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# Exploring Institutional Readiness for Future IoT Adoption in Library Management: Evidence from a Higher Education Institution, Ghana

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**Abstract**

This paper aimed to identify the institutional readiness factors that would affect IoT adoption in library management in the future, validate their relevance in the Ghanaian higher education context and propose recommendations for an IoT adoption framework. An explanatory sequential mixed-methods design was selected to identify the institutional readiness. First, quantitative data were gathered and analysed. Then followed qualitative data, which were used to explain the quantitative data, and, finally, the two approaches were integrated to provide context and explanation. The quantitative results and findings indicated strong consensus and institutional readiness for IoT implementations. Similarly, the results showed strong alignment between institutional policy frameworks and IoT adoption objectives. These results provide empirical support for the contextual relevance of the proposed institutional readiness framework for future IoT adoption in library management.

**Keywords:** IoT adoption framework; Internet of Things (IoT); library management; smart libraries; educational institutions; institutional readiness; digital transformation; Ghana

## 1. Introduction

The digitisation of educational settings has led to the significant integration of the Internet of Things (IoT) into academic library services, which serves as a pivotal technology for transforming these services. The IoT facilitates the interconnection of devices and systems that autonomously gather, exchange, and analyse data, promoting automation, real-time monitoring, and sophisticated service delivery. In the academic libraries space, such capabilities contribute to the creation of smart libraries, where tools such as radio-frequency identification (RFID) tags, automated shelves, sensor-based tracking, and automated access systems enhance resource management, improve the user experience, and boost operational efficiency. These technological advances make it easier for librarians to monitor their collections and for users to receive items promptly. More than just making things more efficient, IoT also provides the opportunity to develop collaborative learning spaces, study zones that facilitate group project work and private study, and share digital resources [1]. In this manner, libraries contribute not only to academic completion rates

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but also mitigate barriers for users who cannot visit the library in person, again reducing the digital divide [2]. Furthermore, other studies have posited that the rapid rise of digital technologies has significantly changed the structure and design of library services, as well as their delivery, shifting many traditional operations toward more interactive, technology-driven environments. One such development is the "Bring Your Own Device (BYOD)" model, which enables users to access institutional systems and digital resources on their personal mobile devices, such as smartphones, tablets, and laptops. Within educational institutions, BYOD has gained considerable attention for promoting flexibility, mobility, and personalised access to information resources [3,4]. In this context, sustainable library management emerges as a key goal to ensure that library services remain efficient, inclusive, and adaptable in the long term. IoT-enabled smart libraries contribute to sustainability by optimising resource use, broadening equitable access to information, and enhancing institutional resilience. The potential of IoT in libraries is evident; however, theories and models that explain the adoption of IoT in education have been subjected to scant investigation. The success of IoT adoption is heavily dependent on infrastructure readiness, costs, and financial implications, as well as data privacy, institutional policy, and user acceptance [5]. These are the areas that the study focuses on, as it attempts to validate an IoT adoption model designed explicitly for sustainable library management in educational centres. The framework aims to enhance users' capabilities in developing focused learning objectives, utilising resources to teach effectively for individualised student learning needs, and providing equal access to knowledge [5,6]. The effectiveness of IoT implementation in libraries depends heavily on establishing a comprehensive IoT adoption framework. This framework must align technological readiness with institutional structures, policy coherence, cost factors, and user acceptance. In the absence of a structured approach, library IoT initiatives may face fragmentation, underutilisation, and sustainability challenges. Therefore, validating these adoption frameworks is crucial, ensuring they are empirically sound, contextually relevant, and functionally effective in guiding decision making within educational settings [2]. In addition to the above, further confirmation of the framework requires consideration of essential factors, including infrastructure readiness, financial cost, data privacy, policy, security, and user adoption, all of which are crucial for the success of IoT adoption in institutional libraries. The lack of context motivated the researchers to bridge the gap by identifying and contextualising the relevance of the proposed institutional readiness framework for future IoT adoption through an empirical assessment of library, IT, and IT faculty staff members across these selected departments within the public university in Ghana.

Accordingly, this study identifies and contextually validates the institutional readiness factors influencing future IoT adoption in library management through an explanatory sequential mixed-methods approach. To achieve this, it was imperative to validate the IoT adoption framework, ensuring that the findings truly represent what is happening in practice. Consequently, following these steps, the study ensures that the data collection instruments were robust and the findings dependable.

*Research Objectives*

This study is a continuation of previous research, which has focused on developing frameworks for IoT adoption through digital transformation in library management [7], as well as reviewing the literature on the implementation of sustainable strategies and factors influencing IoT adoption frameworks in library management in educational institutions [8]. However, these studies have lacked contextualisation and validation of the proposed frameworks. Therefore, the current study's objectives seek to address these gaps by identifying the institutional readiness factors that will affect IoT adoption in library management in

the future, validate their relevance in the Ghanaian higher education context and propose recommendations for an IoT adoption framework. To address these objectives, the selected methods are justified through the extant literature and the data collection strategies used, as presented [8,9] in Figure 1.




**Figure 1.** Research methodology roadmap. Source: Author's own construct (2026).

The rest of the study is organised as follows: the next section discusses the literature review and theoretical framework underpinning the institutional readiness factors of an IoT adoption framework for library management in educational institution, followed by the methodology section, and findings showing institutional readiness and context validation, discussion, limitations, conclusion, and recommendations for future research.

## 2. Literature Review and Theoretical Framework

Some authors define the Internet of Things (IoT) as a network of connected objects, physical devices, appliances, and other items equipped with electronics, software, and sensors/actuators, which enable these objects to communicate and exchange data [10]. These objects can communicate with other devices, such as computing devices and mobile telephones, via the Internet or other communication networks without involving human intervention. IoT opens the door for communicating and transferring data among connected "things", thus making automation and efficiency improvements possible in almost every field, such as smart homes, industry applications, healthcare, and educational institutions. It is increasingly regarded as a disruptive innovation in academic settings [11]. Library-based IoT systems and applications, including RFID and self-checkout technologies, smart shelves, and environmental control created by sensors, have been proven to streamline library operations and community services [6,8]. The critical considerations for IoT adoption in higher education and its libraries include several advantages achieved in terms of efficiency, accessibility, and user experience. The key drivers for adopting IoT technology in higher educational libraries relate to the savings that can be gained through increased efficiencies, greater access to equipment, and an enhanced user experience. These technologically driven solutions can help libraries organize their resources better and provide users with hassle-free, personalised access to the information they need [1].

Academic libraries, in particular, have been recognised as ideal spaces for IoT solutions, given their dual function as repositories of information and social learning spaces. The

authors have suggested that libraries can expand their traditional services through the use of IoT to offer digital access to remote users, collaborative study environments, and be integrated into an institutional learning management system [6]. Library services with integrated IoT can support a range of teaching and learning practices, providing spaces that are conducive to varying learning cultures. In addition, by using IoT to reduce the digital divide, interface and support for those who cannot be on campus but would like access to library services may also benefit [3,6]. IoT certainly has applications in universities. However, it is constrained by the lack of empirical evidence, the expense of deployment and infrastructure, and a lack of human resources. Security and privacy risks pose obstacles to broader adoption, particularly in settings such as libraries where the processing of sensitive data is commonplace [12]. At the policy level, management-led governance and policymakers' direction can support or impede the effective implementation of IoT. User acceptance of an IoT system is crucial, as it implies that the user trusts the system to be beneficial for them, as opposed to users that mistrust or do not want to use the innovation [6]. Overall, the study still lacks knowledge of the extent to which IoT has been applied in higher educational institutions within developing countries [1,8].

