

Article

Beyond Books: Student Perspectives on Emerging Technologies, Usability, and Ethics in the Library of the Future

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Abstract

This research aims to understand the evolving role of academic libraries, focusing on student perceptions of current services and their vision for the future. Data was collected using a survey at a midwestern research university in the United States. The survey contained both quantitative and qualitative questions. The objective of the survey was to understand the current utilization of library services and students' future visions for academic libraries. Qualitative and quantitative analysis techniques were utilized as part of the study. Thematic analysis was employed as part of the qualitative analysis, while descriptive and inferential analysis techniques were utilized in the quantitative analysis. The findings reveal that many students use libraries for traditional functions such as studying and accessing resources. There is also an inclination toward digitalization due to convenience, accessibility, and environmental sustainability; however, print materials remain relevant as well. Another finding was a lack of awareness among some students regarding available library services, indicating a need for better marketing and communication strategies. Students envision future libraries as technology-driven spaces integrating artificial intelligence (AI), augmented reality (AR), virtual reality (VR), and innovative collaborative environments. Ethical considerations surrounding AI, including privacy, bias, and transparency, are crucial factors that must be addressed. Some of the actionable recommendations include integrating ethical AI, implementing digital literacy initiatives, conducting ongoing usability and user experience (UX) research within the library, and fostering cross-functional collaboration to enhance library services and student learning.

Keywords: future libraries; library utilization; academic performance; student perceptions; student vision; artificial intelligence (AI); augmented reality (AR); virtual reality (VR); robotics; collaborative learning spaces; ethics; privacy; transparency; bias; intellectual freedom; libraries of the future; user experience (UX)



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1. Introduction

Linguistically, the word “library” is derived from the Latin word “Liber,” meaning “book”; traditionally, a library is intended to be a collection of books (Welsh & Wright, 2010). Whether a public library or an academic library at an academic institution, libraries are an integral part of the community. According to a 2013 Pew Research Study, public libraries can have a significant impact on their community if they are closed (Pew Research Center, 2013). Although dated, the study underscores the importance of libraries to their respective communities. Libraries serve as an important hub for both educational purposes

and community engagement. Public libraries in low-income communities provide services that people may not be able to afford independently otherwise.

Libraries have evolved from physical books to electronic resources. Academic libraries have transitioned from their traditional roles as repositories of books (Saharkhiz et al., 2017) to become active forces in teaching and research, thereby becoming dynamic hubs of civic, educational, and social engagement. Academic libraries offer a range of digital and non-digital resources for research and collaboration, including, but not limited to, digital research workflows, open access publishing, research data management, and more.

Digital technologies have had a profound impact on society over the last few decades. The profound impact of technology was evident during the COVID-19 pandemic, when it played a crucial role in sustaining education systems during global lockdowns (Haleem et al., 2022). Technology will continue to have an impact on society. Likewise, as libraries continue to evolve to meet the shifting expectations of users, their future is tied to emerging technologies, particularly Web 4.0 and beyond. Technologies such as artificial intelligence, machine learning, and natural language processing are set to become increasingly pervasive and integrated into library systems (PressReader Team, 2024).

Libraries are often referred to as a “third place” (Latimer & Niegaard, 2007), which means a place other than home or work where people can relax and interact with others (Oldenburg, 1999). With the proliferation of smartphones and ubiquitous internet access, libraries are no longer merely physical spaces for storing information; they have become dynamic hubs for knowledge sharing. They are evolving into multifaceted environments that offer digital resources, foster community collaboration, and provide lifelong learning opportunities.

Students are the primary patrons of academic libraries, spending a significant amount of time each week within the library’s confines. This raises the question of how relevant stakeholders perceive the library in its current state and what they envision for its future. Therefore, this paper aims to understand students’ views on current library support and services, as well as their visions for the library of the future. With the rapid evolution of technologies, this study is particularly valuable in the post-COVID and ChatGPT era, as it provides a deeper understanding of students’ expectations. Taking a student-centered approach, these insights offer valuable guidance for academic decision-makers to develop policies and technology strategies that ensure academic libraries are future-ready and aligned with the evolving needs of their patrons.

2. Literature Review

In the rapidly evolving educational landscape, academic libraries are expected to undergo significant transformations to meet the diverse needs of students and maintain their relevance in the digital era. Research indicates that student perceptions play a pivotal role in shaping library services, influencing usage patterns, and guiding the strategic development of library spaces (Malatji, 2023; Posey, 2009).

The positive correlation between library engagement and academic performance further reinforces the strategic importance of these institutions. Gaha et al. (2018) found that students who actively use library services tend to achieve higher GPAs, suggesting that libraries contribute to academic skill development and tangible educational outcomes. Bladek (2019) echoed this view by framing libraries as collaborative and inclusive environments that support individual inquiry and group-based learning. However, the benefits of libraries are not uniformly experienced. For example, distance learners and online students often encounter barriers such as a lack of awareness or difficulty accessing digital resources (Atuase & Maluleka, 2022). These disparities highlight the importance of designing inclusive, accessible, and responsive services for all users.

Prior studies on students' library usage reveal some key insights into their experiences related to user experience, digital transformation, and emerging technologies.

2.1. Student Perceptions and User Experience

Understanding how students perceive and interact with physical and digital library services is important. Studies have delved into how students interact with library services and perceive the usability of both physical and digital resources. For example, [Malatji \(2023\)](#) observed that Tshwane University of Technology students prioritize a user-friendly environment where physical spaces facilitate study, borrowing, note-taking, and internet access. Similarly, [Posey \(2009\)](#) noted that while students value traditional services, there is considerable scope for enhancing staff responsiveness and the overall welcoming atmosphere. These insights underscore the importance of tailoring library services to enhance the user experience, ensuring that both physical and digital interfaces are accessible and intuitive.

2.2. Importance of Human Support

This emphasis on service quality extends to interactions with library staff. Students seek personalized academic support even in an age dominated by search engines and AI-driven tools. [Jameson et al. \(2019\)](#) observed that librarians who serve as accessible, knowledgeable, and supportive guides in the research process significantly enhance students' satisfaction. Their study reflects the enduring relevance of human expertise in the information-seeking journey and advocates for hybrid models that merge traditional in-person assistance with modern digital platforms. By investing in staff development and integrating innovative service channels, libraries can better meet the evolving expectations of digital-native students.

2.3. Libraries as Inclusive and Supportive Spaces

The importance of human connection in libraries extends beyond academic support to encompass the realms of inclusion and community building. [Scoulas \(2021\)](#) demonstrated that libraries play a crucial role in fostering students' sense of belonging, especially when services are tailored to cultural diversity and individual needs. Personalized interactions and culturally competent service delivery contribute to a welcoming environment, which is especially critical for marginalized and underrepresented student populations. However, the abrupt shift to remote learning during the COVID-19 pandemic posed a challenge to these inclusive practices. The lack of face-to-face engagement prompted libraries to rethink how digital services could maintain the same empathy and connection traditionally offered in physical spaces.

