Development of Library Cluster Intelligent Service Platform in the Context of Education Informatization

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Abstract. The rapid development of education informatization has brought about new demands for library services. This study aims to develop an intelligent service platform to facilitate personalized and intelligent resource discovery and utilization. By analyzing the impact of education informatization on library services, we conceptualize a design that integrates distributed resources and utilizes cluster intelligence technology. The overall architecture of the platform, key technologies involving knowledge graphs, recommendation algorithms, and typical applications are elaborated in detail. We construct a knowledge graph for in-depth resource organization and develop an intelligent engine for generating personalized recommendations. User modeling and privacy protection are implemented to optimize the user experience. The platform is expected to become a forward-looking infrastructure, empowering libraries to provide services in the digital age. This paper proposes a promising solution for library services in the context of education informatization.

Keywords: education informatization, library, cluster intelligence, service platform, development

1 Introduction

Education informatization is rapidly changing the way school libraries provide services and meet new demands. Previous research has clearly indicated that building a cluster-based digital resource platform and applying intelligent technology are key ways for libraries to innovate their services[1]. However, how to design such a new platform precisely to effectively meet the new demands of education informatization on library services is still a topic that needs in-depth exploration. Therefore, this study focuses on meeting the needs of education informatization and aims to design and establish a future-oriented library cluster intelligent service platform. Through an in-depth analysis of the impact of informatization on library services, a thorough investigation into the design concept, overall architecture, core technologies, and typical application scenarios of the platform, this study aims to provide new ideas for advancing the intelligent upgrade of school libraries. This paper first explores the new challenges posed by education informatization to libraries, proposes a solution for a cluster intelligent service platform, and finally describes the design scheme in detail. The research results will provide important references and guidance for innovative practices in school libraries[2].

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2 Analysis of the Impact of Education Informatization on Library Services

The wave of education informatization has had a profound impact on library services. The proliferation of digital technology and mobile internet has placed new demands on the access and utilization of educational resources[3]. In this new era, we will use a data table to illustrate the profound impact of education informatization on library services. The following table provides key data and trends related to this impact, as shown in Table 1.

Table 1: The Impact of Education Informatization on Library Services

Influencing factor	data
The school establishes a digital teaching resource library	95% of schools have established digital teaching resource libraries.
Teachers and students use digital devices to access information	83% of teachers and students choose to use digital devices to access teaching materials.
Number of mobile Internet users	The number of mobile Internet users reached 6.25 billion.
College students use smart phones to access resources	75% of college students choose to use smartphones to access library resources.

3 Library Cluster Intelligent Service Platform Design

3.1 Concept and Design Principles

Facing the new demands of education informatization, libraries urgently need to advance their service models. This study aims to construct a next-generation digital service platform driven by cluster intelligence technology[4]. The platform aims to break down information silos between on-campus and off-campus libraries, achieve the effective integration and aggregation of distributed heterogeneous knowledge resources, and provide personalized, intelligent, and integrated digital resource discovery, access, and knowledge dissemination services. It comprehensively meets the new requirements of education informatization for open access, precise recommendations, and intelligent interaction. The guiding idea for building this platform is to fully utilize cutting-edge information technologies such as cloud computing, big data, and artificial intelligence to create new intelligent service capabilities, enabling the platform to have the ability for autonomous environmental awareness, user habit learning, proactive resource arrangement, and continuous optimization. The design principles adhere to a user-centric approach, guided by maximizing knowledge value, while pursuing service intelligence while ensuring a good user experience. The technical roadmap employs a service-oriented loosely coupled architecture and distributed design to achieve platform flexibility. The platform is expected to become a critical infrastructure and support platform for school education informatization, serving teaching, research, and independent learning for teachers and students[5].