To explain these dynamics, researchers have employed theories such as the Technology Acceptance Model (TAM), in which perceived ease of use is described as a primary antecedent of acceptance or rejection of a technology [13,14]. Likewise, the Diffusion of Innovation (DOI) theory explains adoption in terms of characteristics, including relative advantage of an innovation, compatibility, and complexity [15]. At the institutional level, the perceived ease of use (PEOU) has contributed to the understanding of how institutional resources (financial, human, and technological) influence readiness and ability for IoT integration [16]. However, these models offer limited lessons for academic library environments, especially in Sub-Saharan Africa, where market, policy, funding, and levels of digital literacy may carry more weight than what is applicable in developed economies [13,15].

The IoT adoption frameworks require validation to yield valid and actionable results for studies. Validation takes the form of a systematic review, pilots for data collection before full rollout, and statistical validation to more precisely represent constructs such as users' perception, institutional readiness, and the ability of technology to support needs. Findings that are not validated can be either situationally inapplicable or poorly derived. Validation also broadens the applicability of findings, as researchers and practitioners want to use what works, but will only do so to the extent that they are confident that intervention effects can be replicated [15,17,18].

Sustainable library operations are increasingly embedded in advanced technologies, such as the Internet of Things, which is also offered for libraries. The libraries utilize automation, digital sharing of materials, and live monitoring to reduce manual labour while increasing user participation. RFID helps streamline the circulation process, increasing convenience for RFID system users. Sensor-controlled rooms also support the library's sustainability and green initiatives, and sustainability, after all, is more than environmental concerns; it includes the economics of a system, equitable access, and resiliency in light of technological shifts. When implemented responsibly, IoT enables libraries to present inclusive and user-centred services that are resilient and sustainable [19,20]. The current literature on IoT adoption in libraries and educational institutions primarily focuses on developed economies, mainly due to a knowledge gap regarding IoT adoption in developing countries, such as Ghana. Theoretical foundations, contextualisation, constructs, and methodology are rarely sufficiently linked in a comprehensive framework with respect to the sustainability dimension of IoT adoption. Tackling those gaps is a necessity for emerging creative, appropriate, and sustainable approaches to adopt IoT in Ghana [7,8,21].

## 3. Materials and Methods

### *3.1. Research Approach and Sampling*

An explanatory sequential mixed-methods design was employed in the study to validate and contextualise the proposed IoT adoption framework into an educational institution's library. First, quantitative data were gathered and analysed. Then followed qualitative data, which were used to explain the quantitative data, and, finally, the two approaches were integrated to provide context and explanation [22,23] (shown in Figure 1). Again, the authors of [22,24] concur with the researchers who employed a purposive sampling technique to investigate IoT adoption in libraries. Similarly, this method was chosen because it helped the researchers understand the statistical relationships between key ideas and factors that affect IoT adoption in the educational institution's library management, as posited by the authors of [6,24].

### *3.2. Data Collection and Instrument Development*

This study was guided by five key constructs drawn from the existing theories and literature on technology adoption or IoT adoption, comprising perceived ease of use, policy framework, IT infrastructure, institutional readiness, and regulatory body readiness. Likewise, the study was undertaken in two phases, in which phase one used a quantitative research approach to operationalise and measure the three constructs in the conceptual framework using a structured questionnaire. These constructs were chosen in part so that they could be translated into measurable indicators that lend themselves well to statistical analysis. The survey questionnaire items were measured on a five-point Likert scale, where (1 = Strongly disagree and 5 = Strongly agree). The relationships among the constructs in the proposed conceptual framework and their influence on IoT adoption in library management within the institution were analysed using relevant statistical techniques based on data collected from respondents. On the other hand, the second phase utilised qualitative methods to pare down and explain the quantitative results. This phase entailed exploring all five constructs within the conceptual framework through semi-structured interviews with chosen participants. This method helped researchers to grasp participants' experiences with, perceptions of, and contextual insights about the implementation and adoption of IoT technologies within the institution's library settings. It provided detailed perspectives and extra issues that may not have been fully captured through survey responses. Moreover, this was additional data collected from the executive management within the selected departments in the institution on the same topic. A semi-structured interview guide was developed using Microsoft Forms. All of these were deployed using Microsoft Teams. In the quantitative phase, library staff, IT support staff, and faculty members from the institution were surveyed. Further, the qualitative design phase enabled the elicitation of in-depth perspectives and opinions from a focus group through semi-structured interviews. For example, IT infrastructure readiness was not just about having the right technology in-house, but also about executive management buy-in and ongoing maintenance budgets. A mixed-methods design helped the researchers assess the reliability, validity, and impact of the topic by critically unpacking ideas in light of the data, ensuring that ethical standards, including informed consent and confidentiality [22].

Further, the use of online conferencing tools such as Zoom, Microsoft 365 and Microsoft (MS) Teams, WhatsApp, and Skype, among others, became dominant during the COVID-19 pandemic. Organisations, businesses, social groupings, and educational institutions limited physical interactions between people due to the swift spread of the virus when one came into contact with an affected person. These technological tools have proven to be useful even in the post-COVID-19 era [25,26]. Based on this, the researchers set out to adopt online

data collection rather than the physical distribution of questionnaires and semi-structured interviews. Further recommendations were provided based on the findings.

### *3.3. Participant Recruitment*

This study used a purposive sampling technique to select participants from specific departments or units with direct involvement in library management and institutional technology support. Given the specialised nature of the research context, only individuals possessing relevant technical and administrative expertise were deemed suitable for inclusion. As such, these staff members were selected to ascertain the library's institutional readiness for the IoT adoption framework. In this study, the population comprised 74 professionals eligible for consideration across the selected departments within the institution. The link to the online survey on MS was sent to participants via their email addresses and WhatsApp contacts. Among the 74 prospective participants in the selected departments, only 61 responded to the online survey. The next phase of the recruitment was to invite the specific senior officers in the departments to participate in the online semi-structured interviews. As this was a focus group interaction, only the 3 heads were invited; out of the 3, only 1 accepted the invitation to grant the interview. They made some policy documents available for analysis. Yamane's Formula for minimum sampling size is expressed as follows:

$$n = \frac{N}{1 + N(e^2)} \tag{1}$$

Given Values: Population (N) = 74, Margin of Error = (0.05) = 5%

$$\begin{aligned} n &= \frac{74}{1+74(0.05^2)} \\ &= 74/1.185 \\ &= 62.45 \end{aligned} \tag{2}$$

Therefore, the sample size for the study is approximately 62 respondents, which is near census, hence the justification for the sample size (n = 61).

### *3.4. Justification for Mixed-Methods Design and Sampling Technique*

Due to the specific nature of the research context, only persons with appropriate technical and administrative expertise were considered suitable for inclusion. Data were collected from selected staff in the Ghanaian educational institution through purposive sampling, using a semi-structured survey questionnaire and interview guidelines to select participants with direct involvement in IoT integration, digital library systems, and institutional technology management. The total eligible population included 74 professionals from the selected departments. The initial population invited to complete the survey questionnaire, as mentioned above, was selected from this educational institution in Ghana. Of these, 61 answered, giving a response rate of 82.4%. The minimum sample size required to investigate is approximately 62 respondents, using Yamane's formula at a 95% confidence level and a margin of error of about 5%. The final sample (n = 61), thus, meets the criteria for statistical adequacy and represents an estimated near-census of the defined population [27,28].

Moreover, power analyses based on Cohen's criteria posit that the sample size is adequate to detect medium effect sizes across multiple regression analyses at $\alpha = 0.05$ with 80% statistical power. As such, the sample size is deemed methodologically and contextually sufficient for both validation and contextualisation of the framework formulated regarding institutional readiness for future IoT adoption in the library services [29] shown in Table 1.

