International Journal of Engineering Trends and Technology
ISSN: 2231–5381 / https://doi.org/10.14445/22315381/IJETT-V73I6P111

Volume 73 Issue 6, 114-122, June 2025

Original Article

Technological System for the Promotion of Research Production in the Universities of Northern Lima

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Received: 25 January 2025 Revised: 20 May 2025 Accepted: 29 May 2025 Published:

Abstract - *The visibility of scientific research has become a strategic priority for academic institutions seeking to strengthen their reputation, foster collaboration, and increase global impact. Despite an increase in indexed publications, many universities in developing countries lack centralized tools to publicly showcase their research output. This paper presents the design and implementation of a web-based interactive system developed for the Universidad de Ciencias y Humanidades (UCH) in Lima, Peru. The system integrates real-time data from the Scopus API and internal metadata stored in MongoDB to dynamically display researcher profiles, citation metrics, and scientific production trends. A digital totem was deployed in a public university space to allow users to interact with the platform. The system was developed using a prototyping-based approach and built with React.js, Flask, and AWS technologies. A total of 28 researchers participated in usability testing, with 100% task completion and high satisfaction rates across all metrics. The results indicate that the platform effectively improves research visibility and user engagement. Future improvements include mobile compatibility, advanced search filters, and integration with additional academic APIs such as ORCID or Crossref.*

Keywords - *Scientific dissemination, Interactive platform, Scopus integration, Research visibility, Design Thinking, Web-based system.*

1. Introduction

In the current landscape of higher education, scientific visibility has become a fundamental metric of institutional prestige, academic competitiveness, and international collaboration. Universities are increasingly evaluated not only by teaching quality or student outcomes but also by their research output, impact metrics, and global presence in indexing databases such as Scopus, Web of Science, and Google Scholar [1, 2]. However, many institutions, particularly in Latin America, face persistent challenges in consolidating and showcasing their academic production. These include fragmented internal systems, limited integration with global APIs, and a lack of accessible tools for presenting scientific activity to internal and external stakeholders [3].

This often results in undervalued research contributions, low engagement among faculty, and minimal visibility to potential collaborators or funding agencies. These challenges are evident at the Universidad de Ciencias y Humanidades (UCH) in Lima, Peru. Although the institution has increased its scientific publications in indexed journals over recent years, it lacked a centralized, interactive, and user-friendly platform for displaying this information to the public. The absence of such a tool affected the internal recognition of researchers and limited opportunities for institutional positioning and academic networking. To address this issue, this study proposes the development of a web-based interactive system integrated into a digital totem, which serves as a public research visibility portal installed within the university's physical infrastructure. The system retrieves data in real-time from the Scopus API and an internal MongoDB database, displaying researcher profiles, publication metrics, citations, and thematic areas of specialization using interactive charts and dashboards.

The technological foundation of the system includes React.js for the frontend interface, Flask for the backend logic, and AWS S3 for secure image and media hosting. The platform was developed using the Prototyping Model, which allowed for iterative testing and feedback-driven refinement. A usability study involving 28 researchers showed high satisfaction with the system's functionality and visual design, confirming its utility as a tool for institutional academic communication. This initiative aligns with global trends in open science, academic transparency, and digital transformation in higher education [4, 5]. As recommended by organizations such as UNESCO and the European Commission, universities must adopt innovative digital

infrastructures to make research discoverable, measurable, and socially impactful [6]. The remainder of this paper is structured as follows: Section II presents a review of related work; Section III outlines the methodology and system architecture; Section IV reports the evaluation results; Section V discusses the findings and implications; and Section VI presents the conclusions and future directions.

2. Literature Review

Research visibility has become an essential aspect of academic competitiveness in the global context. Institutions must increasingly adopt digital strategies to improve their presence in scientific databases and rankings. Thelwall and Sud [7] emphasize that citation metrics and research output indexing are now fundamental indicators of academic performance. Gorska et al. [8] point out that social media and digital platforms play a growing role in activating research networks and increasing global exposure. The evolution of institutional repositories has also been studied extensively.

Bashir et al. [9] argue that repositories are crucial tools for democratizing access to academic knowledge and reducing the visibility gap between institutions. Boulton [10] supports this by illustrating how institutional repositories can foster academic engagement and transparency.

