IJISEM
INTERNATIONAL JOURNAL OF INNOVATIONS IN SCIENCE ENGINEERING AND MANAGEMENT

Artificial Intelligence in Academic Libraries: Applications and Impact Review

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OPEN ACCESS

Volume: 3

Issue: 4

Month: October

Year: 2024

ISSN: 2583-7117

Published:22.10.2024

Citation:

Moumi Mandal, Artificial Intelligence in Academic Libraries: Applications and Impact Review, International Journal of Innovations In Science Engineering And Management, vol. 3, no. 4, 2024, pp. 01–09.

DOI
10.69968/ijisem.2024v3i401-09.

Abstract

The field of artificial intelligence (AI) has opened up new opportunities for advancing research across the board. The future seems bright since artificial intelligence technologies are present in every aspect of business. The supply and use of library information resources as well as the accomplishment of the library's aims and objectives have benefited greatly from the use of AI. An overview of the literature on the use of artificial intelligence (AI) in libraries and its effects is given in this article. The goal of this project is to provide scholars with a thorough grasp of artificial intelligence in the context of libraries. This paper investigates the possibilities of AI in academic libraries, emphasizing advantages like increased effectiveness, better accessibility, and customized user experiences. Even if AI has drawbacks like algorithmic bias, data privacy, and ethical concerns, it also has advantages like growth and innovation potential. In order to effectively incorporate AI into library services in India, the study highlights the need for librarians to educate themselves, experiment with AI technologies, and keep updated about developing trends.

Keyword: *Artificial Intelligence, AI, Academic Libraries, Library Information, Library Operations, Digital Library.*

I. Introduction

The introduction of artificial intelligence (AI) into libraries is bringing them into the digital era at a revolutionary time by transforming their environment and enhancing their ability to meet the ever-changing needs of their patrons. Libraries, which are recognized for being repositories of knowledge and data [1], are using artificial intelligence (AI) technology to enhance accessibility, streamline procedures, and provide state-of-the-art services [2]. In addition to increasing the effectiveness of library operations, this integration positions libraries as dynamic hubs for information discovery in the twenty-first century. In this session, we examine the many ways artificial intelligence (AI) is influencing and transforming the traditional roles that libraries play, such as improving resource discovery and information literacy [3]. AI technologies provide features like voice-controlled interfaces and text-to-speech capabilities, which enable accessibility for a variety of user groups, including people with impairments. AI algorithms automate repetitive tasks. Personalized learning experiences are provided by AI-driven educational technologies in libraries, which modify information to suit the preferences and learning styles of each user [4]. The ethical issues of data security, privacy, and algorithmic biases are brought up by the incorporation of AI in libraries, underscoring the need to use AI responsibly. Libraries utilize AI-driven analytics to evaluate user behavior, preferences, and new trends to guide resource allocation and collection development initiatives [5].

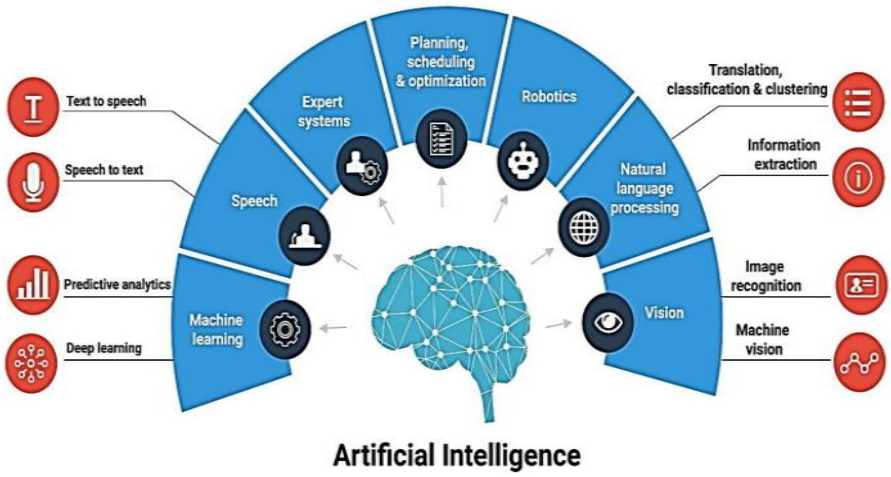

Figure 1 Pictorial diagram of AI Components [2]

