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Exploring the Landscape: A Survey of ChatGPT Implementation in University Libraries of Khyber Pakhtunkhwa, Pakistan.

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Abstract

Objective: This study examines the utilization of ChatGPT by university librarians at public sector universities in Khyber Pakhtunkhwa, Pakistan.

Approach: The researchers utilized survey methods and implemented a Smart Partial Least Square (PLS) measuring model. The research included a sample of 80 individuals working in libraries who were assessed using likert scales that were based on the Technology Acceptance Model (TAM).

Results: The results emphasize the critical importance of how easy and useful librarians believe ChatGPT to be in influencing their views towards adopting it. The study identified effective implementation tactics that increased librarians' readiness to utilize ChatGPT.

Conclusion: The study emphasizes the importance of user-friendly interfaces, clear communication of benefits, proactive obstacle resolution, and strategic planning for successful ChatGPT adoption in university libraries. It draws on theoretical frameworks from prior research

on technology adoption in libraries to offer valuable insights into effective adoption processes and techniques.

Keywords: University Libraries, ChatGPT, Librarians, Khyber Pakhtunkhwa, Technology Acceptance Model.

1. Introduction

University libraries play a critical role in supporting scholarly investigations and satisfying the informational requirements of staff and students. (Cook, 2020). These institutions are not merely repositories of books and journals but dynamic hubs that foster intellectual growth, innovation, and scholarship within the academic community (Mensah & Boateng, 2024). Through their extensive collections, including print and electronic resources, university libraries offer a vast array of scholarly materials spanning various disciplines, ensuring access to up-to-date information and research findings. In addition, they offer important services like reference help, interlibrary loan programs, and information literacy classes that make it easier for people to find their way around the complicated world of scholarly research (Mehta & Wang, 2020). In addition, these libraries are very important for keeping cultural artifacts and archival materials safe for future generations (Aboyade, Ndubuisi-Okoh, Okoche, & Oladokun, 2024). In general, university libraries function as essential centers for the dissemination of knowledge, provision of academic assistance, and stimulation of intellectual thought within the realm of education (Beutelspacher & Meschede, 2020).

University Libraries and Artificial Intelligence (AI)

Over the past few years, university libraries have exhibited a noticeable trend toward incorporating artificial intelligence (AI) technologies, with the intention of transforming conventional library services and support mechanisms (Collins, Dennehy, Conboy, & Mikalef, 2021). AI offers a plethora of innovative solutions that can streamline library operations, improve user experiences, and optimize resource allocation (Ali, Naeem, & Bhatti, 2020). The implementation of natural language processing (NLP) algorithms to power virtual assistants and avatars is a noteworthy instance of AI in action within libraries (Y. Zhang, Wu, Tian, Zhang, & Lu, 2021). These AI-driven interfaces enable users to access information, locate resources, and receive personalized assistance in real-time, thereby enhancing the efficiency and accessibility of library services (Omame & Alex-Nmecha, 2020). Furthermore, recommendation systems that are propelled by artificial intelligence have surfaced as valuable instruments for providing users with customized content suggestions that are informed by their browsing history, preferences, and research interests (Gujral, Shivarama, & Choukimath, 2019). Additionally, in order to optimize library personnel's time for more intricate and value-added endeavors, AI technologies enable the automation of mundane responsibilities including cataloguing, metadata administration, and information retrieval (Ajakaye, 2022). Overall, the increasing interest in AI adoption reflects a broader trend towards leveraging technological innovations to modernize library operations, adapt to evolving user needs, and foster a culture of innovation within academic institutions (Verma & Gupta, 2022).

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ChatGPT

ChatGPT, an avant-garde conversational artificial intelligence model created by OpenAI, has attracted considerable interest on account of its broad range of applications, which encompass customer service and education, among others (Chen, Xie, Zou, & Hwang, 2020). ChatGPT, an advanced language generation model, utilizes cutting-edge deep learning techniques to produce responses to text inputs that resemble those of humans. This functionality empowers users to engage in natural and captivating conversations (Adıgüzel, Kaya, & Cansu, 2023). Regarding the domain of education, ChatGPT holds immense promise for enhancing learning experiences through personalized tutoring, interactive study aids, and virtual classroom assistants (Adeshola & Adepoju, 2023). ChatGPT facilitates a more interactive and adaptable learning environment by replicating human interaction and effectively responding to inquiries, adapting learning materials to accommodate individual learning styles, and providing students with immediate feedback (Lo, 2023). Furthermore, in the realm of customer service, ChatGPT offers businesses and organizations an efficient and scalable solution for addressing customer inquiries, resolving issues, and delivering personalized assistance (Sharma & Yadav, 2022). By automating routine interactions and handling customer queries in real-time, ChatGPT can improve service efficiency, enhance customer satisfaction, and reduce operational costs (Sullivan, Kelly, & McLaughlan, 2023). Overall, the widespread adoption of ChatGPT underscores its transformative potential in revolutionizing communication, learning, and service delivery across diverse sectors, heralding a new era of AI-driven innovation and automation (Grassini, 2023).

Khyber Pakhtunkhwa, a province in Pakistan, hosts 32 public sector universities and degree-awarding institutes. These institutions offer diverse academic programs and research opportunities, playing a key role in the region's educational landscape. Known for their commitment to excellence in education, research, and innovation, they significantly contribute to the intellectual and socio-economic development of both the province and the country.

Universities and Degree Awarded Institute Libraries in Khyber Pakhtunkhwa

University libraries in Khyber Pakhtunkhwa are essential components of these academic establishments, granting access to a vast assortment of learning materials, journals, books, and electronic resources for the benefit of students, faculty, and researchers (Hussain & Jan, 2021). These libraries are not only spaces for studying and research but also hubs of knowledge dissemination and scholarly collaboration. They offer modern facilities, including digital libraries, computer labs, and online databases, ensuring that students have access to up-to-date information and resources to support their academic pursuits (Mr, 2020). Moreover, the university libraries in Khyber Pakhtunkhwa actively promote a culture of reading, critical thinking, and lifelong learning among students and faculty members (Ur Rahman, Idrees, & Khan, 2016). They organize workshops, seminars, and other educational activities to enhance information literacy skills and foster a deeper understanding of various subjects. Additionally, these libraries serve as centers for cultural and intellectual exchange, hosting events, exhibitions, and lectures that contribute to the academic and cultural vibrancy of the university communities and the wider society (Bahader, Naveed, Jan, Jan, & Hussain, 2022).

In conclusion, Integrating ChatGPT with university library services in Khyber Pakhtunkhwa's 32 public sector universities can revolutionize library outreach. By serving as a virtual assistant on library websites, ChatGPT can offer personalized assistance, guide users to resources, answer queries, and facilitate virtual reference services and tutorials. This integration facilitates the promotion of self-service options, enhances the user experience, and cultivates a culture that values academic achievement and continuous learning among faculty, students, and researchers.

