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Assessment of Awareness, Challenges, and Statistical Insights on Wireless Communication and the Internet of Everything (IoE) Among BCA Students in Karnataka

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Abstract

This study aims to assess the level of awareness, usage patterns, and challenges related to Wireless Communication and the Internet of Everything (IoE) among Bachelor of Computer Applications (BCA) students in Karnataka. A structured questionnaire survey method was adopted, and 250 questionnaires were distributed across selected colleges, of which 222 valid responses (88.8% response rate) were analyzed using descriptive statistics and chi-square tests to examine associations between demographic variables and internet usage patterns. The findings reveal that students possess strong theoretical awareness of wireless communication (82.88%) and IoE concepts (77.03%), with 70.72% using the internet daily for academic purposes; however, practical exposure remains limited (65.77%), and key concerns include privacy and security risks (36.04%), high implementation costs (23.88%), and lack of skilled professionals (20.72%). The study highlights a clear gap between theoretical knowledge and practical competence in IoE technologies and underscores the need for curriculum enhancement through hands-on training, infrastructure development, and industry collaboration. This research contributes empirical evidence on IoE awareness among undergraduate computing students in Karnataka, offering valuable insights for curriculum planners, educators, and policymakers aiming to strengthen IoE readiness in higher education.

Keywords: Artificial Intelligence, Chi-square Analysis, Digital Literacy, Internet of Everything (IoE), Internet Usage Patterns, Wireless Communication

1. Introduction

Information and Communication Technology (ICT) has transformed the way information is created, accessed, and shared in the modern digital environment. Various communication channels such as the internet, wireless networks, mobile technologies, and digital platforms have

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significantly improved information exchange in education and research (Narasappa and Kumar, 2016). Nagarajan (2012) stressed that ICT tools including online databases, digital libraries, cloud services, and learning management systems enable students to access academic resources quickly and efficiently. These technologies have become an integral part of higher education, particularly in professional courses such as Bachelor of Computer Applications (BCA).

Despite the rapid development of ICT infrastructure and digital resources, many students still face challenges in effectively using these technologies for academic purposes. Issues such as lack of awareness, inadequate training, limited access to specialized resources, and insufficient practical exposure often hinder the effective utilization of digital information systems. Understanding students' usage patterns, awareness levels, and challenges related to ICT tools and electronic resources is therefore important for improving academic support services and digital learning environments (Kumar and Naik, 2019).

In this context, the present study focuses on examining the usage patterns, awareness, and challenges related to electronic information resources and ICT tools among BCA students in Karnataka. The study analyzes students' information-seeking behavior and evaluates the factors influencing the effective use of digital resources. The subsequent sections of the paper present an overview of BCA education in Karnataka, review of related literature, research objectives and hypotheses, research methodology, data analysis and interpretation, followed by discussion and conclusion.

1.1 Computer (BCA) Education and Engineering Colleges in Karnataka: An Overview

Karnataka is one of India's leading centers for technical and computer education, supported by its strong IT ecosystem centered in Bengaluru. The state has numerous government and private degree and engineering colleges offering BCA and computer-related programs, affiliated with universities such as Bangalore University, Tumkur University, University of Mysore, and Visvesvaraya Technological University. The BCA program provides foundational knowledge in programming, networking, and emerging technologies. However, variations in infrastructure, laboratory facilities, and wireless connectivity across institutions may influence students' practical exposure to advanced technologies such as wireless communication and IoE.

2. Review of the Literature

Previous studies highlight the growing importance of internet access and digital technologies in higher education. Research by Kumar and Naik (2015) shows that college libraries play a significant role in supporting academic internet usage. Similarly, Patil and Kulkarni (2018) emphasize the need for digital literacy training to enhance effective use of e-resources among undergraduate students.

In the context of emerging technologies, Gubbi et al. (2013) discuss the architectural foundations and applications of IoT and IoE systems. Studies such as Chaudhary and Singh (2021) identify infrastructure limitations, security risks, and lack of practical exposure as major barriers to IoT/IoE adoption in higher education. Research on wireless connectivity in Indian colleges (Patwardhan, 2018; Singh & Verma, 2020) indicates that reliable Wi-Fi access positively influences academic engagement, though connectivity issues persist.

While existing literature addresses internet usage, digital literacy, and IoT integration, limited empirical research specifically examines awareness, challenges, and statistical associations related to Wireless Communication and the Internet of Everything (IoE) among BCA students in Karnataka. This study attempts to fill that gap.

