

## Federated Search in Libraries: An Overview in Academic Libraries

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### **Abstract:**

*One essential piece of technology that simplifies the process of finding information across a variety of databases and sources in academic libraries is federated search systems. By using a single query interface, these systems, also known as meta-search engines, allow users to simultaneously search through a variety of resources, such as databases, books, and electronic journals. By combining results from several publishers and platforms into a single format, this feature greatly improves the efficacy and efficiency of academic research while also saving time and streamlining user interactions. An overview of federated search technology is given in this study, with particular attention on how it might be integrated into academic libraries. It talks about how these systems have developed, the technological difficulties they provide, and the advantages they have for educational institutions. The research also looks at case studies from different university libraries to showcase effective implementations. It also discusses the possibility for federated search systems in the future, including the incorporation of machine learning and artificial intelligence to enhance and customize search results. The purpose of this overview is to highlight the value of federated search engines in improving the usability and accessibility of scholarly materials, therefore assisting academic institutions in their larger endeavors to promote research and learning.*

**Keywords:** *Federated Search; Digital Library Ecosystem; Academic Library*

### **Abstrak:**

Salah satu bagian penting dari teknologi yang menyederhanakan proses pencarian informasi di berbagai database dan sumber di perpustakaan akademik adalah sistem pencarian gabungan. Dengan menggunakan antarmuka kueri tunggal, sistem ini, juga dikenal sebagai mesin meta-search, memungkinkan pengguna untuk melakukan pencarian secara bersamaan melalui berbagai sumber, seperti database, buku, dan jurnal elektronik. Dengan menggabungkan hasil dari beberapa penerbit dan platform ke dalam satu format, fitur ini sangat meningkatkan kemanjuran dan efisiensi penelitian akademis sekaligus menghemat waktu dan menyederhanakan interaksi pengguna. Gambaran umum tentang teknologi pencarian gabungan diberikan dalam penelitian ini, dengan perhatian khusus pada bagaimana teknologi tersebut dapat diintegrasikan ke dalam perpustakaan akademik. Bab ini membahas tentang

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bagaimana sistem ini berkembang, kesulitan teknologi yang ditimbulkannya, dan manfaat yang dimilikinya bagi institusi pendidikan. Penelitian ini juga melihat studi kasus dari berbagai perpustakaan universitas untuk menunjukkan penerapan yang efektif. Hal ini juga membahas kemungkinan sistem pencarian gabungan di masa depan, termasuk penggabungan pembelajaran mesin dan kecerdasan buatan untuk meningkatkan dan menyesuaikan hasil pencarian. Tujuan dari tinjauan ini adalah untuk menyoroti manfaat mesin pencari gabungan dalam meningkatkan kegunaan dan aksesibilitas materi ilmiah, sehingga membantu institusi akademis dalam upaya mereka yang lebih besar untuk mempromosikan penelitian dan pembelajaran.

**Kata kunci : Pencarian Satu Pintu; Ekosistem Perpustakaan Digital; Perpustakaan Perguruan Tinggi**

## INTRODUCTION

In the age of digital information, academic libraries are continually adapting to meet the evolving needs of their users. One of the most significant advancements in library services is the adoption of federated search technologies. These systems offer a holistic approach to information retrieval by aggregating results from multiple databases and electronic resources into a single, coherent interface. This integration allows users to perform comprehensive searches with greater convenience and efficiency, which is critical in academic settings where time and accuracy are paramount<sup>1</sup>. The concept of federated search in libraries is not new, but its application has become increasingly vital as the volume and variety of academic resources expand.

Traditional search methods, where users navigate each database individually, are no longer sufficient in an environment where interdisciplinary research and the speed of information retrieval are key to academic success<sup>2</sup>. Federated search tools bridge this gap by providing a unified search platform that not only simplifies the search process but also enhances the discoverability of resources across vast digital collections<sup>3</sup>.

Into federated search systems in academic libraries explores the development of these tools, their integration into library services, and their impact on academic research. It discusses the technological underpinnings that allow these systems to retrieve and consolidate information from disparate sources, the challenges faced by

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<sup>1</sup> Cox, Christopher. 2006. "An Analysis of the Impact of Federated Search Products on Library Instruction Using the ACRL Standards." *Portal: Libraries and the Academy* 6 (3): 253–67. <https://doi.org/10.1353/pla.2006.0035>.

