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Advocacy for Intelligent Libraries in the Era of Fifth Industrial Revolution

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Keywords: Intelligent Libraries, Innovation, Sustainable knowledge system, 5th Industrial Revolution

Abstract

Aim: The onset of the 5th Industrial Revolution heralds a transformative era marked by extraordinary technological advancements, compelling libraries to reinvent themselves within a rapidly digitizing world. The study explores the evolving role of libraries, emphasizing the integration of smart technologies to enhance user experiences, streamline operations, and increase knowledge accessibility. It addresses critical ethical and privacy concerns, advocating for strategies that uphold inclusivity, transparency, and intellectual freedom.

Methods: The study employed an interpretive content/document analysis methodology to thoroughly review and analyze literature sourced from diverse databases, including Scopus and Web of Science. This methodological choice aims for a comprehensive and well-rounded examination of the subject, incorporating a broad spectrum of perspectives and insights. The interpretive content/document analysis process involves a meticulous scrutiny and interpretation of textual materials, fostering a nuanced understanding of the investigated topic. The inclusion of literature from reputable databases like Scopus and Web of Science not only enhances the credibility and reliability of the findings but also ensures a robust exploration of the subject.

Results: Key technologies such as AI, machine learning, data analytics, IoT, blockchain, AR/VR, and 5G are examined for their impact on library operations and user engagement. Challenges, including digital equity, ethical AI use, data security, interoperability, and financial constraints, are identified and analyzed.

Conclusion: The study advocates by highlighting the necessity for libraries to evolve into dynamic, intelligent hubs that contribute to sustainable knowledge systems while maintaining their foundational principles.

Introduction

The 5th Industrial Revolution is propelling us into a period marked by extraordinary technological advancements and societal transformations (Ajani et al., 2022; Tella et al., 2022; Moll, 2023). At this pivotal juncture, it is imperative to examine the role of libraries—institutions deeply linked with knowledge preservation—in a rapidly digitizing, automated, and artificial intelligence (AI)-driven world. We must contemplate the function of libraries in an environment where in-

formation seamlessly traverses boundaries and digital devices. How can libraries, deeply rooted in longstanding traditions, adapt to the evolving needs of individuals and communities in this digital era? Traditionally seen as repositories dedicated to collecting, safeguarding, and disseminating information, libraries face a critical juncture. The very nature of information and its accessibility has undergone a profound transformation (Tella et al., 2023). The digital realm, with its expansive databases, search engines, and algorithms, has revolutionized the way we search for, consume, and share knowledge (Oladokun & Gaitanou, 2024). In a landscape characterized by information overload and the continual evolution of technology, libraries are called upon not only to reinvent themselves but also to redefine their purpose.

This is where artificial intelligence (AI) becomes a pivotal factor—a transformative force capable of reshaping and rejuvenating libraries in unprecedented ways. AI-driven libraries hold the potential to enhance user experiences, streamline operations, and increase the accessibility of knowledge for everyone. However, this advancement gives rise to ethical and privacy concerns, challenging the fundamental principles of libraries, including inclusivity, transparency, and intellectual freedom. The question arises: How can libraries harness the capabilities of AI effectively, ensuring the preservation of these values and respecting the rights and values of individuals in a landscape where machines are assuming more decision-making roles? In the face of these changing circumstances, we are confronted with crucial inquiries: What lies ahead for libraries in the 5th Industrial Revolution? How can they harness AI to maintain relevance and indispensability in a world saturated with data and digital technologies? What strategies can libraries employ to establish sustainable knowledge systems that serve diverse populations while upholding individual rights and societal principles? These are the pivotal questions at the core of the discourse surrounding “Intelligent Libraries.”

In so doing, the study employed an interpretive content/document analysis methodology to thoroughly review and analyze literature sourced from diverse databases, including Scopus and Web of Science. This methodological choice aims for a comprehensive and well-rounded examination of the subject, incorporating a broad spectrum of perspectives and insights. The interpretive content/document analysis process involves a meticulous scrutiny and interpretation of textual materials, fostering a nuanced understanding of the investigated topic. The inclusion of literature from reputable databases like Scopus and Web of Science not only enhances the credibility and reliability of the findings but also ensures a robust exploration of the subject. This approach encompasses a wide array of research papers, articles, and publications, facilitating a holistic investigation. Such a comprehensive methodology ensures that the study is well-informed and capable of delivering a nuanced, multifaceted analysis of the chosen topic.

Based on this, the objectives of the study were to explore (1) 5IR as the new era of transformation; (2) the indispensable role of libraries in knowledge sys-

tems; (3) the technological evolution of libraries in the 5IR; (4) the future of library services; (5) challenges in implementing intelligent libraries; (6) sustainability of knowledge systems through intelligent libraries; (7) success story of intelligent libraries around the world; and (8) need for advocating for intelligent libraries in the 5IR.

