

Information and Communication Technology Competencies among Teachers

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Abstract

The rapid advancement of information and communication technology (ICT) has altered teaching strategies and increased the need for educators to develop the requisite technological skills. Effective ICT integration can enhance teaching, learning, communication, assessment, and access to digital educational resources. However, educators continue to face challenges with infrastructure, training, technical support, digital access, cybersecurity, and pedagogical integration. The study's objectives are to: (1) assess the importance and crucial aspects of teachers' ICT competencies; (2) analyse significant national and international initiatives to improve teachers' digital competencies; (3) identify the main obstacles to ICT integration and offer suitable solutions for improving teachers' ICT competencies. The study uses a qualitative research methodology based on the examination of secondary sources to ICT competencies and technology integration in education, such as pertinent academic literature and policy documents. The National Education Policy (NEP) 2020 of India and international initiatives are the main subjects of the analysis. According to the study, ICT competency requires not just fundamental technical skills but also technological knowledge, pedagogical application, digital content creation, assessment, communication, cybersecurity, ethical technology use, and professional development. Inadequate ICT infrastructure, little unequal access to digital resources, inadequate technical support, technological anxiety, workload, privacy and cybersecurity concerns, and quick technological advancements are some of the main obstacles. The study comes to the conclusion that creating educational systems that are prepared for the future requires improving teachers' ICT proficiency. Effective ICT integration necessitates sustainable professional development, competency-based training, sufficient infrastructure, institutional support, cybersecurity awareness, and fair access to digital resources. Instead of just increasing the amount of technology used in classrooms, ICT should ultimately be used to support high-quality, inclusive, equitable, and learner-centered education.

Keywords: Information and Communication Competency, Sustainable Professional Development, Cybersecurity Awareness, National Education Policy (NEP2020), Digital Educational Resources, Technology Integration.

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Introduction

Information and communication technology, are placing a significant strain on education, particularly teacher preparation (Fuente & Biñas 2020). This is true because a teacher cannot impart knowledge that they do not possess. Since education, both formal and informal, is widely acknowledged as the cornerstone of social , economic development, all educators and students must embrace the era of information and knowledge society (Phan et al. 2020, Tambunan 2014). In order to achieve the Millennium Development Goals (MDGs), which call for learners to read critically, write persuasively, think and reason logically, and solve complex problems, the education sector is seen as the source of technological literacy and the development of new technological skills and other abilities (Gasmi et al 2024). educators and students must develop information processing skills and technological proficiencies for knowledge-building across all domains in order to meet these goals (Selinger 2001, Dutta & Nessa 2022). Even though ICT is still in its early stages, it will have a significant impact on the nation's educational system (Kozma 2011). In the twenty-first century, "technology" has become a worldwide source of information, and it is crucial to many fields, including education (Ekantiningasih & Sukirman 2023). Innovation is essential when integrating technology into education because it has the potential to transform how people live, work, and think (Pilco 2023). The global economy has changed into a knowledge-based economy as a result of ICT, which is seen as a powerful educational tool to improve educational standards. ICT integration in education inspired policymakers, who even made large investments in developing countries. The objectives of education change quickly to meet the demands of the modern world, which necessitate increased capacity (Hasyim et al. 2026). These demands directly impact the educational system. Since they are responsible for managing the educational system, teachers must have strong and effective professional competencies.

The purpose of the study is to critically assess teachers' ICT proficiency, significant national and international initiatives aimed at enhancing digital capabilities, and the main obstacles to successful ICT integration in the classroom. In order to support efficient, inclusive, and learner-centered technology integration, the study also aims to identify suitable strategies concerning professional development, infrastructure, technical support, cybersecurity, ethical technology use, and equitable digital access.

Global initiatives

An essential framework for enhancing teachers' digital competencies is provided by UNESCO's ICT Competency Framework for Teachers (ICT-CFT). In a similar vein, educator-specific digital competencies in professional engagement, digital resources, teaching and learning, assessment, empowering learners, and facilitating learners' digital competence are identified by the European Commission's Digital Competence Framework for Educators (DigCompEdu). It serves as a resource for national initiatives in digital education and teacher preparation. Through professional development, digital pedagogy, and responsible technology use, the European Union's Digital Education Action Plan 2021–2027 supports the growth of teachers' digital competencies and further advances high-quality, inclusive, and accessible digital education. In keeping with the evolving technological

responsibilities of educators, recent EU guidelines also address artificial intelligence, data protection, digital literacy, and misinformation. Globally, UNICEF and the International Telecommunication Union's Giga initiative aim to help governments create sustainable connectivity systems and connect every school to the Internet. The goal of UNICEF's Gateways to Public Digital Learning initiative is to empower educators, students, and families by promoting inclusive national digital-learning platforms. Through investments in digital infrastructure, learning platforms, education-management systems, and digital skills for educators and learners, the World Bank also promotes technology integration. Its methodology places a strong emphasis on how technology should be linked to specific learning goals and supported by teacher capacity-building and relevant digital resources.