**Table 1.** One-sample effect sizes with 95% confidence intervals (CIs) (Hedges' correction).

| Construct | | Standardizer [a] (SD) | Point Estimate | Lower 95% CI | Upper 95% CI |
|---|---|---|---|---|---|
| Perceived Ease of Use (AVG_PEOU) | Cohen's d | 0.41432 | 10.165 | 5.747 | 14.583 |
| | Hedges' Correction | 0.44901 | 9.379 | 5.303 | 13.457 |
| IT Infrastructure (AVG_IT_INFRAST) | Cohen's d | 0.64827 | 5.308 | 4.187 | 6.424 |
| | Hedges' Correction | 0.65909 | 5.221 | 4.119 | 6.318 |
| Policy Framework (AVG_POLICY) | Cohen's d | 0.60029 | 5.615 | 4.553 | 6.672 |
| | Hedges' Correction | 0.60834 | 5.541 | 4.493 | 6.584 |

[a] The denominator used in estimating the effect sizes. Cohen's d uses the sample standard deviation. Hedges' correction uses the sample standard deviation, plus a correction factor. Source: Author's own construct (2026).

While purposive sampling precludes wide statistical generalisability, it facilitates mixed-methods research consistent with the goal of analytical generalisation and theoretical refinement. As a result, the qualitative phase was undertaken to explain, contextualise, and validate the quantitative findings on institutional readiness for future IoT adoption in library management. Three participants from executive management were purposively selected for interviews due to their strategic roles in institutional planning, digital transformation, and policy implementation. However, only one member agreed to participate in the interview. Despite the lower-than-anticipated participation, the interview provided valuable strategic insights into the institutional factors influencing future IoT adoption. To strengthen the credibility of the qualitative findings, the interview data were triangulated with institutional document analysis. Consequently, the qualitative phase served to explain and validate the quantitative findings within the institutional context rather than to generate generalisable conclusions.

### *3.5. Data Analysis*

As indicated, the study adopted an explanatory sequential mixed-methods design, in which the quantitative phase preceded the qualitative phase. The questionnaire was developed from the literature and aligned with the study constructs. To ensure the instrument's quality, the questionnaire was reviewed by experts and pilot-tested with library staff, IT support personnel, and selected faculty members to assess the clarity, relevance, and comprehensibility of the items. Feedback from the pilot study informed revisions to the questionnaire before the main survey was administered.

Following the quantitative data collection, the data were analysed using the Statistical Package for the Social Sciences (SPSS 27) and Microsoft Excel. Data screening and cleaning were first undertaken, followed by descriptive statistics, one-sample *t*-tests, and one-sample effect size analysis with 95% confidence intervals using Hedges' correction. The quantitative findings informed the subsequent qualitative phase.

The qualitative phase involved semi-structured interviews and document analysis to explain, validate, and enrich the quantitative findings. The interview and documentary data were analysed thematically to identify recurring patterns and themes related to institutional readiness for future IoT adoption in library management. This development enabled researchers to have richer insights into the context of IoT adoption in libraries through such a process validation.

### *3.6. Reliability Testing*

Researchers conducted reliability testing to assess the internal consistency of items measuring IoT adoption in library management systems during the development of the quantitative survey instrument. Cronbach's alpha coefficient was adopted to assess internal consistency, which indicates how stable and consistent the items' results are [30,31]. To determine the reliability of multi-item scales in this study, Cronbach's alpha was used, a common measure of instrument reliability in social science and information systems research [31]. In this context, constructs were measured using multiple items in a questionnaire with a five-point Likert scale (strongly agree = 1 to strongly disagree = 5). Internal consistency was assessed using Cronbach's alpha for each construct. According to the established guideline, a Cronbach's alpha greater than or equal to 0.70 indicates acceptable reliability, greater than or equal to 0.80 indicates good reliability, and greater than or equal to 0.90 indicates excellent reliability [32–34]. The coefficient is calculated using the following formula:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum \sigma_i^2}{\sigma_t^2}\right) \quad (3)$$

where

- $k$ = required sample size;
- $\sigma_i^2$ = variance of each item;
- $\sigma_t^2$ = variance of the total (sum) of all items.

Internal consistency was tested for the three constructs measured in this study. The perceived ease of use construct ($\alpha = 0.845$, 12) demonstrated good reliability, indicating that the twelve items consistently measured a single factor with high precision. The construct indicates that the structure is well constructed and that the items are highly related to one another. The policy framework ($\alpha = 0.836$, 10) and IT infrastructure ($\alpha = 0.899$, 15) constructs also demonstrated good internal consistency, supporting their uses in subsequent statistical analysis and academic discourse. Therefore, reliability analysis results showed that all constructs met the recommended threshold for internal consistency in Table 2.

**Table 2.** Acceptable Cronbach's alpha = $\alpha$ ($\geq$0.70).

| Construct | Number of Items | Cronbach's Alpha ($\alpha$) | Interpretation |
|---|---|---|---|
| Perceived Ease of Use | 12 | 0.845 | Good internal consistency |
| Policy Framework | 10 | 0.836 | Good internal consistency |
| IT Infrastructure | 15 | 0.899 | Good internal consistency |

Source: Author's own construct (2026).

### *3.7. Ethical Considerations*

The researchers adhered to ethical principles for protecting participants and the integrity of the study. In accordance with standard research ethics guidelines, ethical approval for data collection was obtained from the institution's research department. Respondents were informed of the research objectives prior to providing written consent to participate; participation was voluntary. People were given an informed consent statement that described the study, their right to refuse to participate, and their ability to withdraw at any time without consequences. No personally identifiable data was collected to maintain confidentiality and anonymity. Data collected were used only for academic and research purposes, and available only to the researcher. The ethical consideration was motivated by the research methodology roadmap in Figure 1.

In summary, the study employed methodological triangulation, using two methods, thereby enhancing validity, depth, and rigor and leading to a more holistic interpretation of the phenomenon. Both findings complement each other and provide a deeper understanding of the study problem. Quantitative results provided empirical evidence for relationships among measurable constructs. Nevertheless, the qualitative results provide insight into the rationale behind such relationships and additional context-bound indicators relevant to investigating IoT adoption.

## 4. Results, Findings and Discussions

This section describes the study's results and discussion based on an explanatory sequential mixed-methods research design. First, a quantitative methodology was employed, using survey data and descriptive statistics to identify potential trends and patterns related to the constructs specified in the literature review [22]. Descriptive statistics were used to present the findings, including central tendencies and response distributions, providing an initial understanding of the factors associated with the phenomenon under investigation.

Following this, a qualitative phase was added to validate and contextualize the quantitative results. The qualitative findings presented here emerged from thematic analysis of semi-structured interview data, revealing key themes and perspectives that complement the quantitative data. Such a progressive integration of quantitative and qualitative results enables a deeper understanding of the research gap by comparing them with the theoretical constructs described earlier [6,8,9].

The section, therefore, presents descriptive statistics on outcomes, main findings, and the type of qualitative integration, followed by a discussion linking the results to the literature and the conceptual framework underpinning the study. Doing so provides a complete picture of the factors that shape the research context, especially in IoT adoption framework and sustainable library management in Ghana educational institutions.

### *4.1. Overview of the Studies Included in the Validation and Contextualisation*

The validation included several items, ranging from the literature review and theoretical frameworks to the methodology roadmap and the participants' demographic data. Further, the studies included variable methods, such as surveys and interviews, for statistical and thematic analysis in Figure 1, supported by Table 3 which summarizes the respondents' demography with (n = 61) a total number who participated in the data collection and analysis. Among these participants, males were (n = 45) 73.8%, females were (n = 15) 24.6%, and preferred not to say (n = 1) were 1.6%. Therefore, the resulting sample is overwhelmingly male, accounting for about three-quarters of the respondents and outnumbering the others by a fair bit over a ratio of 3:1:1/15. Additionally, the staff category comprised IT staff (n = 50) and library staff (n = 11), also presented in Figure 2.

