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ICT-BASED INFORMATION RETRIEVAL PATTERNS AMONG UNDERGRADUATE STUDENTS IN PUBLIC SECTOR UNIVERSITIES OF PESHAWAR

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ABSTRACT

This study investigates ICT-based information retrieval patterns among undergraduate students in public sector universities of Peshawar, focusing on usage frequency, locations of access, purposes, and resource availability. Using a descriptive survey design, data were collected from 290 respondents through a structured questionnaire and analyzed using descriptive statistics. The findings reveal that 62.06% of students engage with ICT tools daily, primarily for exam preparation (46.89%) and online searching (44.13%), with mobile phones (72.41%) serving as the dominant access device. While basic resources like computers and internet connectivity (98.62%) are widely available, advanced tools such as digital cameras (0.68%) and photocopiers (10.34%) remain underutilized. The study highlights a strong reliance on mobile-friendly platforms but identifies gaps in the utilization of institutional ICT resources like libraries (3.44%) and computer labs (2.06%). Recommendations include enhancing digital infrastructure, promoting digital literacy, and aligning institutional ICT policies with students' preferences. This research underscores the vital role of ICT in academic success and calls for targeted interventions to bridge gaps in access, skills, and infrastructure.

Key words: *Information Communication Technology, ICT, Information retrieval, ICT usage, ICT for academic success, Mobile technology, ICT in Peshawar.*

INTRODUCTION

The integration of Information and Communication Technology (ICT) has transformed higher education, enabling students to access, retrieve, and utilize information more effectively. Globally, ICT tools such as e-journals, search engines, and digital libraries are essential for tasks like exam preparation, research, and assignments. However, disparities exist between developed and developing countries, where infrastructural challenges and digital skill gaps limit effective ICT adoption (Kozma & Vota, 2013). In Pakistan, particularly in Peshawar's public sector universities, mobile phones are the primary means of ICT access due to their affordability and portability. Despite widespread access to basic resources like computers and internet connectivity, institutional ICT resources such as libraries and computer labs are underutilized, highlighting gaps in infrastructure and awareness.

The integration of Information and Communication Technologies in higher education, particularly within public sector institutions, has seen significant advancements over the past two decades (Mushimiyimana et al., 2022). These developments have been pivotal in enhancing educational delivery, research capabilities, and administrative efficiencies across

universities in Pakistan (Ahmad & Sheikh, 2021b).

While ICT plays a critical role in academic success, limited research exists on its specific usage patterns among undergraduate students in Peshawar. Key gaps include understanding the frequency of ICT usage, preferred access locations, and purposes such as exam preparation and information retrieval. Furthermore, challenges like underutilization of institutional resources and limited access to advanced tools raise concerns about equitable ICT engagement.

This study aims to explore ICT usage patterns among undergraduate students in public sector universities of Peshawar. It focuses on the frequency and location of ICT usage, its purposes, and the accessibility of ICT resources. The findings will inform strategies to improve digital infrastructure, promote digital literacy, and enhance students' academic experiences.

Literature review.

Information and Communication Technology is a broad spectrum of tools and systems that facilitate the collection, storage, processing, and dissemination of information (Peraković et al., 2019). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), it is a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information and systems (UNESCO, 2019).

In the context of modern education, ICT has emerged as a catalyst for improving learning processes, broadening access to information, and fostering collaborative and interactive learning environments (Caeli et al., 2024). The integration of ICT into education enables educators and students to interact with diverse resources, bridging geographical, cultural, and temporal barriers (Vargas-Montoya et al., 2023). ICT is a revolutionary force in education, transforming conventional pedagogical approaches into dynamic, learner-centered practices. Digital tools in academia enhance the efficiency and effectiveness of teaching, learning, and research activities. Tools like e-journals, online databases, and virtual classrooms provide students with instant access to vast repositories of knowledge (Zeng, 2024).

The ability to use ICT helps in developing essential skills such as digital literacy, critical thinking and problem-solving abilities. ICT fosters an environment of innovation and collaboration, preparing students for the demands of a rapidly evolving digital world (Francis & Babu, 2019). In particular, tools like learning management systems and online assessment platforms enable continuous learning and performance tracking, further enriching the educational experience (Msafiri et al., 2023).