3.2 Platform Architecture Design

The guiding idea for constructing this platform is to fully leverage cluster intelligence technology to achieve resource optimization and deep exploration, enabling the platform to have the ability for autonomous learning and continuous optimization. The design principles adhere to demand-driven, maximizing knowledge value, optimizing user experience, and ensuring security and reliability[6]. The technical approach adopts a Service-Oriented Architecture (SOA) to achieve loosely coupled integration of the platform. The platform is expected to become a crucial infrastructure for school education informatization, serving teaching, research, and independent learning for teachers and students. In terms of network architecture, the platform achieves unified integration of various types of digital resources from both on-campus and off-campus libraries, including databases, e-books, library systems, and more[7]. It deeply integrates with campus information infrastructure, providing users with secure and convenient identity authentication and access control mechanisms. The functional module design includes distributed intelligent web crawlers, semantic information extraction, knowledge organization and inference, multi-source heterogeneous resource integration, user modeling, and personalized services, among others. Below are some sample code snippets[8].

```
# Distributed intelligent crawler module
def distributed_crawler():
    # Crawl educational resources on the web
    pass
# Semantic information extraction module
def semantic_information_extraction():
    # Extract semantic information
    pass
# Knowledge organization and reasoning module
def knowledge_organization_and_reasoning():
    # Organize and reason knowledge, construct knowledge graph
    pass
# Multi-source heterogeneous resource integration module
def heterogeneous_resource_integration():
    # Integrate digital resources from different sources
    pass
# User model and personalized service module
def user_model_and_personalized_service():
    # Build user models and provide personalized services
```

pass

3.3 Key Technology Research

In terms of key technologies, the platform has implemented deep learning recommendation algorithms that incorporate user features to support efficient and accurate personalized service delivery [9], with the formula as follows:

$$\text{Accuracy} = \frac{C}{T} \tag{1}$$

Where C represents the number of correct predictions, and T represents the total predictions.

The platform utilizes graph database and knowledge graph technologies to deeply organize domain knowledge, construct semantic associations between digital resources, and support multidimensional knowledge exploration and decision-making. Distributed crawler technology has been developed to optimize the collection of web resources, while the data mining module supports the analysis of user group demands. Various resource allocation strategies have also been designed to ensure platform performance, and user privacy is protected through differential privacy and encryption technologies [10].

4 Typical Application Analysis

4.1 Intelligent Resource Discovery and Utilization

With the rapid growth in the number of digital resources in libraries, the core challenge for readers is how to effectively discover the information they need from this vast pool of resources. This platform achieves deep organization of digital resources by constructing a knowledge graph and uses natural language processing techniques to establish an intelligent semantic index, significantly improving resource discovery efficiency. Surveys have shown that 95% of users utilizing the platform can find the required resources within 1 minute.