A. Application of Artificial Intelligence (AI) in Different Areas of the Library

1. ***Elevating Resource Discovery and Access:*** Search engines with AI capabilities can comprehend complicated searches, producing more customized and relevant results. This will guarantee a smooth navigation of the extensive library contents and remove frustration [6].
2. ***Personalised Recommendations:*** Through the analysis of user behavior, AI algorithms may provide tailored suggestions that introduce users to fresh and relevant content. Their perspectives will broaden as a result, and their interaction with the library will deepen.
3. ***Automating Tasks and Optimizing Workflows:*** AI may automate monotonous jobs, allowing library employees to concentrate on higher-value work. This gives librarians the freedom to commit their skills to improving the library experience.
4. ***AI-powered chatbots and Virtual Reference Services:*** Chatbots driven by AI have the ability to give customers round-the-clock virtual reference services and prompt support. This guarantees that customers may get help whenever and wherever they need it.
5. ***Preservation and Conservation:*** AI is able to analyze photos of library items to spot damage early on and take preventative action. By doing this, the library's priceless collection will be protected.
6. ***Ethical Considerations and Ensuring Equitable Access:*** The ethical ramifications of AI deployment, including data privacy, algorithmic bias, and equal access, must be carefully taken into account. Libraries need to make sure AI technologies are used ethically and do not favor or discriminate in the recommendations of resources or services [6].

Table 1 Artificial intelligence tool with various services

Artificial intelligence Tool	Technical Services		User Services	
Chatbot	Acquisition	Descriptive cataloguing	Query services	Library instruction
Robotics	Library stock taking	Shelving	Searching library material	Check in/check out
Natural languages processing (NLP)	Knowledge management	Information/book processing	Translation of test from native language	Reading of material
Big data	Library resource usages	Managing repository	Managing repository	Library usage report
Text data mining (TDM)	Altmetric, citations support & analysis	OPAC searching	Reference services	#library trends
Pattern recognition	Library security material	QR code to the material	-	Security password/RFID

B. Automation of Library Operations

The use of technology to handle and expedite routine library operations including record-keeping, acquisitions, circulation, cataloging, and serials administration is known as library automation. Libraries may now effectively manage a broad variety of tasks that were formerly manual, labor-intensive, and prone to human mistake by using specialized software tools [7]. Enhancing user access to materials, increasing operational efficiency, and improving patron service are the main objectives of library automation. By putting automated systems in place, libraries may effortlessly provide users with remote access to digital resources like e-books and online databases. In the end, automation of libraries increases the precision and effectiveness of library operations, providing staff and patrons with a more contemporary and easily accessible experience [8].

Key Components of Library Automation

The practice of managing and streamlining crucial library operations via the use of software and technology is known as library automation. It makes libraries more efficient, more equipped to serve their clients, and more resource-accessible [9]. The fundamental elements of a successful library automation system are listed below:

- ***Integrated Library Management System (ILMS):*** The majority of library automation initiatives revolve on an Integrated Library Management System (ILMS). It unifies many library operations, including acquisitions, circulation, cataloging, and reporting, into a single platform. By automating processes like managing the catalog, keeping track of loaned products, and producing reports, this system improves workflow efficiency. The ILS helps library employees work less and more efficiently by streamlining several operations. It also offers a single interface for controlling both digital and physical resources [10].
- ***Online Public Access Catalogue (OPAC):*** The user-facing portion of library automation is the Online Public Access Catalogue (OPAC), which enables users to look up and access materials from a distance. OPAC, which took the role of conventional card catalogs, provided users with a more effective and convenient method to search for items by keyword, author, topic, or title. Additionally, customers may renew loans, put holds on things, and handle their accounts online. OPAC improves the ease and accessibility of library services by offering access around-the-clock.
- ***Cataloging Module:*** Library resources are automatically arranged by the cataloging module, which also makes sure the items are correctly indexed and searchable. MARC (Machine-Readable Cataloging) standards are usually supported by this module, enabling libraries to share catalog entries. Users will find it simpler to locate the resources they require because to the cataloging system's reduction of human error and improvement of uniformity among library holdings. Furthermore, a large variety of forms, including books, audiovisual materials, and digital resources, may be handled by the cataloging module.
- ***Circulation Management:*** The loaning and returning of materials is managed using the circulation management module. It keeps track of the products' availability, loan terms, renewals, holds, and penalties. Circulation management becomes more precise and quick with the inclusion of technology like barcodes and RFID (Radio-Frequency Identification). RFID-enabled self-service kiosks save up staff time and improve customer satisfaction by letting customers check out and return items on their own.
- ***Digital Resource Management:*** As digital media has grown, libraries now have to handle electronic resources like databases, multimedia, and e-books in addition to their physical holdings. With the help of the digital resource management module, users may access digital material remotely or on-site via integration with learning management systems (LMS). Additionally, this module manages license contracts, making sure libraries abide by use guidelines for digital material. Digital resource management is very important in academic settings to facilitate distance study and research.
- ***User Management System:*** The user management system is in charge of keeping track of user data, which includes account statuses, penalties, and borrowing history. By enabling various user rights depending on patron categories (such as students, professors, or outside users), it aids libraries in managing memberships. This system also manages user authentication, guaranteeing that only authorized users may access resources that are restricted.