From a design perspective, educational platforms that support visibility must also be user-centric. Pande and Bharathi [11] explore how design thinking fosters the creative and functional development of academic tools. Suber [12] and UNESCO [13] both advocate for open-access practices and the implementation of systems that facilitate the discoverability of research, which aligns with the goals of this study. Latin American research environments also face systemic challenges in scholarly communication.

Alperin et al. [14] found that structural barriers in digital dissemination often limit the visibility and citation of Latin American authors. Global policies, such as those from the European Commission [15] and international frameworks for open science [13], recommend adopting technological infrastructures that allow transparent access to research outcomes and facilitate institutional collaboration and policy-making.

Moed [16] highlights that research analytics tools should be implemented not only to track performance but also to support academic planning, outreach, and collaboration. These studies support the development of institutional systems like the one proposed in this paper, which responds to the global call for research transparency, digital access, and academic impact. Within the Peruvian academic ecosystem, the importance of research visibility has grown alongside national efforts to enhance scientific production and institutional competitiveness. Millones-Gómez et al. [17] highlight disparities in research policies among universities and the need for integrated systems to manage and present institutional outputs. Similarly, despite limited infrastructures, Moya-Salazar et al. [18] discuss how Peruvian institutions responded to the COVID-19 pandemic through the rapid digital dissemination of research, despite limited infrastructures.

CONCYTEC [19] has emphasized the importance of improving the visibility of Peruvian scientific production through national indicators and platforms like RENACYT [22]. These efforts aim to centralize information about researchers and their contributions but often lack user-centred design and interactivity. Montoya [20] critiques the low public awareness of Peruvian academic work, calling for more effective dissemination strategies. Rodríguez and Guevara [21] conducted a mapping of research collaboration networks, noting that visibility is key for strengthening scientific communities in Peru. Valverde and Ruiz [23] add that visibility metrics in Scopus are not fully leveraged by local institutions due to limited dissemination tools and outdated platforms.

Meanwhile, Cieza and Alzamora [24] developed a web-based system to manage RENACYT researcher data, which demonstrated the technical viability of creating national-scale platforms but did not focus on public visibility or user engagement. Chávez et al. [25] further validate this gap, indicating that most systems in use remain internal and are not designed for external communication or academic positioning. Finally, the Ministry of Education of Peru [26] has recognized that digital transformation and academic transparency are essential for future university reform, reinforcing the relevance of initiatives like the present system.

3. Methodology

To address the challenge of limited research visibility at the Universidad de Ciencias y Humanidades (UCH), the development of a technological solution was guided by the Prototyping Model. This methodology was chosen for its iterative structure and emphasis on user interaction, making it particularly suitable for projects that demand progressive refinement and early-stage validation of both interface and functionality.

3.1. Justification for the Prototyping Model

The Prototyping Model was chosen due to its iterative nature and strong emphasis on user feedback, which aligned with the project's goal of building a user-friendly academic visibility system. Unlike rigid linear models, this approach allowed for the early development of a functional prototype, rapid testing, and continuous refinement based on feedback from non-technical users such as researchers and administrators. The model enabled the team to validate usability, improve visual elements, and optimize API integration efficiently, ensuring that the final product met real user needs within a short development cycle.

3.2. Justification for the Prototyping Model

The development process was carried out over a period of approximately three months, structured around five key phases derived from the Prototyping Model. Each phase was scheduled with specific objectives to ensure progressive platform refinement and timely user feedback integration.

- Phase 1 - Requirement Gathering (Weeks 1-2):
  Surveys and informal interviews were conducted with faculty members and research administrators to identify system needs and key content requirements.

- Phase 2 - Quick Design (Weeks 3-4):
  A low-fidelity interface and initial system architecture were drafted to define core components such as researcher profiles, metrics display, and API endpoints.

- Phase 3 - Prototype Development (Weeks 5-7):
  The system was implemented using React.js for the frontend and Flask for the backend, integrating Scopus API and MongoDB for real-time data handling.

- Phase 4 - User Evaluation (Week 8):
  The functional prototype was tested by 28 academic users who completed defined tasks and submitted structured feedback.

- Phase 5 - Refinement and Finalization (Weeks 9-12):
  Based on the evaluation results, usability improvements were applied to the interface, and backend performance was optimized for stability and responsiveness.

This structured timeline allowed the project to remain focused, user-oriented, and flexible while ensuring the delivery of a functional system within a defined academic term.