2. Research Objectives

1. *Assess the level of acceptance and perception that university librarians have of ChatGPT technology.*
2. *To investigate ChatGPT's implementation procedure from a librarian's point of view in university library systems.*
3. *To determine the difficulties university librarians had when incorporating ChatGPT into the operations and services of their libraries.*
4. *To investigate practical methods for resolving issues and improving ChatGPT implementation efficacy in university library settings, with an emphasis on librarian viewpoints.*

3. Literature Review

The use of Artificial Intelligence (AI) technology in different industries has attracted significant interest, with ChatGPT emerging as a potent tool for improving user interaction and retrieving information. This literature study examines the present state of ChatGPT application in university libraries in the Khyber Pakhtunkhwa region. It focuses on the adoption, implementation, benefits, obstacles, and successful solutions for addressing these challenges.

3.1 Acceptance of AI and ChatGPT Technology

The adoption of artificial intelligence (AI) technologies, such as ChatGPT, within the context of university libraries necessitates an understanding of the underlying factors influencing technology acceptance among librarians (Yusuf, Adebayo, Bello, & Kayode, 2022). To address this, a comprehensive overview of technology acceptance models (TAMs) is essential. TAMs provide theoretical frameworks for examining users' perceptions and attitudes towards new technologies, thereby offering insights into their adoption and utilization (Rondan-Cataluña, Arenas-Gaitán, & Ramírez-Correa, 2015). The Technology Acceptance Model (TAM), introduced by Davis in the 1980s, is a highly utilized framework. It suggests that users' intention to use a technology is influenced by their perception of its usefulness and simplicity of use (Zaineldeen, Hongbo, Koffi, & Hassan, 2020). Expanding on the Technology Acceptance Model (TAM), later models like the Unified Theory of Acceptance and Use of Technology (UTAUT) have incorporated supplementary elements such as social impact and facilitating situations to improve their explanatory capability (Abbad, 2021). Within the realm of AI implementation in university libraries, these models function as helpful instruments for clarifying the aspects that impact librarians' acceptance and utilization of ChatGPT (Sallam et al., 2023). TAMs provide a detailed understanding of the difficulties and possibilities related to the adoption of AI in

academic library settings by analyzing elements such as perceived utility, convenience of use, and other important considerations (Teerawongsathorn, 2023). This review of Technology Acceptance Models (TAMs) will enhance the examination of librarians' attitudes and behaviors towards the adoption of ChatGPT. Consequently, it will contribute to a comprehensive comprehension of technology acceptance in the specific setting of university libraries.

Numerous studies have delved into the factors influencing technology acceptance among university librarians, shedding light on the complexities inherent in the adoption process (Gamal & Salah, 2023). These investigations have identified various determinants that shape librarians' attitudes and behaviors towards new technologies, including AI systems like ChatGPT (Ma et al., 2024). When librarians decide what technology to use, things like how useful they think it is, how easy they think it is to use, how well it fits with their current workflows, how much technical support they can get, how much training they can get, their organization's culture, and how dangerous they think it is have become very important (Rafique, Almagrabi, Shamim, Anwar, & Bashir, 2020). For example, research by Jang, Ko, Shin, and Han (2021) Emphasized the significance of organizational assistance and resources in promoting the adoption of technology among university librarians. Similarly, studies by Sohn and Kwon (2020) emphasized the role of perceived usefulness and ease of use in shaping librarians' attitudes towards AI technologies in library settings. Moreover, investigations by Vahdat, Alizadeh, Quach, and Hamelin (2021) underscored the impact of training programs and professional development opportunities in enhancing librarians' readiness to embrace new technologies. These studies collectively offer useful insights into the complex nature of technology acceptance among university librarians. They provide guidelines for effectively integrating AI systems such as ChatGPT into library environments.

The literature on librarians' attitudes and perceptions towards AI technologies offers valuable insights into the complexities surrounding the adoption of innovative systems like ChatGPT within library environments. Studies have explored various aspects of librarians' attitudes, including their perceptions of AI's potential benefits, concerns about its implications, and readiness for integration. For instance, research by (Binyamin, Rutter, & Smith, 2019) revealed a generally positive attitude among librarians towards AI technologies, with many recognizing the potential for enhancing user services, automating repetitive tasks, and improving information retrieval processes. However, concerns about job displacement, ethical considerations, and privacy issues have also been documented in studies by (Aljarboa & Miah, 2020; Won, Chiu, & Byun, 2023). Additionally, investigations by (R. Wang, 2024) and (Chen et al., 2020) have highlighted the role of factors such as technological expertise, organizational culture, and institutional support in shaping librarians' perceptions of AI technologies. Furthermore, discussions on the implications of AI adoption for librarians' professional roles, skills development needs, and job satisfaction have been prominent in the literature (Amin, 2021). By synthesizing findings from these studies, this discussion provides a comprehensive understanding of librarians' attitudes and perceptions towards AI technologies, informing strategies for effective integration and support within library settings.

1.2. Deployment of ChatGPT in University Libraries

The integration of artificial intelligence (AI) in library environments has attracted considerable interest in recent years, since it has the capacity to improve user experiences and

optimize library operations (Harisanty, Anna, Putri, Firdaus, & Noor Azizi, 2023). Multiple research studies have investigated the incorporation of artificial intelligence (AI) technologies, including natural language processing (NLP), machine learning (ML), and chatbots, in libraries. The objective is to enhance the retrieval of information, automate repetitive processes, and offer customized services to library users (Kim, 2017; Wheatley & Hervieux, 2019). Researchers have investigated the impact of AI on user satisfaction, information accessibility, and operational efficiency within library environments, highlighting the benefits and challenges associated with adopting AI-driven solutions (Gasparini & Kautonen, 2022).

Multiple case studies and examples demonstrate the effective implementation of ChatGPT, an artificial intelligence-powered conversational model, in academic libraries. Organizations have employed ChatGPT to create virtual assistants that can respond to inquiries, aid with research, suggest resources, and provide round-the-clock support to library patrons (Ylipulli & Luusua, 2019). These installations showcase the ability of ChatGPT to improve the user experience by delivering prompt and precise responses, allowing library staff to focus on more intricate duties, and expanding library services beyond conventional operation hours (Panda & Chakravarty, 2022). Moreover, the integration of ChatGPT in academic libraries has contributed to improved accessibility, increased engagement, and enhanced learning outcomes for students and researchers (Lund & Wang, 2023).