2.4. Digital Transformation in the Post-Pandemic Era

Building on the shift discussed in the previous section, the pandemic also served as a catalyst for accelerating digital transformation in academic libraries. Early foundational work by [Castelli \(2006\)](#) anticipated the growing significance of technology in reshaping collection management, content delivery, and user interaction. Building upon this, recent research by [Nasir and Tyagi \(2023\)](#) highlights the importance of agile and user-centric service models that reflect the expectations of a generation accustomed to immediate, mobile-first access to information. Similarly, [Negi and Sain \(2023\)](#) argue that post-pandemic realities have compelled libraries to adopt more resilient and adaptive approaches to technology integration. These shifts reflect a broader understanding that digital transformation is not merely a matter of implementing new tools but rather involves redefining the library's role within the educational ecosystem. Among the changes driving digital transformation are emerging technologies that may reshape how students interact with physical spaces and digital information.

2.5. Emerging Technologies: AI, AR, VR, in Libraries

Increasingly, students expect academic libraries to adopt emerging technologies, such as artificial intelligence (AI), augmented reality (AR), and virtual reality (VR), to provide immersive and engaging research experiences. Studies by [Abhijith et al. \(2024\)](#) and [Al-Ansi et al. \(2023\)](#) demonstrate that these technologies align with the preferences of tech-savvy learners, offering new possibilities for interactive, multisensory learning environments. As libraries integrate AR/VR into their offerings, they also help bridge access gaps for students with diverse learning styles and needs.

However, with innovation comes new responsibilities. Integrating artificial intelligence into library systems used for cataloging, recommendation engines, and user analytics presents ethical concerns around privacy, data governance, and algorithmic bias. Scholars such as [Ajakaye \(2022\)](#), [Božić \(2024\)](#), and [Ch \(2024\)](#) caution that libraries must adopt frameworks for the ethical use of AI that prioritize transparency, accountability, and user agency. [Mannheimer et al. \(2024\)](#) further stress the importance of AI literacy among staff and users to ensure these tools are implemented responsibly and inclusively.

2.6. Reimagining Physical Spaces for Collaboration and Sustainability

While emerging technologies have influenced digital interfaces, the physical spaces within libraries are also evolving in tandem with technological advancements. Traditional layouts are being reimagined to accommodate maker spaces, collaborative hubs, and flexible learning zones that encourage creativity and innovation. [Adamson and Bunnnett \(2002\)](#) and [Marques \(2018\)](#) documented how multifunctional spaces foster cross-disciplinary collaboration and build stronger academic communities. These spatial transformations reflect the broader trend of libraries positioning themselves as catalysts for learning, research, and co-creation rather than merely serving as access points for information.

In parallel, sustainability and environmental consciousness are becoming central to library strategy. Green library initiatives, including energy-efficient buildings and environmentally responsible operations, are aligned with global sustainable development goals and educate students on ecological citizenship ([Chalukya & Pagore, 2022](#); [Keller, 2023](#)). Inclusivity also remains a critical concern. By adopting assistive technologies and accessibility-focused design, libraries strive to create equitable experiences for users with disabilities ([Biswas et al., 2021](#)). These efforts reflect an understanding that equity, diversity, and sustainability values must guide innovation.

2.7. Conclusion–Literature Review

Academic libraries are undergoing a paradigm shift in their service offerings. They are no longer a simple collection of books, computers, and study spaces but a hub for collaboration, research, and innovation. Some of the existing literature provides valuable insight into libraries' evolving services. However, how students envision the library of the future, particularly in the post-COVID and AI era, may require some exploration. Students expect academic libraries to be technologically sophisticated, inclusive, and supportive of their needs. While digital tools enhance access and convenience, they do not diminish the importance of personal interaction or tailored support. Instead, students seek a balance between automation and human touch, where libraries are simultaneously efficient and human-centric. This study examines how students perceive current library services and their vision for the future library, employing a mixed-methods approach.

3. Methods

This exploratory study aims to understand participants' use of the library, solicit feedback on improving library services, and gain insight into their vision for the future library. Surveys are generally beneficial for describing people's attitudes, opinions, and behaviors (Creswell, 2015).

The study employed a concurrent mixed-methods approach, collecting both qualitative and quantitative data simultaneously (Creswell, 2003) through a survey instrument. The survey instrument consisted of 38 questions, as listed in Appendix A. It included 14 closed-ended questions and 20 open-ended questions. Of the 14 closed-ended questions, 12 pertained to demographics, including age, sex, and location. The remaining two closed-ended questions focused on their current library utilization and their vision of the future library.

The two questions focused on *current library utilization* and *future library vision* and were on a five-point Likert scale (Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree). The *current library utilization* question had 13 sub-questions, and Cronbach's alpha for these sub-questions was $\alpha = 0.897$. Whereas the *future libraries* question had 10 sub-questions, and Cronbach's alpha for these sub-questions was $\alpha = 0.844$. The closed-ended questions were analyzed using descriptive statistics and inferential statistics. The open-ended responses were analyzed using thematic and content analysis.

The Kruskal–Wallis test was conducted to assess whether there were any differences in responses to the “13 current library utilization” and “10 future libraries” survey items based on **sex** and **age**. If any survey item showed any significance, then follow-up pairwise Mann–Whitney U tests were conducted to assess specific differences. While the original purpose of the study was exploratory, these tests were conducted to provide additional insight; however, given the sample size, their results must be interpreted with caution.

The study protocols were approved by the Institutional Review Board (IRB), and the survey was distributed to students at a public midwestern research university in the United States. This institution has an enrollment of over 21,000 students. There are approximately 15,000 undergraduate students and a little under 6000 graduate students. The institution serves a diverse demographic population and offers a range of STEM and non-STEM academic programs.

The survey instrument was shared with over 100 students in the Principal Investigator's (PI) class, and they were also requested to share the survey with other students. This was a voluntary survey. Additionally, one of the research team members shared the survey link with other students via various communication channels, including Slack and social media. The data were collected during April 2024, May 2024, October 2024, and November 2024. There was a pause in data collection in the summer when students were on break. A total of 65 responses were received, some of which had missing data. Because the survey was also shared with others by their peers, it may be challenging to accurately estimate the response rate.

The sample of the study could be classified as a convenience sample. Despite limitations associated with generalizability, the convenience sample can still produce valuable results. A convenience sample may be utilized in exploratory studies and, at times, may present results that are so overwhelming that additional sampling techniques may not be needed (Schindler, 2025). In some instances, the responses may reach thematic saturation or become repetitive after collecting data from a certain number of participants, and further data collection may not yield any new insights.

4. Results and Discussion

The subsequent sections present the findings and a discussion of the survey results. Based on the thematic analysis of the open-ended questions, three major themes emerged that were consistent with the study’s objective. The themes were related to (a) current library utilization, (b) improvement suggestions, and (c) vision for future libraries. Table 1 outlines the relationship between these themes, the research objectives, and the section where the findings are discussed. The content analysis in Table 2 is based on students’ perceptions of the library, which are relevant to the entire paper. Based on the content analysis, the word “AI” occurred 95 times; other words and their frequencies are listed in Table 2 and are also represented in Figure 1. The keywords from Table 2 span all the major themes identified from the open-ended responses. We will first present some information about the student demographic, followed by the findings related to the two primary research objectives—“Students’ Views on Current Library Services” and “Future Library Vision”.

Table 1. Research Objective and Respective Thematic Analysis (Findings).

Research Objective	Theme	Respective Section(s) for Result and Discussion
Students’ Views on Current Library Support and Services	Current Library Utilization	Current Library Utilization User Experience
Students’ Views on Current Library Support and Services	Improvement Suggestions	User Experience Sustainability in Libraries
Future Library Vision	Vision for the future	Artificial Intelligence Intelligent Collaborative Spaces AR/VR and Immersive Learning Spaces in Libraries

Table 2. Content Analysis.