The evolution of ICT in recent years has reshaped academic settings, transitioning from traditional information retrieval methods from books to dynamic, digital-driven systems (Farhana et al., 2024). The information retrieval in academic environments in the past relied heavily on manual processes. Libraries possessed a central stage in this system, with resources cataloged in physical formats. Library tools including card catalogs (Arshad & Shafique, 2014), bibliographies (Saxl, 2023) and book indexes (Coe, 2015) were essential, labor intensive and were often limited by geographic constraints (Meesad & Mingkhwan, 2024).

Information retrieval pattern is the collection of various methods and behaviors individuals use to locate and access relevant information in academic settings. It is effective information retrieval is essential for students and researchers to meet their learning and research needs (Hambarde & Proença, 2023). One way in which researchers retrieve information is browsing, which is an exploratory method of retrieving information from the internet using specific query in mind (Lobbé et al., 2021). The method includes skimming and scanning the available information to identify and use potentially related information.

In digital environments, browsing has become more interactive and dynamic. Browing tools including OPACs - online public access catalogs, e-journal platforms & library portals with features like category-based navigation, and visual content previews help with accessing related materials (Meesad & Mingkhwan, 2024).

Searching on the other hand is a targeted and structured information retrieval pattern. It involves formulating queries to locate specific information. Search patterns can range from simple keyword searches to advanced Boolean queries, enabling users to narrow or expand the scope of their search (Purssell & McCrae, 2024). Search engines, for example Google, and Bing in

contemporary times have revolutionized searching by providing rapid access to vast collections of academic and general information.

Research specific tools allow users to refine searches using filters for publication dates, authors, or subject categories. Research engines such as PubMed, Scopus, and Elsevier for instance help researchers in identifying and using research specific materials for their studies (Brenna, 2023). Effective research requires users to develop technical skills, such as query formulation, understanding metadata, and selecting appropriate search tools (Bahtilla & Huang, 2024). It is important to have information literacy training to enhance students' ability to navigate complex databases effectively (Strømsø, 2023).

Filtering is a critical retrieval process to manage large volumes of information by refining and organizing search results. Filters provided by these research sites help users focus on specific types of content, such as peer-reviewed articles, full-text resources, or materials within a particular date range (Balakin et al., 2024). In academic settings, filtering tools are integrated into search platforms, and university library databases. These tools allow students to tailor search outputs to their needs, saving time and improving search efficiency (Martín-Martín et al., 2018). Filtering mechanisms also play a crucial role in reducing information overload, a common challenge in the digital age, by prioritizing relevant and high-quality materials (Chen, 2018).

The use of ICT in academic settings requires a range of technical, cognitive, and operational skills. Proficiency in ICT not only enhances the abilities of students to retrieve and utilize information but also improves their academic performance and research capabilities (Gerova, 2015). Proficiency in information retrieval involves mastering the techniques required to search for, evaluate, and use information effectively. Skills such as formulating search queries, using Boolean operators, and navigating academic databases are central to this process (Paul & Roy, 2023).

The use of ICT in education varies significantly between developed and developing countries. These differences are shaped by factors such as technological infrastructure, socioeconomic conditions, and access to resources (Lwoga & Sangeda, 2018).

Students in developed countries benefit from widespread access to advanced ICT infrastructure, including high-speed internet, well-equipped computer labs, and digital learning tools. It has been found that students in countries predominantly use ICT for academic tasks such as online research, collaboration, and virtual learning. The integration of ICT into educational curricula ensures that students are proficient in tools like learning management systems, digital libraries, and data analysis software (Thapa & Sæbø, 2014). Developed countries also emphasize the use of ICT for collaborative and interactive learning. Tools like Google Workspace, Microsoft Teams, and online forums enable students to work on group projects and access diverse perspectives (Vimal & Komar, 2024). Additionally, students frequently utilize multimedia resources, such as video lectures and simulation tools, to enhance their understanding of complex topics (Brooks et al., 2024).