The implementation of ChatGPT systems in university libraries necessitates careful consideration of best practices and challenges to ensure successful deployment and adoption (Mali & Deshmukh, 2023). Best practices include conducting thorough needs assessments, defining clear objectives and scope for the ChatGPT system, designing user-friendly interfaces, integrating with existing library systems, and providing ongoing training and support for both users and library staff (Aithal & Aithal, 2023b).

3.2. Challenges in ChatGPT Integration with University Libraries

The integration of AI technologies in library environments presents several common challenges that institutions often encounter. These challenges include data quality and availability issues, the need for specialized technical expertise, compatibility with existing systems and workflows, concerns about data privacy and security, user acceptance and trust in AI-generated content, scalability and maintenance of AI solutions, budgetary constraints, and regulatory compliance requirements (ALİ, 2024). Addressing these challenges requires careful planning, collaboration between stakeholders, ongoing training and support for library staff, transparent communication with users, and adherence to ethical guidelines and best practices for AI implementation in library settings (Hota & Hota, 2023).

University librarians face specific challenges when implementing ChatGPT in their institutions (Ruixue et al., 2023). These challenges often include concerns about the accuracy and reliability of AI-generated responses, the ability to customize and tailor ChatGPT to meet specific user needs, integration with existing library systems and resources, user training and support, ethical considerations related to AI usage, data privacy and security measures, and the impact of AI on traditional librarian roles and responsibilities (James & Filgo, 2023). Researchers and practitioners have explored these challenges in the literature, providing insights

into strategies, best practices, and recommendations for addressing them effectively and maximizing the benefits of ChatGPT in university library environments (X. Zhang, 2023).

Several factors contribute to resistance or barriers to ChatGPT adoption among librarians in academic libraries. These factors include uncertainty about AI capabilities and limitations, concerns about job displacement or changes in job roles, lack of familiarity or comfort with AI technologies, perceived threats to user interactions and human expertise, challenges in integrating AI into existing workflows and services, technical complexities and implementation hurdles, resource constraints, and cultural or organizational resistance to change (Michel-Villarreal, Vilalta-Perdomo, Salinas-Navarro, Thierry-Aguilera, & Gerardou, 2023). Understanding these factors is essential for developing strategies to overcome resistance, build trust and confidence in AI technologies, provide adequate training and support, address ethical considerations, and foster a culture of innovation and collaboration within library teams (Panda, 2023).

3.4 Strategies for Enhancing ChatGPT Implementation

Integrating AI technologies, such as ChatGPT, into library settings poses certain obstacles that can be overcome by employing strategic approaches and following guidelines. Key strategies include fostering collaboration between librarians and AI experts to understand user needs and expectations, conducting pilot tests and usability studies to identify potential issues early on, leveraging open-source platforms and tools for cost-effective implementation, implementing robust data privacy and security measures, and establishing clear communication channels for user feedback and system improvements (Aithal & Aithal, 2023b). Additionally, creating interdisciplinary teams, providing ongoing training and professional development opportunities for library staff, and staying updated with advancements in AI technology are essential for overcoming challenges and ensuring successful integration in library environments (Aithal & Aithal, 2023a).

Librarians training and support play a crucial role in maximizing the effectiveness of ChatGPT utilization in academic libraries (Yamson, 2023). Approaches for enhancing librarians training include offering hands-on workshops and tutorials on ChatGPT functionality, providing access to training resources and documentation, facilitating peer learning and knowledge sharing among librarians, and encouraging continuous learning and experimentation with AI technologies (Ali et al., 2020). Additionally, establishing a dedicated support system with designated experts or helpdesk personnel can address technical issues, provide troubleshooting assistance, and offer guidance on best practices for using ChatGPT effectively in library services (Frederick, 2020). By investing in comprehensive training and support programs, librarians can build confidence, improve proficiency, and leverage ChatGPT to enhance user experiences and meet evolving information needs (Cox & Mazumdar, 2022).

In public sector university libraries, ChatGPT is a powerful tool that helps organize and manage data for easy access and use. This study aims to evaluate how well university librarians accept and handle ChatGPT technology, identify challenges, and find effective strategies. We will also assess the knowledge, skills, and abilities required for using this technology. The results will be valuable for university librarians, academic researchers, senior education officials, and policymakers in Khyber Pakhtunkhwa, Pakistan. Applying these findings will improve the

efficiency and effectiveness of university library services. By providing current and essential information to higher education stakeholders, we can create a better learning and research environment, contributing to the region's educational progress and knowledge sharing.

4. Methodology

The focus of this research is on survey methods. The target population consists of librarians working in public sector universities in Khyber Pakhtunkhwa. The province of Khyber Pakhtunkhwa has a total of 34 public sector universities (Sain, 2023). The study encompassed all campuses affiliated with these universities. Due of the thoroughness of the data collection, all library professionals from these universities were contacted. Irrespective of gender, rank, educational background, or experience, all library professionals from the public sector universities in Khyber Pakhtunkhwa were given an equal chance to take part in the study. Eighty (80) library professionals from these public sector universities were surveyed for data collection.

For this study, we utilized a Smart Partial Least Square (PLS) measurement model to assess the accuracy and consistency of our questionnaire, ensuring it adhered to the required criteria (Hair Jr, Sarstedt, Hopkins, & Kuppelwieser, 2014). The questionnaire we used employed five-point Likert scales, incorporating items derived from pertinent literature to assess the factors stated in the Technology Acceptance Model (TAM). We employed a singular-phase quantitative research approach to gather data from library professionals working in public sector university libraries. We utilized several techniques, including social media, personal visits, posts, and Google Docs, to disseminate the questionnaire. In order to eliminate any potential confusion among participants, we also offered support through mobile devices while they were completing the questionnaire.

4.1 Theoretical Framework

The theoretical framework is based on well-established hypotheses from the literature that have been previously utilized, examined, and recorded by researchers (Gajdzik, Grabowska, & Saniuk, 2021). The Technology Acceptance Model (TAM) is a commonly used paradigm for understanding how consumers accept and adopt modern technology or information systems. The technology acceptance model (TAM) is a conceptual framework that evaluates the perceived usefulness (PU) and perceived ease of use (PEoU) of a technology, in addition to external factors, behavioral intention, and actual system utilization (Chatterjee, Rana, Dwivedi, & Baabdullah, 2021). Davis (1989) proposed a widely-used framework for studying technology adoption. Researchers have developed and refined various theories to explain how users perceive and accept new technology in their work. These include the Theory of Reasoned Action (TRA), Combined TAM & TPB, Theory of Planned Behavior, Model of PC Utilization (MPCU), Social Cognitive Theory, Motivational Model, Information System Success Model, Innovation Diffusion Theory, and Unified Theory of Technology Acceptance and Use of Technology (UTAUT). The Technology Acceptance Model (TAM), which is grounded in the Theory of Reasoned Action, evaluates users' judgments of the utility and simplicity of an information technology system in order to ascertain their propensity to embrace the technology (Martín-García, Redolat, & Pinazo-Hernandis, 2022). Prior research that has examined behavioral goals and the utilization of information technology has commonly employed the Technology Acceptance Model (TAM) framework. It has played a crucial role in studying user adoption of

diverse technologies in various industries, such as enterprise resource planning, consumer relationship management, cloud computing, Software as a Service, and data warehousing.