NEP 2020 in Context to Information and Technology Competencies

The widespread use of technology in instruction, learning, educational planning, and administration is encouraged by NEP 2020. It draws attention to how technology can facilitate personalised learning, lower language barriers, increase access to high-quality education, and improve educational procedures. Teachers need to be able to use digital platforms, multimedia resources, learning management systems, online assessment tools, educational applications, and digital content in ways that are pedagogically appropriate. Therefore, rather than being merely technical proficiency, ICT competency should be viewed as an integration of technological knowledge, pedagogical knowledge, subject knowledge, and professional judgement. Additionally, the policy places a strong emphasis on teachers' ongoing professional development (CPD). Through technology-enabled platforms and online programmes, NEP 2020 promotes ongoing opportunities for educators to learn new pedagogical approaches, innovations, and technological skills. Additionally, it envisions professional standards that encompass the roles and competencies needed at various phases of teachers' careers. ICT competency must therefore be gradually developed through peer learning, in-service training, refresher courses, pre-service teacher education, and self-directed professional development. The shift from technology use to technology integration is a key component of NEP 2020. It is expected of teachers to use ICT to create inclusive, competency-based, learner-centered, and interactive learning environments. The competencies listed in current national ICT curricula for educators cover everything from fundamental computer functions and internet usage to the creation of digital content, data analysis, collaborative learning, research, presentation, cybersecurity, copyright, and ethical technology use. With the increasing use of online platforms, digital repositories, virtual classrooms, artificial intelligence, and data-driven educational tools by educators, these competencies are especially crucial. However, there are still obstacles in the way of teachers becoming ICT competent, including poor infrastructure, unequal access to devices and dependable internet, a lack of practical training, a lack of technical support, a lack of confidence, time constraints, and disparities in teachers' prior digital experience. Research published through the NCERT's Indian Journal of Educational Technology has also highlighted the need to move beyond training focused primarily on basic office applications towards systematic development of teachers' ability to integrate technology, pedagogy, and content. ICT competency should therefore be seen as a fundamental professional ability for

teachers who are prepared for the future within the framework of NEP 2020. Sustained professional development, competency-based ICT training, sufficient digital infrastructure, institutional support, cybersecurity awareness, and opportunities for teachers to create and assess technology-supported learning activities are all necessary for effective implementation. The ultimate goal is to make sure that ICT significantly contributes to quality, equity, inclusion, creativity, and learner-centered education in line with the larger vision of NEP 2020, rather than just increasing teachers' use of technology.

Challenges:

- 1. Inadequate ICT infrastructure:** Teachers' ability to use ICT effectively is limited by a lack of computers, projectors, smart classrooms, digital resources, and dependable Internet. There are significant infrastructure gaps in rural Jammu Division, according to recent research.
- 2. Inadequate ICT training:** Teachers may possess fundamental operational skills but lack advanced competencies for incorporating technology into their teaching methods. Limited training opportunities have been found to be a significant barrier.
- 3. Inadequate pedagogical integration:** Proficiency with technology does not always equate to proficient use of it for instruction.
- 4. Inequitable access and the digital divide:** Inequitable opportunities for ICT use are caused by variations in school location, socioeconomic circumstances, Internet connectivity, and device availability.
- 5. Limited technical support:** When hardware, software, networks, or online platforms malfunction, teachers may encounter challenges.
- 6. Lack of knowledge about digital education initiatives:** It's possible that some educators don't know enough about the educational programmes and digital platforms that are out there. According to a recent study conducted in Meghalaya, participating teachers had little knowledge of government digital education initiatives.
- 7. Cybersecurity and privacy concerns:** Teachers are handling more student records, online accounts, and digital learning materials, which puts them at risk for phishing, unauthorised access, and data breaches.
- 8. Difficulty evaluating digital information:** It can be difficult to separate reliable educational resources from false or misleading content due to the volume of online information.
- 9. Rapid technological changes:** Teachers must constantly update their knowledge of emerging technologies like artificial intelligence, learning analytics, and adaptive learning systems.
- 10. Ethical and responsible technology use:** Concerns about copyright, academic integrity, student privacy, surveillance, and responsible AI use are becoming more and more significant.
- 11. Time constraints and workload:** Teachers' workload may initially increase as a result of preparing digital lessons, learning new platforms, and producing multimedia resources.