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3. Research Objectives

The present study aims to:

- Assess the level of awareness of wireless communication and Internet of Everything (IoE) among BCA students in Karnataka.
- Examine internet usage patterns for academic purposes among BCA students in Karnataka.
- Identify challenges faced in adopting and understanding IoE technologies among BCA students in Karnataka.
- Analyze statistical associations between demographic variables and internet usage patterns.
- Provide recommendations to enhance practical exposure and IoE readiness in higher education institutions.

4. Research Hypotheses

Based on the objectives and statistical analysis, the following null hypotheses were formulated and tested:

H_{01} : There is no significant association between gender and daily internet usage among BCA students.

H_{02} : There is no significant association between year of study and daily internet usage among BCA students.

H_{03} : There is no significant association between exposure to wireless communication/IoE topics and frequency of internet usage.

5. Research Methodology

The study follows a quantitative research design to examine the awareness, usage patterns, and challenges related to wireless communication and the Internet of Everything (IoE) among BCA students in Karnataka. Primary data were collected using a structured questionnaire consisting of multiple-choice and Likert-scale questions covering demographic details, internet usage, awareness of wireless communication, and IoE-related challenges. The population of the study includes BCA students studying in colleges across Karnataka affiliated with universities such as Bangalore University, Tumkur University, and University of Mysore. A total of 250 questionnaires were distributed, and 222 valid responses were collected (Kumar & Naik, 2016). The study used a convenience sampling technique. The collected data were analyzed using descriptive statistics (frequency, percentage, mean) and Chi-square tests to identify relationships between demographic variables and internet usage patterns. The analysis was carried out using SPSS software. Participation was voluntary, and respondents' confidentiality and anonymity were maintained throughout the study. Limitations include the restricted sample size and the use of convenience sampling.

6. Data Analysis and Interpretation

The novelty of this study lies in its focus on BCA students in Karnataka and its attempt to analyze their information-seeking behavior in the context of digital library resources. The study contributes to the understanding of how electronic resources support academic work in professional courses and provides insights for improving library services and digital resource management.

6.1. Key Information about the Study

Table 1 demonstrates the demographic information of 222 respondents. The sample consists of a majority of female students (73.87%), with a smaller proportion of male students (26.13%).

Table 1: Demographic profile of Respondents (N = 222)

SL No	Sub category	Frequency	Percentage
1	Female	164	73.87%
2	Male	58	26.13%
3	Below 18	6	2.70%
4	18-20	180	81.08%
5	21-23	34	15.32%
6	Above 23	2	0.90%
7	1st Year	104	46.85%
8	2nd Year	97	43.69%
9	3rd Year	21	9.46%

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The age distribution shows that a large portion of the respondents are young adults between the ages of 18 and 20 (81.08%), with only a few students falling outside this age range (e.g., only 2 students are above 23 years old). Most students are in the first (46.85%) or second year (43.69%) of their BCA program, suggesting that the sample is largely comprised of students in the early stages of their academic journey.

6.2. Details of Responses towards Wireless Communication and IoE related Topics

The exposure of 222 respondents to wireless communication and IoE related topics are presented in Table 2.

Table 2: Exposure to wireless communication and IoE-related topics (N = 222)

Response	Frequency	Percentage
Yes	148	66.67%
No	74	33.33%

A majority of students (66.67%) reported having studied topics related to wireless communication and the Internet of Everything (IoE), suggesting that these topics are part of the academic curriculum. However, 33.33% of respondents have not been exposed to these subjects, indicating a gap in knowledge or lack of exposure to these critical topics in some cases.

6.3. Distribution of Internet Use

The data reveals that a significant number of students (70.72%) use the internet daily for academic purposes, reflecting the high reliance on digital resources for academic learning and research.

Table 3: Frequency of Internet Usage for Academic Purposes (N = 222)

Sl. No	Frequency	Frequency	Percentage
1	Daily	157	70.72
2	Weekly	38	17.12
3	Rarely	18	8.11
4	Monthly	9	4.05

However, there are still a portion of students (29.28%) who do not engage with the internet daily, with 18.72% using it weekly and 11.36% using it rarely or monthly, indicating potential gaps in the consistent use of internet resources for academic purposes.

6.4. Awareness of Wireless Communication

This section attempts to focus on the awareness of wireless communication.A large majority of students (82.88%) correctly identified wireless communication as being based on radio waves and signals, which aligns with theoretical knowledge on this topic.