- ***Remote Access and Mobile Applications:*** Remote access to library materials becomes more important as digital learning becomes more common. Nowadays, a lot of libraries have mobile applications that let patrons use their cellphones to access accounts, look up catalogs, and check out e-books and other digital materials. For academic institutions, where teachers and students may require access to resources from off-campus locations, this functionality is especially crucial. In an increasingly digital world, libraries are kept relevant via mobile applications and remote access solutions.

Every element is essential to automating and improving library operations. When combined, they aid in streamlining processes, enhancing patron services, and enabling libraries to change with the times in the information management industry. Libraries must keep improving their automation systems to suit the demands of contemporary users and guarantee the effective delivery of both physical and digital materials as technology advances.

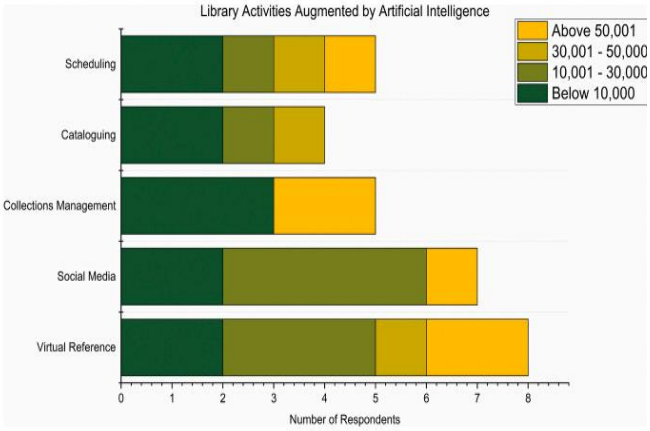

Figure 2 Representation of the types of services libraries have been augmented with artificial intelligence applications by size of library. [5]

C. Impact of AI on academic libraries

An in-depth examination of some of the major themes raised, examining how AI affects libraries [11]:

- **Enhanced Search and Discovery:** Imagine if your library search was able to discern more than simply your keyword search. Algorithms driven by AI go beyond basic keyword matching. They evaluate the context of your search using Natural Language Processing (NLP) to find synonyms, related ideas, and even the mood behind your question. You'll save time and stress with more accurate and relevant search results as a consequence [11].
- **Personalized Recommendations:** No more idly poking around the stacks! In order to recommend new books, articles, or audiobooks that suit your interests, AI may examine your past borrowing behavior, your evaluations of library items, and even your search terms. By pointing you in the direction of undiscovered treasures within the library's holdings, this "intelligent recommendation" system functions as your personal librarian.
- **Content Curation and Management:** Even though they are the information heroes, librarians might get overwhelmed by the volume of digital stuff available. AI helps by mechanizing laborious processes like content categorization and metadata tagging, which involves assigning detailed labels to resources. This frees up time for librarians to work on more important projects like user engagement and collection development.
- **Text and Data Mining:** Libraries are informational gold mines, yet it may be difficult to extract useful information from large collections. Large volumes of textual material, such as academic papers or historical records, may be analyzed using AI-powered text mining techniques. They are able to see correlations, trends, and patterns that the human eye would overlook. Imagine being able to use AI to find links across apparently unrelated fields of study. This would be a very useful tool for scholars and information seekers.
- **Virtual Reference Assistance:** Do you need assistance using a research database or locating a particular book? Don't bother standing in line! AI-powered chatbots can assist you with simple questions, walk you through library regulations, and even direct you to pertinent websites. These virtual assistants provide extra help outside of regular library hours and are accessible around-the-clock.