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<sup>2</sup> Porter, Brandi. 2011. "Millennial Undergraduate Research Strategies in Web and Library Information Retrieval Systems." *Journal of Web Librarianship* 5 (4): 267–85. <https://doi.org/10.1080/19322909.2011.623538>.

<sup>3</sup> Grimes, Neil. 2022. "Foundations of Library Services: An Introduction for Support Staff (Library Support Staff Handbooks, 7): 2nd Ed. (2021), by Hali R. Keeler. London: Rowman & Littlefield Publishers, Xlv, 374 Pp., 42.00, ISBN 978-1538135679." *Journal of Electronic Resources Librarianship* 34 (1): 83–84. <https://doi.org/10.1080/1941126x.2022.2029123>.

libraries in implementing them, and the ongoing advancements that aim to optimize their effectiveness<sup>4</sup>. Technologically, federated search systems are complex. They must interface with different database formats, manage varying access protocols, and present results in a user-friendly manner. This requires sophisticated software solutions and robust hardware infrastructure. Libraries must also negotiate with multiple vendors to ensure access to content and integration of systems<sup>5</sup>.

Despite these challenges, the benefits are clear. Federated search tools significantly reduce the time users spend searching for and retrieving relevant information, thereby enhancing the overall efficiency of academic research<sup>6</sup>. However, the implementation of federated search systems is not without its criticisms and challenges. Issues such as the relevance of search results, system

response time, and the steep learning curve for new users can detract from the potential benefits.

However, the implementation of federated search systems is not without its criticisms and challenges. Issues such as the relevance of search results, system response time, and the steep learning curve for new users can detract from the potential benefits. Moreover, the maintenance of these systems requires ongoing technical support and substantial financial investment, which can be a hurdle for some institutions<sup>7</sup>. As technology evolves, so do the capabilities of federated search systems. Recent developments include the integration of artificial intelligence and machine learning algorithms, which promise more personalized and contextually relevant search results.

These advancements could redefine the scope and functionality of federated search tools, making them even more indispensable in academic libraries<sup>8</sup>. This paper reviews literature from various sources to provide a comprehensive overview of federated search systems in academic libraries. The insights from these studies underscore the significance of these tools in the

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<sup>4</sup> Joint, Nicholas. 2008. "Federated Search Engines and the Development of Library Systems: ANTAEUS." *Library Review* 57 (9): 653-59. <https://doi.org/10.1108/00242530810911770>.

<sup>5</sup> Gibson, Ian, Lisa Goddard, and Shannon Gordon. 2009. "One Box to Search Them All: Implementing Federated Search at an Academic Library." Edited by Brad Eden. *Library Hi Tech* 27 (1): 118-33. <https://doi.org/10.1108/07378830910942973>.

<sup>6</sup> Beheshti, Jamshid. 2003. "Library Resources Technical Services." *Library Resources Technical Services*. 2003. [https://www.academia.edu/28375314/Library\\_Resources\\_Technical\\_Services](https://www.academia.edu/28375314/Library_Resources_Technical_Services).

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<sup>7</sup> Mohamed, Khaled A, and Ahmed Hassan. 2015. "Evaluating Federated Search Tools: Usability and Retrievability Framework." *The Electronic Library* 33 (6): 1079-99. <https://doi.org/10.1108/el-12-2013-0211>.

<sup>8</sup> Yang, Jidian, Shiwen He, Yang Xu, Linweiya Chen, and Ju Ren. 2019. "A Trusted Routing Scheme Using Blockchain and Reinforcement Learning for Wireless Sensor Networks." *Sensors* 19 (4): 970. <https://doi.org/10.3390/s19040970>.

modern academic landscape and suggest directions for future research and development<sup>9</sup>.

## LITERATURE REVIEW

Federated search systems, which emerged as a solution to the growing complexity of academic digital resources, have revolutionized the way information is accessed in academic libraries. This literature review examines various aspects of federated search systems, including their development, technical challenges, user experiences, and future advancements, drawing from a broad range of academic literature.