3.3. Prototyping Model Overview

Preliminary information was collected from academic stakeholders through structured surveys and informal interviews. The objective was to identify the primary needs related to the lack of visibility of researchers and their scientific output. The Prototyping Model facilitates the rapid construction of functional prototypes that are continuously tested, reviewed, and improved in response to user feedback.

This cyclical process enhances alignment with user expectations and reduces the likelihood of system failure upon deployment.

As illustrated in Figure 1, the model comprises a sequence of key phases that interact in a feedback-driven loop. These stages include requirements analysis, quick design, prototype development, user evaluation, and refinement. Upon satisfying all performance and usability criteria, the system progresses to its final implementation.

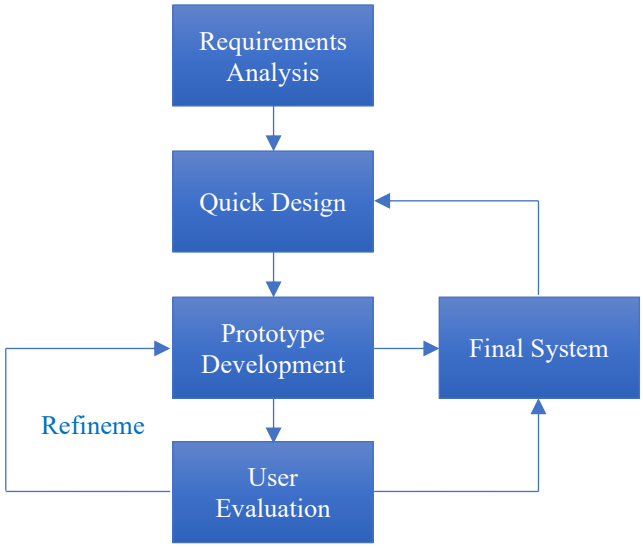

Fig. 1 Prototyping model applied in the development of the interactive research visibility system

The process followed in this study involved five main phases:

3.3.1. Requirement Gathering

Preliminary information was collected from academic stakeholders through structured surveys and informal interviews. The objective was to identify the primary needs related to the lack of visibility of researchers and their scientific output.

3.3.2. Quick Design

Based on the collected requirements, a preliminary design of the system was proposed. This design focused on the essential functionalities, including the display of researcher profiles, scientific publications, citation counts, and graphical dashboards.

3.3.3. Prototype Development

A working prototype of the system was implemented using modern web technologies. The front end was developed using React.js, allowing for dynamic content presentation and interactive user interfaces. The backend was constructed with Python and Flask, providing seamless integration with external APIs such as Scopus, and an internal MongoDB API was created to manage researcher metadata and media content.

3.3.4. User Evaluation

The prototype was presented to a selected group of university researchers and administrators. Their interaction with the system was monitored, and feedback was collected through structured forms focusing on usability, content relevance, and system responsiveness.

3.3.5. Refinement and Finalization

Several iterations were based on feedback to improve the system's usability and functionality. Changes included layout

adjustments, enhancement of data visualizations using Highcharts.js, and performance optimization in API interactions. Once the prototype met all quality and functional expectations, it was finalized and prepared for deployment.

3.4. System Architecture

The proposed system was designed using a modular and scalable architecture to support efficient data flow, secure communication, and future extensibility. This structure ensures that each component functions independently while maintaining interoperability with other system modules.

As illustrated in Figure 2, the architecture is composed of three core layers: frontend, backend, database, and media storage. Each layer is responsible for a distinct set of operations that contribute to the seamless visualization of researcher data.

The frontend, developed with React.js, serves as the user interface layer. It allows users to browse researcher profiles through an intuitive, interactive interface. This includes dynamically loaded content such as names, academic degrees, total publications, citation metrics, and areas of specialization.

The backend, implemented using Flask, acts as an intermediary service layer. It is responsible for handling HTTP requests, managing the logic of API integration, and retrieving publication and citation data from the Scopus API, as well as institutional metadata from a custom-built MongoDB API.

The Database and media Layer manages persistent data storage. MongoDB is used to store structured metadata about researchers, while Amazon S3 handles the storage of profile images and other static media assets. The backend communicates with both storage solutions to deliver content in real time to the front end.