In contrast, ICT usage in developing countries faces significant challenges due to limited access to resources and infrastructural deficits. Wadhwa and Prabu (2021) found unreliable internet connections, insufficient funding for educational technology, and a lack of trained personnel hinder the effective use of ICT in education in India. Students of developing countries primarily rely on basic tools, such as mobile phones and free search engines like Google, for academic purposes (Asrani, 2021).

Ahmad, Khan, and Haq (2022) revealed that in South Asian countries ICT was often used sporadically and is typically limited to simple tasks, such as searching for information or preparing assignments. According to Hussain, Batool, Akbar, and Nazir (2021), the use of advanced tools, such as e-journals and online databases, remains low due to a lack of awareness and training in these countries. The socioeconomic disparities found in the developing countries exacerbate the digital divide, with students from lower-income backgrounds experiencing the greatest challenges in accessing ICT resources (Zafar et al., 2022).

The frequency and purposes of ICT use also differ between developed and developing countries. In developed countries, students use ICT daily for diverse academic and non-academic activities, including research, communication, and entertainment. Conversely, students in

developing countries often use ICT less frequently, with their usage focused primarily on exam preparation and information retrieval for assignments (Appiah-Otoo & Song, 2020). Another notable difference lies in the proficiency levels of students. While students in developed countries generally demonstrate high levels of ICT literacy, those in developing countries often lack the technical skills necessary to effectively utilize advanced tools (Hussain et al., 2021b).

Numerous studies highlight the widespread adoption of ICT among undergraduate students, driven by the increasing availability of digital tools and internet access. Lwoga and Sangeda (2018) found that over 85% of undergraduate students in their study used ICT daily for academic purposes, such as researching, preparing assignments, and accessing online learning materials. Similarly, Aljneibi, Zervopoulos, and Kanas (2024) reported a high adoption rate among students in developed countries, where advanced infrastructure facilitates regular use of ICT for both academic and non-academic tasks.

In developing countries, however, ICT adoption is less consistent due to limited access to resources. Studies found that only 40% of students in Pakistani universities had regular access to computers or the internet, with the majority relying on mobile phones for ICT-based activities (Asad et al., 2020).

The primary use of ICT among undergraduate students revolves around information retrieval, communication, and academic collaboration. Vimal & Komar (2024) found that students often use search engines, digital libraries, and e-journals to gather information for coursework and research. Zhao and Chen (2023) emphasized that students in developed countries use ICT for collaborative purposes, such as participating in virtual group projects or using platforms like Google Workspace and Microsoft Teams.

The effective use of ICT in academic settings is often as described by the literature is hindered by various challenges and barriers, particularly in resource-constrained contexts. Previous studies have identified recurring issues such as inadequate skills, infrastructural deficiencies, and socio-economic constraints. The study investigates how undergraduate students in public universities within Peshawar use Information and Communication Technology (ICT) for accessing and retrieving academic information.

Research Methodology

The study utilized a descriptive survey design to explore patterns of ICT-based information retrieval among undergraduate students in public sector universities of Peshawar. The descriptive approach was selected for its ability to systematically assess behaviors, preferences, and challenges in ICT usage within a defined population. For this purpose, a total of 342 students were invited to participate in the study, and 290 valid responses were collected, yielding a response rate of 84.8%. Participants were selected using a simple random sampling method to ensure a representative sample of students from different academic programs and demographic backgrounds. The data was collected using structured questionnaire which was then fed into Statistical Package for Social Sciences – SPSS analysis.

Results

This section presents the patterns of ICT-based information retrieval among undergraduate students in public sector universities of Peshawar.

