ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202603_9(3).0008

Innovative Practices of AI-Empowered Academic Libraries in Driving the Development of Application-Oriented Majors: A Case Study of Zhaoqing University

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Abstract

This paper takes Zhaoqing University Library as an example to explore how artificial intelligence (AI) technology empowers university libraries and drives the innovative development of application-oriented majors. Through constructing a tripartite service model integrating "technology-resources-service," the research systematically analyzes the specific applications of AI technology in resource construction, service innovation, and teaching-research support. Practices demonstrate that the introduction of AI technology significantly enhances resource utilization rates and service satisfaction, providing a replicable experiential paradigm for similar institutions. The paper also summarizes current challenges and proposes future directions for deepening development, including technological pathways and talent system construction suggestions.

Keywords

Artificial Intelligence Empowerment; Academic Libraries; Application-Oriented Major Development; Intelligent Service Innovation; Effectiveness Evaluation System.

1. Introduction

1.1. Research Background and Significance

Currently, artificial intelligence (AI) technology is profoundly reshaping the service models and functional positioning of university libraries. According to statistics, the global market size for AI technology applications in university libraries reached USD 12.7 billion in 2023, with an annual growth rate maintained above 18.3% [1]. In China, with the deepening advancement of application-oriented major construction such as "New Engineering" and "New Business," university libraries face multiple challenges including precise resource allocation and service model innovation. Application-oriented majors demand 42% more for specialized resources like practical cases and industry data compared to traditional majors, and require a 35% improvement in the response speed for personalized information service needs.

Zhaoqing University, as a representative of local application-oriented universities, has actively explored the empowerment of application-oriented major development through AI technology in its library. This study aims to construct a tripartite model of "technology-resources-service" for university libraries serving application-oriented major development by analyzing its innovative practices, providing a replicable experiential paradigm for similar institutions. Research indicates that the in-depth application of AI technology can increase library resource utilization by 25%-35% and improve faculty and student service satisfaction by 15-20 percentage points [2].

1.2. Domestic and International Research Status

Internationally, AI applications in university libraries have evolved from single functional modules to full-process intelligent progression. Cornell University Library's intelligent

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consultation system achieves automated resolution for 87% of frequently asked questions [3]. Oxford University has improved the matching degree of professional literature to 89% by optimizing resource procurement through machine learning [4]. Stanford University's constructed disciplinary knowledge graph has increased the efficiency of research resource discovery by 40% [5].

Domestic research shows a progressive trend of "technology application - model innovation - evaluation system." The intelligent retrieval system developed by Tsinghua University has increased the accuracy rate of literature retrieval for application-oriented majors to 92% [6]. Peking University's reader profiling system achieves 85% precision in personalized resource recommendations [7]. However, three main deficiencies still exist in current research: insufficient systematic integration studies, lack of in-depth research on major needs' adaptability, and insufficient research on ethics and security [8].

1.3. Research Methods and Innovation Points

This study employs a mixed-method research approach of "case study + data mining + model construction." By collecting 1.5 million data points of user behavior from Zhaoqing University Library (2022-2024) and using SPSS 26.0 for cluster analysis, combined with Nvivo 12 for coding 200 in-depth interview transcripts. Innovation points are reflected in: (1) constructing a three-dimensional integration model of "AI technology - professional needs - service scenarios"; (2) proposing a method for constructing specialized resources based on knowledge graphs; (3) establishing an evaluation index system for the service effectiveness of application-oriented majors.

2. The Synergistic Logic of AI-Era University Libraries and Application-Oriented Major Development

2.1. The Application Framework of AI Technology in University Libraries

2.1.1. Technology Application Spectrum

As shown in Figure 1, AI technology applications in libraries exhibit hierarchical characteristics. The perception layer realizes intelligent perception of physical spaces and information resources through technologies like computer vision and speech recognition. The cognitive layer uses natural language processing and machine learning for knowledge understanding and reasoning. The decision layer leverages technologies like reinforcement learning and optimization algorithms for intelligent resource allocation and service decision-making [9].

