International Journal on Perceptive and Cognitive Computing (IJPCC) Vol 12, Issue 1 (2026)
https://doi.org/10.31436/ijpcc.v12i1.634

Applying the Software Development Life Cycle to Design WeResearch: A Unified Research Environment

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(Received: 22nd November 2025; Accepted: 14th January, 2026; Published on-line: 30th January, 2026)

Abstract— The growing demand for effective academic collaboration tools highlights the need for unified digital environments that support communication, resource sharing, and knowledge management. This study applies the Software Development Life Cycle (SDLC) framework to the design and prototyping of WeResearch, a unified research environment tailored to researchers' needs. A qualitative methodology was employed, combining insights from prior studies with semi-structured interviews conducted with ten researchers from diverse disciplines. The interviews identified critical requirements for research collaboration, including seamless communication, collaborative task management, and intuitive navigation. Based on these requirements, a prototype of WeResearch was designed to visualize platform functionalities and user experience. The SDLC phases of planning, requirements analysis, design, and prototyping were applied to ensure a structured development process. The prototype was then tested with the same group of researchers, whose feedback provided valuable insights into usability and relevance. Findings suggest that the proposed design aligns strongly with user needs, offering solutions to gaps present in existing research collaboration platforms. This study contributes by integrating qualitative needs assessment with the SDLC framework in the academic context, addressing researchers' needs, software requirements, and full prototype design to support a unified research collaboration platform across world universities.

Keywords— Software Development Life Cycle (SDLC), Unified Research Environment, User-Centered Design, Prototype Design

I. Introduction

Effective academic collaboration is essential for advancing research across disciplines and institutions. However, the proliferation of diverse tools and platforms has led to fragmented digital environments, hindering seamless communication, resource sharing, and knowledge management among researchers. This fragmentation often results in inefficiencies, data silos, and challenges in coordinating tasks and managing research outputs [1], [2].

To address these challenges, the Software Development Life Cycle (SDLC) offers a structured framework for designing, developing, and evaluating digital solutions. The SDLC encompasses several phases, including planning, requirements analysis, design, development, testing, deployment, and maintenance [3], [4]. By applying the SDLC methodology, developers can ensure that software solutions are systematically planned, requirements are clearly defined, designs are rigorously developed, and prototypes are iteratively tested to align with end-user needs [5].

This study focuses on the design and prototyping of WeResearch, a unified research environment tailored to the needs of researchers across disciplines. By employing a qualitative methodology that combines insights from prior studies and semi-structured interviews with ten researchers, this study identifies critical requirements for effective research collaboration, including seamless communication, collaborative task management, and intuitive navigation [6], [7].

The resulting prototype demonstrates how SDLC phases—planning, requirements analysis, design, and prototyping—can be applied to create a unified platform that addresses gaps in existing research collaboration tools. This research contributes to the academic field by offering a structured approach to designing research collaboration software, integrating user needs with systematic software engineering principles, and providing a practical prototype that can guide future implementations in global academic contexts [8].

Unlike existing collaboration tools, WeResearch integrates academic task management, reference handling, and institutional coordination in a unified environment. This study focuses specifically on the early phases of the Software Development Life Cycle, namely planning, requirements analysis, design, and prototyping.

https://doi.org/10.31436/ijpcc.v12i1.634

Implementation, deployment, and maintenance phases are beyond the scope of the current work and are planned as future research directions.

This study is guided by the following research questions:

RQ1: What are the key requirements needed for a unified digital research environment from researchers' perspectives?

RQ2: How can early phases of the Software Development Life Cycle (SDLC) be applied to design and prototype a unified research collaboration platform?

RQ3: To what extent does the proposed prototype align with researchers' perceived needs and usability expectations?

II. LITERATURE REVIEW

Effective research methodologies are essential for maintaining the integrity and quality of academic research. However, many researchers, especially graduate students, face challenges due to insufficient guidance on selecting and applying appropriate methods. Alebaikan and Alsemiri [9] examined the attitudes of graduate students at King Saud University towards digital academic integrity and found that a lack of awareness regarding proper research practices often led to issues such as digital plagiarism. Their study highlighted the role of limited faculty guidance, inadequate academic writing skills, and insufficient training in managing digital data as key contributing factors to these challenges. Similarly, Flaxman [10] emphasized the importance of clear ethical guidelines and transparent research processes to prevent misconduct in research and publishing. By fostering a culture of accountability, research institutions can significantly reduce the risk of unethical practices and enhance the credibility of their scholarly output.