The study shows the age, roles, and distributions of 61 respondents, as shown in Table 3 above and Figure 3. A total of 47.5% (n = 29) are aged 41–50 years, indicating significant representation of middle-aged professionals. The second-largest group is aged 31–40 years (29.5%, or 18 respondents), which implies they have the strongest exposure to digital technologies. Those aged 20–30 and 50+ each account for only 9.8% (6 respondents), while the under-20 group is the smallest, at just 3.3% (2 respondents).

**Table 3.** Respondents' demographic summary.

| Demographic Characteristic | Category | n | % |
|---|---|---|---|
| Gender | Male | 45 | 73.8 |
| | Female | 15 | 24.6 |
| | Prefer not to say | 1 | 1.6 |
| Age group | Under 20 years | 2 | 3.3 |
| | 20–30 years | 6 | 9.8 |
| | 31–40 years | 18 | 29.5 |
| | 41–50 years | 29 | 47.5 |
| | Over 50 years | 6 | 9.8 |
| Staff Category | IT Staff | 50 | 82.0 |
| | Library Staff | 11 | 18.0 |
| IT Staff position [a] | Director of IT | 2 | 4.0 |
| | IT Faculty Member | 22 | 44.0 |
| | Senior IT Administrator | 15 | 30.0 |
| | IT Support Officer | 9 | 18.0 |
| | Rank not stated | 2 | 4.0 |
| Library Staff position [b] | Librarian | 3 | 27.3 |
| | Library Assistant | 4 | 36.4 |
| | Library Support Assistant | 4 | 36.4 |

Source: Author's own construct (2026). Note: Values are presented as n (%). Percentages for gender, age, and Staff group are based on the total sample (N = 61). Percentages for IT staff positions are based on IT staff (n = 50), while percentages for library staff positions are based on library staff (n = 11). [a] IT staff position categories are a subset of the 50 IT staff respondents. [b] Library staff position categories are a subset of the 11 library staff respondents.

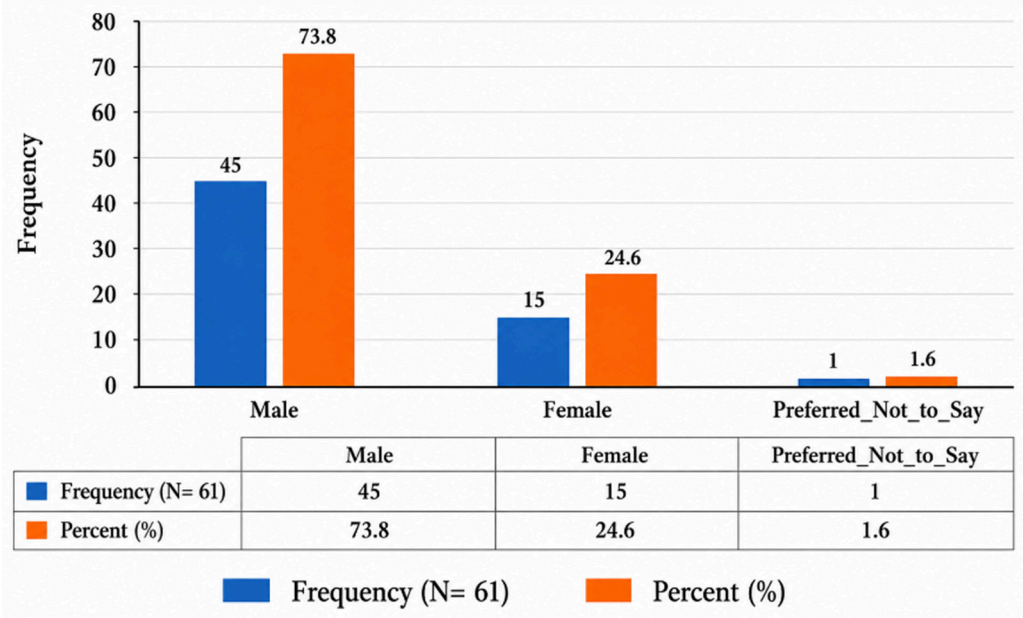
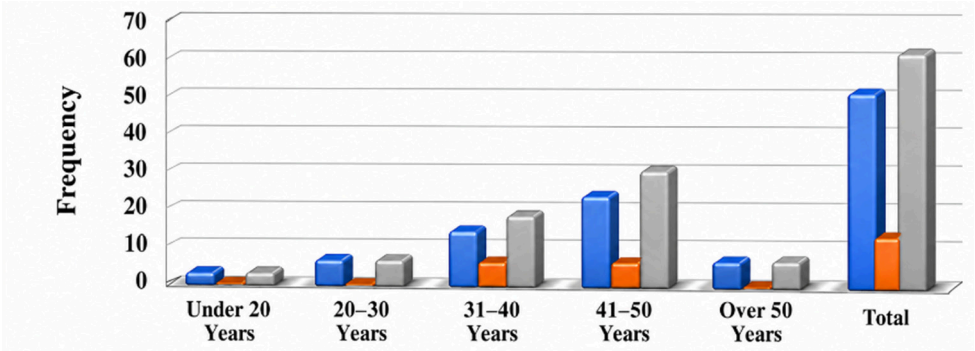



**Figure 2.** Gender of respondents. Source: Author's own construct (2026).




| | Under 20 Years | 20–30 Years | 31–40 Years | 41–50 Years | Over 50 Years | Total |
|---|---|---|---|---|---|---|
| IT_Staff | 2 | 6 | 13 | 23 | 6 | 50 |
| Library_Staff | 0 | 0 | 5 | 6 | 0 | 11 |
| Frequency (N=61) | 2 | 6 | 18 | 29 | 6 | 61 |

**Figure 3.** Distribution of respondents by age group across IT staff and library staff. Source: Author's own construct (2026).

This demographic profile is important in future technology adoption contexts, as older adults often shape perceptions of technology usability and readiness for innovation. The balanced mix of middle-aged demographics highlights that the digitalisation and technology revolution is not a trend limited to the youth, and demonstrates active participation, particularly in institutions where mid-to-senior seasoned professionals engage in technology design decisions.

The researchers first analysed the respondents by professional roles and divisions to establish the diversity of perspectives represented in the study. As shown in Figure 2, IT faculty members constituted the largest respondent group (36.4%), followed by senior IT officers (24.6%) and IT support officers (14.8%). Smaller proportions comprised directors of IT (3.3%), librarians (4.9%), library assistants (6.6%), and library support staff (6.6%). Although the library-related categories made up a minority portion of the sample group, it was important to include them, as it would provide insight into the issues from both the IT and library domains of the institution. The age distribution of respondents is shown in Figure 3 for the two groups of respondents, IT staff and library staff, as the graph shows the number of respondents belonging to each age group. This makes it easy to compare the age distribution of the two respondent groups.

### *4.2. Descriptive Statistics*

In this section, the researchers provide the adjusted results of individual one-sample effect size assessments that tested the degree to which key constructs deviated from the neutral benchmark value (3.00). Both Cohen's d and Hedges' g are presented with 95% confidence intervals (CIs). Cohen's d = 10.165, 95% CI (5.747, 14.583), and Hedges' g = 9.379, 95% CI (5.303, 13.457). The results show a very strong effect size for perceived ease of use (PEOU). Both statistical and practical significance are established because the entire confidence interval is well above zero. The small difference between Cohen's d and Hedges' g indicates that small-sample bias has little effect on the strength of the effect. These results suggest that respondents' perceptions of system usability are well above the neutral benchmark and indicate strong consensus and institutional readiness for IoT implementations. Moreover, the IT infrastructure also has a very high effect size. Indeed, as this confidence interval does not include zero and is relatively narrow, it suggests that these values are stable and accurate (Cohen's d = 5.308; 95% CI (4.187, 6.424); and Hedges' g = 5.221; 95% CI (4.119, 6.318)). The perception of strong, positive institutional

infrastructure propels the IoT adoption framework toward the positive, away from neutral. Similarly, the practical effect of policy support is exceptionally large, with Cohen's d = 5.615, 95% CI (4.553, 6.672) and Hedges' g = 5.541, 95% CI (4.493, 6.584). The CIs are all entirely positive, hence confirming statistical power. This effect is large enough to suggest that there is a strong alignment between institutional policy frameworks and IoT adoption objectives. This construct provides more empirical validation of the structural strength of the proposed IoT adoption framework in library management in Tables 1 and 4–6.

