts and science teachers were extended student learning in a subject through the use of ICT. 62.5% arts teachers and 85% science teachers were encouraged students to go to different educational sites for improvement of learning 87.5% Arts teachers and 92.5% sciences teachers were encouraged student to use e-mail, twitter and face book etc. 12.5% Arts teachers and 30% sciences teacher and 30% science teacher were used data projector for content delivery and social networking.

A- Teaching whole class lesson using ICT.
B- Extended students learning in a subject through the use of ICT.
C- Encouraging student to go to different educational site.
D- Encouraging student to use e-mail/twitter/facebook.
E- Using date projector for content delivery.

The finding revealed also have been presented through histogram in figure 3.

Table 4
Summary of problem of ICT perceived by higher secondary school teachers (Arts & Science stream)
N=80

Sl No	Description of the items	Higher secondary school teachers (Arts) N=40		Higher secondary school teachers (science) N=40	
		Yes	%	Yes	%
1	Higher Secondary Schools having insufficient number of interactive white board	38	95%	35	87.5%
2	Schools having insufficient number of computers	30	75%	34	85%
3	Schools having insufficient internet speed	20	50%	15	37. 5%
4	Schools having insufficient technological support	32	80%	37	92.5%
5	Schools having office software	40	100%	40	100%
6	Schools having printer and scanner	40	100%	40	100%

Table 4 showed that 95% Arts teachers and 87.5% science teachers said that the higher secondary schools were

having insufficient number of interactive whiteboards. It was found out that 75% Arts teachers and 85% science teachers said that these schools were having insufficient number of computers. So, the teachers were faced a lot of problem for a less number of computers. It can be interpreted that 50% Arts teachers and 37.5% science teachers said that the schools were having insufficient internet speed, 80% Arts teachers and 92.5% teachers said that the schools were having insufficient technological support. It was revealed that 100% Arts and science teachers said that the schools were having office software printer and scanner.

Figure 3 number of problem of ICT perceived by higher secondary school teachers

- A- Schools having insufficient number of interactive white board.
- B- Schools having insufficient number of computers.
- C- Schools having insufficient internet speed.
- D- Schools having insufficient technologies support.
- E- Schools having office software
- F- Schools having printer and scanner

The finding revealed also have been presented through histogram in figure1.4.
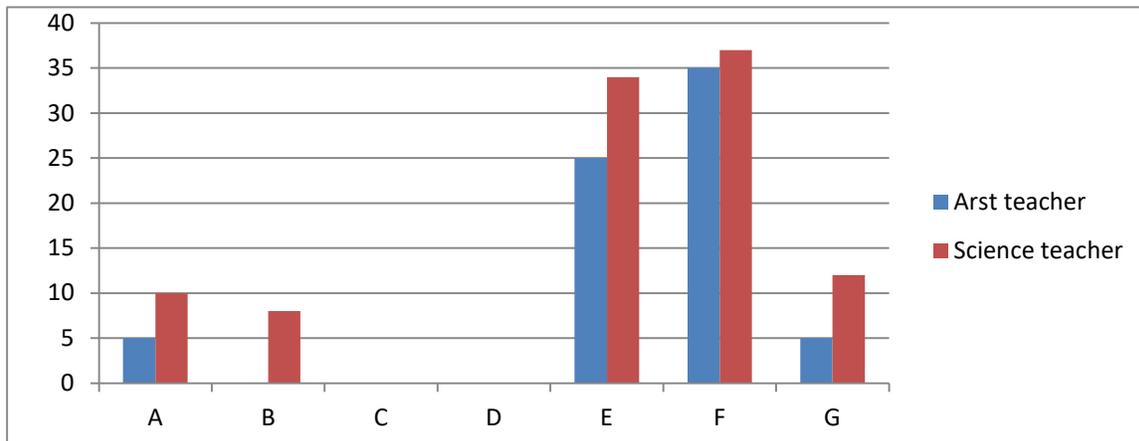
Findings

1. Most of the higher secondary school teachers of both arts and science stream having their own computer, laptop and rarely use the desktop and also did not have their own tablet.
2. Maximum number of teachers were used the computer at every day and having knowledge & skills of ms word, ms power point, internet and email.
3. Most of the arts & science teachers used ICT for downloading learning materials, shopping, email, course work, facebook, instant chat, local news, music and banking.
4. No higher secondary school teachers of both arts and science stream were used ICT for video editing and other purposes.
5. Maximum number of science teachers were accessing an internet site, purchase materials on online & booked ticket in comparison to arts teachers.
6. Most of arts and science teachers were used search engines to find information from internet, to save text and image from web pages, to send & receive email from internet.
7. Maximum number of teachers having insufficient number of interactive white board, computer and technical support in the schools.