A strong understanding of research methodology is crucial for conducting rigorous and reproducible studies. Garg [11] outlined the key components of research methodology, including the formulation of research questions, the selection of appropriate study designs, and the implementation of robust data collection and analysis techniques. This structured approach not only ensures the reliability and validity of research findings but also equips researchers with the skills necessary to navigate complex academic challenges. Sreekumar [12] further highlighted that integrating methodological guidance into academic programs helps students and early-career researchers develop a systematic approach to their work, improving both research quality and professional development.\

Recent studies have further emphasized the necessity of comprehensive methodological training. Altowairiki [13] investigated the application of action research to enhance the development of research methodology knowledge among graduate students. The study found that students were dissatisfied with current courses, leading to knowledge gaps and limited application of research approaches. Through iterative cycles of action research, a book club intervention was implemented, highlighting the potential of action research as a valuable framework for developing students' understanding of research methodologies.

Additionally, Schneider [14] discussed the design of international research experiences for students, emphasizing the importance of providing clear guidance on research methodologies. The study underscored that well-structured research experiences, coupled with appropriate methodological training, can significantly enhance students' research skills and contribute to their academic success.

Overall, the literature underscores the critical need for clear and comprehensive guidance on research methodologies. Accordingly, this study addresses gaps in the research environment by focusing on the conceptual design and prototyping of the Wereesearch platform. The primary objective is to validate the proposed design in terms of functionality, usability, and alignment with identified research needs, rather than to conduct systematic comparative or performance-based benchmarking, which is reserved for future work.

III. METHODOLOGY

This study adopted a qualitative research approach supported by the Software Development Life Cycle (SDLC) framework to guide the structured development of the WeResearch platform. The methodology aimed to identify researchers' needs, translate them into functional requirements, and design a prototype reflecting these requirements. The section outlines the participants, data collection procedures, and data analysis methods used to achieve these objectives.

A. Participants

Ten researchers from diverse academic disciplines participated in this study. Participants were selected using purposive sampling to ensure inclusion of individuals actively engaged in research and publication. Their experience ranged from early-career researchers to senior faculty, providing a comprehensive perspective on research needs and collaboration practices.

B. B. Data Collection

Semi-structured interviews were conducted with each participant, lasting approximately 30–45 minutes. Interviews were held either in person or via phone audio calls. The interview questions focused on researchers' experiences with collaboration, data and document management, access to resources, research planning, and desired features in a digital research environment.

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C. Data Analysis

Transcripts of the interviews were analyzed using thematic analysis. Initial codes were derived from recurring statements and patterns in the data, which were then clustered into broader themes representing researchers' shared experiences and needs. The analysis was conducted manually, as this approach allowed for closer engagement with the data and was appropriate given the manageable sample size. Although software-assisted analysis (e.g., NVivo) can support data management, manual coding was preferred to preserve the depth and contextual richness of participants' responses. Peer debriefing and member checking were employed to enhance the credibility and trustworthiness of the findings.

IV. *RESULTS*

The thematic analysis of the interview data revealed twelve major themes, representing the key features researchers require in a digital research environment:

- Unified Research Environment – Integration of all research tools and resources into a single platform to reduce fragmentation.
- Organized Team Roles – Scheduling and allocation of responsibilities within research teams for coordinated workflows.
- Workbox for Files – Management of personal and shared documents, datasets, and draft manuscripts.
- Visual Access to Models, Theories, and Hypotheses – Tools to support conceptualization and planning.
- Private Notes and Shared Drafts – Facilitating collaboration while preserving individual contributions.
- Wiki of Research Majors – A centralized knowledge base providing quick references across disciplines.
- Direct Access to Online Resources and Libraries – Supporting literature review and data retrieval.
- Direct Contact with Funding Agencies – Streamlining grant and funding application processes.
- Access to Journal and Conference Templates – Supporting proper formatting and submission requirements.
- Communication Tools – Integrated chat and live video for synchronous collaboration.
- Workbox of Previous Studies – Easy retrieval and organization of prior research for reference and citation.
- Integration with Research Platforms – Access to ResearchGate, Google Scholar, and similar platforms to track publications and collaborations.