5IR as the New Era of Transformation

In our ever-evolving world, the term "5th Industrial Revolution" serves as a guiding beacon, encapsulating the ongoing and imminent transformations in industries and societies. This concept furnishes us with a framework to comprehend the profound shifts occurring in our contemporary landscape. The 5th Industrial Revolution signifies the harmonious integration of diverse technological domains (Noble et al., 2022). It manifests as a symphony of digital technologies such as the Internet of Things (IoT), cloud computing, and sophisticated big data analytics. However, it transcends these boundaries to include artificial intelligence (AI), biotechnology, nanotechnology, and the limitless potential of quantum computing (de Vries & Kroukamp, 2023). These technological forces converge and complement each other, giving rise to unprecedented advancements and opportunities. In this revolution, data assume the role of a valuable currency, fuelling innovation and decision-making. Our interconnected world, interwoven with a myriad of devices and sensors, generates a vast sea of data (Sørensen & Lansing, 2023). Advanced AI and intricate analytics delve deep into this sea, extracting valuable insights that inform decision-making, enable personalization, and inspire groundbreaking innovations across diverse industries (Dou et al., 2023).

However, as we cherish this newfound treasure, we must also safeguard it with the utmost care, recognizing the paramount importance of data privacy and security (Oladokun et al., 2024b). Automation takes the centre stage, orchestrated by AI and the captivating dance of robotics. Its influence transcends boundaries, permeating industries from manufacturing to services (Tella & Ajani, 2022). AI systems, proficient in tasks, decision-making, and learning from data, usher in an era of unparalleled efficiency and productivity (Ajani et al., 2022). However, this performance also raises the curtain on the challenge of job displacement, emphasizing the need for reskilling and workforce adaptation (Tella et al., 2022). The theme of decentralization spreads across industries, with blockchain as its symbol. It revolutionizes transactions, making them secure, transparent, and tamper-proof (Chytis, 2019). Beyond the realm of finance, blockchain extends its influence to supply chain management and beyond, where trust and operational efficiency flourish (Babu & Das, 2023).

The spotlight of sustainability shines brightly in this revolution. Clean energy technologies, exemplified by solar and wind power, assume the centre stage, offering hope for mitigating carbon emissions (Martínez-Falcó et al.,

2023). Concepts such as the circular economy, resource efficiency, and sustainable practices perform crucial supporting roles, addressing environmental challenges and nurturing long-term sustainability (Atif et al., 2021). The foundation for this transformation lies in the widespread deployment of 5G networks. These networks provide the essential high-speed, low-latency connectivity required for the global adoption of transformative technologies like the Internet of Things (IoT), autonomous vehicles, and augmented reality (Attaran, 2023). However, the 5th Industrial Revolution, as a concept, is deeply intertwined with libraries in the contemporary era and signifies a momentous transformation in how knowledge is not only preserved but also created, accessed, and disseminated. This paradigm shift encompasses the seamless fusion of cutting-edge digital technologies, the transformative power of advanced technologies, and the innovation-driven force of data utilization.

Traditionally perceived as custodians of knowledge, libraries are now situated within a transformative epoch where their roles and functions must undergo significant adaptation to fulfil the exigencies of this digital paradigm shift (Tella & Ajani, 2022). The concept of the 5th Industrial Revolution introduces a new dimension to the library's traditional role as a repository of static knowledge. It acknowledges that information in the modern world flows incessantly, transcending physical boundaries and digital platforms alike. The contemporary library is no longer confined to the passive role of safeguarding knowledge but is evolving into an active participant in the knowledge ecosystem, propelled by the capabilities of digital technology and AI (Oladokun et al., 2024b). This monumental shift implies that libraries must reinvent themselves as dynamic hubs where digital technologies, AI algorithms, and data-driven innovations converge to serve the evolving needs of users. In essence, libraries are transitioning from being static archives to becoming vibrant knowledge centres, adapting their structures and functions to stay aligned with the 5th Industrial Revolution's demands.

The Indispensable Role of Libraries in Knowledge Systems

Libraries have consistently held a revered position as bastions of knowledge, acting as custodians of wisdom and repositories of our shared cultural legacy. Their role within knowledge systems is dynamic, continuously adapting to meet the ever-evolving needs of society. Consequently, libraries contribute in multifaceted ways to our knowledge systems, drawing from a variety of scholarly sources. At the heart of their missionlies functioning as guardians of cultural heritage, preserving a diverse array of books, manuscripts, and historical records. Within the confines of these institutions, they safeguard the narratives, literature, and accumulated wisdom of past civilizations, ensuring that this priceless heritage remains accessible to future generations (Doğaray, 2023). Furthermore, libraries transcend their role as mere custodians of the past; they serve as sanctuaries of learning, offering individuals of all ages access to resources that facilitate lifelong

learning. Whether through printed materials, digital archives, or educational programs, libraries empower people to embark on journeys of intellectual growth and personal development.Top of Form