8. No higher secondary school teachers of both arts and science stream were used ICT for video editing & other purposes and also to teach whole class & extent student learning in a subject.
9. Below the average number of arts and science teachers were having ICT skills to students.
10. Most of the science teachers were encouraged student to go to different educational site, e-mail, facebook in comparison to arts teachers.

Discussion AND Conclusions

The study's findings highlight substantial problems that higher secondary school teachers experience when using information and communication technology (ICT) in teaching and curriculum delivery. The majority of teachers do not have access to personal computing devices like laptops and tablets, which significantly impact their ability to integrate technology into their teaching practices. This is consistent with Gajek's (2015) findings, which show that access to equipment such as PCs, laptops, and interactive whiteboards has a significant impact on teachers' ability to use ICT effectively in class. Similarly, Francis et al. (2017) stated that financial constraints and the high cost of ICT infrastructure remain significant barriers to implementation in many schools.

Even when devices are available, they are not commonly used in classrooms. Most teachers utilize them infrequently, often due to a lack of confidence or skill in ICT tool use. Wanjala et al. (2011) discovered that many teachers rely on trial-and-error methods rather than formal ICT training, limiting their pedagogical use of technology. Saputra et al. (2024) also showed that, while teachers generally have positive attitudes toward ICT, their use is often limited to the basics, with advanced pedagogical applications not fully developed. These findings show that a lack of professional development and practical experience practical exposure from realizing ICT's revolutionary possibilities.

Teachers also face difficulties in planning and delivering curriculum when integrating ICT. In particular, they find it challenging to organize and manage the use of ICT in the classroom, teach entire classes using technology, and enhance student learning with digital tools. For instance, many educators still find it difficult to utilize projectors and interactive whiteboards for content delivery, which are considered essential ICT skills. Similar trends were observed by Aslan and Zhu (2016), who discovered that pre-service and novice teachers frequently limited their ICT applications to demonstration purposes rather than engaging in interactive or collaborative activities.

These difficulties are made even more difficult by institutional obstacles. Lack of technical support workers, unreliable internet connectivity, and a lack of interactive whiteboards are just a few of the infrastructure issues that many schools deal with. These restrictions are similar to those expressed by Trucano (2012), who emphasized that insufficient infrastructure and lack of support services continue to be major obstacles to the broader adoption of ICT. Rabah (2015) further emphasized that although ICT can improve student involvement and the globalization of education, the dependability of the supporting infrastructure is necessary to its effectiveness. Teachers are forced to spend important time troubleshooting because schools lack dedicated technical staff, which takes away from instructional activities.

Interventions at multiple levels are necessary to address these issues. First and foremost, it is crucial to provide teachers with personal computers like laptops and tablets. According to Ahmed (2015), teachers' attitudes toward integration considerably increase when institutional policies actively encourage the implementation of ICT. Second, priority needs to be given to comprehensive and ongoing professional growth programs. Teachers expressed a great need for organized ICT training in advanced applications including database management and electronic resources, according to Adegbenro et al. (2017). While refresher courses assist trainers in staying up to date with emerging technology, regular seminars, peer-learning sessions, and certification programs can help enhance competence and confidence.

Third, policymakers need to address infrastructure improvements. The obstacles instructors currently have can be lessened by making sure there are enough interactive whiteboards, dependable high-speed internet, and technical

assistance available in schools. According to research by Barnali Ghosh (2024) and Panigrahi (2011), although teachers' attitudes toward ICT are usually favorable, substantial adoption is hampered by a lack of institutional support. Governments can create conditions where teachers are enabled to concentrate on teaching rather than technical or logistical problems by making sure that schools have effective ICT ecosystems.

Overall, the findings indicate that ICT integration in schools cannot be achieved only through the provision of equipment or positive mindsets. Instead, an comprehensive approach that involves resources, teacher training, and institutional infrastructure is required. A well-supported ICT framework not only improves curriculum planning and instructional delivery, but it also prepares students for the challenges of a technologically driven environment. This result is consistent with global attitudes (Voogt & Knezek, 2008) and national policies such as India's National Education Policy 2020 (Government of India, 2020), which emphasizes digital literacy, smart classrooms, and teacher empowerment.