Word	Frequency
AI	95
AR	43
Spaces	55
Technology	62
VR	46

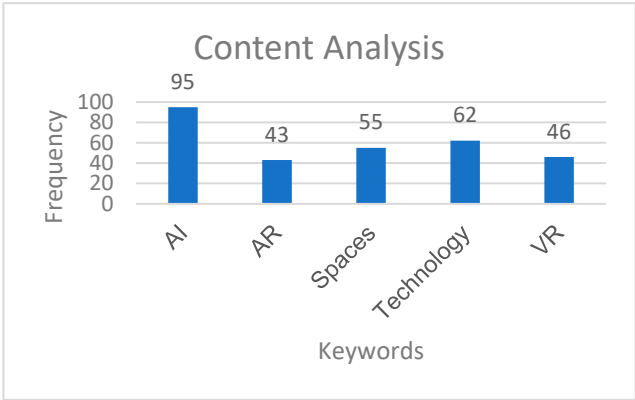


Figure 1. Content Analysis.

4.1. Respondent Demographics

We will first present a little information about the student demographic, followed by the findings related to the major themes. A total of $n = 65$ participants responded to the survey. Tables 3–7 provide participants' demographic information, including sex, race, academic major, and technology proficiency. There were 34 males (52.3%), 25 females (38.5%), and 6 (9.2%) participants who preferred not to answer. Forty-five participants (69.2%) were pursuing a STEM-based degree. 53 (81.5%) of the participants rated their technology skills as either proficient or highly proficient, whereas 7 (10.8%) of the respondents rated their technology skills as not proficient or somewhat proficient.

Table 3. Sex.

Sex	<i>n</i> (%)
Male	34 (52.3%)
Female	25 (38.5%)
Missing (Did not answer)	6 (9.2%)
Total	65 (100%)

Table 4. Age.

Age Group	<i>n</i> (%)
21–25	33 (50.8%)
26–30	13 (20.0%)
31–35	9 (13.8%)
36–40	3 (4.6%)
41–45	1 (1.5%)
46–50	1 (1.5%)
Missing (did not answer)	5 (7.7%)
Total	65 (100%)

Table 5. Race.

Age Group	<i>n</i> (%)
Asian	4 (5.2%)
Black or African American	26 (40.0%)
Hispanic or Latino	2 (3.1%)
White	24 (36.9%)
Multiracial	2 (3.1%)
Other	1 (1.5%)
Prefer not to say	1 (1.5%)
Missing (Did not answer)	5 (7.7%)
Total	65 (100%)

Table 6. Degree Major (Q9).

Degree Major	<i>n</i> (%)
STEM	45 (69.2%)
Liberal Arts	1 (1.5%)
Education	2 (3.1%)
Other	12 (18.5%)
Missing (Did not answer)	5 (7.7%)
Total	65 (100.0%)

Table 7. Technology Skills (Q12).

Technology Skills	n (%)
Not proficient (I need someone to help me with technical issues)	2 (3.1%)
Somewhat proficient (I can troubleshoot 30% of my technical issues myself)	5 (7.7%)
Proficient (I can troubleshoot 60% of my technical issues myself)	32 (49.2%)
Highly proficient (I can troubleshoot 90% + of my technical issues myself)	21 (32.3%)
Missing (Did not answer)	5 (7.7%)
Total	65 (100.0%)

Students Views on Current Library Support and Services

Kruskal–Wallis H tests were conducted to assess if age or sex had any influence on the 13 survey items that focused on the *current library utilization*. There were no statistically significant group differences based on age and sex for any of the 13 survey items, with $p > 0.05$. These results suggest consistent opinions or feedback regarding the current library services across the demographic subgroups, which are further discussed below.

4.2. Current Library Utilization

One of the study's objectives was to gain an understanding of the current utilization of the library. In response to library usage, 9.2% ($n = 6$) never use the library, 43.1% ($n = 28$) rarely use it, 18.5% ($n = 12$) occasionally use it, 16.9% ($n = 11$) often use it, 4.6% ($n = 3$) always use it, and 7.7% ($n = 5$) did not respond. Based on the data analysis, one of the primary uses of the library is for students to study. Students use the library to study either alone or in groups. The participants indicated this utilization of the library, which is supported by the following comments:

"I use the library for reserving a room for a quiet place to do homework with my group mates." (Respondent #1)

"I use the library to study in a quiet space, mostly to concentrate and finish my work." (Respondent #42)

"I normally use the library to either find a quiet spot to study and get my things done. Or I go to meet a group to get some work done. I usually use my own technology and just use the library as a space." (Respondent #11)

The comments suggest that the students perceive the library as a study space, which is a positive aspect because some studies have found a positive relationship between library usage and academic success. For example, [Stemmer and Mahan \(2016\)](#) found that using libraries for academic purposes, such as studying alone, utilizing study rooms, and employing academic technology, has a positive relationship with student outcomes. [Soria et al. \(2013\)](#) found that first-year undergraduate students who used the library had a higher GPA during their first semester than those who did not, and they also had a higher retention rate from fall to spring.

Aside from studying, students also utilize some of the common library resources. Respondents indicated that they used the library to access various resources, including printing services and other digital resources. The following direct quotes support this:

"For studying, using computers, and accessing digital resources." (Respondent #54)

"Utilizing the computers and the printer is what I do most in there." (Respondent #1)

"Meeting space, utilize printing services" (Respondent #9)

These responses reflect another transactional relationship with the library, which includes the utilization of computers, printers, and potentially other resources that may be difficult for some to access at home. For students who may have financial challenges, such

resources may not go unnoticed. Access to technology devices is one of the socioeconomic factors that drives student success and student engagement (Instructure, 2022). Therefore, this may also become an equity issue to ensure that students have access to various resources that contribute to their success and minimize the digital divide. Therefore, institutions must not overlook such resources by underfunding them.

The library typically offers a range of additional resources. Table 8 presents data on students' views regarding current library services. Most students either strongly agreed, agreed, or remained neutral about the current library services on most of the survey items. The one exception was related to awareness of what services the library offers, where about 33% of the participants were unaware of some of the library resources or services.

Table 8. Students' views related to current library utilization.