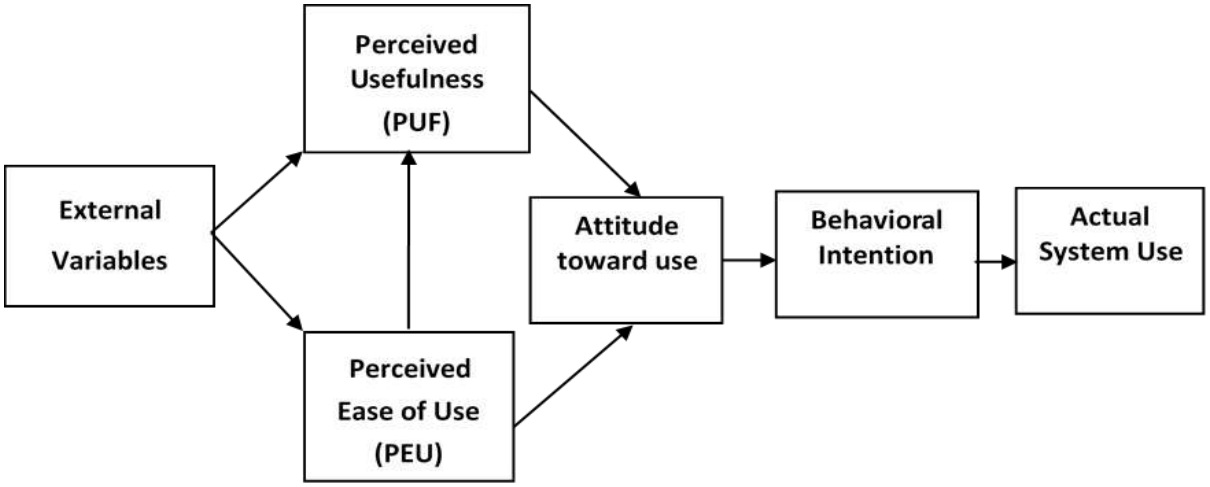


Figure: 1. Technology Acceptance Model (TAM) (Davis, 1989)

In Pakistan's Khyber Pakhtunkhwa region, which hosts numerous public sector university libraries, we targeted 32 institutions. Out of this population, we received 70 responses, which were then analyzed using SPSS version twenty-sixth and Partial Least Squares (PLS-4) software. The analysis sought to validate hypotheses and extract significant insights from the gathered data, so enhancing our comprehension of technology adoption and usage in university library environments.

4.2 Proposed framework and Hypotheses development

Based on our research objectives and the TAM by (Davis, 1989), following is a proposed framework along with corresponding factor names.

1. **Perceived Usefulness (PU):**

Evaluate the acceptance and perception of ChatGPT technology among university librarians.

2. **Perceived Ease of Use (PEoU):**

Examine the implementation process of ChatGPT within university library systems from the perspective of librarians.

3. **Perceived Challenges (PC):**

Identify challenges faced by university librarians during the integration of ChatGPT into library services and operations.

4. **Strategies for Enhancement (SE):**

Examine strategies to overcome obstacles and improve the efficiency of using ChatGPT in university library settings, with a specific emphasis on the viewpoints of librarians.

4.3 Hypotheses Development and proposed Model

4.3.1. Usefulness (PU) of ChatGPT

Y. Wang, Liu, and Tu (2021), Conducted a study on the determinants of the inclination to utilize artificial intelligence (AI) in higher education. Their special attention was on the role of perceived usefulness (PU), simplicity of use, and system quality. Their research uncovered a notable correlation between the perceived utility of AI technologies and their adoption among users in higher education environments. When individuals regard AI systems as beneficial, they are more inclined to accept and embrace them. Tran et al. (2021), Conducted an investigation into the elements that affect the inclination to utilize artificial intelligence (AI) in education, with a specific focus on perceived value, perceived risk, and perceived trust. Their research unveiled a robust and affirmative association between the perceived usefulness (PU) of AI technologies and users' propensity to utilize them in the field of education. This emphasizes the pivotal significance of perceived usefulness in the acceptance of technology among users. Hua, Petrina, Young, Cho, and Poon (2023), conducted a multi-group analysis on learners' acceptance of AI-based educational systems and found that perceived usefulness (PU) significantly influenced their acceptance, confirming the positive relationship between PU and technology acceptance. Chai et al. (2020), proposed a unified theoretical framework for investigating factors affecting university students' intention to use AI learning systems. The researchers determined that perceived usefulness (PU) plays a crucial role in influencing students' intention to utilize technology. This finding supports the premise that there is a positive association between PU and technology acceptance. Based on the literature mentioned above, the following hypothesis has been formulated.

(H1):

- *There is a significant positive relationship between perceived usefulness (PU) of ChatGPT technology and its acceptance among university librarians.*

4.3.2. Perceived ease of use (PEoU) of ChatGPT

According to Davis (1989), the Technology Acceptance Model (TAM) was created, highlighting the importance of perceived ease of use (PEoU) and perceived usefulness (PU) in the acceptance of information technology by users. The study demonstrated that when a technology exhibits user-friendliness, individuals are more inclined to embrace and implement it. This source is significant because it establishes the basis for comprehending the significance of Perceived Ease of Use (PEoU) in the acceptance of technology. It supports the premise that a greater level of PEoU of ChatGPT results in effective deployment as perceived by librarians. Venkatesh, Morris, Davis, and Davis (2003), contributed to the development of a unified view of user acceptance of information technology. They highlighted the interplay between factors like PEoU, PU, and user satisfaction in shaping technology acceptance. it underscores the role of PEoU in user acceptance, which aligns with the hypothesis that higher PEoU of ChatGPT is positively associated with successful implementation as perceived by librarians. Mahardika and Suhari (2023), investigated the impact of PEoU and PU on user satisfaction and intention to use digital library resources. They explored how these factors influence user behavior in utilizing technology resources. It demonstrates the direct influence of PEoU on user satisfaction and

intention to use technology resources, supporting the hypothesis that higher PEoU of ChatGPT contributes to successful implementation in university library systems.

Saleh, Nat, and Aqel (2022), extended the TAM model to investigate elements influencing the adoption of E-learning systems. The study included variables such as PEoU, PU, and user satisfaction to understand the adoption behavior of users.

