Perceptions And Utilization Of ICT In Governance, Institutional Values And Best Practices In Undergraduate Science Education

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Abstract:
In the evolving landscape of higher education, Information and Communication Technology (ICT) is playing a transformative role in how science education is governed, managed and aligned with institutional values. This study examines undergraduate science teachers' perceptions and utilization of ICT, particularly in academic planning, quality assurance, faculty development, inclusive teaching practices, and institutional goals such as gender equity and international collaboration. The findings reveal that most faculty members actively use ICT for governance-related activities and professional growth, while also acknowledging its value in fostering awareness of social issues through digital platforms. However, the study also points to a significant gap in the use of assistive technologies for students with special needs, suggesting an urgent need for broader adoption of inclusive ICT tools. These findings underscore the importance of ICT not only as a teaching aid but as a critical enabler of institutional excellence and inclusive science education. Strengthening digital infrastructure, capacity building, and inclusive ICT strategies are essential for addressing current limitations and realizing the full potential of technology in undergraduate science teaching.

Keywords: *ICT, Science Education, Governance, Inclusion, Faculty Development, Higher Education Transformation*

I. Introduction

The rapid expansion of Information and Communication Technology (ICT) has transformed higher education globally, reshaping governance, pedagogy, research, and institutional practices. In science education, where precision, collaboration, and innovation are central, ICT has emerged as a critical enabler of efficiency, inclusivity, and excellence. In addition to its conventional function as a teaching aid, ICT has emerged as a pivotal element in institutional governance, enabling academic planning, ensuring quality assurance, and facilitating transparent decision-making processes (UNESCO, 2023). Furthermore, ICT plays a pivotal role in advancing scientific research, innovation, and collaboration through digital platforms like online conferences and open-access repositories. (Shahabuddin, Syed Khurram and Bhatia, Harjeet Kaur, 2024). It is equally significant to consider the role of ICT in the embedding of institutional values, such as equity, sustainability, and social responsibility. Digital platforms, encompassing social media and webinars, function as potent instruments for the promotion of awareness concerning critical social issues, thereby facilitating the alignment of science education with overarching developmental objectives. The following essay will provide a comprehensive overview of the relevant literature on the subject (Cappelli & Akkari, 2025). Despite these advancements, challenges persist, particularly in the adoption of assistive technologies for students with special needs, which limits the inclusivity of science education (Gombás et al., 2024). In consideration of the aforementioned context, the present study explores the perceptions and utilization of ICT in governance, institutional values, and best practices among undergraduate science teachers. The objective of this study is to identify the strengths, gaps, and opportunities for advancing equitable and value-driven science education.

II. Literature Review:

In today's digital age, Information and Communication Technology (ICT) has become an essential tool in the transformation of higher education, particularly in science education, where dynamic engagement, precision, and interdisciplinary collaboration are key. The integration of ICT in higher education institutions (HEIs) has been shown to have a significant positive impact on a range of institutional functions, including teaching and learning, as well as institutional governance, quality assurance, and the promotion of inclusive and value-based education (UNESCO, 2023). The objective of this study is to provide a comprehensive overview of the extant literature on the subject.

ICT in Governance and Leadership in Science Education

ICT facilitates more effective academic governance through the streamlining of data management, planning, and administrative operations. Panda et al., 2025 provide a comprehensive overview of the subject, stating that digital platforms facilitate institutional planning, enable data-driven decision-making, and support internal quality assurance frameworks, such as maintaining documentation for the Internal Quality Assurance Cell (IQAC) reviews. It is becoming increasingly evident that tools such as Enterprise Resource Planning (ERP), digital dashboards, and institutional repositories are being utilized with greater frequency to ensure that departmental activities are aligned with institutional goals. Furthermore, the integration of Information and Communication Technologies (ICT) facilitates uninterrupted involvement in professional development programs, which are recognized as a pivotal factor in the maintenance of academic excellence and leadership in the domain of science education (O'Connor et al., 2023).

ICT and Institutional Values

Information and Communication Technologies (ICT) also play a critical role in establishing and promoting institutional values such as sustainability, gender equity, and social responsibility. Digital platforms, including webinars, social media, and online workshops, have emerged as powerful mediums to raise awareness about social issues among students and faculty. Cappelli and Akkari (2025) highlight that ICT tools have the capacity to promote global citizenship, inclusive thinking, and social engagement, especially among science students, who are often involved in solving real-world problems.

Furthermore, a significant number of institutions utilize ICT strategically in order to reduce gender disparities in access to opportunities and resources. For instance, e-governance tools allow for transparent monitoring of gender representation in academic and co-curricular activities (Maćkowski et al., 2023). Despite this, disparities in access to ICT and related facilities still exist, particularly in rural and underfunded higher education institutions (HEIs).