Survey Item	N	M (SD)	Frequency Strongly Disagree	Frequency Disagree	Frequency Neutral	Frequency Agree	Frequency Strongly Agree
The library provides a physical environment that allows students to engage in academic activities.	59	4.31 (0.815)	1 (1.7%)	0 (0%)	7 (11.9%)	23 (39.0%)	28 (47.5%)
The library offers me personalized services to engage in academic activities.	59	3.92 (0.952)	1 (1.7)	2 (3.4)	17 (28.8%)	20 (33.9%)	19 (32.2%)
I am aware of all the services that the library provides.	58	3.22 (1.229)	4 (6.9%)	16 (27.6%)	11 (19.0%)	17 (29.3%)	10 (17.2%)
I am satisfied with all of the services that the library provides.	58	3.95 (0.907)	1 (1.7%)	1 (1.7%)	16 (27.6%)	22 (37.9%)	18 (31.0%)
I am satisfied with the book collection that the library offers.	58	3.50 (0.903)	1 (1.7%)	5 (8.6%)	24 (41.4%)	20 (34.5%)	8 (13.8%)
I am satisfied with the makerspace facility provided by the library.	58	3.48 (0.960)	3 (5.2%)	2 (3.4%)	25 (43.1%)	20 (34.5%)	8 (13.8%)
I am satisfied with the computing resources provided by the library.	58	3.88 (0.839)	0 (0%)	4 (6.9%)	12 (20.7%)	29 (50.0%)	13 (22.4%)
It is easy to find the resources that I need in the library.	59	3.75 (0.921)	2 (3.4%)	2 (3.4%)	16 (27.1%)	28 (47.5%)	11 (18.6%)
My current college or university library uses up to date technologies.	59	3.69 (0.876)	3 (5.1%)	0 (0%)	16 (27.1%)	33 (55.9%)	7 (11.9%)
My current college or university library provides useful technologies.	59	3.95 (0.775)	1 (1.7%)	2 (3.4%)	7 (11.9%)	38 (64.4%)	11 (18.6%)
The library provides instructions on how to use the library technologies.	59	3.69 (0.969)	1 (1.7%)	5 (8.5%)	18 (30.5%)	22 (37.3%)	13 (22.0%)
The library provides technology-centered collaboration spaces.	59	3.97 (0.946)	1 (1.7%)	3 (5.1%)	12 (20.3%)	24 (40.7%)	19 (32.2%)
The library provides a quiet space for personal contemplation, reflection, meditation, prayer, or relaxation.	59	4.25 (1.044)	2 (3.4%)	3 (5.1%)	5 (8.5%)	17 (28.8%)	32 (54.2%)

Library patrons must be aware of the services provided by the library, as this can significantly influence their library usage. Additionally, a lack of awareness regarding library services may also impact student success among those with lower socioeconomic status. A study by [Atuase and Maluleka \(2022\)](#) found that over 80% of the survey respondents' library usage would be influenced by library marketing. Therefore, library services should be adequately marketed through various sources, including but not limited to social media, the library's website, the university portal, the university's transportation system, syllabi, and computer displays across the campus. This may encourage the use of the library and

its services. This would raise awareness among the general student population and ensure equitable visibility of all library services, thereby increasing the chances of student success.

Prior research suggests that library usage has a positive impact on student performance and academic success (Atuase & Maluleka, 2022; Gaha et al., 2018; McCarthy, 2017). Allison (2015) stated, “It is difficult to say whether library use makes good students, or library use is a characteristic of a good student” (p. 37). Therefore, it is essential to recognize that while such findings may not necessarily indicate a causal relationship (Bladek, 2019), they cannot be disregarded altogether. Such studies emphasize the need for brick-and-mortar library spaces to provide students with a unique academic experience and the means to achieve academic success. Librarians can leverage such data to demonstrate the impact of their work, advocate for additional resources, and persuade faculty of the benefits of library instruction for students (Gaha et al., 2018).

4.3. User Experience

Some respondents did not utilize the library frequently, as supported by the following statement from Respondent #52:

“I hardly use the library. I have only been there a couple of times to visit other offices for my student ID card and one time for some studies.”

While further investigation may be required as to why some students do not use the library, there is also a slim possibility that the lack of utilization may be related to marketing and user experience. The libraries offer a range of resources and services. Unfortunately, not everyone is aware of the resources and services. In responding to the survey item “I am aware of all the services that the library provides,” 20 participants (33%) strongly disagreed or simply disagreed. This means that at least 1/3 of the participants were unaware of some of the library resources or services.

“The library should really make their website easy to navigate. A section could be added to [the website] where we have a collection of books, articles, etc., that is easy to find. And a library chatbot will be a great addition to the website for a student to find resources easily.” (Respondent #52)

“The online library resources [...] is difficult to navigate.” (Respondent #52)

“The library could make it clearer how to access/find physical books they have” (Respondent #60)

“Make all their services visible to first-time users.” (Respondent #50)

These data suggest that students’ experiences with library services are also influenced by how effectively the library designs and communicates its services. The libraries have a unique need for exemplary user experience because it may lead to the success or failure of the library patrons (students, staff, and faculty). Physical and electronic spaces, such as websites and mobile applications, should be designed using a people-centered approach. People-centered design focuses on “understanding how people feel about a product and their pleasure and satisfaction when using it, looking at it, holding it, and opening or closing it” (Rogers et al., 2023, p. 14). User experience (UX) design “is a process of creating products and systems for users that meet their tasks and is both accessible and usable for them” (Maguire, 2022, p. 18). Usability refers to “ensuring that interactive products are easy to learn, effective to use, and enjoyable from the person’s perspective” (Rogers et al., 2023, p. 20). The usability of a product is defined based on various constructs, including (a) effectiveness, (b) efficiency, (c) learnability, (d) memorability, (e) enjoyability, and (f) utility (Rogers et al., 2023). Libraries are no longer just repositories of books; they offer an array of academic resources that must cater to students and other library patrons.

Given that there may be a potential relationship between the utilization of library resources and student success, these data suggest that UX improvement should be an essential requirement for enhancing student success.

The indirect usability issues referenced by the students underscore the significance of user experience. User experience and usability considerations can have a positive impact on library patrons. A people-centered design can improve accessibility for the diverse library audience. As stated earlier, prior research suggests a positive relationship between library usage and academic performance (Atuase & Maluleka, 2022; Gaha et al., 2018; McCarthy, 2017). If patrons have a positive user experience, they are more likely to return in the future and recommend the library to others.

The library's UX cannot be underestimated; therefore, ongoing UX research should be an operational part of the library's processes to address ongoing UX challenges and evolving expectations. Aside from having a dedicated UX team, academic libraries can partner with academic units specializing in architecture design, interior design, human–computer interaction, or similar domains; such a partnership may be a mutually beneficial situation for the library and its students. The libraries could gain fresh and relevant perspectives cost-effectively, while students would attain relevant, practical, and hands-on experience. The fresh and relevant perspectives may include ideas and suggestions about the latest trends and technologies, such as artificial intelligence (AI).

Future Vision of the Library

The Kruskal–Wallis H tests were conducted to assess if age or sex had any influence on the 10 survey items that focused on the libraries of the future. There were no statistically significant group differences based on “sex” for any of the survey items, with $p > 0.05$, suggesting consistent feedback or opinions about the libraries of the future among participants regardless of sex. However, there was a statistically significant difference related to the survey item “The libraries of the future will utilize augmented reality to provide personalized user experiences” based on “age”, which will be further discussed in the respective section next.

4.4. Future Vision of the Library

Survey item #18 presented a series of forward-looking statements addressing anticipated developments in library services and technologies to gauge participants' perceptions of how academic libraries may evolve. Respondents were asked to indicate their level of agreement with statements related to adopting artificial intelligence, increasing reliance on digital resources rather than print, immersive technologies (such as virtual and augmented reality), and the potential implementation of robot librarians. Other items gauged views on the importance of digital literacy, concerns surrounding data privacy, and interest in personalized academic services. Table 9 summarizes the responses, illustrating how users envision the future role and functionality of academic libraries. These findings demonstrate the students also envision the future libraries as intelligent and interactive environments.

Table 9. Students' views related to the future of the library.

Statement	N	M (SD)	Frequency Strongly Disagree	Frequency Disagree	Frequency Neutral	Frequency Agree	Frequency Strongly Agree
Libraries of the future will utilize advanced technologies.	59	4.54 (0.727)	1 (1.7)	0 (0)	2 (3.4)	19 (32.2)	37 (62.7)
There will be privacy concerns in the libraries of the future due to pervasiveness of technologies.	59	3.86 (0.899)	0 (0)	4(6.8%)	16(27.1)	23 (39.0)	16(27.1)

Table 9. Cont.