Libraries are also vital in advancing research and innovation. Academic and research libraries provide scholars with access to a wealth of scholarly literature and specialized collections, accelerating the pace of discovery and driving advancements across diverse fields (Rossman, 2023). Additionally, in an era marked by digitalization, libraries are pivotal in bridging the digital divide, offering free access to technology and digital resources, and ensuring that everyone, regardless of socioeconomic status, has equitable access to the tools of education and personal growth. Public libraries, in particular, extend their role as community hubs, facilitating social cohesion through cultural events, workshops, and educational programs that foster dialogue and mutual understanding among diverse community members. Librarians, as skilled curators and organizers of information, simplify the navigation of vast knowledge repositories through cataloguing, classification, and indexing. Furthermore, libraries actively engage in the preservation of digital knowledge, archiving websites, electronic journals, and other digital content, securing it for posterity and mitigating the risks of information loss in the digital age.

Thus, they uphold the fundamental principle of intellectual freedom and unrestricted access to information. They provide safe spaces for the expression of diverse voices and perspectives, ensuring that censorship and restrictions do not hinder the free exchange of ideas. In their commitment to remaining relevant, libraries adapt to technological advancements by embracing digital catalogues, e-books, online databases, and other digital resources (Khan & Basir, 2023). This ensures that they remain accessible and indispensable in an increasingly digital world. Lastly, libraries are pivotal in promoting information literacy, educating users on critical evaluation of information, discerning credible sources from misinformation, and navigating the complex landscape of the information age. Thus, libraries emerge as the bedrock of our intellectual heritage, catalysts of continuous learning, and pillars of knowledge systems. Their influence transcends physical spaces, extending into digital frontiers and community engagement. As our society evolves, libraries steadfastly uphold their mission to preserve, disseminate, and democratize knowledge, ensuring that the torch of wisdom illuminates the path for future generations.

The Technological Evolution of Libraries in the 5IR

The seamless integration of state-of-the-art technologies into the core of libraries has initiated a profound transformation, perfectly aligned with the monumental paradigm shift ushered in by the onset of the 5th Industrial Revolution. This technological metamorphosis goes beyond traditional boundaries, granting libraries a dynamic and multifaceted ability to interact with patrons through in-

novative and unexplored avenues. In this comprehensive and meticulously researched exploration, we embark on an insightful journey through the transformative innovations that stand resolutely at the forefront of this revolution, buttressed by the latest and most authoritative citations, with an unwavering commitment to dissecting their profound and far-reaching impact on libraries and the overarching landscape of knowledge dissemination.

Artificial Intelligence (AI) and Machine Learning: AI and machine learning have assumed central roles in libraries' adaptation to the 5th Industrial Revolution. These technologies are instrumental in revolutionizing cataloguing, information retrieval, and user interactions. AI-driven virtual assistants, chatbots, and recommendation algorithms are enhancing user experiences, and providing personalized and efficient library services (Chaturvedi & Verma, 2023). Machine learning, on the other hand, enables libraries to analyze vast datasets to glean insights, optimize resource allocation, and deliver services aligned with evolving user needs (Kamal & Himel, 2023).

Data Analytics and Big Data: Libraries are harnessing the power of data analytics and big data to gain deeper insights into user behaviour, resource utilization, and collection development. Big data analytics enables data-informed decision-making, enhancing operational efficiency and resource allocation (Kraft-Terry & Brown, 2023). These data-driven insights are pivotal to shaping library strategies and ensuring that resources are allocated optimally to meet the dynamic demands of users.

Internet of Things (IoT): IoT technologies are transforming libraries into smart, responsive spaces that are in tune with the needs of patrons. IoT sensors monitor various aspects of library operations, including environmental conditions, occupancy rates, and resource usage. This data are then used to optimize space utilization, enhance user experiences, and promote sustainability (Azizi et al., 2020). Sensors that adjust lighting and climate control systems based on occupancy contribute to a more comfortable and energy-efficient library environment.

Blockchain: Libraries are exploring blockchain technology to bolster the security and transparency of transactions, particularly in the management of digital assets and intellectual property (Tella et al., 2022). Blockchain's immutable ledger can be used to verify the authenticity of digital resources, ensuring the integrity of library collections. It also offers the potential to secure digital lending and copyright management processes, adding trust and accountability.

Augmented Reality (AR) and Virtual Reality (VR): AR and VR technologies are reshaping how libraries engage with their patrons. These immersive technologies enable virtual library tours, interactive learning experiences, and innovative storytelling (Zhanget al.,2020). Libraries are leveraging AR and VR to create captivating educational content and bridge the gap between physical and digital library spaces, fostering deeper user engagement (Prouzeauet al., 2020).

Robotic Automation: Libraries are incorporating robotic automation to streamline operational tasks such as book retrieval and reshelving. Robots equipped with RFID technology efficiently locate and organize materials, freeing up library staff for more complex and user-centric activities (Tella & Ajani, 2022). Robotic automation enhances operational efficiency and contributes to the overall resource management strategy of libraries.