To map themes to SDLC stages, Table 1 illustrates that as the following:

TABLE 1
MAPPING OF THEMES TO SDLC STAGES (ORGANIZED BY SDLC SEQUENCE)

Theme	Mapped
Unified Research Environment – Integration of all	Planning,
Direct Contact with Funding Agencies – Streamlined	Planning,
Cross-Disciplinary Accessibility – Requirement for	Planning,
Organized Team Roles – Scheduling and role	Analysis,
Visual Access to Models, Theories, and Hypotheses	Analysis,
Workbox for Files – Management of personal and	Design,
Private Notes and Shared Drafts – Collaboration	Design,
Wiki of Research Majors – Centralized disciplinary	Design,
Direct Access to Online Resources and Libraries –	Design,
Access to Journal and Conference Templates –	Design,
Integration with Research Platforms – Linking with	Design,
Resource Sharing and Version Control – Issues with	Design,
Communication Tools – Integrated chat and video	Design,
User-Friendly Interface – Need for simplicity and	Design,
Workbox of Previous Studies – Organized access to	Design,

These findings provide a structured framework of features that informed the design of the WeResearch platform, ensuring it is user-centered, comprehensive, and aligned with the actual needs of researchers.

A. Planning

The planning stage was informed by a comprehensive literature review and a series of semi-structured interviews with researchers. These inputs provided a foundation for identifying key gaps in existing digital research environments and aligning the platform's objectives with actual user needs. The insights gained were translated into a clear project scope, with the goal of designing a unified platform that facilitates research collaboration, data management, and access to resources.

B. Requirements Analysis

The requirements analysis stage focused on systematically mapping the identified needs of researchers to platform features. From the interviews, twelve thematic categories of needs were identified, including collaboration support, document management, resource accessibility, planning tools, and integration of research workflows. Each theme was translated into functional requirements, ensuring that the proposed features directly addressed researchers' priorities and pain points. The functional Requirements include the following points:

User & Role Management: Functional Requirements

FR1.1: University Registration

- University Admin registers the university on the platform.
- Verification ensures legitimacy using either:
  - Institutional email domain, or
  - Official approval letter from the university.

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- Once verified, the university becomes the primary account holder on the platform.

FR1.2: Platform Admin Verification

- Platform Admin reviews and approves:
  - University registration.
  - University Admin accounts representing the institution.
- Ensures all registrations comply with platform standards.

FR1.3: University Admin Role Management, Role Assignment, and Transfer

- University Admin Manages the university profile (official information, description, logo, policies).
- University Admin can:
  - Assign Coordinators to manage academic staff and research activities.
  - Transfer the University Admin role to another verified user if needed (e.g., resignation or reassignment).
  - Transfer Coordinator roles to other verified users when necessary (e.g., workload redistribution or replacement).

FR1.4: Coordinator Assignment and Roles

- University Admin assigns Coordinators to manage academic staff and research activities.
- Coordinators responsibilities:
  - Add Academic staff.
  - Oversee research submissions and collaborations.
  - Act as academic staff: submit research, join projects, and invite external collaborators.
- Multiple coordinators can be assigned for redundancy and workload distribution.
- Coordinate research with academic staff and collaboration with other institutions.

FR1.5: Academic Staff Onboarding

- University Admins onboard academic staff via:
  - Email invitation (single or multiple).
  - Bulk upload using CSV or Excel template.
- Academic staff accounts are automatically linked to the university.

FR1.6: Research Collaboration

- Academic staff can:
  - Submit research projects.
  - Join or collaborate on existing projects.
  - Invite external collaborators with controlled permissions (view/edit/submit).
- All research activities are tracked under the university account.

FR1.7: Audit and Administration

- Platform maintains logs of all actions, including:
  - Role transfers.
  - Staff onboarding.
  - Research submissions.
- Platform Admin can intervene for:
  - University Admin reassignment.
  - Handling inactive accounts or exceptional cases.

C. System Modeling

To translate the identified requirements into a structured representation of the system, Unified Modeling Language (UML) diagrams were developed. UML provides a standardized way to model the functional and structural aspects of the platform, serving as a bridge between requirements analysis and detailed design. Three primary diagrams were produced: The Use Case Diagram, the Activity Diagram, and the Class Diagram. Together, these models describe the intended functionality, workflows, and structural organization of the WeResearch platform.