Statement	N	M (SD)	Frequency Strongly Disagree	Frequency Disagree	Frequency Neutral	Frequency Agree	Frequency Strongly Agree
Libraries will utilize artificial intelligence.	59	4.42 (0.675)	0 (0)	0 (0)	6 (10.2)	22 (37.3)	31 (52.5)
Libraries will prioritize digital resources over print materials.	59	4.14 (0.955)	1 (1.7)	2 (3.4)	11 (18.6)	19 (32.2)	26 (44.1)
Libraries will offer remote access for all of their services.	59	4.12 (0.930)	2 (3.4)	1 (1.7)	7 (11.9)	27 (45.8)	22 (37.3)
The library will implement robot librarians.	59	3.32 (1.195)	5 (8.5)	9 (15.3)	18 (30.5)	16 (27.1)	11 (18.6)
The library patrons will need to have a certain level of technology competency to effectively utilize the library resources.	59	4.02 (1.025)	4 (6.8)	1 (1.7)	3 (5.1)	33 (55.9)	18 (30.5)
Libraries will have technologies and services to support virtual reality, mixed reality, and augmented reality meetings.	59	4.08 (0.772)	1 (1.7)	0 (0)	9 (15.3)	32 (54.2)	17 (28.8)
The library will utilize augmented reality to provide a personalized user experience.	59	3.98 (0.956)	1 (1.7)	3 (5.1)	12 (20.3)	23 (39.0)	20 (33.9)
I would be interested in personalized services to engage in academic activities.	59	4.31 (0.815)	1 (1.7)	0 (0)	7 (11.9)	23 (39.0)	28 (47.5)

4.4.1. Artificial Intelligence

There was a consensus among the participants' responses that AI will be used in future libraries. Based on the Likert-scale item, 53 (89.83%) participants agreed or strongly agreed that "Libraries will utilize artificial intelligence." Whereas 27 (45.76%) participants strongly agreed or agreed with the statement "The library will implement robot librarians," while 14 (23.72%) strongly disagreed or disagreed. Lastly, 18 (30.50%) were neutral. The questionnaire included several open-ended questions related to participants' visions of future libraries or the technologies they believed should be utilized in the library.

Based on the content analysis of the open-ended questions, the word "AI" (artificial intelligence) was mentioned 95 times. This implies that the respondents see AI as part of the library's future. This is consistent with the descriptive findings stated earlier regarding the potential future use of AI in libraries. Some selective comments related to respondents' thoughts on the library and AI are provided below:

"I think everything with AI will play a significant role in the future of libraries as we improve it and find ourselves using it more and more every day." (Respondent #11)

"Libraries will use AI for personalized recommendations, automating tasks, virtual assistants, and enhancing accessibility." (Respondent #46)

"I envision the use of AI to be extremely hands-on in the future, and for people to be only using AI when going to libraries." (Respondent #20)

"I envision generative AI models being implemented in some capacity." (Respondent #4)

"Lots of technologies used, kiosks with AI to help find features of the library." (Respondent #2)

Although ChatGPT's release to the general public in late 2022 brought a major spotlight to AI, it has been in use in various applications for the last couple of decades. Some examples of AI from the last couple of decades include the Netflix recommendation system, introduced in 2000; Amazon's recommendation system, introduced in 2001; Roomba's AI-

driven robotic vacuum, introduced in 2002; IBM Watson, introduced in 2011; and Amazon's Alexa, introduced in 2014 (Miller, 2024). Mannheimer et al. (2024) identified three major themes related to the use of AI in libraries: (a) metadata extraction, (b) recommendation and reference, and (c) assessments.

Respondent # 46 also indicated the use of a personalized recommendation system. The recommendation models would recommend various resources to the students or other library patrons to support their growth and success. Various organizations, such as Amazon and Netflix, are already utilizing recommendation systems. Hence, having a library recommendation system is not a far-fetched idea. While there is optimism regarding the integration of AI in libraries, potential ethical issues also exist, which will be discussed later.

4.4.2. Intelligent Collaborative Spaces in Libraries

In response to the survey item, "The library provides technology-centered collaboration spaces," forty-three (72.9%) participants either strongly agreed or agreed, indicating that most respondents perceive the library as offering adequate technology-centered collaboration spaces. Additionally, the word "spaces" was mentioned 55 times in the survey items, and the general perception of students is for these spaces to be intelligent or technologically advanced, as supported by these direct quotes:

"I would suggest making the space a little more updated, as well as providing technology resources for all students. Like a 3D printer that students can use, an area where students can eat and not just drink coffee. I think the library could explain all of their services they offer a bit better as well!" (Respondent #20)

"More group study rooms, 3D printing, or maker spaces. It will be interesting to have more collaborative spaces with technology like whiteboards, etc., to use." (Respondent #54)

"Spaces that combine learning with the visualization of real-life applications, offering an immersive educational experience." (Respondent #45)

"Digital-first, with a focus on collaboration and flexible spaces." (Respondent #54)

"Open, multi-use spaces with comfortable seating and interactive tech." (Respondent #54)

"For the physical spaces, I see libraries evolving into more flexible environments with modular furniture that can be rearranged to suit different activities, from quiet study areas to collaborative workspaces. These spaces might also include more interactive zones with digital screens and virtual reality setups." (Respondent #46)

"Libraries of the future will incorporate flexible, adaptable spaces for both quiet study and group collaboration, with advanced technology like augmented reality (AR) for interactive learning, digital archives accessible through immersive interfaces, and areas for hands-on innovation such as makerspaces and virtual reality labs. These spaces will also promote community engagement, offering multifunctional areas for events, workshops, and social interactions." (Respondent #38)

These comments suggest that students are looking for spaces that are beyond individual study spaces or static areas for group work, which may only have a whiteboard and some basic furniture. The comments suggest that students are interested in flexible physical spaces with features and technologies that can adapt to a diverse audience. These technologies could include but are not limited to 3D printing, immersive technologies such as virtual or augmented reality, interactive collaboration boards, and flexible furniture. Some of these features provide an enhanced learning experience.

Academic literature corroborates students' vision of libraries as spaces for technological and collaborative innovation. These multifunctional and adaptable spaces facilitate collaboration among students, faculty, and subject specialists, thereby enhancing both

academic and personal growth (Marques, 2018). The rise in the “Learning Commons” is serving as a model that reshapes the design and function of library spaces in the present and the future (Garoufali & Garoufallou, 2022).

Collaborative spaces have gained significant traction in the evolution of academic libraries, facilitating interaction, innovation, and group learning. This trend aligns with the broader shift from allocating space primarily for physical collections toward prioritizing student-centered study, work areas, and learning commons (Adamson & Bunnnett, 2002). According to Choy and Goh (2016), these spaces are designed to accommodate group activities such as brainstorming, project work, and presentation practice. Libraries provide a managed environment where students can leverage flexible seating configurations, modular furniture, and advanced technological tools such as smartboards, large monitors, and projection systems.