Related Works

According to Fuente & Binas's (2020) research, educators have an intermediate level of information and communications technology competency across a variety of skill sets. Furthermore, teachers' ICT proficiency is not significantly impacted by their age, gender, highest level of education, or teaching position. Nonetheless, a sizable number of teachers attended ICT-related seminars and training in spreadsheets, computer ethics, security, and ICT fundamentals. Phan et al. (2020), revealed that the application of the role of many technological tools to promote better social interaction and the growth of a learning community should be enhanced as technology advances, with IT being the primary factor. virtual reality settings and social media. Tambunan (2014) found that teachers' perceptions of information technology, their use of IT tools, their interpersonal communication skills, and their own self-improvement all have a direct or indirect impact on their information technology competency. Gasmi et al. (2024) emphasise the need for transparent and well-informed regulatory decision making, particularly in nations with varying degrees of digital literacy. Our work contributes to the larger conversation in IS research by highlighting the critical role that digital literacy plays in influencing the regulatory and access environments of emerging technologies and advocating for a multidisciplinary approach to policy formulation. Selinger (2001) describes ICT as a cognitive tool and takes into account the creation and design of ICT lessons and resources. Dutta & Nessi (2022) study demonstrated how to raise both teachers' and students' levels of competency. The study also examined how library professionals use technology in the teaching and learning process. Kozma (2011) makes recommendations regarding the availability and accessibility of broadband connectivity, Internet devices, software, and digital resources for research, communication, content creation, and collaboration for all educators and learners. However, the plan goes beyond infrastructure considerations. According to a study by Ekantingsih & Sukirman (2023), competency-based education and training are highly successful in raising teachers' ICT proficiency in preparation for the fourth industrial revolution. According to Pilco (2023), any educational system must work hard to develop 21st century skills and competencies. In addition to a constant shift in decision-making, society as a whole must care about children's futures and give them the resources, they need to accomplish their own objectives, empowering and nurturing them from an early age as independent citizens with the self-assurance to build their own future.

Research Gap

The existing literature has examined teachers' ICT skills, digital training, infrastructure, and technology integration, but the majority of it concentrates on these elements separately. A single framework has not adequately examined technical, pedagogical, cybersecurity, digital content, ethical, and professional competencies. Furthermore, there hasn't been enough emphasis on connecting teachers' ICT competency development with NEP 2020 and important national and international initiatives while looking at persistent challenges and practical solutions for sustainable ICT integration. Recent data demonstrating ongoing deficiencies in infrastructure, training, and technical support underscores the need for a more thorough policy-oriented synthesis.

Objectives of the study

- To analyze the nature and importance of ICT competencies that educators need in order to effectively teach and learn in the digital age.
- To evaluate significant national and international programmes targeted at enhancing teachers' ICT proficiency.
- To determine the main obstacles to teachers' efficient acquisition and integration of ICT competencies.
- To recommend suitable methods for improving teachers' ICT proficiency and encouraging efficient, inclusive, and responsible technology integration in the classroom.

Methodology

The current study examines teachers' information and communication technology (ICT) competencies using a qualitative research methodology based on secondary data analysis. Peer-reviewed research articles, research reports, government publications, reports from international organisations, policy documents, teacher education frameworks, and reliable educational databases will all be used to gather secondary data. Publications from UNESCO, the OECD, UNICEF, the Indian government's Ministry of Education, and other pertinent educational and technology organisations will be important sources. Keywords like ICT competencies among teachers, teacher digital competence, ICT integration in teaching, digital literacy, technology-enabled pedagogy, teacher ICT skills, and digital professional development will be used to find pertinent literature. The selection of sources will be based on factors such as methodological clarity, academic credibility, relevance, and contribution to the understanding of teachers' ICT competencies. Rather than depending on a single source or viewpoint, the study will critically examine both enabling factors and challenges affecting teachers' ICT competencies. The results will then be combined to identify key trends, gaps that still exist, and implications for professional development, teacher education, and ICT integration in the classroom.

Discussion

The current study emphasises how information and communication technology (ICT) proficiency is now a crucial professional prerequisite for educators in the modern classroom. According to the reviewed literature, teachers need to be able to choose, manage, assess, and pedagogically integrate digital tools into teaching, learning, assessment, and professional activities in order to effectively teach in a technology-enabled environment. As a result, ICT competency is a crucial part of teachers' professional development and helps to create learning environments that are interactive, learner-centered, and supported by technology. The results also show that systematic development of teachers' digital competencies has become increasingly important in international initiatives, such as the European Commission's DigCompEdu and UNESCO's ICT Competency Framework for Teachers. These frameworks acknowledge proficiencies in teaching and learning, digital resources, professional engagement, assessment, and learners' digital competency. These advancements show a wider movement away from just giving teachers access to technology and towards helping them use it responsibly and meaningfully. By highlighting technology-enabled instruction,