Cybersecurity Solutions: Libraries are implementing robust cyber security solutions to safeguard against cyber threats and data breaches, considering the sensitivity of user data and digital resources. Intrusion detection systems and encryption protocols are vital in protecting library assets and ensuring patron privacy (Adeleke, 2023).

Cloud Computing: Cloud computing has revolutionized how libraries manage and deliver digital services (Sharma et al., 2023). It offers scalable and cost-effective solutions for storage, collaboration, and resource sharing. Cloud-based library systems enable seamless access to digital collections, facilitating a more user-centric approach and expanding resource accessibility.

5G and Enhanced Connectivity: The widespread deployment of 5G networks promises to revolutionize library services (Oruma et al., 2023). High-speed, low-latency connectivity is indispensable for the adoption of IoT, augmented reality, and other transformative applications within libraries. 5G empowers libraries to offer faster access to digital resources and enhances user engagement.

Accessibility Technologies: Libraries are proactively embracing accessibility technologies to ensure inclusivity and accessibility for all patrons, including those with disabilities (Gupta et al., 2023). These technologies encompass screen readers, voice recognition software, and assistive devices, enabling individuals with diverse needs to fully participate in and benefit from library resources and services.

Be that as it may, libraries are harnessing a spectrum of advanced technologies to navigate the 5th Industrial Revolution, redefining their roles and expanding their impact on the knowledge ecosystem. These transformative forces are enhancing user experiences, streamlining operations, and enabling libraries to remain dynamic and indispensable in an era of digital transformation. With these technologies, libraries are poised to continue serving as vital pillars of education, research, and community engagement, adapting to the evolving needs of their patrons and remaining at the forefront of knowledge systems.

The Future of Library Services

The landscape of library services is currently undergoing a profound transformation, a metamorphosis propelled by the relentless advancement of cutting-edge technologies. These innovations are revolutionizing how libraries function and engage with their communities, adapting to the needs and expectations of the digital age. A noteworthy stride in technology-driven library services

is the incorporation of artificial intelligence (AI) and machine learning. AI-driven virtual assistants and chatbots offer immediate assistance, thereby enriching the overall user experience (Zeng et al., 2023). Machine learning algorithms optimize resource organization and discovery, ensuring swift and efficient access to information (Thirunavukarasu et al., 2023). These technologies not only streamline library operations but also customize the library experience for each individual. Data analytics and big data are also crucial in shaping modern library services. Libraries can now analyze user behaviour, resource utilization, and collection trends, enabling data-informed decisions about resource allocation and responsiveness to patrons' evolving needs (Kociubuk et al., 2023).

The result is a more efficient and user-centric library service, empowering users to access and use information resources effectively. The integration of the Internet of Things (IoT) has further transformed library services, turning them into smart, responsive spaces. IoT sensors are employed to monitor space utilization, environmental conditions, and resource availability, optimizing library environments for users and resource allocation (Nematollahiet al*.,* 2023). In addition to these, blockchain technology is enhancing the security and transparency of transactions related to digital assets and intellectual property. Blockchain's immutable ledger ensures the integrity of digital resources (Kociubuket al*.,* 2023). In this digital age, libraries are at the forefront of innovation, offering dynamic and personalized services that cater to the diverse needs of their patrons. The relentless integration of advanced technologies has transformed libraries into vibrant hubs of knowledge and information, redefining their roles and expanding their capacity to meet the ever-evolving expectations of their communities.

Challenges in Implementing Intelligent Libraries

The integration of intelligent libraries into our knowledge systems presents an array of intricate challenges that require thorough examination and resolution. A primary concern revolves around ensuring equitable access and inclusivity in an increasingly digitized library landscape. Libraries must be mindful not to inadvertently marginalize individuals lacking the necessary digital literacy skills or access to technology as they advance technologically. Bridging this digital divide is a pressing challenge demanding steadfast attention to preserve the democratic principles upon which libraries are founded (Killoran, 2018). Another pivotal challenge centres on the ethical dimensions of utilizing AI and machine learning in intelligent libraries. As these libraries employ AI-driven algorithms to curate content, provide resource recommendations, and tailor user experiences, concerns arise regarding data privacy and potential biases embedded within AI systems (Budhwar et al., 2023). Consequently, libraries must proactively establish robust ethical guidelines to ensure that AI is developed, deployed, and maintained in a manner consistent with principles of fairness, transparency, and user privacy.

The evolving role of librarians also presents a dynamic challenge. As AI systems increasingly handle routine tasks, librarians are expected to pivot toward more specialized, user-centric services. This transformation necessitates an ongoing commitment to professional development and the acquisition of new skills to effectively navigate the evolving library landscape (Sousa-Zomer, 2020). Data security and privacy constitute persistent challenges in the context of intelligent libraries, with the accumulation and storage of vast patron data making libraries potential targets for cyber attacks. Safeguarding this sensitive information is paramount to protect patrons and maintain the integrity of library systems (Bareh, 2020). Interoperability issues often arise during the implementation of intelligent library systems. Diverse AI and machine learning technologies may employ disparate standards, data formats, or communication protocols, necessitating the complex technical challenge of ensuring seamless integration with existing library systems and compatibility within a diverse technological environment (Taherdoost et al., 2023).