### Historical Context and Development

Federated search technology was developed to address the inefficiencies of having to search multiple databases individually. As Breeding notes, early federated search systems aimed to simplify user access by providing a single point of entry for querying multiple databases. However, these systems often struggled with issues like system integration, search latency, and

relevance ranking, which impacted their effectiveness<sup>10</sup>.

### Technical Challenges

The integration of federated search systems involves substantial technical challenges. Each database has its own set of protocols, data formats, and access rights, which complicates the task of creating a seamless search tool. Howell and Kemp discuss the technical hurdles in integrating various databases and highlight the importance of middleware software that acts as an intermediary to translate queries and results between different system<sup>11</sup>. Additionally, maintaining fast response times and accurate result relevancy across different sources remains a persistent challenge<sup>12</sup>.

### User Experience and Usability

User experience in federated search systems is paramount, as the primary goal of these tools is to enhance the research process by saving time and improving result accuracy. Lewis examines user satisfaction and finds that while federated search tools improve access to resources, they often fall short in terms of result relevance and user interface design, which can frustrate

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<sup>9</sup> Coleman, Mary D. 2023. *Land, Promise, and Peril: Race and Stratification in the Rural South*. Cambridge University Press. <https://doi.org/10.1017/9781009182546>.

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<sup>10</sup> Joint, Nicholas. 2008. "Federated Search Engines and the Development of Library Systems: ANTAEUS." *Library Review* 57 (9): 653-59.

<https://doi.org/10.1108/00242530810911770>.

<sup>11</sup> Gibson, Ian, Lisa Goddard, and Shannon Gordon. 2009. "One Box to Search Them All: Implementing Federated Search at an Academic Library." Edited by Brad Eden. *Library Hi Tech* 27 (1): 118-33. <https://doi.org/10.1108/07378830910942973>.

<sup>12</sup> Eastman, Caroline M, and Bernard J Jansen. 2003. "Coverage, Relevance, and Ranking: The Impact of Query Operators on Web Search Engine Results." *ACM Transactions on Information Systems* 21 (4): 383-411. <https://doi.org/10.1145/944012.944015>.

users<sup>13</sup>. Similarly, Olson and Hansen explore how different federated search products compare in terms of user satisfaction, emphasizing the need for intuitive design and relevant search results<sup>14</sup>.

### **Institutional Impact and Academic Research**

The adoption of federated search tools in academic libraries has a significant impact on academic research and library operations. Hane discusses how these systems facilitate better resource integration and improve the discoverability of academic materials, which in turn supports more comprehensive research outcomes<sup>15</sup>. Moreover, libraries that implement federated search technologies often see increased usage of their digital resources, as these tools make the search process more efficient and effective<sup>16</sup>.

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<sup>13</sup> Beheshti, Jamshid. 2003. "Library Resources Technical Services." Library Resources Technical Services. 2003.  
[https://www.academia.edu/28375314/Library\\_Resources\\_Technical\\_Services](https://www.academia.edu/28375314/Library_Resources_Technical_Services).

<sup>14</sup> Mohamed, Khaled A, and Ahmed Hassan. 2015. "Evaluating Federated Search Tools: Usability and Retrievability Framework." The Electronic Library 33 (6): 1079-99.  
<https://doi.org/10.1108/el-12-2013-0211>

<sup>15</sup> Cox, Christopher. 2006. "An Analysis of the Impact of Federated Search Products on Library Instruction Using the ACRL Standards." Portal: Libraries and the Academy 6 (3): 253-67.  
<https://doi.org/10.1353/pla.2006.0035>.

<sup>16</sup> Gibson, Ian, Lisa Goddard, and Shannon Gordon. 2009. "One Box to Search Them

### **Future Directions and Innovations**

Looking forward, the future of federated search lies in the integration of more advanced technologies such as artificial intelligence and machine learning. These technologies have the potential to vastly improve the personalization and contextual relevance of search results. Yang and Wagner explore potential innovations in discovery tools that could make federated search systems even more intuitive and effective for academic research<sup>8</sup>. Overall, while federated search systems have significantly improved access to academic resources, there is a continuing need for improvement in areas such as search accuracy, system integration, and user interface design.