**Table 4.** One-sample effect sizes relative to the neutral midpoint of the five-point Likert scale.

| Construct | N | M | SD | t | df | *p* | Cohens d (95% CI) | Hedges g (95% CI) |
|---|---|---|---|---|---|---|---|---|
| Perceived Ease of Use | 11 | 4.211 | 0.414 | 9.697 | 10 | <0.001 | 2.924 (1.519–4.305) | 2.698 (1.402–3.972) |
| IT Infrastructure | 47 | 3.441 | 0.648 | 4.667 | 46 | <0.001 | 0.681 (0.360–0.996) | 0.670 (0.354–0.979) |
| Policy Framework | 58 | 3.371 | 0.600 | 4.703 | 57 | <0.001 | 0.618 (0.334–0.896) | 0.609 (0.330–0.884) |

Note: M = mean; SD = standard deviation; CI = confidence interval; d = Cohen's standardized mean difference; g = Hedges' corrected standardized mean difference. One-sample *t*-tests used 3 (Neutral) as the reference value. Response coding: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. $p < 0.001$.

**Table 5.** (**a**) One-sample statistics. (**b**) Descriptive statistics of institutional readiness by respondent group.

(**a**)

| Construct | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| AVG_PEOU | 11 | 4.2114 | 0.41432 | 0.12492 |
| AVG_IT_INFRAST | 47 | 3.4413 | 0.64827 | 0.09456 |
| AVG_POLICY | 58 | 3.3707 | 0.60029 | 0.07882 |

(**b**)

| Construct | Respondent Group | N | Mean | Std. Deviation (SD) | 95% Confidence Interval of the Difference | |
|---|---|---|---|---|---|---|
| | | | | | Lower | Upper |
| AVG_PEOU | Library Staff | 11 | 4.2114 | 0.41432 | 3.9331 | 4.4898 |
| AVG_IT_INFRAST | IT Staff | 47 | 3.4413 | 0.64827 | 3.2510 | 3.6317 |
| AVG_POLICY | Library and IT Staff | 58 | 3.3707 | 0.60029 | 3.2129 | 3.5285 |

Source: Author's own construct (2026).

**Table 6.** One-sample test.

| Construct | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|
| AVG_PEOU | 11 | 4.2114 | 0.41432 | 0.12492 |
| AVG_IT_INFRAST | 47 | 3.4413 | 0.64827 | 0.09456 |
| AVG_POLICY | 58 | 3.3707 | 0.60029 | 0.07882 |

Source: Author's own construct (2026).

Additionally, the study brings to the fore the descriptive statistics. Perceived ease of use (PEOU) had the highest mean score (M = 4.2114, SD = 0.41432), indicating that respondents largely agreed that an IoT system in a smart library is easy to use. A relatively low standard deviation (0.314) suggests response consistency and low response dispersion. Information technology infrastructure (IT_INF) was the third most favourable area, with a moderate-to-high mean score (M = 3.4413, SD = 0.64827), indicating generally positive

perceptions of infrastructural readiness, although responses were more varied. Policy support also had a mean of 3.3707 (M = 3.3707, SD = 0.60029), suggesting moderate institutional policy alignment in favour of IoT adoption. The moderate deviation implies a certain amount of divergence in opinions on the efficacy of policy. Reliability statistics indicate that all three constructs have mean values above the neutral benchmark of 3.00, suggesting favourable institutional conditions for IoT adoption. On the other hand, a relatively higher mean and lower variability of PEOU suggest that ease of use is perceived as stronger and more consistent than infrastructural and policy dimensions. The PEOU construct has the strongest effect, followed by policy support and IT infrastructure. The size or magnitude of these effect sizes suggests that all three constructs have a positive practical significance when compared to neutral (3). In all, the findings indicate that several interrelated factors determine the success of IoT adoption in library management. Consequently, perceived ease of use, IT infrastructure, and the policy framework can be seen as interdependent elements of IoT adoption rather than independent requirements for it. The findings provide evidence of respondents' perceptions of the conditions; nevertheless, they cannot be interpreted as consensus evidence of the institution's readiness within the educational institution investigated in Ghana.

In Table 4, a one-sample *t*-test was applied, with Neutral (3) as the reference category. All three variables were above the Neutral category, and there were statistically significant differences among them. Perceived ease of use (mean = 4.211, SD = 0.414) had the highest value of the three, with t (10) = 9.697, $p < 0.001$; the effect size was very large (d = 2.924, 95% CI (1.519, 4.305)). IT infrastructure (mean = 3.441, SD = 0.648) and policy framework (mean = 3.371, SD = 0.600) also were significantly different from neutrality, where t (46) = 4.667, $p < 0.001$: effect size is small to medium (d = 0.681, 95% CI (0.360, 0.996)); and t (57) = 4.703, $p < 0.001$: effect size is small.

The study used inferential statistical methods to investigate differences among groups of variables in relation to the research questions (rather than formal hypotheses). More specifically, analysis of variance (ANOVA) was used to test for statistically significant differences among groups and within groups on the variables examined.

A one-way ANOVA was performed to determine whether the study groups differed significantly on the key constructs. Examples of the constructs are IT infrastructure (AVG_IT_INFRAST), perceived ease of use (AVG_PEOU), and policy framework (AVG_POLICY). Results of ANOVA are shown in Tables 7 and 8. The statistical summary of these relationships is contained in Table 7. As shown by the ANOVA, there are no statistically significant differences between the two groups across the three constructs: AVG_IT_INFRAST, AVG_PEOU, and AVG_POLICY. The results for IT infrastructure showed F = 0.094 and $p = 0.761$, indicating that perceptions of sufficient IT infrastructure do not differ between the groups, as the null hypothesis cannot be rejected ($p > 0.05$). In the same way, F = 0.001 and $p = 0.972$ for PEOU also indicated no significant difference between the two groups' views on the system's usability. Lastly, according to policy framework, F = 0.211 and $p = 0.648$ show that the respondents share the same opinion on whether policy frameworks influence the adoption and implementation of the systems mentioned. Again, as shown in the second ANOVA table in Table 8, there are no statistically significant group differences across all constructs. Similarly, the next section on IT infrastructure shows F = 1.191 and $p = 0.329$, indicating that parties from different groups have relatively equal perceptions of the provision of technological infrastructure. Similarly, we did not detect any differences between groups on perceived ease of use (F = 0.453, $p = 0.518$), indicating equivalence in perceptions of how easy it would be to use the technology. Finally, the same can be said for the policy framework analysis, which shows no noteworthy differences in F (0.235) and *p* (0.917), indicating consensus among groups on policy factors.

**Table 7.** Variance by gender.

| Construct | | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| AVG_IT_INFRAST | Between Groups | 0.040 | 1 | 0.040 | 0.094 | 0.761 |
| | Within Groups | 19.292 | 45 | 0.429 | | |
| | Total | 19.332 | 46 | | | |
| AVG_PEOU | Between Groups | 0.000 | 1 | 0.000 | 0.001 | 0.972 |
| | Within Groups | 1.716 | 9 | 0.191 | | |
| | Total | 1.717 | 10 | | | |
| AVG_POLICY | Between Groups | 0.077 | 1 | 0.077 | 0.211 | 0.648 |
| | Within Groups | 20.463 | 56 | 0.365 | | |
| | Total | 20.540 | 57 | | | |

Source: Author's own construct (2026).