individualised learning, digital resources, online assessment, and ongoing professional development, NEP 2020 supports this shift in the Indian context. Instead of being restricted to technical skills, the policy perspective proposes that ICT competency should incorporate pedagogical, technological, and subject-specific knowledge. However discussion also highlights enduring obstacles, such as poor infrastructure, erratic internet access, a lack of hands-on training, a lack of technical assistance, unequal access, technological anxiety, cybersecurity issues, and a growing workload. Overall, the data points to the need for an all-encompassing institutional strategy to improve teachers' ICT proficiency. It is essential to have opportunities for both self-directed and collaborative learning, sufficient infrastructure, technical support, cybersecurity awareness, ongoing professional development, and practical competency-based training. ICT integration should therefore be viewed as a continuous process of pedagogical transformation with the goal of enhancing quality, inclusion, equity, and learner-centered education rather than just as the adoption of new technologies.

Recommendations and suggestions

- ***Strengthen ICT infrastructure:*** To help teachers use ICT effectively, educational institutions should supply enough computers, smart classrooms, projectors, digital learning resources, and dependable high-speed
- ***Internet Continuous ICT training:*** Rather than restricting training to basic computer operations, regular, competency-based professional development programmes should be arranged to enhance teachers' technical, pedagogical, and digital-content development skills.
- ***Encourage pedagogical integration:*** ICT training should emphasise how technology can be effectively incorporated with learner-centered approaches, subject matter, instructional strategies, assessment, and classroom interaction.
- ***Develop cybersecurity awareness:*** Teachers should be systematically trained in cybersecurity, including safe online practices, data protection, privacy, phishing prevention, password management, and responsible handling of students' digital information. Teachers are handling more and more student records and online accounts, which makes this especially pertinent.
- ***Reduce the digital divide:*** By enhancing connectivity, supplying suitable devices, and guaranteeing fair access to digital resources, special consideration should be given to educators working in remote and resource-constrained areas.
- ***Create institutional technical support:*** In order to provide teachers with timely assistance with hardware, software, networks, and digital platforms, schools and higher education institutions should maintain easily accessible technical support systems.
- ***Promote ongoing professional development:*** In line with NEP 2020's focus, ICT competency should be gradually developed through pre-service education, in-service training, refresher courses, peer learning, mentoring, and self-directed professional development.

- **Enhance digital information literacy:** Teachers should receive training on how to critically assess online information and discern between reliable educational resources and inaccurate, deceptive, or inappropriate content.
- **Prepare educators for new technologies:** To ensure that educators are always up to date on their skills, professional development programmes should frequently cover new technologies like artificial intelligence, learning analytics, adaptive learning systems, and digital assessment tools.
- **Encourage ethical and responsible use of ICT:** Educational institutions should create explicit policies about student privacy, copyright, academic integrity, responsible use of AI, digital citizenship, and proper use of learner data.
- **Reduce teachers' workload during ICT adoption:** Since creating digital lessons and learning new platforms can initially increase teachers' workload, adequate preparation time, digital resources, technical assistance, and institutional support should be provided.
- **Boost policy implementation:** Educational policymakers should link ICT competency programmes to specific learning goals and offer ongoing funding, oversight, expert assistance, and infrastructure for successful execution.

Suggestions for Future Research

Future research should look at teachers' ICT proficiency across various geographical areas, school types, teaching levels, and subject specialisations. Differences between teachers in rural and urban areas as well as between teachers with varying degrees of teaching experience could be examined through comparative research. The connection between teachers' ICT proficiency and actual classroom procedures, student learning outcomes, cybersecurity awareness, and preparedness to use AI should also be investigated in future studies. It may be possible to ascertain whether ongoing professional development results in long-term gains in teachers' ICT proficiency through longitudinal research. Further evidence for creating successful teacher-training programmes and ICT policies would also come from mixed-method and empirical studies with larger and more varied sample sizes.

Conclusion

According to the study's findings, ICT proficiency is now a crucial professional prerequisite for educators working in modern classrooms. Teaching, learning, communication, assessment, and access to digital educational resources can all be improved by using ICT effectively. Additionally, the study emphasises that competency encompasses not only technical skills but also the capacity to integrate technology with subject knowledge, pedagogy, professional judgement, and responsible digital practices. According to NEP 2020, meaningful ICT integration requires ongoing professional development, sufficient infrastructure, hands-on training, cybersecurity awareness, and institutional support. However, teachers' ICT competency is still hampered by poor infrastructure, insufficient training, unequal digital access, technical challenges, workload, cybersecurity issues, and quick technological advancements. Therefore, consistent, competency-based professional development backed by fair digital infrastructure and institutional mechanisms is necessary to strengthen teachers' ICT

competencies. Ultimately, ICT should be utilised to support high-quality, inclusive, equitable, learner-centered, and future-ready education rather than just as a technical tool.

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