1) Use Case Diagram

The Use Case Diagram illustrates the interaction between external actors and the system. Key actors include the University Administration, WeResearch Administration, University Coordinators, Academic staff, and Research Collaborators. The diagram illustrates the major system functionalities, including managing platform settings, registration, adding academic staff and external researchers (collaborators). doing research and publishing. This high-level view highlights the scope of the system and clarifies the boundaries between users and platform services. Figure 1 illustrates the key actors of the WeResearch platform using a UML case diagram.

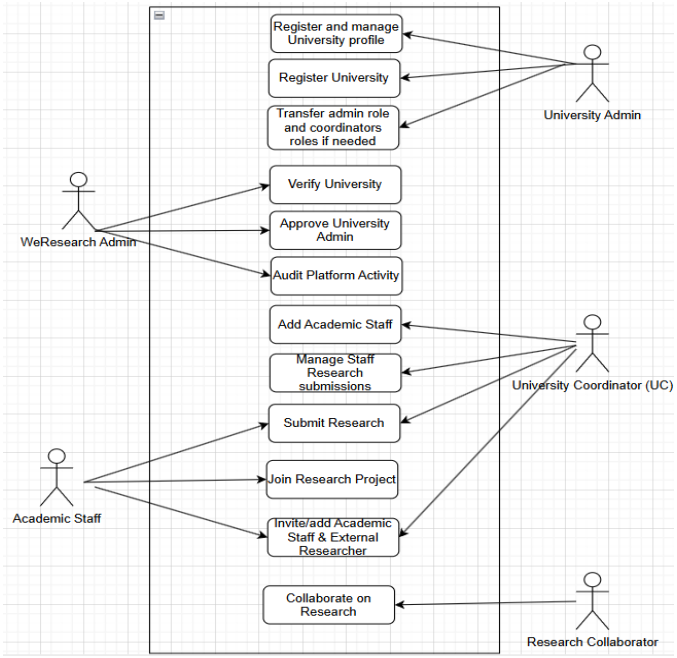

Fig. 1 UML case diagram of WeResearch

https://doi.org/10.31436/ijpcc.v12i1.634

2) Activity Diagram

As part of the system design process, a UML Activity Diagram was developed to model the dynamic behavior of the proposed platform. The activity diagram provides a visual representation of the workflow of actions and decisions that occur when users interact with the system. The activity UML diagram can be described as follows:

2.1 Start (Initial Node)

2.2 University Admin Login/Register

- University Admin creates an account or logs in.

2.3 Platform Verification

- Decision: Platform Admin verifies the university and University Admin account.

2.4 Assign Coordinators

- Action: University Admin assigns one or more Coordinators.

2.5 Coordinator Login/Register

- Action: Coordinator logs in or registers if newly assigned.

2.6 Add Academic Staff

- Coordinators or University Admin can onboard academic staff via:
  - Option A: Bulk upload (CSV/Excel)
  - Option B: Manual entry

2.7 Academic Staff Self-Registration

- Action: Staff complete their profile after being invited.

2.7 Start Research Activities

- Academic staff and coordinators can:
  - Submit research projects
  - Collaborate with peers.
  - Assign tasks/roles.
  - Share drafts and files.
  - Prepare publications.

2.8 External Collaboration

- Action: Invite external researchers to collaborate on projects
- Action: Organize/Invite to conference.

2.9 End (Final Node)

The activity diagram represents the dynamic workflow of the platform, focusing on how tasks are executed in sequence. This diagram emphasizes the logical progression of activities, the flow of control between users and the system, and the decisions that guide different operational paths. Figure 2 demonstrates the UML activity diagram of WeResearch platform.