Keeping in view the mentioned literature the subsequent hypothesis has been developed.

(H2):

- *Perceived ease of use (PEoU) of ChatGPT within university library systems is positively associated with the successful implementation process from the perspective of librarians.*

4.3.3. Perceived Challenges (PC)

The adoption of new technologies in university libraries has become increasingly important in modernizing library services and improving user experiences. One such technology gaining attention is ChatGPT, an AI-powered chatbot system that offers potential benefits in information retrieval and user interaction. Nevertheless, the effective assimilation of ChatGPT relies on multiple aspects, encompassing the perceived obstacles encountered by university librarians during its implementation. This article seeks to examine the potential negative effects of perceived obstacles on the effectiveness and acceptance of ChatGPT in university library environments. Davis (1989), introduced the Technology Acceptance Model (TAM), which highlights the importance of perceived usefulness and simplicity of use in the adoption of technology. This model presents a conceptual structure for comprehending how perceived difficulties impact the adoption of technologies, such as ChatGPT. Rogers, Singhal, and Quinlan (2014) discussed the diffusion of innovations, highlighting the role of resistance and barriers in hindering the adoption of new technologies within social systems. The challenges identified by university librarians can be viewed through this lens, illustrating their impact on the integration of ChatGPT. Venkatesh et al. (2003) consolidated various theories of technology acceptance, emphasizing the influence of perceived challenges and obstacles on user acceptance. This work provides insights into the unified view of technology adoption, reinforcing the importance of addressing challenges in implementing ChatGPT. Sari, Adelia, Yusmini, and Nurofik (2023) conducted a study on perceived usefulness and ease of use in technology adoption, which resonates with the challenges faced by university librarians in integrating ChatGPT. Their findings support the hypothesis that perceived challenges can affect the perceived usefulness of ChatGPT. Ahmad et al. (2023) reviewed challenges in adopting new technologies in academic libraries, shedding light on the specific hurdles that may impact the successful integration of ChatGPT in university library environments.

Based on the literature reviewed, it is hypothesized that the perceived challenges (PC) faced by university librarians during the integration of ChatGPT into library services and operations negatively impact its effectiveness and acceptance. This hypothesis underscores the

importance of addressing these challenges to enhance the successful implementation of ChatGPT in university libraries.

(H3):

- *The perceived challenges (PC) faced by university librarians during the integration of ChatGPT into library services and operations negatively impact its effectiveness and acceptance.*

4.3.4. Effective Strategies (ES)

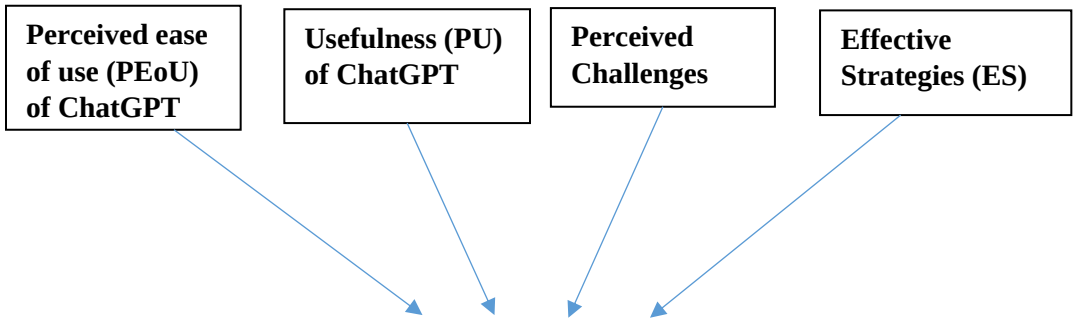
The successful integration of ChatGPT in university library environments hinges on not only addressing challenges but also implementing effective strategies (ES) to optimize its acceptance and effectiveness as perceived by librarians.

Rogers' theory of diffusion of innovations remains relevant, emphasizing the pivotal role of implementation strategies in fostering the adoption of new technologies like ChatGPT. By employing strategies that address challenges, librarians can facilitate smoother adoption and acceptance (Rogers et al., 2014). Dongbo, Miniaoui, Fen, Althubiti, and Alsenani (2023) focused on library chatbots, providing insights into implementation strategies and challenges faced by librarians. It emphasizes the need for tailored strategies to enhance chatbot acceptance, including ChatGPT. Abidi, S. (2023). C. Wang et al. (2023) Exploring the Role of Implementation Strategies in Library Technology Adoption. This study explores implementation strategies in library technology adoption, shedding light on effective approaches to address challenges and improve technology acceptance. The findings are applicable to ChatGPT implementation in university libraries. Borgohain, Bhardwaj, and Verma (2024) Offers a framework for implementing AI chatbots in libraries, including strategies for overcoming challenges. It provides practical insights into enhancing ChatGPT implementation and acceptance.

Drawing from recent literature, it is hypothesized that implementation strategies (SE) aimed at addressing challenges and enhancing ChatGPT implementation in university library environments positively influence its acceptance and effectiveness as perceived by librarians. This hypothesis underscores the significance of tailored strategies in optimizing ChatGPT integration and user satisfaction within library settings.

(H4):

- *Implementation effective strategies (ES) aimed at addressing challenges and enhancing ChatGPT implementation in university library environments positively influence its acceptance and effectiveness as perceived by librarians.*



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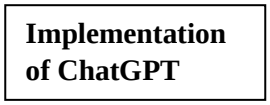

Figure 2. Proposed Model

5. Results

5.1. Demographic Information

There are total 34 public sector universities and degree awarded institutes in the province of Khyber Pakhtunkhwa, Pakistan (Rehman, Khan, & Akhtar, 2024) (see annexure –I). Total number of library professionals in these universities are 80, whose demographic information are as follow.

The demographic information table 01 offers a thorough summary of the library staff's composition, including their positions/designations, professional experience, and gender distribution. Within the staff, Chief Librarians account for 4.286% (3 individuals) and Associate Librarians represent 2.858% (2 individuals) of the total. The Deputy Librarians make up the largest portion, accounting for 21.428% (15 individuals), followed closely by the Assistant Librarians at 50% (35 individuals), and the Cataloguers/Classifiers also at 21.428% (15 individuals). Regarding professional experience, a substantial proportion of the staff consists of individuals with 6-10 years of experience, accounting for 35.7142% (25 individuals). This is followed by individuals with 11-15 years of experience, making up 34.2857% (24 individuals), and those with up to 5 years of experience at 15.7142% (11 individuals). The distribution also consists of 6 persons, or 8.5714% of the workforce, who have 16-20 years of experience. Additionally, there are 4 individuals, or 5.7142% of the staff, who have 20-25 years of experience. In terms of gender, the staff makeup is predominantly male, with males accounting for 87.1428% (61 individuals), while females represent 12.8571% (9 individuals) of the total staff assessed.