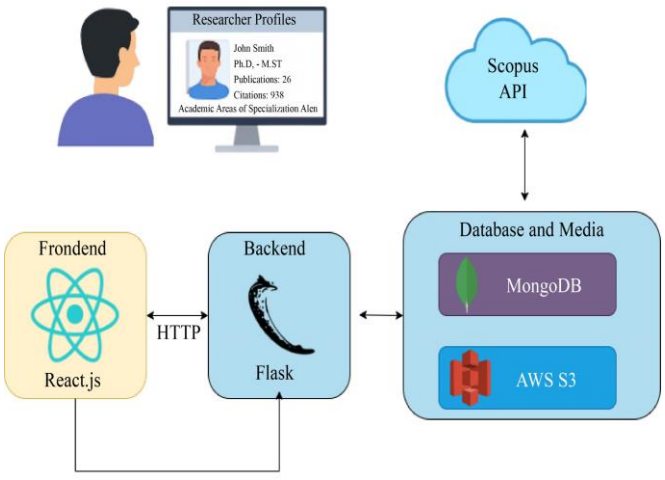

Fig. 2 System architecture diagram illustrating the integration of Frontend, backend, external APIs, and cloud-based media and metadata storage

3.5. User Sampling and Participant Profile

To validate the functionality, usability, and relevance of the developed system, a group of academic users was involved in the testing and evaluation phases. The sampling strategy followed a purposive non-probability sampling method, selecting participants directly related to the system's intended use.

A total of 28 participants were involved in the validation process. All participants were faculty members and research affiliates from different academic departments at the Universidad de Ciencias y Humanidades (UCH). The sample was chosen to ensure representation across various research areas such as Engineering, Health Sciences, Education, and Social Sciences.

The inclusion criteria for participants were:

- Active affiliation with UCH as a researcher or academic.
- At least one indexed publication in Scopus.
- Willingness to participate in prototype testing and provide feedback.

During the evaluation phase, participants interacted with the prototype through a guided session using the deployed system interface. They were instructed to explore the functionalities-including browsing researcher profiles, citation metrics, and publication dashboards-and to complete a structured feedback form afterwards. The form collected quantitative metrics (ease of use, visual clarity, perceived usefulness) and qualitative comments.

All participant data were anonymized, and no personal identifiers were stored. Ethical compliance was maintained following institutional guidelines, ensuring voluntary participation and informed consent.

3.6. Evaluation Instruments and Techniques

To ensure a rigorous assessment of the system's usability, functionality, and overall user satisfaction, a multi-method evaluation strategy was adopted, combining structured questionnaires, observational analysis, and qualitative feedback collection. A custom-designed feedback instrument was administered to participants immediately after interacting with the prototype. This instrument included a Likert-scale section that quantitatively measured key dimensions such as ease of navigation, visual clarity, information relevance, loading performance, and overall user experience, using a 5-point scale ranging from "strongly disagree" to "strongly agree."

The structure of the questionnaire was inspired by the System Usability Scale (SUS) and adapted to the context of academic systems. In parallel, a set of guided tasks was provided to users during the testing sessions, including actions such as identifying top researchers by citation count, exploring publication trends, and interpreting research area

distributions. These tasks enabled the evaluation team to observe behavioral patterns, interaction flow, and task completion rates. Observers documented difficulties, navigation delays, and feedback behaviors. Upon completing the interaction, participants were invited to provide open-ended feedback through a short debriefing, allowing the collection of qualitative insights not captured by numeric metrics.

This triangulation of methods-combining direct measurement, observation, and subjective input-ensured a well-rounded evaluation of the prototype's usability and effectiveness. All instruments were reviewed by methodological experts and approved under the institution's research ethics protocol to guarantee reliability, voluntary participation, and data privacy.

4. Result

4.1. Quantitative Evaluation Results

As part of the system evaluation, participants were asked to rate several key features of the platform after interacting with the prototype. These features included ease of navigation, visual clarity of the data charts, perceived relevance of the displayed content, and the extent to which the platform improved their awareness of the university's research output. The responses were collected through a structured Likert-scale questionnaire.

Table 1 presents a summary of the percentage of users who expressed positive agreement (either "Agree" or "Strongly Agree") with each evaluated category.

Table 1. Summary of user feedback on key evaluation metrics

Evaluation Metric	Positive Responses (%)
Ease of Navigation	85.7%
Visual Clarity of Charts	92.8%
Perceived Relevance of Displayed Content	89.3%
Increased Awareness of Research Output	100%
Overall Satisfaction	94.6%

These values indicate a strong positive perception of the system's functionality and user experience. Notably, 100% of participants reported that the system increased their awareness of institutional research output-demonstrating success in achieving the primary objective of this project.