A modern learning common blends traditional library, computer lab, and lounge functions into a flexible, student-centric environment that supports various learning activities (Educause Learning Initiative, 2011). It fosters collaboration through informal gathering areas, meeting rooms, writing centers, multimedia labs, and advising offices. This model for library space design is tech-infused (Jain & Behera, 2023), meaning it supports an intelligent space with technologies such as augmented reality, interactive 3D displays, and mobile apps. The learning commons model offers dynamic, tech-enhanced environments that serve as hubs for knowledge creation (Roberts, 2007). Additionally, Johnson (2016) coined the term “creative library spaces,” where priority is placed on users creating content, including multimedia, 3D objects, and electronic devices, rather than merely being consumers. Maker spaces, on the other hand, will increasingly support hands-on collaboration, prototyping, and STEM-focused activities (Burke, 2015). This aligns with students’ desires for spaces that are not only collaborative but also interactive.

4.4.3. AR/VR and Immersive Learning Spaces in Libraries

Libraries of the future may integrate technologies such as augmented reality (AR) and virtual reality (VR) into their spaces to provide immersive experiences. As part of the content analysis, the words “AR” and “VR” were mentioned 43 and 46 times, respectively. This indicates a growing interest in these technologies. In response to the survey item, “Libraries will have technologies and services to support virtual reality, mixed reality, and augmented reality meetings,” forty-nine (75.4%) participants strongly agreed or agreed with the statement. This represents three-fourths of the respondents who believe AR/VR and mixed reality (MR) will be integrated into libraries. Some of the other comments from the respondents are provided below:

“Libraries will be equipped with the latest tech, including interactive touchscreens, smart tables, and virtual reality (VR) areas for immersive learning experiences.” (Respondent #59)

“3D printers or AR/VR would be cool” (Respondent #16)

“Libraries of the future will be fluid, transformative spaces with modular, technology-enabled zones that seamlessly shift between quiet study areas, collaborative maker spaces, holographic research stations, community gathering spots, and immersive learning environments, all designed to adapt instantly to diverse user needs and technological innovations.” (Respondent #53)

“Future collaborative spaces will have technologies like interactive whiteboards, VR/AR setups, and advanced video conferencing tools.” (Respondent #46)

“AI, VR, and AR technologies can be added to the libraries.” (Respondent #13)

The Kruskal–Wallis H tests were conducted to assess if age or sex had any influence on the 10 survey items that focused on the libraries of the future. There was a statistically significant difference related to the survey item “*The libraries of the future will utilize augmented reality to provide personalized user experiences*” based on age with $H(5) = 11.21$, $p = 0.047$. This implies that at least one age group responded significantly differently to this survey item. Therefore, to further explore this difference, pairwise comparisons were conducted using the Mann–Whitney U test. A total of 15 pairwise comparisons were made, and two pairwise comparisons were statistically significant at an α of 0.05 and are provided below.

1. Participants aged 26–30 (mean rank = 29.19, $n = 13$) reported significantly higher agreement with the augmented reality item than those aged 21–25 (mean rank = 20.48, $n = 32$), $U = 127.50$, $Z = -2.12$, $p = 0.034$.
2. Similarly, participants aged 31–35 (mean rank = 28.56, $n = 9$) expressed significantly higher agreement than the 21–25 age group (mean rank = 18.88, $n = 32$), $U = 76.00$, $Z = -2.25$, $p = 0.025$.

These results suggest that individuals in their late-twenties to mid-thirties may be more optimistic about augmented reality in future library settings. However, these results must be interpreted with extreme caution, given the sample size and the number of comparisons made. Therefore, a Bonferroni correction was applied to control for Type I error. Since 15 pairwise comparisons were made, the adjusted threshold was set to 0.0033, calculated by dividing the alpha level (0.05) by 15. Under these stricter guidelines, the earlier results are no longer statistically significant. Although a trend appears to be present, it is not statistically significant; however, it may be worth investigating further with a larger sample size.

Augmented and virtual reality (AR and VR) are “two of the most innovative technological advancements in the world today” (Al-Ansi et al., 2023). Augmented reality overlays digital information onto the physical world, providing users with enriched experiences that seamlessly blend physical and digital elements. Conversely, VR uses advanced computer graphics, motion sensors, and display technologies to fully immerse users in realistic simulations of real and imagined environments. (Al-Ansi et al., 2023). For instance, AR applications can guide users through library stacks, offer real-time language translation, or provide multimedia overlays on historical artifacts. Virtual reality can bring scientific or abstract ideas to life through simulations, immersing users in a digital environment to explore historical locations (Abhijith et al., 2024). These technologies can provide an experiential and interactive learning environment that bridges the gap between theory and practice. Therefore, students may be in favor of AR/VR technologies for an enhanced learning experience.

While these technologies present significant opportunities for the library and its patrons to innovate and enhance the user experience, they also pose challenges associated with their implementation. High costs, accessibility issues, scalability concerns, the need for technical expertise among library patrons, and the need for regular updates to both hardware and software can be hurdles (Nguyen et al., 2019; Biswas et al., 2021; Scavarelli et al., 2019). Additionally, such technologies may also have potential health-related side effects (e.g., motion sickness) or may not be suitable for people with certain physical impairments (LaMotte, 2017). Therefore, libraries must plan and prioritize the strategic implementation of these technologies.

4.4.4. Sustainability in Libraries

The respondents also shared their feedback on the environment and sustainability, as well as on how the library can contribute to environmental sustainability. Students preferred digital resources over print, citing environmental benefits as the primary reason. The following quotes support this:

“I prefer digital, I feel less bad about the environment when using a digital device for reading.” (Respondent #20)

“Digital because it’s better for the environment.” (Respondent #15)

The respondents also shared their feedback in response to another open-ended survey item: “In what ways future libraries can contribute to environmental sustainability?” Some of the responses are provided below:

“Not throwing out old books, repairing and re-spinning old books, reducing e-waste from an increased hardware presence.” (Respondent #60)

“Using clean energy, encouraging recycling, or even better, maintenance of its resources/materials.” (Respondent #56)

“Eco-friendly buildings, digital resource-sharing, and energy-efficient systems. More virtual services and ebooks than print.” (Respondent #38)

“Can cut down on the use of paper tremendously virtual libraries will reduce the size of libraries consequently reducing the demand for building materials.” (Respondent #51)

“By providing knowledge in open spaces and ensuring that vital information is readily available, libraries can inspire solutions to environmental challenges.” (Respondent #45)

“Future libraries can contribute to environmental sustainability by using eco-friendly building materials, implementing energy-efficient systems, and incorporating renewable energy sources like solar power. They can promote digital resources to reduce paper consumption, host sustainability-focused educational programs, and create green spaces that support biodiversity. Additionally, libraries can adopt circular economy principles by recycling materials, offering tools for eco-friendly projects, and facilitating community initiatives focused on sustainability and climate action.” (Respondent #38)

The United Nations Brundtland Commission defined sustainability in 1987 as “meeting the needs of the present without compromising the ability of future generations to meet their own needs” ([United Nations, n.d.](#)). The commitment to sustainability in libraries gained traction following the 1990 Talloires Declaration, which urged academic institutions to adopt sustainable practices and adopt a greener approach ([Kurbanoglu & Boustany, 2014](#)). The American Library Association (ALA) later adopted a resolution at its 2019 Mid-winter Meeting, declaring sustainability a core value of librarianship. According to ALA, “to be truly sustainable, an organization or community must embody practices that are environmentally sound, economically feasible, and socially equitable” ([Rebekkah, 2019](#)).