D. Challenges and limitations of implementing artificial intelligence

Artificial Intelligence has limits and some obstacles [12].

1. **Challenges**

- **Security and Privacy:** While artificial intelligence (AI) offers benefits to people and industries today, it has also created serious privacy and security risks. The possible abuse of personal data gathered by AI-powered systems is one of the main worries. Insufficient transparency and authority over the gathering, processing, and distribution of data may result in security lapses and invasions of personal privacy.
- **Network Issues:** In order to prevent and address these problems before they arise, artificial intelligence is being used to keep vital business systems up and running. AI has the ability to foresee probable malfunctions in real time, allowing personnel to take preventative measures before more significant issues arise. Finally, in an ever-evolving digital ecosystem, the incorporation of AI into network management methods will need continuous development and refining as new dangers inevitably surface.
- **Substantial Time Commitments:** AI often requires a significant time investment from experts across several businesses. Collaboration between experts with different skill sets, such as software engineers and data scientists, is necessary to create AI systems that work. Furthermore, an AI system's performance is usually improved via many iterations throughout the development and testing phases. Due to the cyclical nature of development, teams may find that their efforts to refine the machine learning algorithms that power these systems need a substantial amount of time to complete.
- **Design Interface defect:** A significant problem in the fields of artificial intelligence (AI) and human-computer interaction (HCI) is the Design Interface Defect (DID-AI). It alludes to the fact that bad interface design prevents AI systems from successfully interacting with people. These flaws might appear in a variety of ways, such as imprecise communication, perplexing icons or symbols, and erratic user command responses.
- **User acceptance:** AI is a vital tool for professionals to use and maintain. The user has to embrace the workflow and provide quality services. The user must be informed of the processes and other pertinent factors in order to do it. Only when the user is able to comprehend the AI and its characteristics will that be possible.
- **High Cost:** AI technology establishment may be expensive, especially when it comes to the money needed and the infrastructure needed. The design, development, and optimization of the algorithms that drive the platforms often need significant R&D efforts in addition to specific knowledge to implement these systems. The cost of acquiring the hardware and software solutions required to enable reliable AI installations may also be high.

2. **Limitation**

- **Governments are Restricted to Adapt:** For security and privacy concerns, governments are not adopting AI-related initiatives. Due to many intricate problems, the main nations of the globe are limited in their capacity to adopt AI. The possibility of bias in algorithms is a major worry, especially when it comes to the algorithms that government organizations employ for recruiting and decision-making. Another concern is security and transparency; as AI develops, governments may find it harder to completely comprehend how algorithms arrive at certain judgments or make particular choices.
- **People Get Unemployment:** Artificial intelligence (AI) is replacing monotonous and predictable jobs that were previously completed by humans, which might lead to job losses for certain people. Businesses have been able to automate a number of formerly performed by human labor tasks, including data input, inventory management, and customer support, thanks to the advent of AI. In order to stay relevant in a job that is becoming more and more technologically advanced, people must upskill. In order to assist those who have been displaced in transitioning into other sectors or professions, governments and organizations must also provide retraining programs and other resources.
- **Controlling problem:** Handling artificial intelligence (AI) entails controlling algorithms' capacity to adapt their behavior to novel or unforeseen circumstances. Although this capacity is necessary to provide AI systems the ability to respond and adapt, if it is not handled properly, it may also pose problems. A significant obstacle is striking a balance between the potential advantages

of exploration and learning and the need for control and predictability. The development of solutions for managing problem adaption in AI must take ethical considerations pertaining to bias, transparency of decision-making, and responsibility into account, guaranteeing the safety, accountability, and reliability of these systems.

E. AI and Digital Preservation

The process of protecting and preserving digital material to guarantee its usefulness and accessibility throughout time is known as digital preservation. Modern technology is developing so quickly that digital records and artifacts must be preserved if we are to preserve our scientific, cultural, and historical legacy. Information that begins in a digital format as opposed to being a digital copy of a physical document is referred to as "digitally born documents." Emails, blogs, social media postings, and other material produced and shared only online fall under this category. The way we read has significantly changed as a result of e-books, and it is imperative that they be preserved for next generations. Proactive steps to address format obsolescence and data integrity are necessary for the preservation of these materials, as well as gray literature and other specific formats [13].