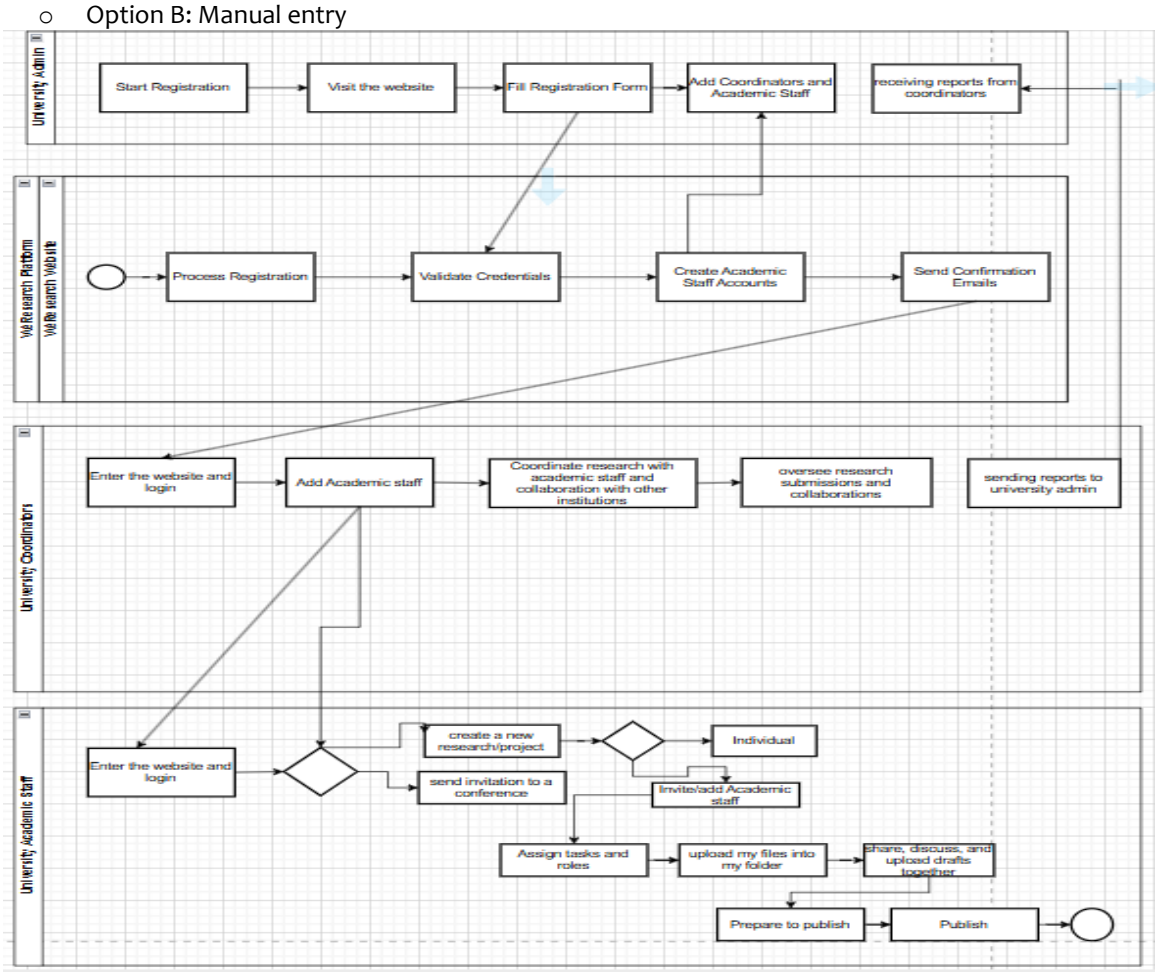

Fig. 2 UML Activity Diagram of WeResearch

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3) Class Diagram

The Class Diagram models the structural aspects of the system by showing its main entities, their attributes, and the relationships between them. Core classes include the following entities:

3.1 WeResearch Admin:

- Attributes: adminID, name, email, password
- Operations: verifyUniversity(), ,approveUniversityAdmin(), auditSystem(), monitorActivity()

3.2 University

- Attributes: universityID, name, address, status
- Operations: verifyRegistration(), approveCoordinator()
- Relationships: 1 University → 1 UniversityAdmin
  1 University → many Coordinators
  1 University → many AcademicStaff

3.3 University Admin

- adminID, universityID(), name , email, password
- Operations: registerUniversity(), manageUniversityProfile(), assignCoordinator(), transferAdminRole(), transferCoordinatorRole()
- Relationships: 1 University → 1 UniversityAdmin
  1 University → many Coordinators
  1 University → many AcademicStaff

3.4 Coordinator

- Attributes: coordinatorID, name, email, password, universityID
- Operations: login(), addAcademicStaff(), uploadCSV(), manageResearchSubmissions(), submitResearch(), joinProject(), inviteCollaborator()
- Relationship: 1 Coordinator manages many AcademicStaff

3.5 Academic Staff

- Attributes: staffID, name, department, email, password, universityID.
- Operations: login(),completeprofile(), startResearch(), collaborate(), shareFile(), shareDraft(), assignTask(), inviteCollaborators()
- Relationship1: AcademicStaff belong to University
- Relationship2: AcademicStaff ↔ AcademicStaff
- Relationship3: AcademicStaff → many ResearchProjects