By systematically tackling these difficulties, the education system can get closer to fulfilling ICT's revolutionary power—creating an engaging, efficient, and future-ready learning environment.

References

1. Adegbenro, J. B., Gumbo, M. T., & Olugbara, O. O. (2017). In-service secondary school teachers' technology integration needs in an ICT-enhanced classroom environment. *South African Journal of Education, 37(4),* 1–12. https://doi.org/10.15700/saje.v37n4a1499
2. Adegbenro, J. B., Gumbo, M. T., & Olakanmi, E. E. (2017). In-service secondary school teachers' technology integration needs in an ICT-enhanced classroom. *Turkish Online Journal of Educational Technology, 16(3),* 79-87.
3. Adeyemi, T. O., & Olaleye, F. O. (2010). Information communication technology (ICT) for the effective management of secondary schools for sustainable development in Ekiti State, Nigeria. *American Journal of Scientific Research, 5(2),* 106–113.
4. Ahmed, A. A. (2015). The current state and implementation of ICT in Khartoum State secondary schools. *International Journal of Education and Development Using Information and Communication Technology, 11(2),* 36–53.
5. Ahmed, A. (2015). Managing information and communication technology in Sudanese secondary schools. *Journal of Education and Practice, 6(32),* 1–7.
6. Aslan, A., & Zhu, C. (2016). Influencing factors and integration of ICT into teaching practices of pre-service and starting teachers. *International Journal of Research in Education and Science, 2(2),* 359–370.
7. Azizan, F. H. (2010). The effectiveness of using internet as a principal information resource in teaching and learning activity in higher educational institutions in Malaysia. *Regional Conference on Knowledge Integration in ICT, 7–12*.
8. Bashir, F., & Siddiqui, M. H. (2012). Usage of ICT by the students in higher secondary schools of Jammu and Kashmir. *IOSR Journal of Humanities and Social Science, 4(2),* 37–41. http://www.iosrjournals.org.
9. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13(3),* 319–340. https://doi.org/10.2307/249008
10. Francis, N., Ngugi, D. K., & Kinoti, M. (2017). The influence of selected factors on implementation of ICT in public secondary schools in Kenya. *International Journal of Education and Development Using Information and Communication Technology, 13(2),* 70–86.
11. Gajek, E. (2015). ICT implementation by language teachers: Benefits and challenges. *Teaching English with Technology, 15(3)*, 22–38.

12. Ghosh, B. (2024). Attitude of secondary school students towards the use of information and communication technology (ICT) in rural and urban areas of West Bengal: A study. *A Multidisciplinary Online Journal of Netaji Subhas Open University, 7(1),* 35–41.

13. Government of India. (2020). National education policy 2020. Ministry of Human Resource Development. https://www.education.gov.in/nep2020

14. Gunduz, Ş. (2017). Problematic internet usage among ICT teachers. *Turkish Online Journal of Educational Technology, 16(2),* 45–56.

15. Gunduz, S. (2017). Problematic internet usage of ICT teachers. *Research Inventy: International Journal of Engineering and Science, 7(6),* 1–4. http://www.researchinventy.com

16. Hadjerrouit, S. (2009). Didactics of ICT in secondary education: Conceptual issues and practical perspectives. *Issues in Informing Science and Information Technology, 6*, 1–14.

17. Jonassen, D. H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), Instructional-design theories and models: A new paradigm of instructional theory (Vol. II, pp. 215–239). Lawrence Erlbaum Associates.

18. Kozma, R. B. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments, 1(2),* 117–156. http://dx.doi.org/10.17011/ht/urn.2005355.

19. Mahajan, G. (2016). Attitude of teachers towards the use of technology in teaching. *Educational Quest: An International Journal of Education and Applied Social Sciences, 7(2),* 141–146.

20. Mandal, A. K. (2023). Attitude of higher secondary students towards the use of information and communication technology in West Bengal. *Polyphony: Bankura University Journal of Education, 1(1),* 33–40.

21. Manisha. (2012). Attitude of secondary school teachers towards using new technology in Northern Goa. *International Journal of Education and Psychological Research, 1(2),* 34–39.

22. Meerza, A. (2017). Critical factors impacting undergraduates' use of ICT in learning at Kuwait universities. *Education and Information Technologies, 22(5),* 2027–2046. https://doi.org/10.1007/s10639-016-9539-2

23. Meera, A. (2017). Factors influencing undergraduates' attitudes towards ICT: An empirical study in Kheis. *Turkish Online Journal of Educational Technology, 16(12),* 1–10.