One respondent stated, “They [Libraries] can adopt green building practices, use energy-efficient tech, and promote digital resources for sustainability.” Other statements also emphasized the importance of reducing waste, repairing old books, and promoting recycling, all of which support library sustainability. Students’ emphasis on sustainability may reflect the generational values around environmental issues.

The concept of sustainability in libraries aligns with the “green library” model, which refers to a library that is “environmentally friendly” ([Chalukya & Pagore, 2022](#)). According to [Vijayalaxmi \(2010\)](#), every green library must have characteristics such as the use of natural, recycled, and locally available materials; use of reflecting roof and ground; use of insulating windows, water, energy, and paper maintenance; use of energy-efficient lighting to

reduce consumption; system for optimized cooling; appropriate plantation both inside and outside the building; circulation of fresh and healthy air; use of environmentally friendly technology. As libraries adopt sustainability practices, they reduce waste, maximize the use of renewable resources, and operate more cost-effectively (Chalukya & Pagore, 2022).

4.5. Ethical Considerations

Artificial intelligence (AI) has gained significant traction in recent years. Undoubtedly, AI will play a role in academic and public libraries. However, implementing artificial intelligence (AI) can pose various ethical issues that cannot be overlooked. These issues include privacy, biases, transparency, intellectual freedom, equity, and accessibility. Although the survey included an explicit question related to “privacy,” it did not include any explicit questions related to the other ethical considerations. However, a brief discussion of the other topics is also provided below.

4.5.1. Privacy

In response to the survey item, “There will be privacy concerns in the libraries of the future due to the pervasiveness of technology,” thirty-nine (60%) of the participants either strongly agreed or agreed that they have privacy concerns, while sixteen (24.5%) were neutral. This raises an important concern regarding users’ privacy. According to the Library Bill of Rights by the American Library Association (ALA, n.d.), “All people, regardless of origin, age, background, or views, possess a right to privacy and confidentiality in their library use. Libraries should advocate for, educate about, and protect people’s privacy, safeguarding all library use data, including personally identifiable information.” This raises the question of the extent to which predictive analytics can be utilized in the library ecosystem without compromising users’ privacy and confidentiality.

Through machine learning, artificial intelligence processes vast amounts of data to identify and predict patterns, enabling predictive analytics to offer personalized recommendations, optimize resource allocation, and enhance services. However, this capability relies heavily on user data, which introduces significant privacy risks. Personal information, when mishandled, can be exploited for unethical purposes, making data protection a central concern. Libraries, as long-standing guardians of privacy, face the challenge of striking a balance between upholding their ethical commitment to user confidentiality and exploring the potential of predictive analytics to enhance user experiences.

To address this tension, libraries must implement stringent safeguards to protect user data using AI-driven tools. Ensuring anonymous interactions with AI systems (Ajakaye, 2022) can reduce the risk of exposing personally identifiable information. At the same time, predictive analytics models should be designed to rely on de-identified data where possible. Libraries must also educate users about how their data is utilized and involve them in decisions about data sharing.

4.5.2. Bias

AI bias occurs when systems reflect and reinforce societal inequalities from biased training data, flawed algorithms, or skewed predictions. AI systems have been known to exhibit biases, as seen in healthcare systems, application tracking systems, and image generation, among other areas (IBM Data and AI Team, 2023). If AI bias is not addressed, it can undermine trust, limit the potential of AI, and perpetuate disparities, particularly for marginalized groups (Sreerama & Krishnamoorthy, 2022). There may also be a potential for bias in AI’s recommendation system, as it may favor certain authors or institutions and exclude others, potentially affecting specific demographics. Biased AI could misrepresent or exclude diverse voices, skewing cataloging and recommendations toward dominant perspectives. For instance, algorithms trained predominantly on Western scholarship might

marginalize non-Western works. The effectiveness of recommendation systems is only as good as the dataset and algorithms used; hence, any bias in them would only lead to a bias in the recommendation system.

4.5.3. Transparency

There are known issues related to AI recommendation transparency (Govea et al., 2024). For AI systems to be considered ethical, they must maintain transparency that allows users and stakeholders to comprehend how decisions are made (Božić, 2024). There is generally a lack of clarity regarding the data and logic used in decision-making, often referred to as the “black box” in AI (Rudin, 2019). The opacity of these systems can create hesitancy among users, making them less inclined to trust or adopt AI-driven outputs (Božić, 2024). Library patrons may also question the rationale behind a recommendation and require an explanation. It is, therefore, imperative that transparency is prioritized to include information on the system’s accuracy, fairness, and the role of human oversight, with explainability to justify the individual decisions made by the system when making recommendations.

4.5.4. Intellectual Freedom

AI systems have been known to censor or block information that falls under the category of free speech (Ali & Kumar, 2024). AI technologies are widely used to automatically detect and remove harmful or inappropriate content, such as hate speech, misinformation, and violent imagery, at a scale and speed beyond the capabilities of human moderators. While these systems effectively reduce the spread of harmful content, they also raise significant concerns about censorship, biases, and the erosion of free speech (Ali & Kumar, 2024).

A primary issue with AI-driven content moderation is the potential for overreach, where legitimate expression may be mistakenly flagged and removed. The opacity of AI algorithms and the lack of transparency in moderation practices often make it challenging for users to understand or contest decisions regarding content that has been removed. Additionally, AI systems can unintentionally reinforce existing biases, disproportionately impacting marginalized groups and exacerbating social inequalities.

In the context of libraries, these challenges can extend to AI-powered tools such as chatbots used for research or finding relevant literature. For example, content moderation algorithms may incorrectly flag legitimate academic resources as inappropriate or harmful, constraining users’ access to critical information. While AI in content moderation is essential for safeguarding privacy by minimizing human review of sensitive communications, these limitations highlight the need for careful calibration and oversight to ensure that AI systems uphold users’ rights to access information without unjust restrictions.

5. Contextual Reflection of the Findings

The current study offers insights into the current usage of an academic library and students’ visions for the future library. Since this study was conducted at a Midwestern Research University in the United States, the results may be influenced by the physical context of the University, students’ experiences, and their demographics. Similarly, the phrasing of some of the questions may have influenced the students’ responses; for example, some open-ended questions may have encouraged students to think more imaginatively and consider future possibilities rather than being grounded in current educational, operational, and economic realities.

As we know, various societal, cultural, economic, and other factors can influence a person's norms, values, and views. While there is nothing wrong with this, it is worth noting that the current context of the study and the recent surge in AI technologies may have influenced how the participants responded. Had this study been conducted in a different region of the United States, in a different country, or on another continent, the findings of such studies would have also been influenced by the context and the participants' backgrounds. This shows the significance of interpreting students' responses as perceptions that are shaped by their context and realities.

The study provided some insight on a few different topics, such as (a) current library utilization, (b) user experience, (c) students' vision of the future library, and (d) some ethical considerations. These topics are interrelated and, individually and collectively, provide meaningful insight to the decision-makers. For example, the current library's utilization can inform the stakeholders of some of the library's resource utilization patterns and the potential rationale behind them. The data on the library utilization can be used to enhance the user experience (UX) by addressing potential usability or marketing issues. The students also envision the future library as having various resources and technologies that may address some of the current gaps that they may have experienced. However, integrating technical and non-technical resources would require appropriate ethical and UX considerations. Additionally, simply addressing the ethical and UX considerations may not be sufficient because students may not utilize the innovations if they are not aware of them; hence, careful marketing campaigns become important. Last but not least, such ongoing evaluations are important so that libraries can provide relevant resources that students can use to be successful in their academic journeys.