Table. 01. Demographic of the Respondents

Positioning / Designation	**No.**	**Percentage %**
Chief Librarian	03	4.286
Associate Librarian	02	2.858
Deputy Librarian	15	21.428
Assistant Librarian	35	50
Cataloguer/ Classifier	15	21.428
Professional Experience		
Up to 5 years	11	15.7142
6 - 10 Years	25	35.7142
11- 15 years	24	34.2857
16 – 20 Years	06	8.5714
20 – 25 years	04	5.7142
Gender		

Male	61	87.1428
Female	09	12.8571

N= 70

5.2. Structural Equation Modeing (SEM)

Structural Equation Modeling (SEM) is a statistical method used to analyze relationships between observable and underlying factors. It includes two main components: the measurement model, which examines links between observable variables and their hidden constructs using factor analysis, and the structural model, which explores causal pathways between latent variables. SEM is widely used in fields like psychology, sociology, economics, and education to study complex relationships within data.

5.2.1 Measurement Model: (Convergent Validity)

Convergent validity is a key part of the measurement model, examining the connection between latent variables and their items. This involves evaluating external loadings, Cronbach's Alpha for internal consistency, composite reliability, and Average Variance Extracted (AVE). This research paper assesses the convergent validity of the SEM framework, ensuring the accuracy and reliability of the measurement tools. The results were positive, showing that all SEM model components met the required validity and reliability standards. Cronbach's Alpha values over 0.7 indicated high internal consistency. Composite reliability values above 0.7 and AVE values over 0.55 confirmed the robustness and accuracy of the constructs. Table 1 summarizes these findings, providing a thorough assessment of validity and reliability metrics. In summary, the study's methods were meticulous and dependable, reinforcing the trustworthiness and accuracy of the results.

Table 1. Convergent Validity

Constructs	Cronbach's alpha	Composite reliability (rho_a)	Average variance extracted (AVE)
ChatGPT Acceptance	0.710	0.720	0.538
PEoU of ChatGPT	0.816	0.821	0.645
Usefulness of ChatGPT	0.952	0.959	0.840
Effective Strategies	0.934	0.937	0.791
Challenges of ChatGPT	0.769	0.807	0.513

5.2.2 Discriminant Validity

Discriminant validity ensures the accuracy and reliability of a measurement model by confirming that different constructs are distinct and not overlapping. This is crucial for confident interpretation of research findings. The Farnell and Larcker criterion is a common test for discriminant validity, examining if correlations between constructs and their indicators are significantly lower than 1, indicating strong distinctiveness.

Table 2 shows a cross-loading analysis, where higher loadings on intended constructs and lower loadings on unrelated constructs indicate good discriminant validity. This ensures that the variables measured are unique and not redundant.

Table 2. Cross Loadings

Items	Challenges of ChatGPT	ChatGPT Acceptance	Effective Strategies	PEoU of ChatGPT	Usefulness of ChatGPT
Chall_1	0.696				
Chall_2	0.824				
Chall_3	0.861				
Chall_4	0.578				
Chall_5	0.571				
ChatGPT_A_1		0.819			
ChatGPT_A_2		0.756			
ChatGPT_A_3		0.709			
ChatGPT_A_4		0.637			
ES_1			0.873		
ES_2			0.911		
ES_3			0.921		
ES_4			0.894		
ES_5			0.844		
PEoU_1				0.805	
PEoU_2				0.873	
PEoU_3				0.807	
PEoU_4				0.721	
Usefulness_1					0.945
Usefulness_2					0.940
Usefulness_3					0.894
Usefulness_4					0.901
Usefulness_5					0.899

Table 3 of the research article presents the results of discriminant validity tests, showing that the measurement model effectively distinguishes between different constructs. Both the Farnell and Larcker criterion and cross-loading analysis met the required standards, indicating high discriminant validity. These findings enhance the reliability and validity of the study's outcomes, ensuring the measurement instruments accurately capture the unique characteristics of each

construct. Overall, meeting these criteria demonstrates the robustness and effectiveness of the measurement model in accurately representing and assessing the constructs in the study.

Table. 3. Farnell and Larcker

Consturcts	Challenges of ChatGPT	ChatGPT Acceptance	Effective Strategies	PEoU of ChatGPT	Usefulness of ChatGPT
Challenges of ChatGPT	0.716				
ChatGPT Acceptance	0.757	0.733			
Effective Strategies	0.623	0.808	0.889		
PEoU of ChatGPT	0.586	0.798	0.486	0.803	
Usefulness of ChatGPT	0.868	0.787	0.645	0.511	0.916