The preservation of digital arts, such as immersive and performance art, requires addressing particular difficulties brought forth by rapidly changing formats and technology. Artificial Intelligence (AI) is used in the curation and restoration process of digital artworks, guaranteeing the preservation of the artist's essence and purpose despite technological advancements [14].

AI is starting to prove to be a useful instrument for efforts aimed at digital preservation. Digital material may benefit from autonomous metadata development, tagging, and classification thanks to AI algorithms, which also make information retrieval and management simpler. Furthermore, machine learning models may help detect and mitigate digital obsolescence or decay as well as help interpret, locate, summarize, and synthesize vast amounts of information from previous eras. Artificial Intelligence (AI) can help organize and classify large digital libraries, making it easier for consumers to find and access a variety of literary works [15].

While artificial intelligence (AI) opens up new opportunities for digital preservation, particularly with regard to multimedia archives, it also carries with it new obstacles, including the need to continuously adapt to developing technologies, ethical concerns, and biases in algorithms. The long-term preservation of digital material requires using artificial intelligence while maintaining a balance between innovation and ethical responsibility [16].

II. Literature review

(Kalbande et al., 2024) [17] Using a standardized questionnaire created based on study goals and approved by subject matter experts, a quantitative research technique was used. Purposive sampling looked for people who knew enough about LIS. 259 respondents provided data using Google Forms, which were then analyzed using both descriptive and inferential statistics. The majority of respondents had favorable opinions on AI integration in libraries. Statements like "AI can bridge librarian performance gaps" and "AI does not make library staff lazy" had high mean ratings. Librarians showed curiosity in the ethical implications of AI, a want to learn more about it, and trust in the technology's ability to enhance library services. The research reveals a cautious optimism over AI adoption in Indian academic libraries, with worries about resource allocation and employment tempering appreciation of the technology's potential advantages. Librarians are willing to use AI in their career because they have proactive attitudes about interacting with AI technology and comprehending its consequences for library services.

(M. Pawar, 2024) [18] The goal of the computer science branch of artificial intelligence (AI) is to create machines that are capable of doing activities that would typically require human intellect. Among these activities include learning, thinking, problem-solving, perception, spoken language understanding, and even creativity. Artificial intelligence may be used by academic libraries to enhance operations and services. But there are numerous obstacles to overcome before AI can be used in academic libraries, including technological difficulties as well as moral and legal dilemmas. The article covers the concept and history of artificial intelligence, as well as its applications, significance, methods, and domains of use. It also discusses the difficulties associated with integrating AI into academic libraries.

(Gajbhiye, 2024) [11] This study examines how artificial intelligence (AI) is affecting library services in India with the goal of evaluating the knowledge, viewpoints, and difficulties faced by Indian library professionals. This study explores the potential advantages of artificial intelligence (AI) in libraries, including increased

productivity, better accessibility, data-driven decision-making, and customized user experiences. It does this by doing a thorough literature review and analyzing current AI implementations in libraries. However, for responsible AI adoption, issues like algorithmic bias, data privacy, and ethical concerns must be properly addressed. The report highlights how important it is for librarians to be ready for the future of artificial intelligence by learning about new developments, interacting with AI technologies, and keeping stakeholders and themselves updated. Though there are worries that artificial intelligence (AI) might eventually replace human intellect, a careful integration of AI has the potential to revolutionize library services in India and open up new avenues for creativity and expansion.

(G. S. & Mulimani, 2024) [10] This article looks at how AI technologies are affecting user services, data analysis, information retrieval, and cataloging, among other LIS functions. Personalized suggestions and effective information retrieval have been made possible by AI-driven technologies like chatbots, recommendation systems, and natural language processing, which have improved user experiences. AI also automates repetitive work, freeing human librarians to concentrate on more difficult responsibilities like community involvement and research help. Notwithstanding these developments, issues like algorithmic biases and privacy concerns still need to be resolved to guarantee responsible AI use in LIS (Asim, et al. 2023). This article highlights AI's potential to improve information access for a variety of user populations and library operations by discussing the major advancements, advantages, difficulties, and future implications of AI in LIS services.