**Table 8.** Variance by age.

| Construct | | Sum of Squares | df | Mean Square | F | Sig |
|---|---|---|---|---|---|---|
| AVG_IT_INFRAST | Between Groups | 1.969 | 4 | 0.492 | 1.191 | 0.329 |
| | Within Groups | 17.363 | 42 | 0.413 | | |
| | Total | 19.332 | 46 | | | |
| AVG_PEOU | Between Groups | 0.082 | 1 | 0.082 | 0.453 | 0.518 |
| | Within Groups | 1.634 | 9 | 0.182 | | |
| | Total | 1.717 | 10 | | | |
| AVG_POLICY | Between Groups | 0.358 | 4 | 0.090 | 0.235 | 0.917 |
| | Within Groups | 20.182 | 53 | 0.381 | | |
| | Total | 20.540 | 57 | | | |

Source: Author's own construct (2026).

The findings emphasise that there are no significant differences in perceptions of IT infrastructure, perceived ease of use, and the policy framework across the sampled population, indicating homogeneity of institutional and technological environments. The results also indicate the technology adoption drivers important to peers, which are consistent across demographics and organisations.

Further, the one-sample statistics in Table 5a indicated that 58 valid respondents were included in the analysis of the policy framework construct. The construct recorded a mean of 3.3707 (SD = 0.60029), indicating that respondents agreed that policy-related factors support the future adoption of IoT technology in library management. Similarly, the perceived ease of use construct was analysed using responses from 11 library staff members. The mean score of 4.2114 (SD = 0.41432) indicates a favourable perception of the ease of use of future IoT-adoption library systems.

Table 5b presents the descriptive statistics for the study constructs categorised by respondent group. The analysis was performed independently for IT staff and library staff to account for their distinct responsibilities. The assessment of PEOU was conducted exclusively among library staff, as the construct relates to the usability of library services. The IT infrastructure assessment was conducted exclusively among IT staff because they are accountable for the technological framework. The policy framework was evaluated among both respondent groups to analyse institutional governance and policy support

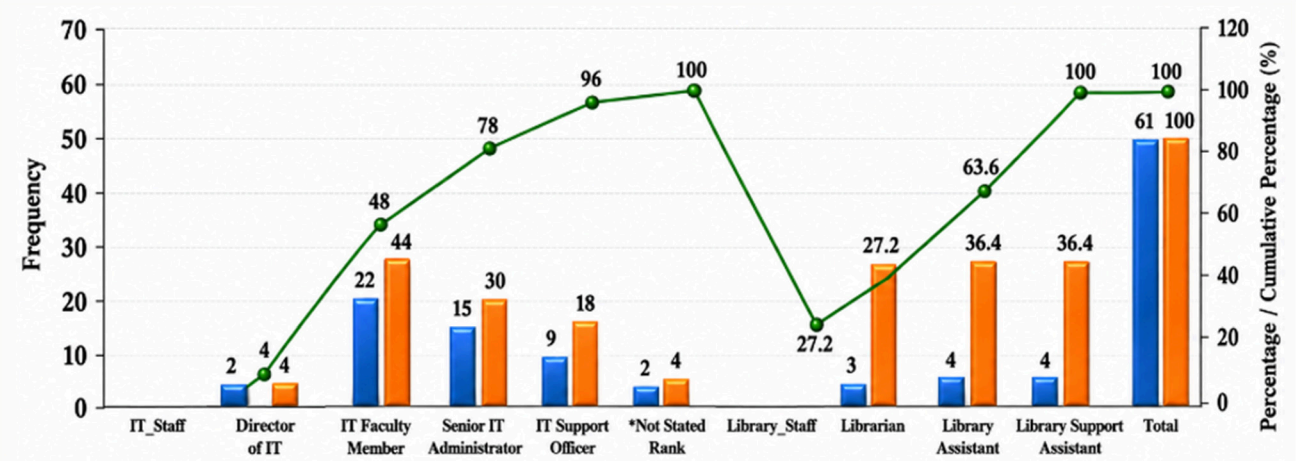
for future IoT adoption. The mean and standard deviation for each construct reflect the respondents' overall perceptions in their respective areas of responsibility.

Figure 3 shows the age distribution of respondents. The respondents in the study include five age groups: less than 20 years, 20–30 years, 31–40 years, 41–50 years, and more than 50 years. The highest number of respondents in the study was in the 41–50 years group (n = 29), followed by the 31–40 years group (n = 18), while the rest of the respondents were as follows: 20–30 years (n = 6), more than 50 years (n = 6), and less than 20 years (n = 2).

Analysis of the respondents' age group showed that most were in the IT staff group. That is, there were 23 IT staff members aged 41–50 years, 13 aged 31–40 years, 6 aged 20–30 years, 6 aged more than 50 years, and 2 aged less than 20 years. On the other hand, library staff were represented only in the 31–40 years (n = 5) and 41–50 years (n = 6) age groups, with no representation in the less than 20 years, 20–30 years, or more than 50 years' age groups.

From the above age distribution, it can be seen that the study sample is predominantly middle-aged, comprising staff aged 31–50 years. That means that the study's results reflect the perspective of people with extensive experience dealing with institutional matters. Therefore, the respondents in this age bracket will provide an insightful opinion into the readiness of institutions to adopt IoT technology in library management in the future.

Table 1 presents the one-sample effect sizes for perceived ease of use, policy framework, and IT infrastructure. The reported effect sizes are mostly moderate and slightly positive, suggesting that a coherent model exists in which institutional factors are related to IoT adoption and perceptions of ease of use through technological enablers. Moreover, important relationships between the constructs reveal that PEOU and policy framework have a moderately positive association; environments with a more transparent policy framework seem to correspond to higher perceived ease. The association is consistent with the idea that policy clarity reduces ambiguity and the motivational effort required [35–37]. The policy framework also had a significantly positive relationship, indicating that governance and institutional readiness would facilitate diffusion. Albeit cross-country, IT infrastructure reflects the intuition that technical capacity underpins adoption. The policy framework and IT infrastructure also have a positive relationship, as the findings suggest a strong interrelationship between policy governance and IT infrastructure readiness. While governance provides the strategic direction, policies, and institutional support for IoT adoption, infrastructure readiness provides the technological capacity required for implementation. Together, these factors create an enabling environment for future IoT adoption in library management, as shown by the one-sample test (Table 6). Similarly, Figure 4 illustrates the staff distribution of the respondents across IT and library-related roles. The distribution provides perspectives from personnel with varying levels of involvement in IT and library operations, which are relevant to understanding perceptions of IoT adoption in library management.




| | IT_Staff | Director of IT | IT Faculty Member | Senior IT Administrator | IT Support Officer | *Not Stated Rank | Library_Staff | Librarian | Library Assistant | Library Support Assistant | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (N = 61) | – | 2 | 22 | 15 | 9 | 2 | – | 3 | 4 | 4 | 61 |
| Percent (%) | – | 4 | 44 | 30 | 18 | 4 | – | 27.2 | 36.4 | 36.4 | 100 |
| Cumulative Percent (%) | – | 4 | 48 | 78 | 96 | 100 | – | 27.2 | 63.6 | 100 | 100 |

**Figure 4.** Combined IT and library Staff summary. Source: Author's own construct (2026). * is the respondent who declined to disclose their rank.

### *4.3. Quantitative Findings*

#### 4.3.1. Interpretations

The results offer valuable insights into how academic libraries at various levels of framework development perceive IoT adoption through digital transformation. The far higher reliability levels of perceived ease of use and the policy framework indicate that the institution's library has an organised digital transformation framework, supported by solid infrastructure and staff preparedness. The finding aligns with prior research showing that for the IoT adoption to be successful, both structural (infrastructure) and human factors (digital competencies) need to co-evolve [35–38].