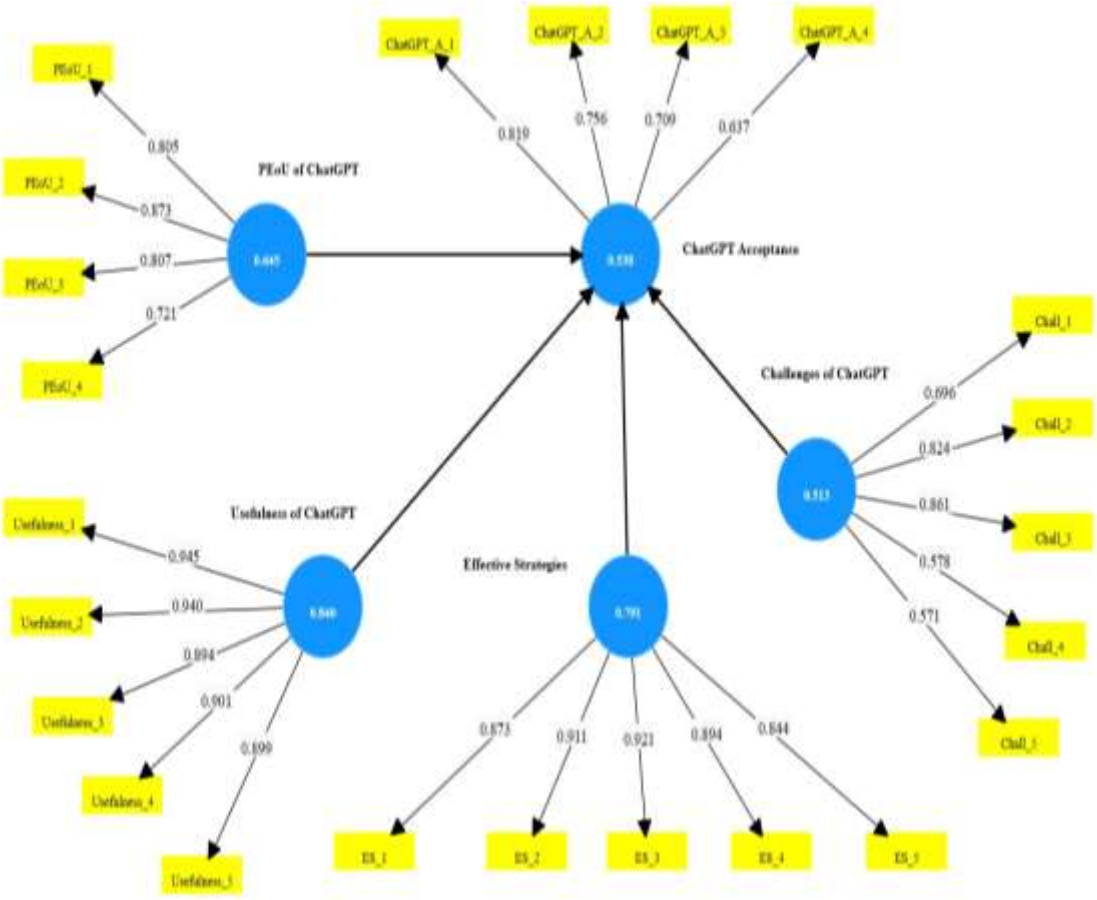

Figure 3. Measurement Model

5.3 Structural Model and Hypothesis Testing

The findings of the structural model analysis in Table 4 provide insights into the relationships among the components and confirm hypotheses from current research. Evaluating P values and T values is essential for assessing these relationships. Table 4 shows that most hypotheses (except H1) are supported by statistically significant results, with low P values and high T values, indicating strong evidence for these relationships. This validates the proposed framework and its alignment with theoretical expectations. These findings have practical implications for real-world applications, such as technology adoption, organizational strategy, and resource allocation. Confirming ideas through statistical testing enhances research credibility and informs decision-making. The results contribute to scholarly understanding of factor interactions and offer practical recommendations for professionals and policymakers aiming to achieve positive outcomes in their fields.

Table 4. Path Coefficient

Hypotheses	Paths	T statistics	P values	Results
H1	PEoU of ChatGPT -> ChatGPT Acceptance	6.874	0.000	Significant
H2	Usefulness of ChatGPT -> ChatGPT Acceptance	2.405	0.016	Significant
H3	Challenges of ChatGPT -> ChatGPT Acceptance	0.430	0.667	In Significant
H4	Effective Strategies -> ChatGPT Acceptance	6.317	0.000	Significant

6. Discussion

This study explores how university librarians perceive ChatGPT technology for improving library services. It examines hypotheses about the influence of perceived ease of use (PEoU), usefulness, difficulties, and effective techniques on ChatGPT acceptance. By comparing findings with existing literature, it provides a comprehensive analysis of technology acceptance in libraries. The study aims to offer valuable insights into promoting successful ChatGPT implementation in university libraries.

Hypothesis 1: Perceived Ease of Use (PEoU) of ChatGPT -> ChatGPT Acceptance

The first hypothesis examined the link between librarians' assessments of ChatGPT's usability and its acceptability. A significant finding ($p = 0.000$) indicates that perceived ease of use greatly influences ChatGPT adoption among librarians. This supports the Technology Acceptance Model (TAM), which suggests that individuals are more likely to adopt a technology if they find it user-friendly.

Studies by Faruqe (2023) and others have consistently shown that perceived ease of use is a critical factor influencing technology adoption in various contexts, including libraries. Similarly, study of Panda and Chakravarty (2022) performed a thorough assessment of the usability of chatbot technologies, specifically ChatGPT, in library settings. The findings demonstrated a robust association between the evaluations made by librarians about the use of chatbots and the degree of acceptability they perceived. This supports the result of the current study, suggesting that the perceived ease of use has a major impact on the uptake of ChatGPT among librarians. Factors such as user interface design, accessibility, training programs, and support resources all contribute to librarians' perceptions of ease of use, which in turn impact their acceptance and utilization of ChatGPT (Mali & Deshmukh, 2023).

Hypothesis 2: Usefulness of ChatGPT -> ChatGPT Acceptance

The second hypothesis examined the relationship between librarians' perceptions of ChatGPT's usefulness and its acceptance. The significant result ($p = 0.016$) suggests that librarians' positive perceptions of ChatGPT's usefulness contribute to its acceptance. This finding is consistent with prior research by C. Wang et al. (2023) and others, highlighting the importance of perceived usefulness in technology adoption. Simiarly Zhai and Shi (2020) examined the

impact of perceived utility on the uptake of mobile learning. There is a high probability that a correlation exists between the perceived usefulness and adoption, similar to the favorable outcomes observed with the simplicity of use of ChatGPT. Moreover, Franque, Oliveira, Tam, and Santini (2021) Investigated the correlation between the perceived usefulness, user contentment, and intention to continue using. It is likely that you discovered a correlation between the perceived utility of ChatGPT and user happiness and their intention to continue using it. This aligns with your favorable findings on ChatGPT's simplicity of use.

Perceived usefulness encompasses factors such as the relevance of ChatGPT to librarians' tasks, its ability to improve efficiency or service quality, and its alignment with organizational goals (Adigun, Ajani, & Aboyade). When librarians perceive ChatGPT as a valuable tool that enhances their work or improves user experiences, they are more likely to accept and integrate it into their daily operations.

Hypothesis 3: Challenges of ChatGPT -> ChatGPT Acceptance

The third hypothesis aimed to explore whether the challenges associated with ChatGPT have an impact on its acceptance among university librarians. As given in Table 04, the non-significant result ($p = 0.667$) suggests that while challenges may exist in implementing ChatGPT within library systems, they do not significantly influence the overall acceptance of the technology. This finding is interesting because it denotes that despite potential hurdles like technical complexities or integration issues, librarians' willingness to adopt ChatGPT is not significantly hindered by these challenges alone.

To contextualize this result, it's important to consider previous research on technology acceptance in library settings. Studies by Smith (2023) have highlighted common challenges such as technical complexity, data privacy concerns, and user resistance as factors that can impact technology adoption. However, the non-significant relationship in this study indicates that these challenges may not be the primary drivers of ChatGPT acceptance among university librarians. Similarly, the research conducted by Hsiao and Tang (2015) explored the determinants that impact librarians' adoption of novel information technologies. Their research thoroughly investigated the obstacles and many elements that influence the adoption of technology in library environments. This research provides significant and pertinent insights for our investigation into the difficulties associated with the acceptability of ChatGPT among university librarians.