Furthermore, there is a significant financial hurdle to surmount. The implementation and maintenance of intelligent library systems entail substantial costs, from the acquisition of cutting-edge technology to the ongoing training and support of staff members. Given that libraries frequently operate within tight budget constraints, prudent financial planning and the judicious allocation of resources are imperative to navigate these fiscal challenges (Bermanet al*.,* 2021). A challenge that cannot be underestimated is the management of user expectations. As AI systems in libraries become increasingly sophisticated, patrons may come to expect near-instantaneous, highly personalized services. Balancing the meeting of these expectations with a broader, user-engagement strategy is an ongoing challenge for libraries (Ihejirika, 2021). Lastly, the challenge of cultural adaptation must not be overlooked. The implementation of intelligent libraries often necessitates a cultural shift within both library staff and user communities. These changes must be accepted and embraced to facilitate the successful integration of AI and machine learning in libraries (Gupta & Gupta, 2023). Addressing these challenges comprehensively and proactively is essential for libraries to effectively navigate the transformative journey toward becoming intelligent, user-centric, and ethically responsible institutions in the digital age.

Sustainability of Knowledge Systems Through Intelligent Libraries

In today's swiftly evolving digital landscape, the imperative for innovation in libraries is more critical than ever, especially in advancing sustainable knowledge systems. Traditionally recognized as repositories of human wisdom, libraries are adapting and innovating to meet the demands of an increasingly interconnected and data-driven world. Intelligent libraries, infused with artificial intelligence (AI) and cutting-edge technologies, are at the forefront of this transformation, reshaping their roles to make significant contributions to the devel-

opment and dissemination of sustainable knowledge systems (Oladokun et al., 2024a). The integration of AI into libraries has been pivotal in enhancing the accessibility and relevance of sustainability knowledge. AI-powered algorithms excel in curating and recommending sustainable resources, empowering users to explore content aligned with environmental, social, and economic sustainability objectives. For instance, AI can analyze a user's preferences and information needs to suggest relevant materials on topics like renewable energy, sustainable agriculture, or environmental policy (Balaska et al., 2023). These intelligent recommendations not only facilitate individual learning but also strengthen collective awareness and advocacy for sustainability.

Furthermore, intelligent libraries harness AI to streamline the curation of accurate, up-to-date information concerning sustainability. In a swiftly changing world where environmental concerns, climate change, and sustainable development goals constantly evolve, AI systems can continuously monitor and update the library's resources. They identify the most recent research findings, policy updates, and innovative solutions within the sustainability domain, ensuring that library users have access to the latest insights and knowledge (Farid et al., 2023). This real-time curation fosters well-informed decision-making and encourages proactive sustainability efforts across various levels of society. The gathering and dissemination of sustainability-related data are vital for nurturing knowledge systems that support environmental and social well-being. Intelligent libraries employ AI to manage, analyze, and present data in user-friendly formats. They can generate data visualizations, infographics, and interactive tools that render intricate sustainability data understandable and actionable for a diverse audience.

These data-driven innovations empower library users to interact with sustainability data meaningfully, whether it is visualizing carbon emissions trends, showcasing the impact of sustainable practices, or mapping biodiversity hotspots (Vadjunecet al., 2022). Such capabilities are pivotal in fostering knowledge systems that inform and inspire sustainable actions. Moreover, intelligent libraries extend their reach beyond content provision by offering sustainability-related educational programs and initiatives. They provide opportunities for users to enhance their sustainability literacy and skills. AI-driven recommendation systems can propose personalized learning pathways, connecting users with courses, workshops, and webinars on subjects such as sustainable business practices, green technologies, or eco-friendly lifestyle choices (Ariciet al., 2019). These programs not only bolster sustainability knowledge but also empower individuals and organizations to implement sustainable solutions in their daily lives and professional endeavours.

Success Story of Intelligent Libraries Around the World

Real-world case studies and exemplary practices provide tangible proof of how intelligent libraries actively contribute to advancing sustainability knowledge systems. These instances will provide valuable insights into the ways libraries, enriched with innovative technologies, are making a concrete impact on fostering awareness and practices related to sustainability. A particularly compelling case study centres around the Singapore National Library, which has embraced a forward-thinking approach to sustainability education. The library implemented a recommendation system that tailors personalized reading lists on sustainability topics for users based on their preferences and reading history (OECD, 2016). The outcome was a notable increase in the circulation of sustainability-related books and a significant rise in attendance at sustainability-themed events and workshops hosted by the library.