Figure 3 provides a visual breakdown of satisfaction levels across the evaluated features. The highest satisfaction was observed in relation to research visibility, followed closely by visual clarity and ease of navigation. The relevance of the displayed data also received high approval, suggesting that users found the information both meaningful and well-presented.

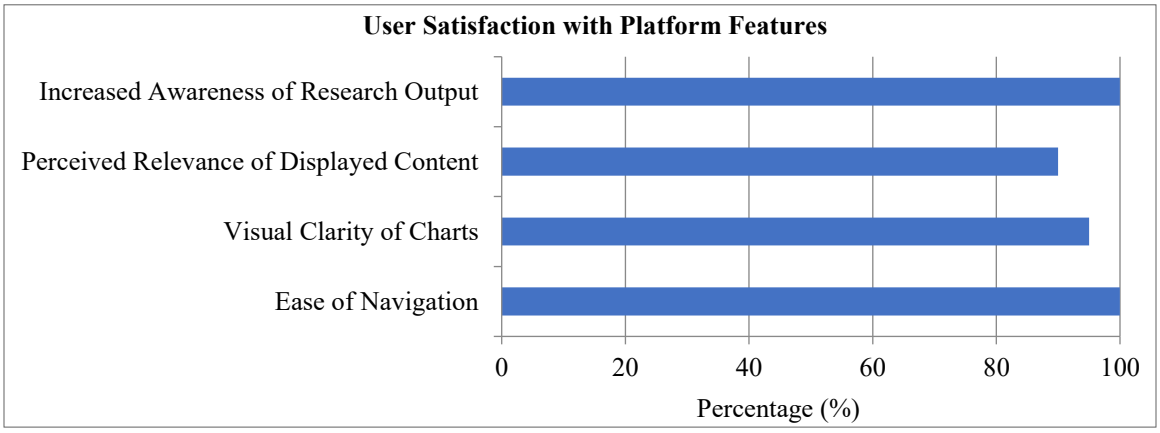

Fig. 3 User satisfaction with platform features based on evaluation metrics from the structured feedback questionnaire

4.2. Qualitative Observations

In addition to completing the structured Likert-scale questionnaire, participants were invited to share open-ended feedback based on their interaction with the platform. This qualitative input provided valuable insights that went beyond numerical data, shedding light on user expectations, perceived strengths of the system, and suggestions for improvement.

A thematic analysis was conducted on the collected responses to identify recurring topics and user sentiments. The analysis revealed five core themes: research visibility, search functionality, usability and interface design, clarity of profile information, and suggestions for enhancement. Each theme reflects specific aspects of the user experience that multiple participants frequently mentioned.

To illustrate the findings, Table 2 summarises the major themes and representative quotes drawn directly from user responses. For example, several participants noted how the platform helped them become aware of ongoing research activities at the university that were previously unknown to them. Others emphasized the need for keyword-based filters to improve the discoverability of researchers working in similar areas. Users also highlighted the clarity of the data

visualizations and appreciated the inclusion of researcher details such as academic degrees and areas of specialization.

These qualitative findings reinforce the positive reception observed in the quantitative results and suggest a clear direction for future development phases of the system. By integrating participant suggestions-such as advanced filtering or mobile compatibility-the platform can further enhance its role as a tool for increasing research visibility and institutional engagement.

Table 2. Thematic categorization of qualitative feedback

Theme	Representative User Quote
Research Visibility	"I did not know how much was being published at the university until I saw this platform."
Search Functionality	"A keyword filter would help me find collaborators working on similar topics."
Usability and Interface Design	"The layout is intuitive, and the charts are easy to interpret even for non-technical users."
Profile Information Clarity	"Access to each researcher's degrees and specialities is very helpful for networking."
Suggestions for Improvement	"Consider adding mobile compatibility or the ability to export publication data."

4.3. Task Performance and Observational Findings

A task-based evaluation was conducted to assess the usability of the platform beyond perception-based feedback further. Participants were asked to perform a series of predefined tasks that reflected typical user interactions, such as locating the most cited researcher, navigating through researcher profiles, and identifying academic areas with the highest publication volumes. These tasks were designed to evaluate the functional performance and intuitiveness of the system interface.