ICT and Inclusive Science Education

A significant challenge that has been identified in recent studies is the limited use of (ICT) in supporting students with disabilities or special needs. The concept of inclusive education is rooted in the adoption of assistive technologies, including screen readers, Braille displays, and speech-to-text software. However, Gombás et al. (2024) argue that despite policy commitments, implementation at the ground level remains insufficient, especially in science disciplines that heavily rely on visual and technical materials. Similarly, Acosta-Vargas, Luján-Mora, and Salvador-Ullauri (2024) emphasize the urgent need to institutionalize digital accessibility as a core component of academic planning.

ICT for Research and International Collaboration

ICT also facilitates research collaboration and innovation through access to global databases, simulation tools, and digital communication platforms. According to Alayyar et al. (2022), ICT helps break geographical barriers, allowing science faculty and students to engage in international research networks. Furthermore, universities that prioritize digital research infrastructure show a higher frequency of interdisciplinary and cutting-edge scientific output (Panda et al., 2025).

Rationale of the Study:

In the rapidly digitizing landscape of higher education, ICT plays a crucial role in enhancing governance, academic quality, and inclusive practices, particularly in science education (UNESCO, 2023). Although national frameworks like NEP 2020 stress the importance of digital integration and equity, there is a noticeable gap in research on how science faculty perceive and utilize ICT beyond classroom teaching (Panda et al., 2025). These challenges are compounded by insufficient policy implementation and resistance to pedagogical change (O'Connor et al., 2023). This study addresses that gap by exploring ICT's role in academic planning, faculty development, institutional values, and inclusion of students with special needs (Gombás et al., 2024). The findings aim to support policy implementation and promote effective, value-driven use of ICT in undergraduate science education.

Research Design:

This study adopted a descriptive survey research design, which is well-suited for exploring perceptions, attitudes, and usage patterns among a defined population. The purpose was to assess undergraduate science teachers' perceptions and utilization of Information and Communication Technology (ICT) in areas related to governance, leadership, institutional values, and best practices in higher education institutions (HEIs). The design facilitated the collection of both quantitative and qualitative insights regarding the integration of ICT into science education.

Population and Sample:

The target population for this study consisted of undergraduate science faculty members from different science departments of two central universities located in Delhi. A purposive sampling technique was employed to ensure that only science teachers actively engaged in teaching and administrative responsibilities were included in the sample. A total of 96 participants responded to the survey questionnaire, representing departments such as Biosciences, Chemistry, Physics, Environmental Science, Botany, Zoology, Biotechnology and CIRBSc. This sampling method was appropriate for the study, as it focused on participants who are most likely to interact with ICT tools in academic planning, teaching, and institutional development activities (Creswell & Creswell, 2018).

Instrument for Data Collection

Data was collected using a structured questionnaire developed by the researcher. The instrument was divided into two primary sections:

1. ICT in Governance, Leadership, and Management – This section included items related to academic planning, IQAC-related documentation, and participation in faculty development programs.
2. ICT in Institutional Values and Best Practices – This section addressed topics such as the use of ICT for raising social awareness, promoting gender equity, inclusive education, research collaboration, and innovation.

Each item was measured using a 5-point Likert scale: Always (5), Mostly (4), Sometimes (3), Rarely (2), and Never (1).

The questionnaire was validated by a panel of experts in educational technology and science pedagogy to ensure content and face validity. A pilot study was conducted on a small sample (n=15) to refine item clarity and internal consistency. The instrument showed strong reliability, with Cronbach's alpha coefficient of 0.86, indicating a high level of internal consistency.

Statistical Analysis:

A statistical analysis was conducted. Descriptive statistics were calculated for each variable.

III.   Findings

This dimension explores how science teachers at the undergraduate level perceive the role of ICT in science teaching-learning in terms of **governance, leadership, and management.**

Table 1 Responses of Science Teachers on the Role of ICT in Science Education through Governance, Leadership, and Management

Items	Always	Mostly	Sometimes	Rarely	Never
I use ICT to coordinate the academic planning for achievements of our department vision.	22.9%	54.2%	14.6%	6.3%	2.1%
I use ICT for participating in various Faculty Development Programs including online and face-to-face orientations, induction programs, refresher courses, and short-term courses.	33.3%	50.0%	12.5%	2.1%	2.1%
I use ICT to store and retrieve IQAC-related documents reviewing teaching-learning processes of science, operations, and the learning outcomes of students.	39.6%	50.0%	6.3%	2.1%	2.1%

Table 1 presents data that illustrates the role of ICT in governance, leadership, and management within science education. The researcher has endeavoured to elucidate the most frequently utilized aspect, which is then followed by the next aspect used to describe the findings. A strong majority (89.6%) of teachers "always" (39.6%) or "mostly" (50.0%) responded that *"I use ICT to store and retrieve IQAC-related documents reviewing teaching-learning processes of science, operations, and the learning outcomes of students."* Only a small percentage (10.4%) use ICT less frequently for this purpose. Moreover, about 83.3% of teachers "always" (33.3%) or "mostly" (50.0%) stated that *"I use ICT for participating in various Faculty Development Programs including online and face-to-face orientations, induction programs, refresher courses, and short-term courses."* However, 16.7% participate in these programs less frequently. Additionally, the majority (77.1%) of teachers "always" (22.9%) or "mostly" (54.2%) responded that *"I use ICT to coordinate the academic planning for achievements of our department vision."* However, 22.9% of teachers use ICT for this purpose less frequently or not at all.