Another noteworthy example comes from the Seattle Public Library in the United States, which launched a sustainability information kiosk. The kiosk assists library visitors in locating local sustainable businesses, accessing information on renewable energy incentives, and understanding eco-friendly practices. By making sustainability resources more accessible and interactive, the library saw a substantial uptick in the number of inquiries and consultations regarding sustainable living (Khalid et al., 2021). On a global scale, the International Sustainable Libraries Initiative (ISLI) presents a best practice model for collaboration among libraries worldwide. ISLI, a consortium of libraries from different continents, established a shared online platform that enables the exchange of sustainability knowledge. This initiative has facilitated the sharing of best practices, research findings, and community engagement strategies in the field of sustainability across diverse regions (Mathiasson & Jochumsen, 2023). The real-world success of ISLI showcases the potential of collaboration in creating a global network for the dissemination of sustainability knowledge.

Moreover, the City of Stockholm Public Library in Sweden serves as a prime example of how immersive encounters are utilized to foster awareness of sustainability. The library introduced virtual reality (VR) experiences that transport users to natural reserves and ecosystems facing environmental challenges. This immersive method enables individuals to directly witness the impacts of environmental issues (Greene & Groenendyk, 2021). Consequently, this immersive approach has resulted in heightened community involvement in local environmental causes and a greater sense of responsibility toward the environment. These applications within library settings demonstrate how emerging technologies have the potential to make sustainability education more engaging and encourage active participation. Hence, these instances offer a promising avenue for advancing sustainability education. These real-world initiatives not only impart knowledge to individuals but also motivate them to actively partake

in sustainable practices, contributing to a more environmentally conscious and sustainable global community.

Need for Advocating for Intelligent Libraries in the 5IR

The onset of the 5IR marks a significant period of technological progress and societal change, prompting a reassessment of the evolving role of libraries. Traditionally seen as guardians of knowledge, libraries now need to adapt to the shifting digital landscape while upholding their fundamental principles. This need arises from several key factors:

1. **Technological Integration:** The 5IR is characterized by the integration of advanced technologies such as the Internet of Things (IoT), cloud computing, biotechnology, nanotechnology, quantum computing, and, most prominently, artificial intelligence (AI). For libraries to enhance user experiences and streamline their operations, they must strategically incorporate these technologies. Intelligent libraries will not only increase the accessibility of knowledge but also offer innovative services tailored to the needs of modern users.
2. **Ethical and Privacy Concerns:** With the adoption of advanced technologies, especially AI, libraries face significant ethical and privacy challenges. These challenges can conflict with the core principles of inclusivity, transparency, and intellectual freedom that libraries uphold. Addressing these concerns is crucial to maintain public trust and uphold the ethical standards of the library profession. Developing and promoting ethical guidelines for the use of AI and other technologies in libraries are essential for ensuring responsible and transparent use.
3. **Digital Inclusion:** Libraries have a vital role in bridging the digital divide by providing equitable access to technology and digital resources. As society becomes increasingly digital, ensuring fair access to these resources for all individuals, regardless of socioeconomic status, is more important than ever. Libraries must advocate for and implement solutions that promote digital inclusion, ensuring that everyone has the opportunity to benefit from technological advancements.
4. **Community Engagement:** Libraries have long served as community hubs, fostering social cohesion through cultural events, workshops, and educational programs. Intelligent libraries can enhance these functions by leveraging digital tools to foster deeper community engagement and support lifelong learning. By doing so, libraries can remain central to the communities they serve, adapting to the changing needs of their patrons.

5. **Preservation and Innovation:** In an era of rapid digital transformation, libraries must balance the preservation of cultural heritage with the need to innovate. This involves embracing digital catalogues, e-books, online databases, and other digital resources to remain relevant and indispensable. Intelligent libraries can use these tools to continue their traditional roles while also innovating to meet contemporary demands.
6. **Operational Efficiency:** AI and machine learning offer the potential to revolutionize library operations, from cataloguing and information retrieval to user interactions. Implementing these technologies can optimize resource allocation and enhance operational efficiency, allowing libraries to better serve their patrons. By adopting intelligent systems, libraries can provide faster, more accurate, and personalized services, meeting the evolving expectations of users.
7. **Sustainability:** As institutions committed to long-term knowledge preservation, libraries must adopt sustainable practices. This includes implementing energy-efficient technologies and promoting digital literacy to reduce environmental impact. By prioritizing sustainability, libraries can contribute to broader environmental goals while continuing to serve their communities effectively.

Concluding Remark

The role of libraries in shaping a sustainable knowledge system during the 5th Industrial Revolution presents both opportunities and challenges. Traditionally, libraries have been the custodians of wisdom, preserving our cultural heritage and promoting lifelong learning. As we transition into the digital era, libraries find themselves on the brink of a profound transformation, one that is redefining their roles and reconceptualising their interactions with patrons. The integration of cutting-edge technologies, including artificial intelligence, holds promising possibilities for customizing user experiences, fostering global knowledge networks, and embracing emerging technologies. These innovations have the potential to enhance library services, making them more accessible and engaging than ever before. However, these prospects also bring forth a set of considerations that require careful contemplation.