During the observation sessions, evaluators monitored task completion rates, and time taken per task, and any signs of confusion, hesitation, or repetitive behavior. The overall findings indicate that the system is highly usable and intuitive. All participants (100%) were able to complete the tasks successfully, with minimal external assistance. The average task completion time ranged from 22 to 48 seconds, depending on the complexity of the action.

Some minor usability issues were observed, particularly related to the image loading delay when switching between researcher profiles. This was noted in approximately 21% of user sessions, suggesting a need for optimization of image retrieval and caching strategies. However, no critical system errors, crashes, or navigation breakdowns were reported during testing.

Table 3. Task-based usability performance summary

Task Description	Success Rate	Average Completion Time	Common Observations
Locate the most cited researcher	100%	22 sec	Immediate identification using citation charts
Browse researcher profiles by department	100%	36 sec	There is a minor delay in image loading during profile transitions
Identify the research area with most publications	100%	30 sec	All users interpreted bar charts correctly
View all researchers in a given specialization	100%	48 sec	Some repeated clicks on filter buttons before success

These findings reinforce the effectiveness of the user interface and confirm that participants were able to interact with the system as intended. The observational data also highlights small areas of technical improvement that will be addressed in future development phases to enhance performance and responsiveness.

5. Discussion

The results obtained from the evaluation of the proposed platform demonstrate a strong alignment between user needs and the system's functionalities. The high satisfaction levels reported in the structured questionnaire and the 100% task completion rate in the observational assessment confirm that the interactive platform effectively fulfils its objective of increasing the visibility of institutional research output.

The findings reveal that the platform's design-particularly its interactive interface, centralized researcher profiles, and integrated data visualizations-was well received by users. This supports the initial hypothesis that limited visibility of academic contributions within institutions can be addressed through technological solutions focused on usability and information accessibility. Furthermore, the unanimous user agreement on the system's impact in raising awareness of ongoing research activity highlights its potential as an internal tool and a mechanism for external academic communication.

The results are consistent with previous studies, such as those by Gorska et al. [1] and Millones-Gómez et al. [6], which underscore the importance of digital platforms in amplifying research visibility and encouraging collaboration. However, unlike many static repositories or publication databases, the dynamic nature of this system-enabled by real-time integration with Scopus and interactive dashboards-

offers a more engaging and informative user experience. Qualitative feedback provided additional insights into areas for future enhancement, such as implementing advanced search filters, mobile compatibility, and collaboration visualizations. These suggestions indicate that users are receptive to the current functionality and envision broader applications of the platform, including networking and institutional benchmarking. While the system performed reliably during testing, some performance-related issues were identified, such as image loading delays in specific scenarios. These findings point to opportunities for backend optimization, particularly in media caching and API response handling, to improve user experience under heavier loads. Overall, the discussion of results confirms the system's utility as a visibility and engagement tool for academic institutions. Its successful implementation also demonstrates the effectiveness of the prototyping model in aligning iterative design with real user feedback.

6. Conclusion

This study presented the design, development, and evaluation of an interactive digital platform to improve the visibility of scientific research produced by the Universidad de Ciencias y Humanidades (UCH). The system successfully integrates real-time data from external sources such as Scopus and internal metadata repositories, offering a dynamic, accessible, and visually engaging interface for academic dissemination. The evaluation process, which included both structured questionnaires and task-based observation, revealed high levels of user satisfaction and confirmed the effectiveness of the system's functionalities. All participants were able to complete core navigation and data interpretation tasks with ease, and the platform was recognized as a valuable tool for enhancing institutional research visibility. Additionally, qualitative feedback provided actionable insights for further system refinement.

Implementing the Prototyping Model proved to be a suitable methodological approach, enabling iterative improvements driven by direct user feedback. Based on React.js, Flask, and MongoDB, the architecture demonstrated sufficient scalability and performance for the institutional context. Looking ahead, several lines of improvement and expansion are proposed. These include the incorporation of advanced filtering and search capabilities, integration of ORCID or Crossref APIs for extended researcher profiling, and support for mobile platforms to increase accessibility.

Future versions of the system may also include analytics modules for measuring long-term research trends, identifying collaboration networks, and benchmarking academic performance across departments. In summary, the developed system has demonstrated its potential to transform how academic institutions manage and showcase their research activity, contributing to greater academic visibility, engagement, and recognition in both national and international contexts.

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