3.6 Research

- Attributes: ResearchID, title, status, startDate, endDate
- Operations: assignRole(), addDraft(), shareFiles(), preparePublication()
- Relationships: ResearchProject has many AcademicStaff (aggregation), 1 ResearchProject → many Publications, 1 ResearchProject → many ExternalCollaborators

3.7 Collaborator (External Researcher)

- Attributes: CoolaboratorID, name, email
- Operations: collaborate(), receiveInvitation()
- Relationship: ExternalCollaborator ↔ ResearchProject

3.8 Publication

- Attributes: publicationID, title, type, submissionDate, status
- Operations: submit(), review(), publish()
- Relationships: 1 Publication → belongsTo → ResearchProject

Figure 3 illustrates the UML class diagram of WeResearch platform.

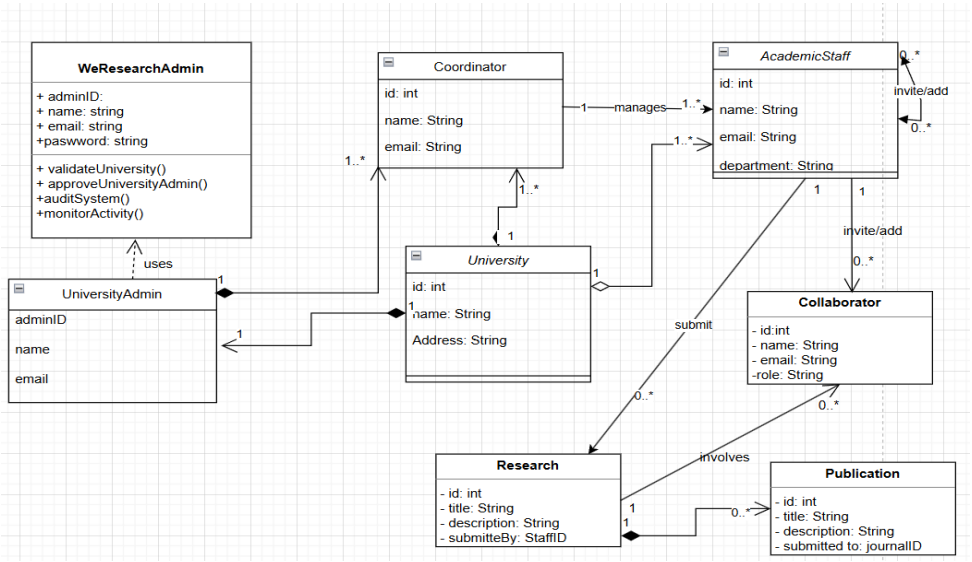

Fig. 3 UML Class Diagram of WeResearch

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By combining these UML models, the system structure and functionality are clearly defined, ensuring that the subsequent design stage is grounded in a well-documented representation of user requirements and platform interactions.

C. Design

In the design phase, the system architecture was outlined to define the structural components of the platform and their interactions. Interface mockups were developed to provide a visual representation of the user experience, with an emphasis on simplicity, intuitiveness, and efficiency. Navigation flows were mapped to ensure seamless movement between modules, and design tools were employed to create wireframes that guided the subsequent prototyping process.

D. Prototyping

The prototyping phase resulted in the development of a working prototype that visualized the platform's core functionalities. This prototype served as both a demonstration of the proposed environment and as a basis for iterative testing and refinement with users. The prototype highlighted key features such as collaborative workspaces, integrated document and data management, research planning modules, and resource access. Figure 4 shows the screen of Researchers' tasks and roles management, and an organized workbox of their files. While Figure 5 shows the WeResearch reference manager.

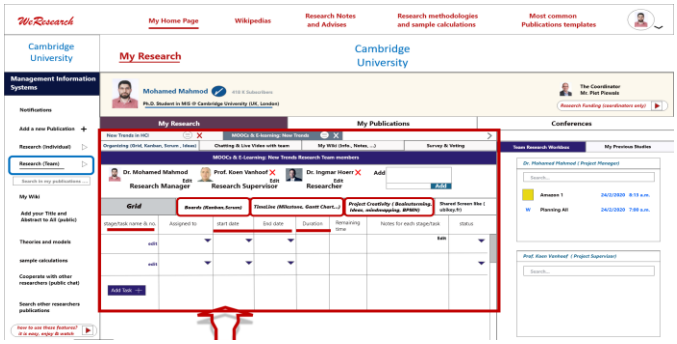

Fig. 4 Screenshots of Researchers' tasks and roles management, and an organized workbox of their files