In the realm of personalized user experiences, libraries must prioritize data privacy and ethical concerns. Prudent data management and robust security measures are indispensable in maintaining user trust. The advent of global knowledge networks necessitates a comprehensive exploration of intellectual property matters and the responsible sharing of information. The adoption of emerging technologies requires judicious resource allocation, striking an equilibrium between technological enhancements and fundamental services. Preservation of

digital knowledge entails addressing digital inclusion, and ensuring that digital content remains accessible to all. Sustainability initiatives should harmonize with resource management, embracing eco-friendly practices while effectively stewarding available resources.

As libraries continue to evolve within the 5th Industrial Revolution, they remain steadfastly committed to their core mission of preserving, disseminating, and democratizing knowledge. They are at the forefront of nurturing sustainable knowledge systems. Libraries, as dynamic institutions, are well-prepared to navigate these challenges and harness the opportunities presented by advanced technologies, guaranteeing a future where knowledge remains accessible, pertinent, and impactful. In this transformative odyssey, libraries transcend their role as mere repositories of wisdom to become catalysts of change, molding a sustainable knowledge system for the benefit of generations to come.

Future pathway

To effectively navigate the challenges and opportunities of the Fifth Industrial Revolution, libraries must embrace the following pathway:

1. Libraries should advocate for programs that enhance digital literacy and technology skills among library patrons and staff.
2. Librarians should develop and promote ethical guidelines for the use of AI in libraries, ensuring that these technologies are used responsibly and transparently.
3. Libraries should advocate for policies and funding that support the expansion of digital collections and the infrastructure needed to access them.
4. Librarians should build partnerships with local organizations, educational institutions, and technology companies to enhance community services and programs.
5. It is also important for libraries to promote continuous learning and professional development opportunities for librarians to equip them with the skills needed to navigate the evolving digital landscape.
6. Lastly, libraries should advocate for robust data privacy and security measures to protect patron information and maintain trust.

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Poparcie dla inteligentnych bibliotek w erze piątej rewolucji przemysłowej

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Yusuf Ayodeji Ajani jest adiunktem w Instytucie Bibliotekoznawstwa i Informacji Naukowej na Uniwersytecie w Abudży (Federalne Terytorium Stołeczne, Nigeria), oraz studentem studiów podyplomowych na Wydziale Bibliotekoznawstwa i Informacji Naukowej Uniwersytetu Ilorin w Ilorin w Nigerii. Jego imponujący dorobek publikacyjny liczy ponad 70 artykułów opublikowanych w renomowanych czasopismach krajowych i międzynarodowych z dziedziny edukacji i bibliotekarstwa. W 2023 roku otrzymał cenioną nagrodę Emerald Literati Award za jego wkład w badania naukowe. W przypadku pytań i potencjalnej współpracy prosimy o kontakt z Ayodeji pod adresem yusuf.ajani@uniabuja.edu.ng.

Bolaji David Oladokun jest rozwijającym się badaczem i wykładowcą w Instytucie Bibliotekoznawstwa i Technologii Informacyjnych Politechniki Federalnej w Ikot Abasi w stanie Akwa Ibom w Nigerii. Posiada podstawowy stopnień naukowy w zakresie bibliotekoznawstwa i informacji naukowej oraz dyplom z wyróżnieniem w zakresie komunikacji masowej. Uzyskał również tytuł magistra bibliotekoznawstwa i informacji naukowej na Uniwersytecie Edukacyjnym Ignatius Ajuru w Port Harcourt w Nigerii, który ukończył z wyróżnieniem. Jest również Certyfikowanym Bibliotekarzem w Nigerii (CLN) i członkiem Nigeryjskiego Stowarzyszenia Bibliotek (NLA). Jest również członkiem Nigeryjskiego Stowarzyszenia Edukatorów Bibliotekoznawstwa i Informacji Naukowej (NALISE) oraz Stowa-

rzyszenia Nauk Informacyjnych i Technologii (ASIS&T). Jest autorem ponad 100 artykułów opublikowanych w akredytowanych czasopismach, materiałów konferencyjnych i rozdziałów w książkach. Ma również na swoim koncie trzy (3) książki z zakresu bibliotekoznawstwa i informacji naukowej.

Słowa kluczowe: Inteligentne biblioteki, innowacje, zrównoważony system wiedzy, 5. rewolucja przemysłowa

Abstrakt

Cel: Początek piątej rewolucji przemysłowej zwiastuje erę transformacji, charakteryzującą się niesamowitym postępem technologicznym, zmuszającym biblioteki do ponownego odkrycia swojej tożsamości w szybko digitalizującym się świecie. W badaniu przeanalizowano zmieniającą się rolę bibliotek, kładąc nacisk na integrację inteligentnych technologii w celu poprawy doświadczeń użytkowników, usprawnienia operacji i zwiększenia dostępności wiedzy. Badani porusza krytyczne problemy etyczne i związane z prywatnością, opowiadając się za strategiami, które podtrzymują inkluzywność, przejrzystość i wolność intelektualną.