Table 4: Awareness of wireless communication (N = 222)

Sl.	Answer Option	Frequency	Percentage
1	Radio waves and signals	184	82.88%
2	Cables	14	6.31%
3	Landline networks	10	4.50%
4	None of the above	14	6.31%

However, a small group (6.31%) mistakenly selected communication through cables, and another 6.31% selected "None of the above," indicating some misunderstanding or lack of clarity around the different types of communication systems.

6.5. Understanding of IoE and Its Applications

The majority of students (77.03%) demonstrated a clear understanding of IoE, recognizing it as a concept where devices, people, and data are interconnected.

Table 5: Understanding of IoE and Its Applications (N = 222)

Sl.No	Response Option	Frequency	Percentage
1	Interconnectivity of devices, people, and data	171	77.03%
2	A type of wireless network	32	14.41%
3	A high-speed internet service	17	7.66%
4	None of the above	2	0.90%

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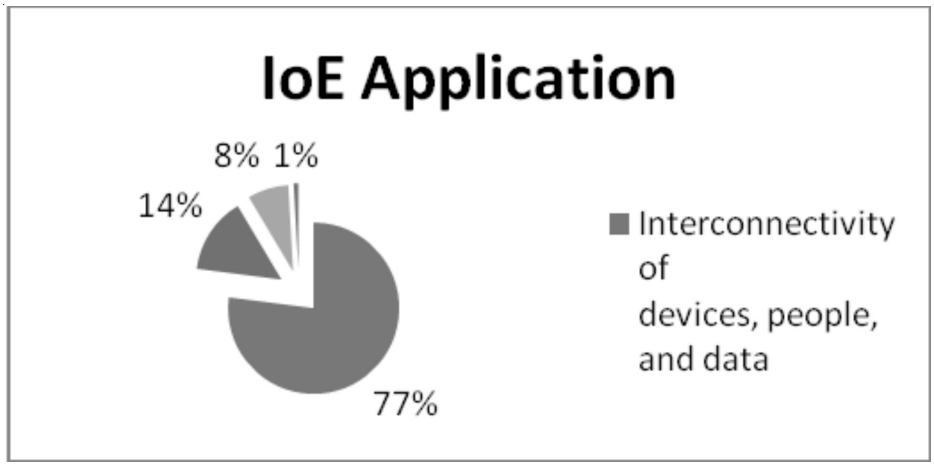


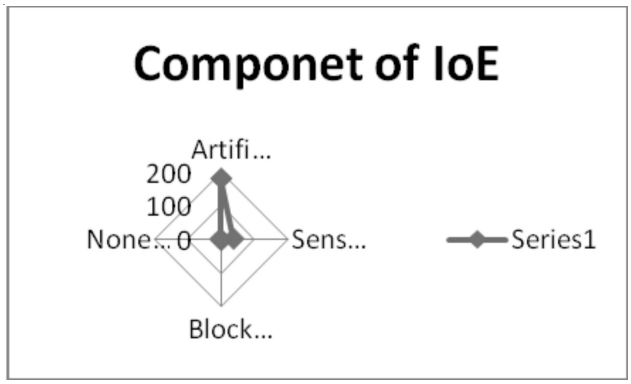
However, some students (14.41%) mistakenly defined IoE as a type of wireless network, and 7.66% thought it was a high-speed internet service. These findings reflect a strong theoretical understanding of IoE but suggest some confusion about its broader scope and application.

6.6. Key Components of IoE

The majority of students (80.63%) identified Artificial Intelligence (AI) as a key component of IoE, which aligns with the widespread understanding of AI's role in interconnected systems.

Table 6: Key Components of IoE (N = 222)

Sl. No	Component	Frequency	Percentage
1	Artificial Intelligence (AI)	179	80.63%
2	Sensors and Connectivity	36	16.22%
3	Block chain Technology	5	2.25%
4	None of the above	2	0.90%



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A smaller proportion of students recognized the importance of sensors and connectivity (16.22%), while only 2.25% associated IoE with blockchain technology. These findings suggest that while AI is widely recognized, other critical components like sensors and blockchain are less understood.

6.7. Perceived Advantages of Wireless Communication

A significant portion of students (45.50%) recognized the primary advantage of wireless communication as faster data transmission, highlighting the practical benefits of wireless technologies in enhancing speed and efficiency.