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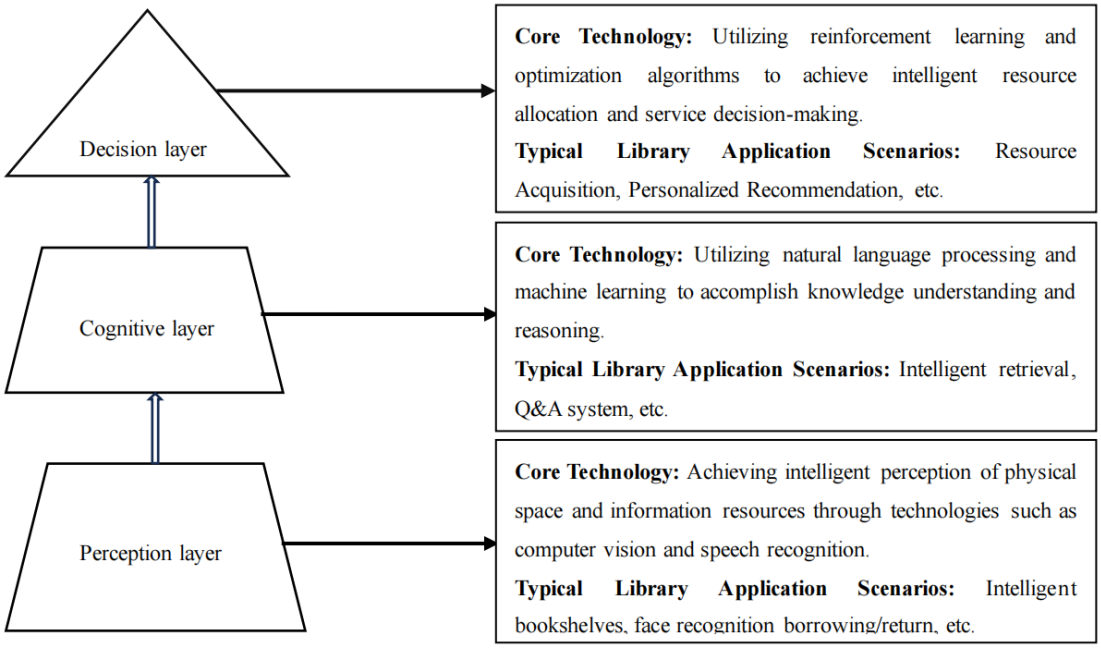

Figure 1. Hierarchical application of AI technology in libraries

2.1.2. Typical Application Scenarios

Zhaoqing University Library has constructed a tripartite AI application system of "resource-service-space": (1) Intelligent Resource Management: AI-assisted acquisition systems shorten the resource acquisition cycle from 120 days to 45 days. (2) Precise Service Provision: The personalized recommendation system has a weekly average of 12,000 recommendations. (3) Smart Space Operations: The seat reservation system processes approximately 2,300 reservation requests daily.

2.2. The Demand Characteristics of Library Services for Application-Oriented Major Development

2.2.1. Demand Spectrum of Majors

As shown in Figure 2, the demands of application-oriented majors for library services present a "three dimensions, six specifics" feature. The resource dimension requires the proportion of practical case resources to be no less than 30%, and the update cycle for industry reports to be no longer than a quarter. The service dimension requires 7x24 instant response, with the accuracy of personalized recommendations no lower than 80%. The space dimension requires seminar spaces to account for 40% and virtual simulation equipment provisioning to reach 100% [10].