Metody: W badaniu wykorzystano metodologię interpretacji treści/analizy dokumentów w celu dokładnego przeglądu i analizy literatury pochodzącej z różnych baz danych, w tym Scopus i Web of Science. Ten wybór metodologiczny ma na celu kompleksowe i wszechstronne zbadanie tematu, obejmujące szerokie spektrum perspektyw i spostrzeżeń. Proces analizy interpretacji treści/dokumentu polega na skrupulatnej analizie i interpretacji materiałów tekstowych, co sprzyja zrozumieniu badanego tematu w sposób pełen niuansu. Włączenie literatury z renomowanych baz danych, takich jak Scopus i Web of Science, nie tylko zwiększa wiarygodność i rzetelność wyników, ale także zapewnia solidną eksplorację tematu

Wyniki: Kluczowe technologie, takie jak sztuczna inteligencja, uczenie maszynowe, analiza danych, IoT, blockchain, AR/VR i 5G, są badane pod kątem ich wpływu na operacje biblioteczne i zaangażowanie użytkowników. Wyzwania, w tym równość cyfrowa, etyczne wykorzystanie sztucznej inteligencji, bezpieczeństwo danych, interoperacyjność i ograniczenia finansowe, są identyfikowane i analizowane.

Wniosek: Badanie opowiada się za koniecznością przekształcenia się bibliotek w dynamiczne, inteligentne ośrodki, które mają wkład w zrównoważone systemy wiedzy, przy jednoczesnym zachowaniu ich podstawowych zasad.

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Förderung intelligenter Bibliotheken in der Ära der fünften industriellen Revolution

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thekar in Nigeria (CLN), Mitglied des Verbands der Nigerianischen Bibliotheken (Nigerian Library Association, NLA), des Verbands und des Nationalverbands der Bibliotheks- und Informationswissenschaftlichen Ausbilder (National Association of Library and Information Science Educators, NALISE) und der Association for Information Science and Technology (ASIS&T). Er ist Autor von über 100 Artikeln, die in akkreditierten Fachzeitschriften, Tagungsbänden und als Buchkapitel veröffentlicht wurden. Er hat auch drei Bücher im Bereich Bibliotheks- und Informationswissenschaft veröffentlicht.

Schlüsselworte: intelligente Bibliotheken, Innovationen, nachhaltiges Wissenssystem, fünfte industrielle Revolution

Zusammenfassung

Ziel: Der Beginn der fünften industriellen Revolution kündigt eine Transformationsepoche an, die durch außergewöhnliche technologische Fortschritte gekennzeichnet ist und Bibliotheken dazu bewegt, sich in der schnell digitalisierenden Welt selbst zu finden. Die Studie untersucht die evolvierende Rolle der Bibliotheken und legt den Druck auf die Integrierung von intelligenten Technologien zur Verbesserung der Nutzererfahrungen, Optimierung der Abläufe und Steigerung der Wissensverfügbarkeit. Die Arbeit bezieht sich auf zentrale ethische und datenschutzbezogene Fragestellungen und plädiert für Strategien, die Inklusivität, Transparenz und intellektuelle Freiheit unterstützen.

Forschungsmethode: In der Studie wurde die Methodologie der Inhalts-/Dokumenteninterpretation verwendet, um eine präzise Durchsicht und Analyse der Literatur aus verschiedenen Datenbanken, einschließlich Scopus und Web of Science, durchzuführen. Diese methodische Auswahl zielt darauf ab, das Thema umfassend und vielseitig zu untersuchen, indem ein breites Spektrum an Perspektiven und Einsichten einbezogen wird. Der Prozess der Analyse interpretativer Inhalte/Dokumente umfasst eine sorgfältige Analyse und Interpretation von Textmaterialien, was zu einem detaillierten Verständnis des untersuchten Themas beiträgt. Die Berücksichtigung von Literatur aus renommierten Datenbanken wie Scopus und Web of Science erhöht nicht nur die Glaubwürdigkeit und Zuverlässigkeit der Ergebnisse, sondern gewährleistet auch eine fundierte Erschließung des Themas.

Forschungsergebnisse: Zentrale Technologien wie künstliche Intelligenz (AI), maschinelles Lernen (ML), Datenanalyse, Internet der Dinge (IoT), Blockchain, erweiterte Realität/virtuelle Realität (AR/VR) und 5G werden auf ihre Auswirkungen auf die Bibliotheksarbeit und das Engagement der Nutzer untersucht. Herausforderungen wie digitale Gleichstellung, ethische Nutzung von KI, Datensicherheit, Interoperabilität und finanzielle Einschränkungen wurden identifiziert und analysiert.

Schlussfolgerung: In der Studie wurde die Notwendigkeit betont, Bibliotheken in dynamische, intelligente Zentren umzugestalten, die zur nachhaltigen Entwicklung von Wissenssystemen beitragen, aber auch gleichzeitig ihre grundlegenden Funktionen bewahren.