24. Meera, S. (2000). Relative effectiveness among different models of computer-based instruction in relation to students' personality traits (Doctoral dissertation, Bharathiar University).

25. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108(6),* 1017–1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

26. Mukherjee, R., Goon, A., Mukherjee, S., & Bhat, S. C. (2024). Use of information and communication technology in the teaching–learning process in higher secondary school education with respect to teachers' perception. *International Journal of Advanced Research, 12(8),* 1200–1213. https://dx.doi.org/10.21474/IJAR01/19363.

27. Murungi, V. M., Kibaara, T. M., & Mwaniki, T. M. (2017). Impact of implementing information technology on teaching in public secondary schools in Mbeere Sub-County, Embu County, Kenya. *IJRDO Journal of Educational Research, 2(8),* 190–214.

28. Naveen Kumar, L. C. (2019). A study on secondary school teachers' attitude towards using new technology. *Journal of Emerging Technologies and Innovative Research, 6(1),* 1060–1064.

29. Neeraj, K., & Anitha, S. (2010). Computer and internet awareness among school-going students. *Edutracks, 9(10),* 22–25.

30. Nimavathi, V., & Gnanadevan, R. (2008). Effectiveness of multimedia programme in teaching science. *Edutracks, 7(8),* 12–15.

31. Panigrahi, M. R. (2011). Teachers' perception toward ICT utilization: A study of senior secondary school teachers in Haryana. *Turkish Online Journal of Distance Education, 12(4),* 45–52.

32. Pelgrum, W. J., & Law, N. (2003). ICT in education around the world: Trends, problems and prospects. UNESCO-IIEP.

33. Pradhan, S. (2025). Attitude of secondary school students towards the use of information and communication technology (ICT). *Scholarly Research Journal for Humanity Science & English Language, 13(68),* 186–191. https://www.srjis.com/issues_data/248.

34. Rabah, J. (2015). Benefits and challenges of ICT integration in Quebec English schools. *International Journal of Research in Education and Science, 1(2),* 122–133.

35. Rachmawati, Y., & Cynthia, R. (2010). Information and communication technology (ICT)-based learning in teaching secondary school in Indonesia. International Conference on Technical & Vocational Education and Training, Bandung, Indonesia, 10–11.

36. Rajakumaran, V., Soureche, R., & Viswanathan, P. (2010). Role of ICT in teaching and learning mathematics. *Edutracks, 9(10),* 33–36.

37. Saha, B. (2023). Information and communication technology in higher secondary school education in West Bengal: An empirical study. *International Education & Research Journal, 9(7),* 11–13.

38. Saputra, R., Pratama, A., & Lestari, D. (2024). Secondary school teachers' attitudes toward ICT integration in post-COVID classrooms. *International Journal of Instructional Technology and Distance Learning, 21(1),* 77–91.

39. Sengamalaselvi, J., Gnanam, A., & Kannan, S. (2017). The impact of ICT at the higher secondary level using GeoGebra in mathematics. *Journal on School Educational Technology, 12(4),* 14–21.

40. Siddiqui, M. H. (2012). Use of ICT by the students in higher secondary schools of Jammu and Kashmir. IOSR *Journal of Humanities and Social Science, 4(2),* 37–41.

41. Singaravelu, G., & Muthukrishnan, T. (2007). ICT: A boon for higher education. *Edutracks, 6(12),* 12–15.

42. Teeroovengadum, V., Heeraman, N., & Jugurnath, B. (2017). Examining the antecedents of ICT adoption in education using an extended technology acceptance model. *International Journal of Education and Development Using Information and Communication Technology, 13(3),* 4–23.

43. Trucano, M. (2012). ICT in education: Policy, practice and possibilities. World Bank.

44. UNESCO. (2009). ICT in education: A framework for policymakers. UNESCO.

45. Voogt, J., & Knezek, G. (2008). International handbook of information technology in primary and secondary education. Springer. https://doi.org/10.1007/978-0-387-73315-9

46. Wanjala, M. M. S., Khaemba, E. N., & Mukwa, C. W. (2011). Significant factors in professional staff development for the implementation of ICT education at secondary school level in Kenya. *International Journal of Education and Development Using Information and Communication Technology, 7(1),* 5–15.