Frequency of usage of ICT Tools among students

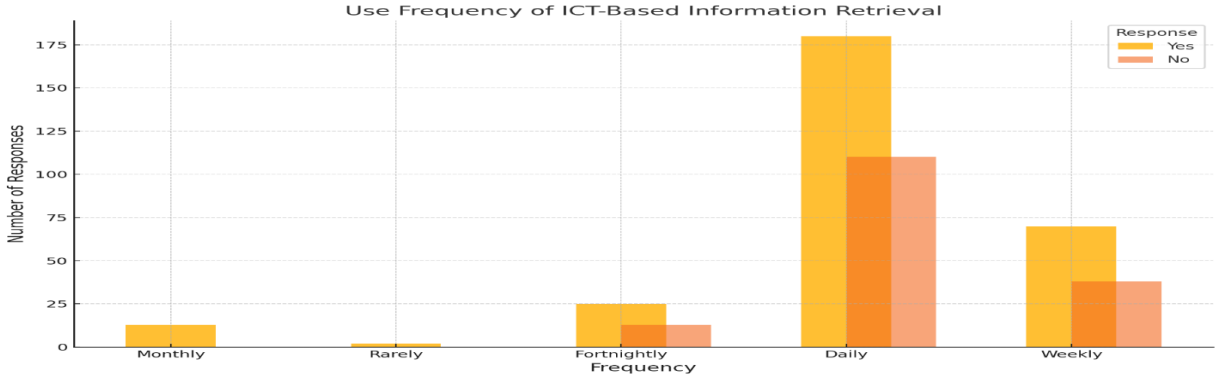


Figure 1 highlights the frequency of ICT usage among the undergraduate students in Peshawar.

The bar chart illustrates the frequency of ICT-based information retrieval among undergraduate students, comparing "Yes" (students who use ICT) and "No" (students who do not). Most students (62.06%) reported daily usage of ICT resources, while 37.93% indicated they do not use ICT daily. Weekly usage follows as the second most common pattern, with 24.13% of students reporting usage and 13.10% not using ICT weekly. Less frequent usage patterns include fortnightly (8.62% "Yes" and 48% "No"), monthly (4.48% "Yes"), and rarely (0.68% "Yes").

Place of ICT Tools Usage

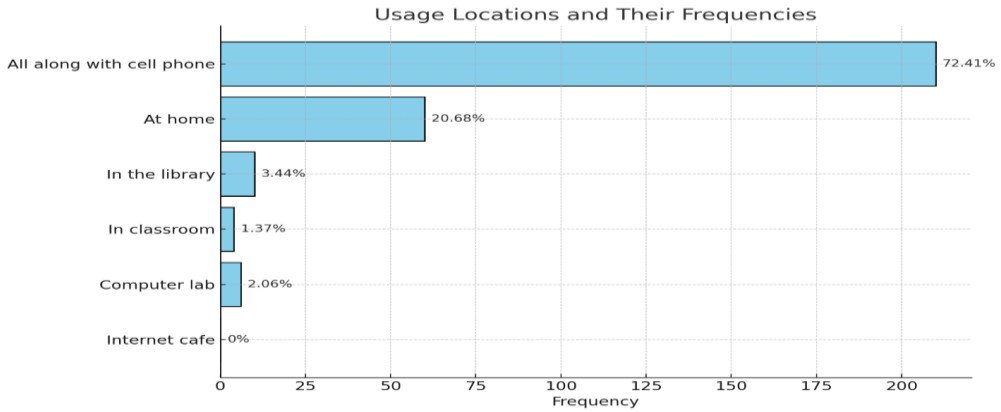


Figure 2 represented by bar graphs shows the usage of ICT tools in different locations. The horizontal bar chart illustrates the distribution of ICT usage locations among undergraduate students. The majority (72.41%) access ICT resources "all along with cell phone," followed by 20.68% at home. Usage in libraries (3.44%), classrooms (1.37%), and computer labs (2.06%) is significantly lower, while no students reported using ICT in internet cafes.