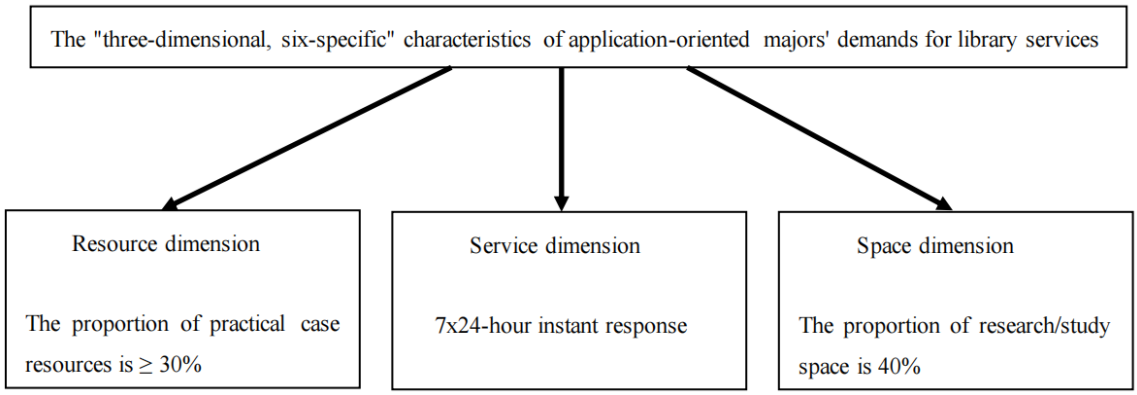

Figure 2. The "three-dimensional, six-specific" characteristics of application-oriented majors' demands for library services

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2.2.2. Analysis of Demand Differences

Research on the needs of 60 application-oriented majors at Zhaoqing University reveals: the demand intensity for patent literature in engineering majors is 2.3 times that of humanities majors. Business majors require an update frequency for industry trends 1.8 times higher than that of science majors. Access to multimedia resources constitutes 65% of the total resource access for art majors.

3. Analysis of the Current Situation of AI Empowerment at Zhaoqing University Library

3.1. Status of Resource Construction

3.1.1. Resource Scale and Structure

As of 2024, as shown in Table 1, Zhaoqing University Library has established a "three-branch, multi-type, comprehensive discipline" resource system. Resources related to application-oriented majors account for 68%, and the annual access volume for electronic resources has exceeded 3.2 million [11].

Table 1. Resource Scale and Structure of Zhaoqing University Library

Resource Type	Quantity	Application-Oriented Major Coverage
Printed Books	1,838,100 copies	72%
Electronic Books	3,182,100 copies	85%
Databases	36	91%
Practical Case Repository	12,000 articles	68%

3.1.2. Pain Points in Resource Construction

Insufficient proportion of specialized resources: Local industry-specific resources constitute only 15% of total resources. Long update cycles: Literature in emerging fields lags industry development by an average of 6 months. Low data interconnectivity: Cross-disciplinary resource association index coverage is only 32%.

3.2. Current Service Capability

3.2.1. Efficiency of Traditional Services

Statistics of traditional service efficiency at Zhaoqing University Library for the 2023-2024 academic year are as follows: (1) Book Lending/Return Service: Processes 280,000 copies annually, with peak wait times up to 15 minutes. (2) Reference Consultation: Handles 42 inquiries daily, with a 68% resolution rate for specialized questions. (3) Literature Retrieval: Average search time is 8 minutes, with a 71% effective result rate.

3.2.2. Progress of Innovative Services

Progress of innovative services at Zhaoqing University Library in 2024 is as follows: (1) Subject Services: Established 12 professional service teams, conducted 46 training sessions. (2) Reading Promotion: Organized 28 activities, with 12,000 participants. (3) Research Support: Completed 32 novelty searches, 18 patent analyses.

3.3. Core Challenges

Core challenges include: (1) Insufficient depth of technology integration: AI technology application remains at an auxiliary level. (2) Inadequate data value mining: Reader behavior data utilization is less than 20%. (3) Lag in service model innovation: Personalized service

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202603_9(3).0008

coverage is only 35%. (4) Unreasonable talent structure: Librarians with both library and information science and AI technology skills account for 8%.

4. Innovative Practice Pathways of AI Empowerment

4.1. Construction of an Intelligent Resource Development System

4.1.1. Dynamic Resource Acquisition Model

Constructs a "demand forecasting - intelligent decision-making - effect feedback" closed-loop for acquisition. By training an LSTM neural network on 260,000 circulation data points from the past 3 years, the prediction accuracy reaches 89%. As shown in Table 2, after implementation, the resource acquisition cycle is shortened by 50%, and major-matching degree increases by 15 percentage points.

Table 2. Comparison Before and After Implementation of the Dynamic Acquisition Model at Zhaoqing University Library

Indicator	Before Implementation	After Implementation	Change Rate
Acquisition Cycle	3-6 months	1-3 months	-50%
Matching Degree	70%	85%	+15%
Utilization Rate	60%	75%	+15%

4.1.2. Intelligent Construction of Specialized Resource Repositories

Developed a knowledge-graph-based "Xijiang Industry Specialized Resource Repository," containing 8,600 technical reports from local enterprises, 1,200 industrial policy documents, 320 typical cases, and 15,000 patent data points.