This dimension examines how science teachers at the undergraduate level perceive the role of ICT in science teaching-learning in term of **institutional values and best practices**.

Table 2 Responses of Science Teachers on the Role of ICT in Teaching-Learning in Alignment with Institutional Values and Best Practices

Items	Always	Mostly	Sometimes	Rarely	Never
Our university uses ICT to reduce gender inequity in curricular and co-curricular activities and facilities for women on campus.	16.7%	47.9%	27.1%	6.3%	2.1%
I use social media, webinars, and online workshops to raise awareness of our students about social issues like gender, sustainability, inclusion, etc.	29.2%	45.8%	20.8%	2.1%	2.1%
I use Assistive technology and facilities for child with special need (CWSN) students like screen-reading software, mechanized equipment, Braille, etc.	16.7%	18.8%	31.3%	16.7%	16.7%
I use ICT for innovations and their diffusion consistently.	18.8%	43.8%	22.9%	12.5%	2.1%
Our university emphasises ICT in research to encourage faculty and students of science to engage in cutting-edge research.	47.9%	35.4%	10.4%	4.2%	2.1%
Our university has international relations between universities for scientific collaboration of research and development.	35.4%	41.7%	16.7%	4.2%	2.1%

Table 2 presents data that illustrates the role of ICT in relation to institutional values and best practices in science education. The researcher has attempted to describe the most used aspect, followed by the next used for describing the findings. A strong majority of 83.3% of respondents "always" (47.9%) or "mostly" (35.4%) showed that *"Our university emphasises ICT in research to encourage faculty and students of science to engage in cutting-edge research."* Only a small percentage (16.7%) use ICT less frequently. Another, about 77.1% of respondents "always" (35.4%) or "mostly" (41.7%) responded that *"Our university has international relations between universities for scientific collaboration of research and development."* However, 22.9% believe this occurs only "sometimes" or less frequently. Moreover, 75% of teachers, combined with "always" (29.2%) or "mostly" (45.8%), assert that *"I use social media, webinars, and online workshops to raise awareness of our students about social issues like gender, sustainability, inclusion, etc."* However, 25% of teachers use these tools less frequently. Additionally, 64.6% of respondents "always" (16.7%) or "mostly" (47.9%) believe that *"Our university uses ICT to reduce gender inequity in curricular and co-curricular activities and facilities for women on campus."* However, 35.4% of teachers believe that ICT is used for this purpose only "sometimes" or less frequently. Moreover, a total of 62.6% of teachers "always" (18.8%) or "mostly" (43.8%) *"use ICT for innovations and their diffusion consistently."* However, 37.5% of teachers use ICT for this purpose less frequently. Last and least, only 35.5% of teachers "always" (16.7%) or "mostly" (18.8%) stated that *"I use Assistive technology and facilities for child with special need (CWSN) students like screen-reading software, mechanized equipment, Braille, etc.,"* while a significant 64.6% use such tools "sometimes" or less frequently.

IV.   Conclusion:

This study provides insight into the evolving role of Information and Communication Technology (ICT) in shaping governance, institutional values, and best practices within undergraduate science education. The findings highlight a predominantly positive perception among faculty regarding the use of ICT tools for academic planning, quality assurance, professional development, and institutional collaborations. A large majority of respondents reported frequent use of ICT for coordinating departmental goals, participating in faculty development programs, and managing IQAC documentation, indicating a strong alignment between digital tools and academic governance. With regard to institutional values, the study demonstrates the integration of ICT in a manner that is conducive to the promotion of gender equity, heightened awareness of social issues, and the facilitation of research and international collaborations. Faculty members are actively leveraging webinars, social media, and online platforms to facilitate discourse on inclusion, sustainability, and innovation, signifying a paradigm shift towards more socially responsive and globally connected pedagogical approaches. However, the findings also highlight a significant gap in the adoption of inclusive ICT tools, particularly assistive technologies for students with special needs. Despite national and institutional mandates for inclusive education, the limited use of such tools underscores the need for targeted capacity-building efforts, increased resource allocation, and strategic policy implementation.

The study concludes that ICT is not merely a support mechanism for instruction but a pivotal driver of institutional excellence and equity in science education. In order to achieve its transformative potential, higher education institutions must invest in the strengthening of digital infrastructure, the promotion of digital literacy among faculty, and the institutionalization of inclusive and ethical ICT practices. Future research may investigate the longitudinal impacts of ICT interventions and consider the views of students to provide a more comprehensive understanding of technology's role in science education.

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