The purpose of using ICT Tools

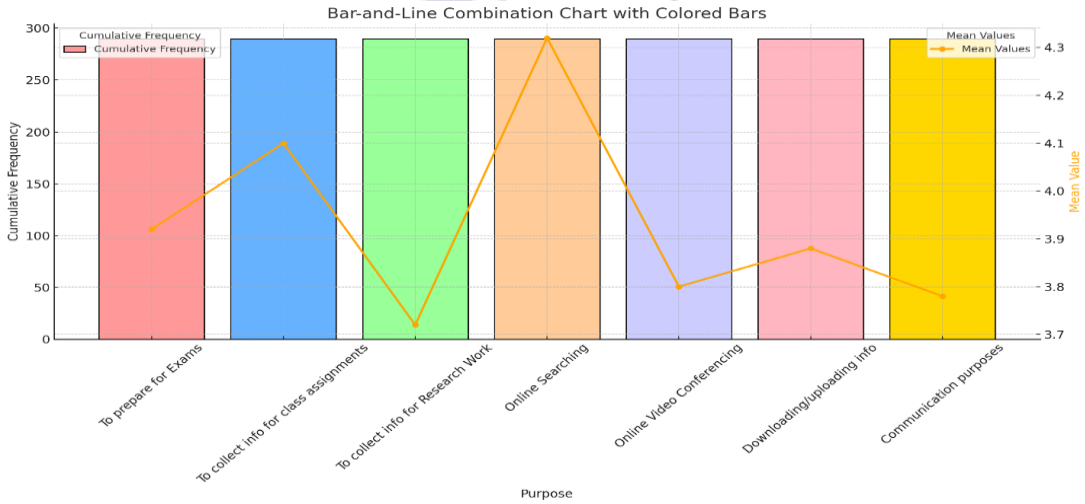
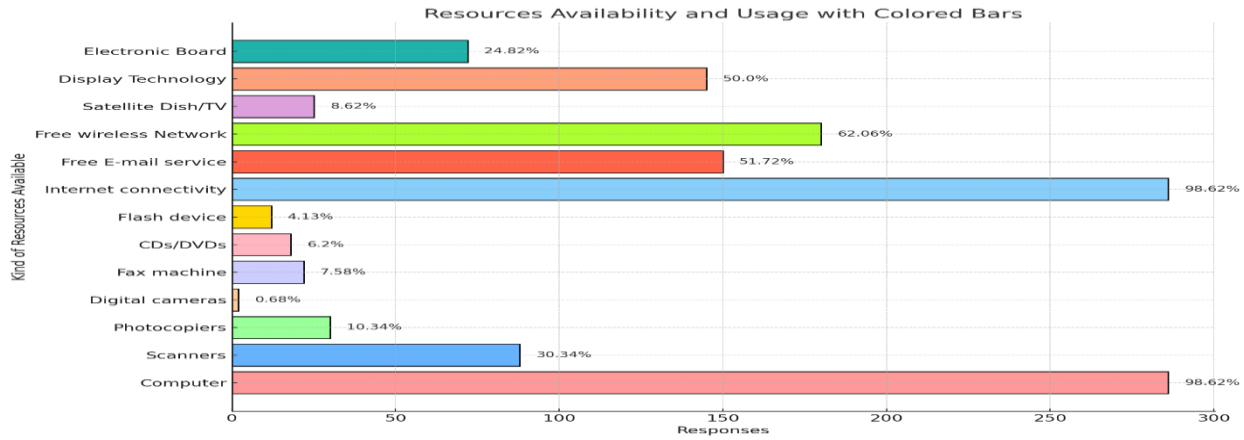


Figure 3, as specified in the bar-and-line combination chart illustrates the cumulative frequency and mean values of different purposes for ICT usage among students. The bars represent the cumulative frequency for purposes such as preparing for exams, class assignments, research, and online searching. Meanwhile, the line chart overlays the mean values, highlighting the relative importance of each purpose. Online searching shows the highest mean value, indicating its primary role in ICT usage, whereas purposes like communication and research work have comparatively lower mean values

Resource availability for the students

The visualization in Figure 4 illustrates the availability and usage of various ICT resources among students. Computers (98.62%) and internet connectivity (98.62%) are the most widely available and used resources, followed by

free wireless networks (62.06%) and free email services (51.72%). Display technology (50.0%) also sees significant usage, whereas resources like flash devices (4.13%), digital cameras (0.68%), and photocopiers (10.34%) were much less common.