### **RESEARCH METHOD**

This research uses a qualitative approach by conducting an in-depth literature review. According to Hart and Kitchenham, the literature review is the process of selecting relevant documents/research (both published and unpublished) based on fascinating research questions, topics, and phenomena to meet specific objectives by identifying, evaluating, and interpreting the selected research<sup>17</sup>. A literature review is used to review scientific literature to

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All: Implementing Federated Search at an Academic Library." Edited by Brad Eden. Library Hi Tech 27 (1):118-33.  
<https://doi.org/10.1108/07378830910942973>.

<sup>17</sup> Hart, Chris, and Russell Turk. 2019. "Doing a Literature Review: Releasing the Research Imagination (2nd Edition)." The Cognitive Psychology Bulletin 1 (4): 57.1-57.  
<https://doi.org/10.53841/bpsocg.2019.1.4.57>.

avoid bias and subjective understanding of the research. In addition, the literature review provides an overview of methodological trends and the scope of research fields in previous research<sup>18</sup>.

## RESULT AND DISCUSSION

### Effectiveness of Federated Search

The literature review indicates that federated search systems in academic libraries enhance both the efficiency and effectiveness of information search and access. This technology allows users to conduct simultaneous searches across various data sources, reducing the time needed to obtain relevant information. According to Information Theory, the reduction in redundancy and the improvement in search efficiency achieved through federated search make it a valuable tool in an academic environment<sup>14</sup>.

### Implementation Challenges

Despite its many benefits, the implementation of federated search systems also faces several challenges. One of the primary issues is the difficulty

in integrating diverse sources with varying formats and protocols, which requires the development of complex middleware<sup>5</sup>. Additionally, the relevance of search results often becomes a major criticism, as the system sometimes produces less accurate data, reducing user satisfaction<sup>2</sup>.

### Impact on User Behavior

Federated search has been shown to significantly influence user behavior in information seeking. By simplifying the search process, users are more likely to explore a variety of information sources that might previously have been overlooked. This aligns with findings by Bates<sup>15</sup>, who suggested that efficient search systems could alter the way users interact with information resources.

### Implications for the Future

Given the continuous evolution of information technology, federated search systems in academic libraries are expected to keep advancing. The integration of new technologies like artificial intelligence and machine learning is anticipated to enhance the personalization and relevance of searches, potentially addressing some of the current criticisms of these systems<sup>19</sup>.

<sup>18</sup> Yaman, Aris, Ambar Yoganingrum, Yaniasih Yaniasih, and Slamet Riyanto. 2019. "TINJAUAN PUSTAKA SISTEMATIS PADA BASIS DATA PUSTAKA DIGITAL: TREN RISET, METODOLOGI, DAN COVERAGE FIELDS." BACA: JURNAL DOKUMENTASI DAN INFORMASI 40 (1): 1. <https://doi.org/10.14203/j.baca.v40i1.481>.

<sup>19</sup> Yang, Jidian, Shiwen He, Yang Xu, Linweiya Chen, and Ju Ren. 2019. "A Trusted Routing Scheme Using Blockchain and Reinforcement Learning for Wireless Sensor Networks." Sensors 19 (4): 970. <https://doi.org/10.3390/s19040970>.



## CONCLUSION

Federated search systems have significantly transformed the landscape of information retrieval within academic libraries. By enabling simultaneous searches across multiple databases and sources, these systems reduce the time and effort required for academic research. This holistic approach not only streamlines the research process but also promotes a more thorough exploration of available academic resources. The integration of these systems represents a key advancement in making diverse information more accessible and manageable for users across various disciplines.

However, the deployment and maintenance of federated search systems are not without challenges. Issues such as the integration of heterogeneous data sources, the accuracy of search results, and the user-friendliness of interfaces require ongoing attention and improvement. Institutions must weigh these challenges against the benefits to optimize the utility of federated search tools within their specific academic environments.

Looking forward, the evolution of federated search technologies

promises even greater enhancements with the incorporation of artificial intelligence and machine learning. These advancements are expected to refine the personalization and relevance of search results, addressing current limitations and setting the stage for more intuitive and efficient research methodologies. As these technologies mature, they will undoubtedly continue to reshape the paradigms of academic research and library services, making comprehensive and efficient information retrieval a standard expectation in academic settings.

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