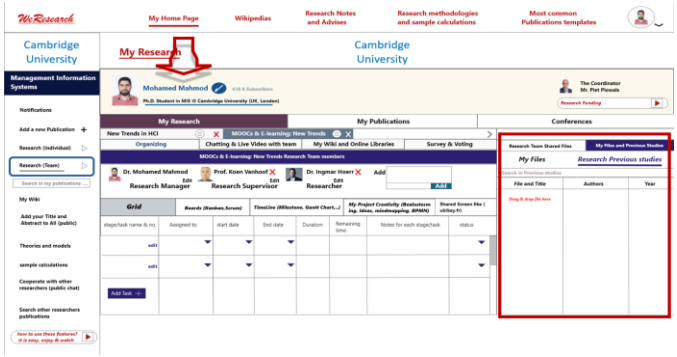

Fig. 5 WeResearch reference manager

The design phase meets the needs of researchers by offering their private and shared notes and files. Figure 6 illustrates the researcher's own notes and draft. Figure 7 shows the researchers' shared notes.

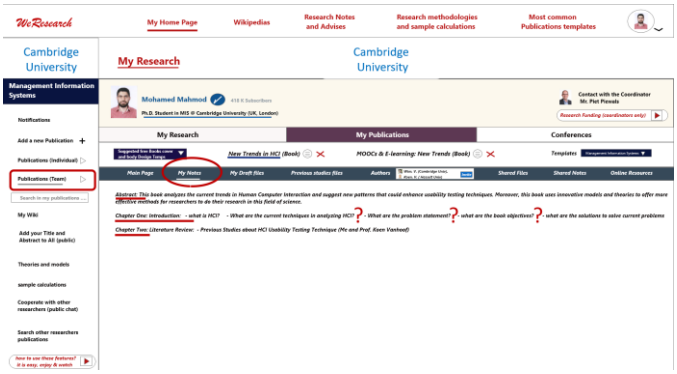

Fig. 6 Researcher's private notes and draft

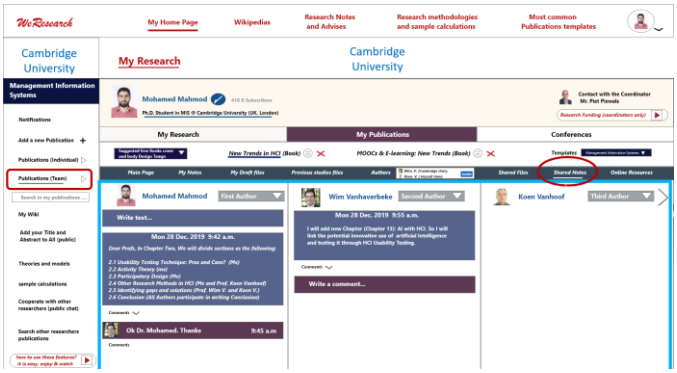

Fig. 7 researchers shared notes

To meet researchers' needs, the design of WeResearch offered journal and article templates which is ready to be downloaded to work quickly without looking for on other websites. Figure 8 shows WeResearch service of offering journal and articles templates.

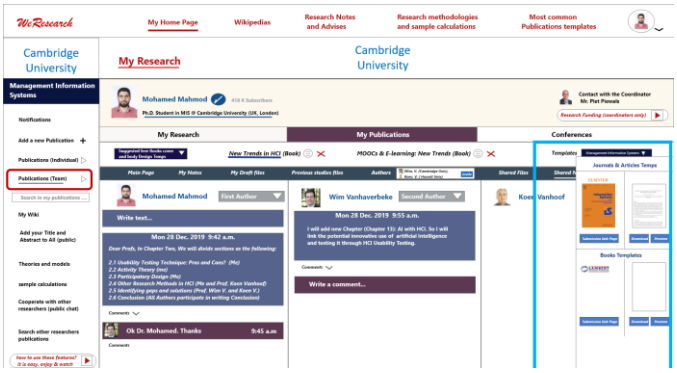

Fig. 8 journal and article templates

In addition, due to researchers demand of the necessity of offering the upcoming conferences and invitations to it,

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WeResearch offers their needs and puts it in its design and protoyping as shown in Figure 9.