Hypothesis 4: Effective Strategies -> ChatGPT Acceptance

The fourth hypothesis focused on the impact of effective strategies for implementing ChatGPT on its acceptance. The significant result ($p = 0.000$) suggests that well-planned and effective strategies play a crucial role in enhancing ChatGPT acceptance among librarians. This finding aligns with established literature emphasizing the importance of strategic planning, stakeholder engagement, and clear communication in technology implementation projects within library contexts (Harland, Stewart, & Bruce, 2017).

Drawing from research by Meyers, Durlak, and Wandersman (2012), effective strategies encompass elements such as needs assessment, user training, ongoing support, and feedback mechanisms. In yet another study Rahmani (2023) examined methods for incorporating artificial

intelligence (AI) technology, specifically ChatGPT, into library services. The results highlighted the crucial importance of well-crafted tactics in shaping the acceptance of AI among librarians, therefore confirming the hypothesis regarding the value of effective methods for the acceptance of ChatGPT. These methods encompass technological elements, organizational culture, user preferences, and sustainability, all of which collectively contribute to a favorable acceptance and adoption of ChatGPT in university library environments.

In summary, this study explored the adoption of ChatGPT among university librarians, focusing on perceptions of usability, usefulness, encountered challenges, and effective strategies. Findings indicate that librarians' assessments of ChatGPT's usability significantly influence its adoption, aligning with theories like the Technology Acceptance Model (TAM). The study also affirmed the importance of perceived usefulness in driving acceptance, consistent with prior research on technology adoption. Despite technical challenges, these did not significantly deter adoption, suggesting librarians' readiness to embrace ChatGPT despite difficulties. Successful implementation strategies played a critical role in boosting acceptance, underscoring the importance of well-planned tactics. These insights deepen our understanding of technology adoption in libraries, emphasizing the need for user-friendly, valuable technologies and effective implementation strategies to foster acceptance and integration within library settings. Furthermore, the study challenges common assumptions about technology barriers, revealing that librarians' willingness to adopt ChatGPT outweighs potential obstacles. Strategic planning, stakeholder involvement, and clear communication were pivotal in achieving positive outcomes, highlighting the importance of comprehensive approaches that consider technological, organizational, and support factors for successful technology integration in libraries.

7. Findings and Recommendations

Findings

The study highlighted that perceived ease of use significantly promotes ChatGPT acceptance among university librarians ($p = 0.000$), stressing the importance of user-friendly interfaces, accessibility features, training, and support. Additionally, librarians' positive perceptions of ChatGPT's utility ($p = 0.016$) strongly influence its acceptance, consistent with previous technology adoption research. Despite technical challenges, they do not significantly hinder ChatGPT adoption among librarians ($p = 0.667$), indicating readiness to adopt innovative technologies. Effective implementation strategies, such as strategic planning and user training, play a crucial role in enhancing ChatGPT acceptance ($p = 0.000$), ensuring successful integration in library settings.

Recommendations

According to the results, it is advised that university libraries prioritize improving the user-friendliness of ChatGPT interfaces, enhancing accessibility features, implementing extensive training programs, and developing strong support resources. These endeavors can substantially enhance librarians' perception of how easy it is to use, thus promoting increased adoption and use of ChatGPT.

In addition, libraries should prioritize highlighting the efficacy of ChatGPT in optimizing workflow efficiency, enhancing service quality, and aligning with organizational objectives. Emphasizing these advantages can enhance librarians' favorable views of ChatGPT's utility, resulting in increased rates of acceptance.

Although there is no substantial correlation between issues and acceptability, it is imperative for libraries to tackle potential obstacles such as technical intricacies, data privacy apprehensions, and user reluctance. Implementing proactive methods such as frequent updates, user feedback systems, and ongoing improvement projects can effectively address these difficulties and improve general acceptance.

Finally, libraries should embrace efficient approaches for implementing ChatGPT, which involve strategic planning, engaging stakeholders, providing user training, offering continuous assistance, and considering sustainability factors. These tactics are crucial for establishing a favorable climate that fosters the acceptance, integration, and sustained success of ChatGPT inside university library environments.

8. Conclusion

This study examines the various features of ChatGPT adoption among university librarians, including criteria such as perceived ease of use, usefulness, obstacles, and effective implementation tactics. The results emphasize the crucial significance of the perceived ease of use and utility in influencing librarians' favorable attitudes and intentions towards using ChatGPT. Although there are technical complexities, the study shows that librarians are highly willing to adopt ChatGPT, especially with the help of good implementation tactics. This highlights the significance of not just creating user-friendly and valuable technology, but also executing holistic strategies that tackle difficulties, convey advantages, and promote continuous support and involvement.

Moreover, the findings of the study enhance our knowledge of how technology is adopted in library settings. They highlight the importance of comprehensive approaches that take into account both technological factors and organizational dynamics. The lack of a substantial association between challenges and acceptance contradicts commonly held assumptions, emphasizing the ability of librarians to remain resilient and adaptable when confronted with possible obstacles. Key factors in creating a favorable environment for the acceptance and integration of ChatGPT in university libraries include effective techniques such as stakeholder engagement, clear communication, user training, and sustainability considerations.

Based on these discoveries, libraries are advised to give priority to design principles that focus on the needs and preferences of users, effectively communicate the advantages of their services, proactively tackle obstacles, and strategically plan the adoption of technology. Libraries may optimize the acceptance, utilization, and long-term success of ChatGPT and other innovative technologies by taking a complete approach that considers user demands, organizational goals, and continuous support mechanisms within their operational frameworks.

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Annexure 01

Public Sector Universities of the Province Khyber Pakhtunkhwa

1. University of Peshawar
2. Abdul Wali Khan University, Mardan
3. Bacha Khan University, Charsadda
4. Shaheed Benazir Bhutto Women University Peshawar
5. Gomal University, D.I. Khan
6. Hazara University, Mansehra
7. Institute of Management Sciences
8. Islamia College Peshawar
9. Khyber Medical University
10. University of Agriculture, Peshawar
11. Shaheed Benazir Bhutto University, Sheringal
12. University of Swabi
13. Kohat University of Science and Technology
14. University of Science and Technology Bannu
15. University of Swat
16. University of Engineering and Technology, Peshawar
17. University of Agriculture D.I.Khan
18. Abbottabad University of Science & Technology
19. FATA University, Dara Adam Khel
20. University of Lakki Marwat
21. Women University Swabi
22. Shuhad-e-APS University of Technology Nowshehra
23. University of Chitral
24. Women University Mardan

25. University Of Buner
26. University of Engineering And Applied Sciences Swat
27. University of Engineering & Technology, Mardan
28. Khushal Khan Khattak University, Karak
29. University of Malakand, Malakand
30. University of Haripur
31. University of Agriculture Swat
32. Pak-Austria Fachhochschule Institute Of Applied Sciences And Technology, Haripur
33. University of veterinary & animal sciences, Swat
34. University of shangla, Swat