#### 4.3.2. Construct Frequency with Acceptance Level

The study explored the digital transformation tools that institutional library, IT and faculty staff at the educational institution used to enhance an IoT adoption framework for library management in educational institution.

#### 4.3.3. Qualitative Themes

The qualitative themes derived from the interview and supporting documents complement the quantitative findings by illustrating how institutional structures, governance processes, and contextual realities shape the readiness and feasibility of IoT adoption in library management. The findings reinforce the conceptual framework's constructs: (1) institutional readiness, (2) IT infrastructure (3) policy framework, regulatory preparedness, and (4) perceived ease of use. This highlights areas that require strategic emphasis for sustainable IoT deployment.

#### 4.3.4. Institutional Readiness and Leadership Commitment

The interview data reveals strong executive leadership commitment to digital transformation, with the Vice-Chancellor promoting a technology-oriented mandate. This confirms

the literature noting that top-management support is a critical determinant of technology adoption in higher education and IoT-enabling environments [1,15]. Institutional support raises perceived usefulness and reduces perceived risk, core antecedents in the TAM [14]. Similarly, studies grounded in DOI theory emphasise that leadership endorsement positively shapes perceptions of relative advantage and institutional legitimacy [13].

The participants' note that leadership is "totally committed" aligns with recent evidence showing that institutional vision directly facilitates resource mobilisation and technology culture formation [6]. However, this readiness is constrained by operational gaps. Although leadership is supportive, the absence of requisite infrastructure or financial resourcing slows real implementation. This pattern is widely reflected in the literature on technological transformation in African higher education contexts, where policy aspirations often outpace infrastructural capabilities [2,12].

#### 4.3.5. IT Infrastructure

Transitioning from information and communication technology (ICT) to the Internet of Things (IoT), the interview revealed that the institution's infrastructure was primarily centred on computers and internet connectivity, with limited deployment of IoT-specific technologies such as RFID systems, smart shelves, beacons, and sensor-enabled environments. This finding suggests that the institution remains at an ICT-focused stage of digital development rather than an IoT-enabled environment. This is consistent with Shahzad et al. [6], who argue that libraries often achieve ICT maturity long before attaining IoT maturity. The participant further observed that the institution "*has not moved beyond computing devices to any other IoT devices*", which illustrates this gap.

Moreover, ANOVA results indicated no statistically significant differences among the respondent groups regarding IT infrastructure. There were no significant differences in perceived ease of use and policy framework because all $p$-values were above 0.05. These outcomes indicate general agreement among respondents on the role of the constructs in determining future IoT adoption. It is known that IoT adoption depends on the presence of required infrastructure, a sensor network, interoperability, and a budget for its maintenance [1,8]. Ineffective IT infrastructure leads to a high perceived complexity of the process, which is considered an inhibitor according to the Technology Acceptance Model and Diffusion of Innovation model and negatively influences perceived ease of use [14]. Therefore, the findings of the study corroborate previous research and indicate that IT infrastructure is an important determinant or factor of IoT adoption [3,5], although the lack of significant differences among respondents' views can be interpreted as contextual validation of the propositions suggested by the TAM, UTAUT, and DOI models.

In contrast, UTAUT treats infrastructure as a unified construct, implying that respondents experience it similarly and perceive that adequate support exists for technology use. Likewise, DOI suggests that institutional policies influence technology adoption at the institutional level and therefore tend to exhibit less variation across groups. The findings of this study indicate a shared institutional environment within the Ghanaian higher education context, where empirical evidence on institutional readiness for future IoT adoption remains limited. These findings suggest that, rather than targeting specific user groups, strategies for future IoT adoption should prioritise improvements in institutional infrastructure and enabling policy frameworks. Overall, the findings highlight the importance of institutional readiness factors that are consistently perceived across respondents and contribute context-specific evidence to the limited body of research on future IoT adoption in higher education libraries in developing countries [39].

#### 4.3.6. Policy Framework and Governance Structures

The interview and documentary evidence show how policy development emerged as a major theme. The institution has established ICT strategies, business continuity plans, disaster recovery protocols, and risk management policies, all formulated through committees and aligned with the institutional strategic plan. Research on digital transformation governance argues that alignment between institutional policy and technology enhances adoption success, reduces ambiguity, and promotes user confidence [40].

However, the qualitative evidence that policies are "not fully implemented" due to lacking infrastructure reinforces findings that implementation capacity is often the limiting factor, not policy creation itself [2]. The sequential nature policy design, stakeholder input, approval, and phased operationalisation is consistent with institutional technology governance models in higher education [41].

#### 4.3.7. Data Privacy, Security, and Regulatory Compliance

A significant portion of the interview addressed privacy and security readiness, including adherence to the Data Protection Act, strict separation of public versus private information, and the use of multi-factor authentication (MFA). The response aligns with global research indicating that privacy and security concerns are among the most significant barriers to IoT adoption in educational institutions [6,12]. The need to balance user access rights to information against privacy concerns is consistent with findings in IoT and data-governance studies that emphasise careful data-classification processes and policy safeguards [5]. From a theoretical standpoint, trust and perceived security are recognised as mediators that influence behavioural intention in TAM and IoT adoption models [14]. Thus, the institution's emphasis on MFA and privacy measures enhances user trust and reduces perceived risks, improving perceived ease of use and the likelihood of acceptance.

#### 4.3.8. User Exposure, BYOD Policies and Perceived Ease of Use

The interview highlighted the institution's immediate focus on Bring Your Own Device (BYOD) to support access while IoT-specific deployment remains in progress. BYOD strategies are widely recognised for increasing participation, system familiarity, and technological self-efficacy [3,4]. Theoretical models indicate that increased exposure improves perceived ease of use, a core TAM determinant [13]. However, research also warns that BYOD intensifies cybersecurity risks if institutional networks and authentication systems are not robust [12]. The institution's use of MFA demonstrates alignment with recommended security practices.

### *4.4. Qualitative Data Synthesis*

The qualitative results, based on interview data and supported by document analysis, provided greater insight into institutional readiness for future IoT adoption in library management. It became clear that institutional readiness is driven by the leadership's commitment to digital transformation and ongoing staff capacity development, as outlined in the institution's ICT strategic plan. At the same time, the participant pointed out that the rate of adoption will depend on the availability of financial and technological resources.

Concerning the policy framework, it became clear from the interview that the institution had put in place policies concerning ICT, information security, and training of employees, thus marking the beginning of digital transformation. Additionally, documents showed that such policies were consistent with the institution's goals and needed to be updated due to emerging IoT technologies.

Regarding IT infrastructure, both interview data and document analysis showed that the institution had a basic technological platform that could sustain the deployment of IoT

in the future. However, limited computing capacity, non-deployment of IoT technologies, and reliance on BYOD currently demonstrate a piecemeal approach to IoT implementation. This means that, to be ready for IoT deployment, additional investment in IoT infrastructure would be required, in addition to traditional computing facilities.

Further, one cannot ignore the importance of regulatory bodies' readiness. The executive emphasised that compliance with higher education regulations, the institution's ICT governance, and data protection law was important for the successful introduction of digital transformation technologies. This position was confirmed by the institution's policy document, which demonstrated compliance with the Data Protection Act and other applicable laws.

Finally, the evidence indicated that the perceived ease of use was an important variable in the deployment of IoT systems. The participant noted that any future IoT adoption would need to be user-friendly and easy to use, and that regular user training programs would need to be considered. In addition, policies related to the training of ICT users, user guidelines, and security issues such as multi-factor authentication also have to be taken into account. However, there is also the view that the ease of use is dependent on user familiarity with the IoT technologies. All in all, combining interview and documentary evidence has improved the reliability of the study's qualitative findings. The findings indicate that several factors will determine an institution's ability to embrace IoT in the future.