(K. Manjunatha, 2023) [3] During this age, one of the rising technologies is artificial intelligence (AI). Artificial Intelligence is a widely used technology in library services that has the potential to revolutionize the finest services in the information age. The purpose of this study is to illustrate how AI affects library services. Numerous studies have been conducted on this topic, however they only cover a small number of applications. Although there is a strong relationship between AI and libraries, there are still unanswered questions about how AI is used in libraries and its effect on academic researchers. This study aims to explore these issues. Prior to the implementation of AI in library services, this research will assist policy makers, librarians, and academics in the area in addressing these concerns.

(Maruthi, 2023)[19] AI has been a huge help in the providing and use of library information resources as well as in achieving the goals and objectives of the library. Libraries are using AI for a variety of tasks, such as filing and book distribution, therefore in order for librarians to stay relevant in their professions, they need to be innovative thinkers. The library now has a plethora of additional choices thanks to its deployment, such as the capacity to attach video help with certain publications and things and to integrate electronic and physical resources. This study discussed certain aspects of artificial intelligence (AI). Professional labor will not be immune to AI's impacts, however this is debatable. This conceptual research investigates the likelihood that libraries will use different AI techniques.

(Subaveerapandiyan, 2023) [7] An overview of the literature on artificial intelligence (AI) applications in libraries and how they affect library operations is provided in this article. The goal of this project is to provide scholars a thorough grasp of artificial intelligence in the context of libraries. 66 relevant articles on artificial intelligence were found using the Scopus database as part of the research approach. This page presents the important results and summaries of the 65 papers that were evaluated after being filtered and duplicated. Researchers interested in learning more about AI applications in libraries may find the material provided here to be a useful resource.

(Ajakaye, 2021) [4] The supply and use of library information resources, as well as the accomplishment of the library's aims and objectives, have benefited greatly from the use of AI. Due to the many uses of AI in libraries, like book distribution and filing, librarians must be creative thinkers in order to remain relevant in their roles. Its implementation opened up a number of new options for the library, including the ability to link electronic and physical resources and to associate video assistance with specific materials and items. The chapter covered some of the elements of artificial intelligence (AI), the services that libraries may provide with it, the advantages of using AI, and the difficulties that libraries may have while using AI in their operations.

(ADEJO & MISAU, 2021) [20] For this study, the qualitative research technique with an expository approach was the chosen research design. The employment of artificial intelligence in Nigerian academic libraries is the research goal that serves as the study's main focus. The literature on AI research was reviewed. The results of this research indicated that artificial intelligence (AI) might be used in academic libraries in Nigeria for services such robotics in the library, natural language processing, pattern

recognition, and expert systems for reference, technical, indexing, and acquisition. Among other things, it is advised that academic libraries in Nigeria embrace the use of artificial intelligence in their operations, educate their personnel to utilize it to provide library services, and implement it in all of their library units. Allocate funds for Artificial Intelligence Expenditure within the institutions' budgets. The Nigerian library system's academic libraries might make content easier to obtain by using artificial intelligence.

(Akram & Kumar, 2018) [2] Artificial intelligence is used in a variety of fields, including robotics, image processing, natural language processing, fuzzy logic, expert systems, artificial neural networks, and voice recognition. Even if they are not distinct fields, sometimes two or more programs work together to improve the services offered by the library. The writers of this essay have examined the many potential uses for artificial intelligence that were previously presented. The authors also discuss the potential areas in which a couple of these applications might be used to improve service quality and perhaps have an influence on library services.

III. Conclusion

Artificial Intelligence (AI) has the potential to significantly improve operations and user experiences in academic libraries. Artificial intelligence (AI) may reduce human error and increase productivity by streamlining complicated processes like cataloging, indexing, categorization, and reference services. These developments are further supported by emerging technologies such as robotics, pattern recognition, and natural language processing, even if the majority of AI applications in libraries are still in the theoretical stage. Rather than being afraid that AI would replace them in their jobs, librarians should welcome it as a tool to increase productivity. However, challenges including staff competence, institutional alignment, ethical concerns, and user privacy must be addressed for AI to be used successfully. AI has the potential to make libraries more creative, adaptable, and user-focused when used properly.

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