Discussion

The discussion explains and analyzes the data collected by linking it with the previous studies.

Frequency and Patterns of ICT Use in the Context of Student Needs and Behaviors

The usage of Information and Communication Technology among undergraduate students has become an integral part of modern education, transforming traditional learning approaches into dynamic and interactive processes (Slechtova, 2015). ICT serves as a vital tool for enhancing students' academic experiences by facilitating access to digital resources, fostering collaboration, and promoting self-directed learning (Gasaymeh, 2018). Hailegebreal et al. (2022) found that undergraduate students extensively rely on ICT for activities such as preparing for exams, completing assignments, conducting research, and engaging in online discussions.

The findings of this study highlight the predominance of daily ICT usage (62.06%) among undergraduate students, reflecting the critical role of technology in their academic routines. This frequent engagement with ICT resources aligns with students' reliance on digital tools for time-sensitive and dynamic academic tasks, such as exam preparation, online searches, and assignment completion. The high proportion of daily users underscores the growing integration of ICT into academic life, driven by the accessibility and convenience of devices like smartphones.

A study by Verhoeven et al., (2014) revealed that that daily ICT usage is the most common pattern among undergraduate students in developed countries, reflecting their reliance on technology for time-sensitive activities like exam preparation and assignment completion. Interestingly, weekly ICT usage (24.13%) emerged as the second most common frequency, catering to students who might engage with ICT resources intermittently, possibly due to specific academic requirements or personal habits. In contrast, fortnightly (8.62%), monthly (4.48%), and rare ICT usage (0.68%) frequencies indicate a minority of students who either face barriers to access or have less dependency on technology in their academic practices. This variability suggests that while ICT has become an integral part of most students' learning experiences, certain groups may still rely on traditional information retrieval methods or have limited access due to infrastructural challenges.

The use of devices for accessing ICT tools varies significantly between developed and developing countries, reflecting disparities in infrastructure, affordability, and accessibility (Schlomann et al., 2020). In developed countries, students typically utilize a wide range of devices, including laptops, desktops, tablets, and smartphones, for academic and personal tasks (Verhoeven et al., 2020). Conversely, in developing countries, mobile phones dominate as the primary device for accessing ICT tools (Tolani-Brown et al., 2010).

The patterns observed resonate with broader trends in developing countries, where mobile devices are the primary means of accessing ICT resources. The overwhelming use of ICT "all along with cell phone" (72.41%) further supports

this conclusion. Students' preference for mobile-based ICT access highlights its portability, cost-effectiveness, and ability to seamlessly integrate into their study habits. However, the limited usage of libraries (3.44%) and classrooms (1.37%) as access points raises concerns about the underutilization of institutional ICT resources, such as digital libraries and computer labs. These findings suggest a disconnect between students' preferences for flexible, personal ICT tools and the static, formal resources provided by universities.

From a behavioral perspective, students' reliance on mobile devices and frequent ICT usage reflects their adaptability and inclination toward self-directed learning. However, it also points to potential gaps in institutional support, such as a lack of structured guidance on leveraging advanced ICT tools or minimal promotion of ICT-based learning environments. Addressing these gaps could enhance students' ability to optimize ICT for research, collaboration, and critical thinking.

While the reliance on ICT for academic purposes is consistent across contexts, this study reveals notable differences when comparing students in developing regions, like Peshawar, with those in developed countries. For instance, students in developed nations often have diverse ICT usage patterns that include advanced collaborative tools, virtual labs, and real-time video conferencing platforms (Hambarde & Proenca, 2023). In contrast, the limited usage of tools such as online video conferencing (10.34% strongly agree) and communication platforms among students in Peshawar highlights a gap in the adoption of advanced ICT capabilities.

Another stark difference lies in the accessibility of institutional resources. In developed countries, institutional ICT infrastructure, including digital libraries, computer labs, and high-speed internet, is widely utilized by students (Lwoga & Sangeda, 2018b). However, this study found minimal usage of libraries (3.44%) and classrooms (1.37%) as ICT access points, suggesting a disconnect between institutional offerings and student preferences in the Peshawar context. This finding is consistent with Asad et al. (2020), who reported similar underutilization of formal academic resources in South Asia.