Table 7: Perceived Advantages of Wireless Communication (N = 222)

Sl. No	Option	Frequency	Percentage
1	Faster data transmission	101	45.50%
2	Mobility and flexibility	32	14.41%
3	No physical cables	7	3.15%
4	All of the above	82	36.94%

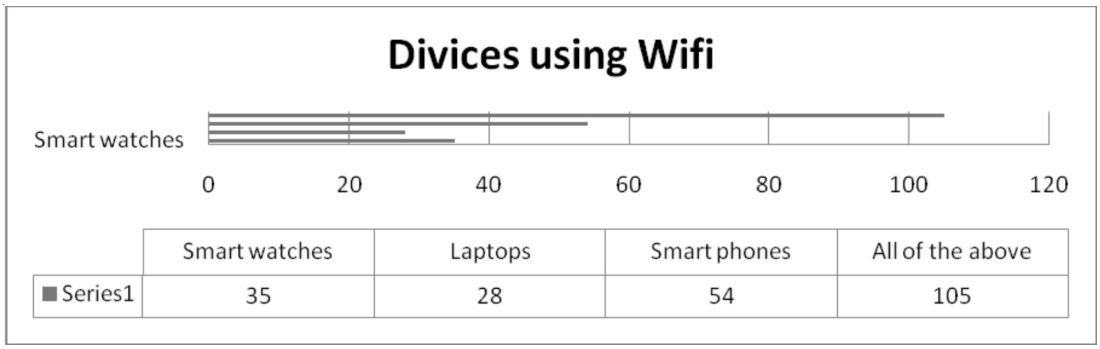
An additional 36.94% selected "All of the above," acknowledging both faster data transmission and better mobility/flexibility as key advantages. Only a small group (3.15%) selected the advantage of having no physical cables, indicating that students view the ability to transfer data quickly and without constraints as the most significant benefit.

6.8. Devices Used to Access Wireless Communication

A substantial portion of respondents (47.30%) correctly identified smart phones, laptops, and smart watches as devices that use wireless communication, reflecting a clear understanding of the widespread application of wireless technologies in everyday life.

Table 8: Devices Using Wireless Communication (N = 222)

Sl. No	Device	Frequency	Percentage
1	Smart watches	35	15.77%
2	Laptops	28	12.61%
3	Smart phones	54	24.32%
4	All of the above	105	47.30%



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However, there is a noticeable difference in how specific devices are acknowledged, with fewer students specifically mentioning smart watches (15.77%) and laptops (12.61%), suggesting a stronger association with smart phones.

6.9. Technologies Enabling IoE Connectivity

The details of technology enabling IoE connectivity are presented in Table 9. The vast majority of students (50.45%) correctly recognized that a combination of Wi-Fi, Bluetooth, and 5G networks enables IoE connectivity.

Table 9: Technologies enabling IoE connectivity (N = 222)

Sl.No	Technology	Frequency	Percentage
1	Wi-Fi	42	18.92%
2	Bluetooth	28	12.61%
3	5G Networks	40	18.02%
4	All of the above	112	50.45%

This indicates that most students are aware of the different technologies that facilitate IoE. However, some students only selected individual technologies (e.g., Wi-Fi or 5G), suggesting some lack of awareness regarding the broader suite of technologies involved in enabling IoE.

6.10. Users' Statement towards Knowledge and Skills in IoE

The self-assessment data indicates that students generally perceive themselves as moderately knowledgeable about wireless communication and IoE applications, with mean scores between 3.60 and 3.90 (on a scale from 1 to 5).

Table 10: Self-assessment of knowledge and skills in IoE (Likert Summary)

Sl.No	Statement	Mean	Median	Mode
1	Basic understanding of wireless communication	3.6	4	4
2	Aware of IoE in smart cities/industries	3.77	4	4
3	Role of IoE in healthcare/automation	3.9	4	5
4	Can differentiate IoE and IoT	3.2	3	4
5	Coursework helped understand wireless communication	3.52	4	4
6	Confident in discussing IoE	3.8	4	4
7	Hands-on experience with IoE tech	2.85	3	3
8	Interested in learning more	3.81	4	4
9	IoE will impact future technologies	4.22	4	5

The highest mean score (4.22) corresponds to the belief that IoE will significantly impact future technologies, showing optimism about the technology's potential. The lowest mean score (2.85) was for hands-on experience with IoE technologies, highlighting a significant gap between theoretical understanding and practical competence.

6.11. Frequency of Access to Wireless Networks

The data shows that connectivity issues are a common concern for many students, with 23.42% reporting frequent problems and 44.14% experiencing issues occasionally.