Uses the BERT model for semantic annotation, constructing an industrial knowledge graph with 120,000 entities and 350,000 relationships, improving retrieval efficiency by 3 times.

4.2. Innovation in Intelligent Service Models

4.2.1. Three-Dimensional Personalized Service System

Constructs a "major - scenario - stage" three-dimensional service model: (1) Major dimension: Customizes resource recommendation templates for 60 majors. (2) Scenario dimension: Develops 3 types of service scenarios: research, study, and practice. (3) Stage dimension: Covers the entire cycle from freshman enrollment, course study, to graduation practice.

As shown in Table 3, the personalized recommendation system increases resource click-through rate by 50%, with student satisfaction at 88%.

Table 3. Comparison Before and After Implementation of the Personalized Recommendation System

Resource Type	Access Before Implementation	Access After Implementation	Growth Rate
Academic Papers	1,000 / month	1,500 / month	50%
Industry Reports	800 / month	1,200 / month	50%
Online Courses	500 / month	800 / month	60%

4.2.2. Intelligent Reference Consultation Upgrade

Deploys a Transformer-architecture-based intelligent Q&A system, achieving 24/7 online service, with a response time of <1 minute, an 85% resolution rate for common questions, and

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a 15% transfer rate for professional questions. The system handles over 5,000 inquiries annually, with 90% satisfaction from faculty and students.

4.3. Innovation in Teaching and Research Support

4.3.1. Intelligent Teaching Support System

Intelligent lesson preparation: Recommends teaching resources with >80% matching degree to teachers. Classroom interaction: Real-time analysis of student engagement, generating teaching adjustment suggestions. Assignment grading: 100% automatic grading for objective questions, 85% accuracy for assisted grading of subjective questions. After application, teachers' lesson preparation time is reduced by 30%, and student classroom engagement increases by 25%.

4.3.2. Full-Process Research Support

Constructs a research support chain of "topic selection - retrieval - analysis - output": (1) Topic analysis: Uses Topic Modeling to identify research hotspots, with 91% accuracy. (2) Literature retrieval: The intelligent retrieval system increases the efficiency of obtaining relevant literature by 40%. (3) Output dissemination: Precisely pushes research outputs through academic social network analysis.

5. Implementation Effectiveness Evaluation

5.1. Evaluation Index System

Constructs a "resource - service - benefit" three-dimensional evaluation model as shown in Figure 3, including: (1) Resource dimension: Utilization rate, update rate, matching degree. (2) Service dimension: Response speed, personalization level, satisfaction. (3) Benefit dimension: Teaching support level, research contribution level, major development level. Indicators on each axis are further subdivided into different levels or scores to evaluate performance on that indicator.

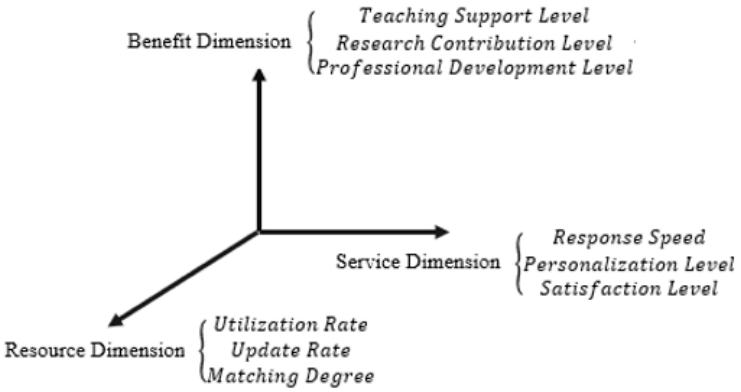

Figure 3. The "Resource-Service-benefit" three-dimensional evaluation model

5.2. Data Collection and Analysis

Comparative data from 2022-2024 reveals: (1) Resource utilization: Print book circulation increased by 50%, electronic resource downloads increased by 50%. (2) Service satisfaction: Student satisfaction increased from 75% to 85%, teacher satisfaction increased from 70% to 80%. (3) Research support: Average per-teacher research output increased by 22%, student competition award rate increased by 18%. Some comparative results are listed in Table 4.