Conclusion

The findings of this study provide a comprehensive understanding of ICT-based information retrieval patterns among undergraduate students in public sector universities of Peshawar. The study highlights the critical role of ICT in facilitating academic tasks, with a significant majority of students demonstrating daily engagement with ICT tools for purposes such as exam preparation and online searching. The preference for mobile phones as the primary device for ICT access reflects the transformative impact of mobile technology, particularly in resource-constrained settings where affordability and portability are essential. However, the limited use of institutional resources such as libraries and computer labs underscore the need for universities to align their ICT infrastructure with students' preferences for flexible and accessible learning tools.

The results also reveal variability in ICT usage patterns, with a minority of students using ICT resources infrequently, likely due to barriers such as inadequate access, lack of digital literacy, or reliance on traditional methods. Additionally, while basic resources like internet connectivity and computers are widely available, the underutilization of advanced tools and institutional ICT services points to gaps in awareness, training, and infrastructure. These findings resonate with broader trends observed in developing countries, where mobile technology plays a dominant role but challenges such as resource constraints and skill gaps persist.

The study contributes to the existing literature by emphasizing the importance of ICT in supporting students' academic needs while identifying areas for improvement in institutional support and infrastructure. To maximize the benefits of ICT, universities in developing regions must focus on enhancing digital literacy programs, promoting the use of institutional ICT resources, and expanding access to advanced tools. Furthermore, integrating mobile-friendly learning platforms and ensuring equitable access to digital resources are essential steps toward fostering inclusive and effective ICT engagement.

In conclusion, ICT has become an indispensable component of academic life for undergraduate students, offering significant potential to enhance learning experiences and academic success. However, addressing the challenges identified in

this study, particularly in the context of developing countries, requires a collaborative effort between policymakers, educators, and institutions. Future research could explore the impact of ICT usage on academic performance and examine the role of socio-economic factors in shaping ICT behaviors to provide more targeted solutions. By bridging gaps in access, infrastructure, and skills, universities can better support their students in leveraging ICT for academic excellence and lifelong learning.

Recommendations

1. Enhance ICT Infrastructure and Accessibility

To address the variability in ICT usage patterns, universities should invest in improving the availability and quality of ICT infrastructure. This includes upgrading internet connectivity, expanding the number of computer labs, and ensuring 24/7 access to digital libraries and e-resources. Mobile-friendly platforms and applications should be prioritized to align with students' preference for using mobile phones as their primary device for ICT access. Additionally, universities should explore partnerships with telecommunications providers to offer affordable data packages for students, particularly in resource-constrained settings.

2. Promote Digital Literacy and Skill Development

The study highlights gaps in students' proficiency with advanced ICT tools and resources. To address this, universities should implement targeted digital literacy programs that focus on information retrieval skills, critical evaluation of online content, and the effective use of academic databases and learning management systems. These programs could be integrated into the curriculum or offered as standalone workshops. Librarians and IT staff should also play an active role in providing ongoing training and support to ensure that students can fully utilize available ICT resources.

3. Encourage the Utilization of Institutional ICT Resources

The underutilization of libraries, computer labs, and other institutional ICT resources suggests a need for better promotion and accessibility. Universities should develop strategies to increase awareness of these resources, such as orientation programs for new students, digital resource guides, and regular communication campaigns. Extending access hours for libraries and computer labs and integrating their use into academic activities and coursework can also encourage greater engagement.

5. Align ICT Policies with Student Preferences and Needs

The study reveals a preference for mobile technology and specific ICT usage patterns centered around exam preparation and online searching. Universities should tailor their ICT policies and services to align with these preferences. This includes developing mobile-optimized platforms for academic resources, creating user-friendly interfaces for institutional databases, and offering tools that support personalized and self-directed learning. Feedback mechanisms, such as student surveys, should be regularly employed to assess and adapt ICT policies to evolve student needs.

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