6. Conclusions

This study aimed to understand the current utilization of the library and how participants envision future academic libraries. Both qualitative and quantitative analysis techniques were used, including thematic coding, descriptive statistics, and inferential analysis. This study presents original empirical evidence on students' visions for academic libraries, highlighting their interests in AI, AR/VR, and sustainability considerations. The study highlights the importance of user experience (UX) in the design and development of libraries and their services. A positive user experience (UX) could lead to the success of library patrons. Cutting-edge technologies will be an integral part of the future of libraries, but ethical considerations, such as bias, transparency, and user privacy, must also be taken into account.

6.1. Recommendations

The following recommendations are based on the current findings:

1. Institutions should develop ethical frameworks and usage policies that address the integration of AI.
2. Institutions should engage students in digital literacy efforts that help them understand and navigate emerging technologies within the library ecosystem.
3. To ensure the usability of library resources, ongoing usability testing and user experience studies should be integrated into the libraries' operational practices.
4. There should be increased collaborative partnerships among library staff, technologists, and instructional designers to enhance user-centered service delivery in alignment with evolving digital expectations.

6.2. Limitations and Future Research

The current study has certain limitations, including a relatively small sample size within a specific age range, primarily consisting of students, and most participants being STEM majors. Therefore, the following conclusions were drawn:

1. Future studies should be conducted with a more diverse audience, taking into account their personal, professional, and academic backgrounds.
2. Future studies should also include faculty and staff.
3. Future studies should be conducted with larger samples to uncover potential trends and relationships among various variables, such as demographic factors and their opinions on technology adoption.
4. An in-depth qualitative and quantitative study should be conducted to understand the potential uses and benefits of augmented reality and virtual reality in libraries.

In Simon Wells' 2002 movie *The Time Machine*, the main character encounters a holographic AI librarian at the library who converses with him and provides various recommendations. The holographic AI librarian is connected to all the world's databases. With the advances in AI and holographic technology, such ideas may become a reality sooner than expected. However, extensive planning and testing are required to implement such technology. With any new technology, one must consider all the positives and negatives before implementing it.

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Abbreviations

The following abbreviations are used in this manuscript:

AI Artificial Intelligence
VR Virtual Reality
AR Augmented Reality

Appendix A

Survey Instrument

1. Sex
 - a. Male
 - b. Female
 - c. Other
 - d. Prefer not to say
2. Age
 - a. 18–20
 - b. 21–25
 - c. 26–30
 - d. 31–35

- e. 36–40
 - f. 41–45
 - g. 46–50
 - h. 51–55
 - i. 56–60
 - j. 61–65
 - k. 66–70
 - l. 70+
3. Degree level
- a. Certificate
 - b. Undergraduate
 - c. Graduate (Master's)
 - d. Doctoral
 - e. Other
4. Pursuing education
- a. Part time
 - b. Full time
 - c. Currently not pursuing higher education
5. When did you last attend higher education?
- a. Currently attending college or university
 - b. Last attended 1–5 years ago
 - c. Last attended 6–10 years ago
 - d. Last attended 11–15 years ago
 - e. Last attended more than 16 years ago
6. Degree Major
- a. STEM
 - b. Liberal Arts
 - c. Education
 - d. Other
7. Country
- a. Type or [Drop Down Menu] of all countries
8. State/Province
- a. Type or [Drop Down Menu] of associated states/provinces
9. What is your race?
- a. Asian
 - b. Black or African American
 - c. Hispanic or Latino
 - d. White
 - e. Native American or Alaska Native
 - f. Native Hawaiian or Other Pacific Islander
 - g. Multiracial
 - h. Other
 - i. Prefer not to say
10. On a weekly basis, I visit the library approximately ____ time(s)
- a. 0
 - b. 1–3
 - c. 4–6

- d. 7–10
 - e. 11+
11. How often do you use online resources provided by the library?
 - a. Never
 - b. Rarely
 - c. Occasionally
 - d. Often
 - e. Always
 12. How would you rate your technology proficiency?
 - a. Not proficient (I need someone to help me with technical issues)
 - b. Somewhat proficient (I can troubleshoot 30% of the problems myself)
 - c. Proficient (I can troubleshoot 60% of the technical issues myself)
 - d. Highly proficient (I can troubleshoot 90% of the technical issues myself)

Current Library

Item	SD, D, N, A, SA
1. The library provides a physical environment that allows students to engage in academic activities.	
2. The library offers me personalized services to engage in academic activities.	
3. I am aware of all the services that the library provides.	
4. I am satisfied with all of the services that the library provides.	
5. I am satisfied with the book collection that the library offers.	
6. I am satisfied with the makerspace facility provided by the library.	
7. I am satisfied with the computing resources provided by the library.	
8. It is easy to find the resources that I need in the library.	
9. My current college or university library uses up to date technologies.	
10. My current college or university library provides useful technologies.	
11. The library provides instructions on how to use the library technologies.	
12. The library provides technology-centered collaboration spaces.	
13. The library provides a quiet space for personal contemplation, reflection, meditation, prayer, or relaxation.	

Open Ended Questions

1. How do you currently utilize the library (e.g., for studying only, using library computer, to use specific service, to use specific technology, etc.). Please provide as much detail as possible.
2. What improvements, if any, would you suggest for the library's services?
3. What additional services would you like to see in the library?
4. Any other feedback or comments that you would like to share about your current library?

Libraries of the Future

Item	SD, D, N, A, SA
1. Libraries of the future will utilize advanced technologies	
2. There will be privacy concerns in the libraries of the future due to pervasiveness of technologies.	
3. Libraries will utilize artificial intelligence	
4. Libraries will prioritize digital resources over print materials	
5. Libraries will offer remote access for all of their services.	
6. The library will implement robot librarians.	
7. The library patrons will need to have a certain level of technology competency to effectively utilize the library resources.	
8. Libraries will have technologies and services to support virtual reality, mixed reality, and augmented reality meetings.	
9. The library will utilize augmented reality to provide a personalized user experience.	
10. I would be interested in personalized services to engage in academic activities.	

Open-Ended Questions

1. How do you envision the libraries of the future?
2. How do you envision the physical spaces of the libraries of the future?
3. How would the library of the future serve its patrons or students?
4. What technologies do you think will play a significant role in the libraries of the future?
5. How will libraries utilize artificial intelligence?
6. What technologies will be available for collaborative spaces in the future?
7. What will a study space look like for a student in the future?
8. What will be the format of information resources (Books, Magazines, etc.) in the library of the future?
9. How do you anticipate digital resources and e-books evolving in the libraries of the future?
10. What are services that libraries will provide in the future that are not provided now?
11. What would you like to see in the library of the future?
12. What would you like to see in the library of the future in terms of technology?
13. What would you like to see in the library of the future in terms of services?
14. Do you prefer digital or print resources? Why?
15. What type of collaborative spaces would you like to see in the library of the future?
16. What is your vision for the library of the future?
17. Do you think there will be an emphasis on online or virtual library services of the future?
18. How do you believe future libraries can become more inclusive and accessible to a diverse range of users?
19. In what ways future libraries can contribute to environmental sustainability?
20. What do you think the library of the future will actually look like? This question is not about how you envision the library should look but how it will actually be.

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