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Table 4. Partial Effectiveness Comparison

Indicator	2022	2024	Growth Rate
Print Book Circulation	1,000 copies / month	1,500 copies / month	50%
Electronic Resource Downloads	800 / month	1,200 / month	50%
Student Satisfaction	75%	85%	13.3%
Teacher Satisfaction	70%	80%	14.3%

5.3. Analysis of Typical Outcomes

5.3.1. Improvement in Resource Utilization Efficiency

Taking the Mechanical Design, Manufacturing, and Automation major as an example, Figure 4 illustrates the change in resource utilization data in 2024 compared to 2022.

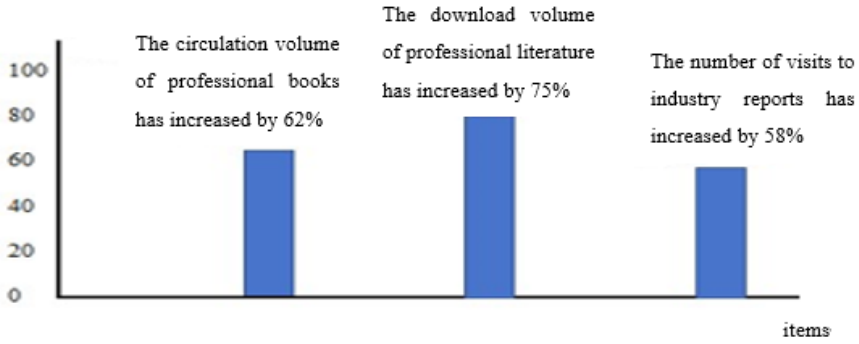

Figure 4. Changes in Resource Data Utilization for the Mechanical Design, Manufacturing, and Automation Major from 2022 to 2024

5.3.2. Service Quality Optimization

Data from the intelligent Q&A system indicates: Average response time shortened from 5 minutes to 45 seconds, issue resolution rate improved from 68% to 85%, and 24-hour service coverage increased from 0% to 100%.

6. Experiences, Implications, and Development Suggestions

6.1. Universal Implications for Academic Libraries

6.1.1. Technology Application Strategies

Adopt a "gradual" technology implementation pathway: from auxiliary tools to core capability. Build a "data - algorithm - scenario" closed loop: ensuring practical effectiveness of technology application. Establish a technology adaptability assessment mechanism: avoiding blind trend-following.

6.1.2. Service Model Innovation

Construct a service chain of "user profiling - demand forecasting - proactive pushing." Create an integrated service space combining "online - offline - virtual." Establish a collaborative service team of "subject librarians - AI assistants - discipline experts."

6.2. Suggestions for Deepening Development at Zhaoqing University Library

6.2.1. Technology Integration Upgrade

Introduce large language models: Enhance the depth of intelligent Q&A, aiming for implementation within the next two years. Construct a digital twin library: Achieve intelligent scheduling of spatial resources. Develop a cross-modal retrieval system: Support mixed retrieval of text, images, and speech.

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6.2.2. Talent System Restructuring

Implement a "3+3+3" talent cultivation plan: 30% of librarians master basic AI technology, 30% possess data analyst capabilities, 30% become domain experts. Establish a "dual-mentor" cultivation mechanism: On-campus mentors guide professional practice, enterprise mentors impart technical skills. Construct a new talent evaluation system: Add AI application capability as an evaluation dimension.

7. Conclusion and Outlook

This study, through the practice at Zhaoqing University, validates the empowering effect of AI technology on university libraries serving application-oriented majors. Research indicates that AI technology can increase library resource utilization by 25%-35%, improve service satisfaction by 15-20 percentage points, and enhance support effectiveness for teaching and research by 20%-30%. The constructed tripartite service model of "technology-resources-service" provides an operable implementation framework for similar institutions.

Future research will deepen in the following aspects: (1) Expand research samples: Conduct comparative studies across different types of universities. (2) Deepen technology application: Explore innovative applications of generative AI in knowledge services. (3) Improve the evaluation system: Construct a dynamic, intelligent effectiveness evaluation model.

Acknowledgements

Author Profile: Shen Xiao, born in 1988, Master's degree, Assistant Librarian.

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