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Table 11: Frequency of Access Issues with Wireless Networks (N = 222)

Sl. No	Response	Frequency	Percentage
1	Frequently	52	23.42%
2	Sometimes	98	44.14%
3	Rarely	48	21.62%
4	Never	24	10.81%

Only 10.81% of students reported never encountering connectivity issues. This suggests that while internet access is essential for academic success, the quality and reliability of wireless networks in academic settings need significant improvement.

6.12. Challenges in IoE Adoption

The primary challenge reported by most students (65.77%) is limited practical exposure to IoE technologies, which underscores the need for more hands-on learning opportunities in the curriculum.

Table 12: Challenges in IoE Adoption (N = 222)

Sl.No	Challenge	Frequency	Percentage
1	Limited practical exposure	146	65.77%
2	Lack of study materials	44	19.82%
3	Lack of faculty guidance	22	9.91%
4	No interest in the topic	10	4.50%

Other notable challenges include a lack of study materials (19.82%) and insufficient faculty guidance (9.91%), pointing to gaps in academic resources and support for students interested in IoE topics.

6.13. Test of Hypothesis

To examine the association between selected demographic variables and internet usage patterns, the Chi-square (x^2) test was applied at a 5% level of significance ($\alpha = 0.05$), against H_{01}: There is no significant association between gender and daily internet usage.

Table 13: Chi-square Test: Gender vs Daily Internet Use

Gender	Daily Internet Use	Not Daily Internet Use
Female	110	54
Male	47	11

The calculated Chi-square value was $x^2 = 0.127$ with 1 degree of freedom and a p-value of 0.721. Since the p-value is greater than 0.05, the null hypothesis (H_{01}) is accepted. Therefore, there is no statistically significant relationship between gender and daily internet usage among BCA students.

H??: There is no significant association between year of study and daily internet usage.

Table 14: Chi-square Test: Year of Study vs Daily Internet Use

Year	Daily Internet Use	Not Daily Internet Use
1st Year	70	34
2nd Year	52	18

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The calculated Chi-square value was $x^2 = 1.016$ with 1 degree of freedom and a p-value of 0.314. As the p-value exceeds 0.05, the null hypothesis (H_{02}) is accepted. Hence, there is no statistically significant association between the year of study and daily internet usage.

The statistical results indicate that demographic factors such as gender and year of study do not significantly influence daily internet usage patterns among BCA students. This suggests that internet usage for academic purposes is relatively uniform across these groups.

7. Discussion

The results of the present study indicate significant patterns in the usage and awareness of electronic information resources among BCA students in Karnataka. The findings show that students widely depend on digital sources such as e-journals, e-books, and academic databases for their academic work. Similar observations were reported by Tenopir et al. (2015), who found that electronic resources have become the primary source of scholarly information for students and researchers in higher education.

The study also reveals that ease of access and availability of online resources influence students' information-seeking behavior. This result supports the findings of Ahmed and Thomas (2021), who observed that digital libraries and online databases significantly improve information accessibility in academic environments. However, the present study identified certain challenges such as lack of awareness of specialized databases and limited training in information retrieval. Comparable issues were highlighted in earlier studies on electronic resource usage in academic libraries.

Furthermore, the findings suggest that institutional support, user education programs, and library orientation sessions can enhance effective utilization of digital resources. Previous studies have also emphasized the importance of information literacy programs in improving the use of electronic resources among students.

Hence, the present study confirms the growing importance of electronic information resources in academic learning and aligns with earlier research findings, while also highlighting the need for improved awareness and training among students to maximize the benefits of digital library services.

8. Conclusion

This study examined the usage patterns and accessibility of electronic information resources among BCA students in Karnataka. The findings reveal that digital resources such as e-journals, e-books, and online databases play a significant role in supporting academic learning and research activities. The study highlights that while students frequently use general online resources, awareness and effective utilization of specialized academic databases remain limited. The results demonstrate the growing importance of digital information systems in higher education and emphasize the need for improved user education and infrastructure.

Based on the findings, it is recommended that academic libraries conduct regular information literacy programmes, user orientation sessions, and training workshops to enhance students' awareness and effective use of electronic resources. Institutions should also improve digital infrastructure, ensure reliable internet access, and subscribe to relevant academic databases to support students' learning and research needs.

In the future, similar studies can be extended to other disciplines and universities to compare patterns of electronic resource usage. Further research may also explore the impact of emerging technologies such as artificial intelligence and digital learning platforms on students' information-seeking behaviour and library services in higher education.

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