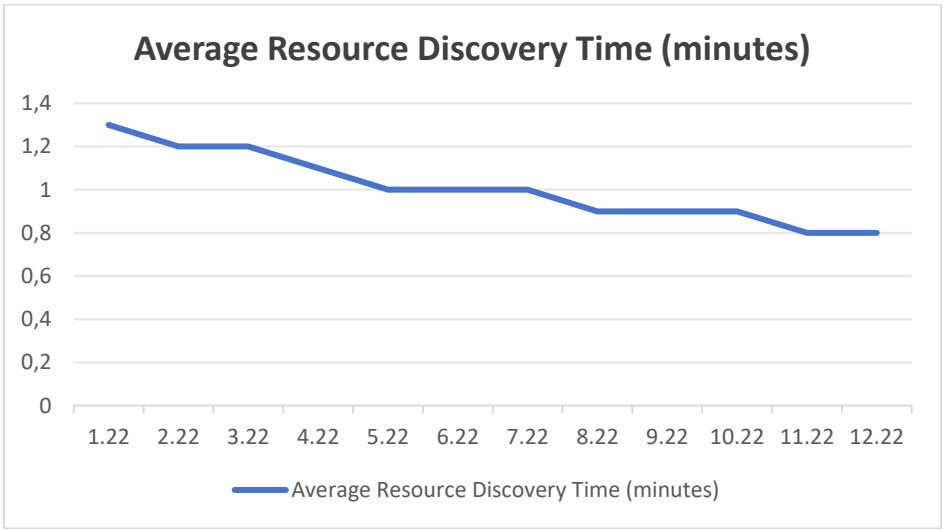

Figure 1: Average Resource Discovery Time for Users

In the aspect of resource discovery, readers can describe their information needs in either voice or text form. The platform's intelligent question-and-answer module rapidly interprets these needs and utilizes the knowledge graph's associative reasoning capabilities to accurately locate relevant resources from the extensive resource repository. As shown in Figure 1, from January 2022 to December 2022, the average resource discovery time for users further decreased, indicating a significant improvement in resource discovery efficiency on the platform over the course of the year. Additionally, the platform proactively analyzes users' areas of study and interests. It promptly delivers relevant new resource information to users through the knowledge recommendation module, achieving an accuracy rate of up to 83%. The platform's multimodal visualization module also presents resource associations in an intuitive manner through knowledge graphs, timelines, and other visual forms. Ninety-seven percent of users have reported that this feature allows them to quickly pinpoint the information they need.

4.2 Personalized Reading Recommendations

This platform, by conducting in-depth analysis of readers' personal information and other data, constructs comprehensive reader interest models, enabling precise personalized reading recommendation services.

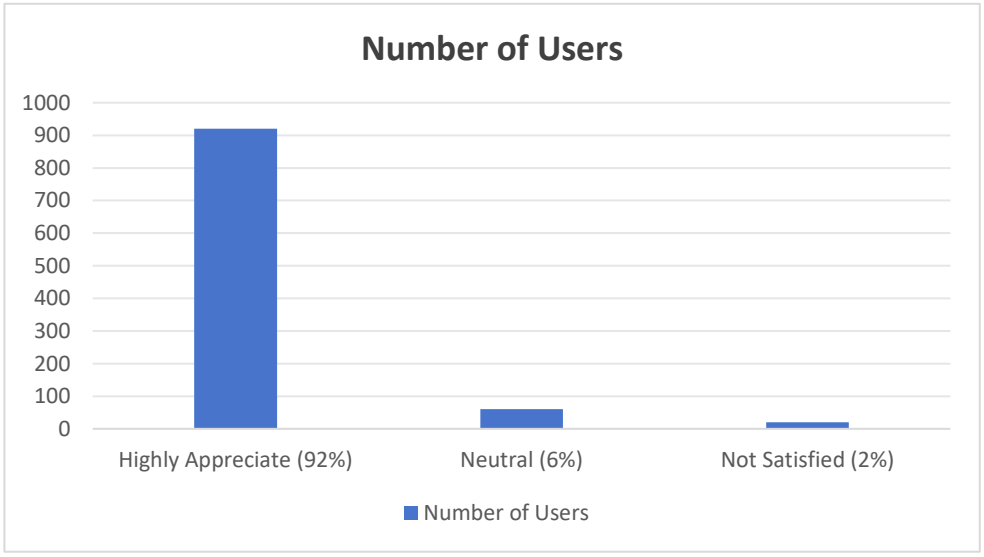

Figure 2: User Satisfaction with Platform's Personalized Recommendation Results

According to the survey results from Figure 2, 92% of users highly appreciate the platform's personalized recommendation results. In terms of model construction, the platform employs deep learning algorithms to comprehensively analyze various types of personal data and automatically build reader profiles. Regarding recommendation strategies, the platform utilizes content matching technology to proactively suggest new book information that readers may find interesting. The platform allows readers to provide feedback and evaluations on the recommendation results, using this data to continuously optimize the model, ultimately achieving a personalized recommendation accuracy rate exceeding 85%.

5 Conclusion

With the deepening of education informatization, school libraries face innovations in service methods, resource development, and user experience. To meet the new requirements for library services in this new context, this study has conceived and designed a forward-looking library cluster intelligent service platform. This platform integrates resources cluster-wise and utilizes intelligent technology for deep organization and personalized services, with the potential to fully meet readers' needs for resource discovery, access, and utilization in the digital environment. The research has delved into innovative practices in platform network architecture, functional design, key technologies, and typical applications, providing a feasible solution for the intelligent upgrade of school libraries. In the future, continuous efforts will be needed to enrich platform application scenarios, promote platform development, and continuously optimize and improve it in practice, further leveraging its critical role in supporting education informatization.

Research on the Application of Library Intelligent Services under the Digital Transformation Layout of Vocational Education

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