Figure 5 also shows a distribution of responses regarding the adoption of IoT in library management, reflecting a strongly positive stance: the majority (57.23%) agree with the statement. The high percentage reflects a positive institutional disposition, unlike the qualitative data, which has focused on the preparedness and willingness of the institutions and the readiness of the leadership to adopt digital transformation, driven by strong endorsement of the technology by top management [6,8]. Nonetheless, it is important to note that several respondents with neutral or negative attitudes point to infrastructure and resource constraints, as the IoT adoption environment is still in its initial stage [5,6,8]. Although the adoption of IoT technologies is not yet widespread, it has occurred gradually. It has also revealed the importance of appropriate policies and data protection practices in forming user attitudes toward the IoT.

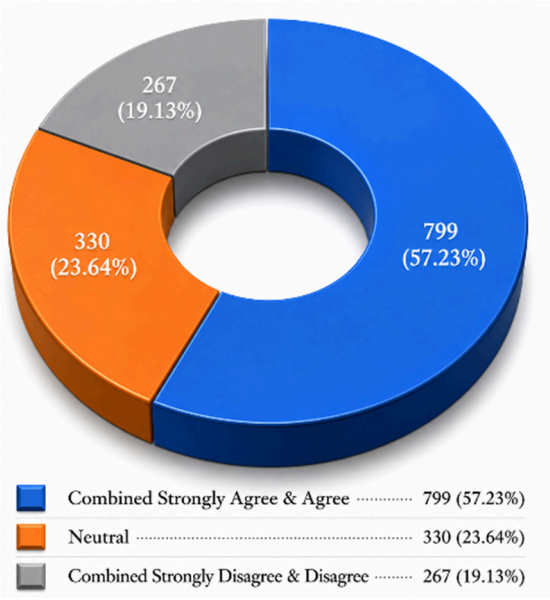



**Figure 5.** Aggregated constructs frequency with percentage level. Source: Author's own construct (2026).

### *4.5. Conceptual Framework*

Figure 6 shows the various constructs or variables within the conceptual framework of IoT adoption in library management. It is important to note that the study draws on the Technology Acceptance Model (TAM) and institutional readiness theories to develop a conceptual framework for IoT adoption in library management [13,14]. The framework focuses on five key constructs: institutional readiness, policy framework, IT infrastructure, regulatory body readiness, and perceived ease of use. On a positive note, it indicates that the perceived ease of use of IoT systems in library management is also driven by institutional readiness, a relevant policy framework, appropriate IT infrastructure, and regulatory body preparedness [8,15]. The framework relates to the aim of this study and motivates an empirical analysis and validation [18].

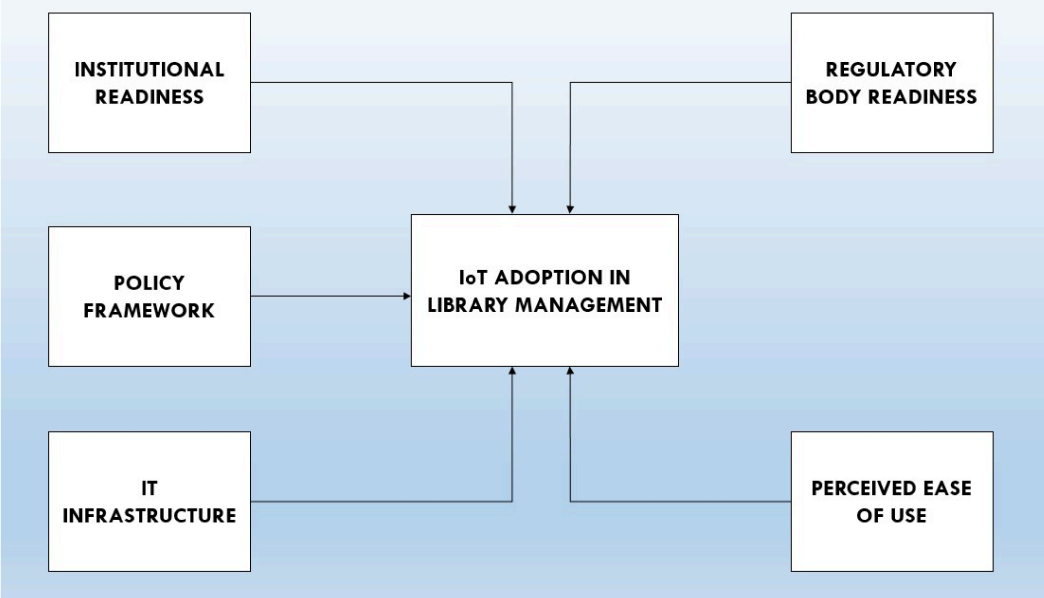



**Figure 6.** Proposed conceptual framework. Source: Author's own construct (2026).

## 5. Limitations and Future Research

This study is limited by methodological and contextual constraints that should be acknowledged when interpreting the findings. First, the qualitative insights were drawn from a relatively small number of participants within a single higher education institution in Ghana, which may restrict the transferability of the findings to other institutional contexts with different governance structures, resource levels, or regulatory environments. Second, while the mixed-methods design strengthened triangulation, the quantitative sample dominated by IT staff may introduce occupational bias and underrepresent the experiences of other key stakeholders such as students, entire institutional faculties, and external regulatory actors. Third, three institutional executives were invited to participate in the interview process, and only one agreed. Therefore, the qualitative data collected from the interviews represent the opinion of one institutional executive. However, the individual executive participated actively and held an executive position at the institution, making the qualitative data relevant to the study. In addition, qualitative data were validated through analysis of documents provided by the institution, thereby enhancing the validity of the data gathered, as shown in Table 9. Furthermore, the validation of the institutional readiness for future IoT adoption framework was conducted within a developing-country setting where infrastructural limitations, bandwidth constraints, and budgetary pressures shape technology decisions, potentially narrowing its generalisability to institutions with

more advanced IoT ecosystems. Finally, the qualitative findings were interpreted as context-specific and complementary to the quantitative results rather than as broadly generalisable.

**Table 9.** Evidence from executive interview and documentary analysis on institutional readiness factors.

| Institutional Readiness Factor | Documentary Evidence |
|---|---|
| Institutional Readiness | ICT Strategic Plan |
| Policy Framework | ICT Policy; Information Security Policy, and Staff Development Policy |
| IT Infrastructure | ICT Infrastructure Plan |
| Perceived Ease of Use | User Guidelines; ICT Training Policies |
| Regulatory Body Readiness | National ICT Policies; Regulatory Guidelines; Institutional Compliance Documents |

Note: Table 9 presents qualitative findings from a semi-structured interview with one purposively selected executive member, corroborated by analysis of institutional documents. The table demonstrates the qualitative validation of the institutional readiness factors identified in the quantitative phase. Source: Author's own construct (2026).

## 6. Conclusions and Recommendation

This study explored the factors of institutional readiness for the adoption of IoT technologies in the future management of libraries in a higher educational institution in Ghana, using a mixed-methods research approach. Based on the quantitative results, institutional readiness is not solely about information technology infrastructure; it also involves governance, policies, regulations, adequate IT infrastructure, and a favourable user attitude towards emerging technologies within the context. Similarly, qualitative findings indicate the need for strategic leadership, institutional commitment, and documentation to foster digital transformation. In summary, the study concludes that the concept of institutional readiness is multi-dimensional and influenced by institutional capability and changing regulations, among other factors. Furthermore, the findings clearly indicate that a well-designed mixed-methods strategy, supported by well-crafted, unbiased data instruments aligned with the study objectives, is required to obtain credible and relevant insights into opinions, experiences, and institutional readiness to adopt IoT in future library management. Thus, the study contributes to contextual knowledge of the strengths that higher education institutions need to develop to increase their readiness for IoT adoption in the future.

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**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data will be made available upon request.

**Acknowledgments:** The authors confirm that they authored the content of this manuscript and take full responsibility for it.

**Conflicts of Interest:** The authors declare no conflicts of interest.

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