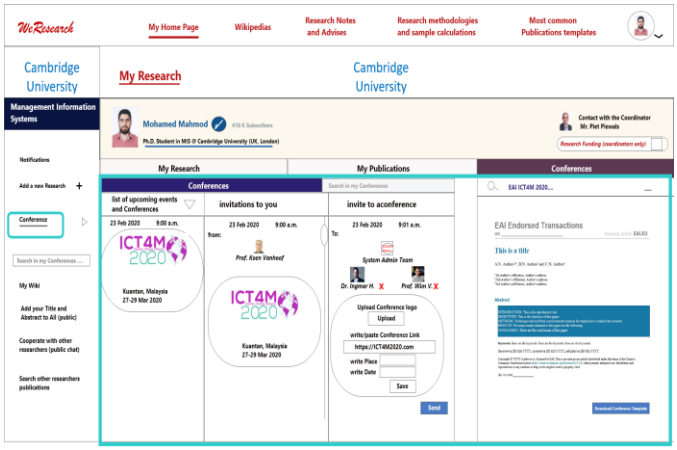

Fig. 9 Conference invitations and templates

Furthermore, WeResearch offers research design types, theories and models per major and clear explanation for each to facilitate the research methodologies as shown in figures 10, 11,12 and 13.

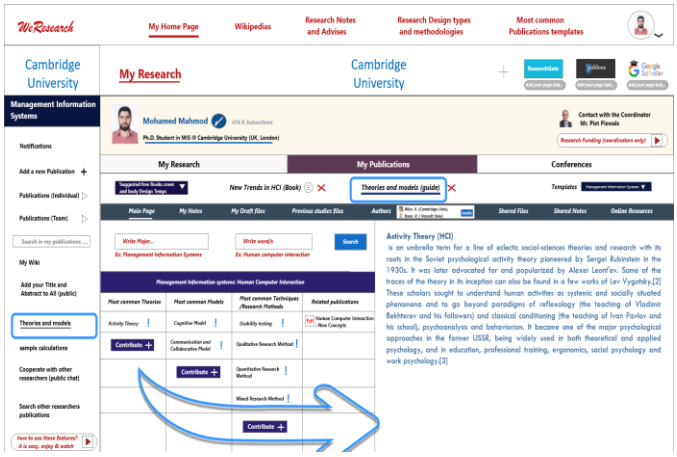

Fig. 10 Theories and models fitted with major

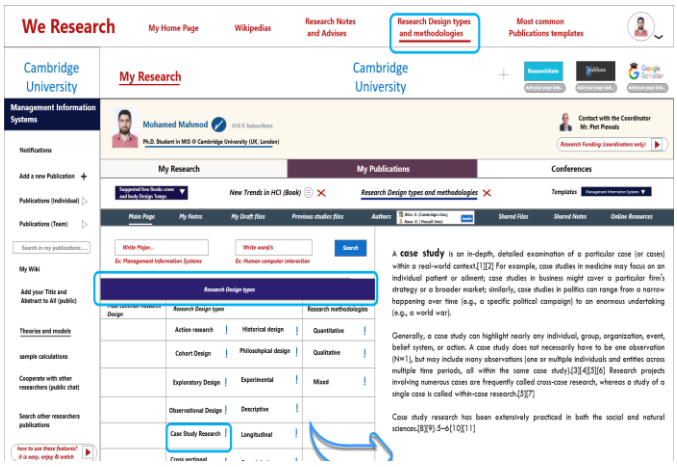

Fig. 11 Research design types definitions for researchers

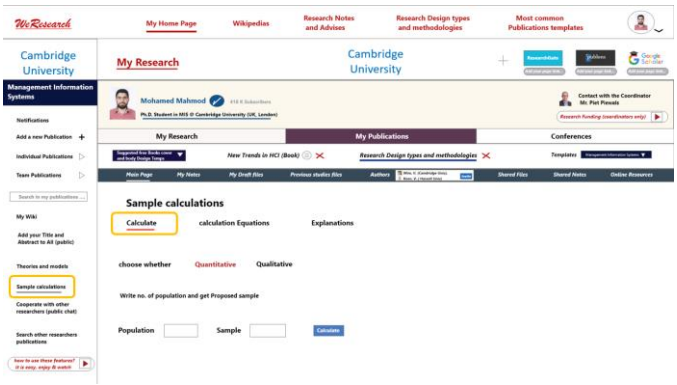

Fig. 12 Sample calculator for quantitative studies

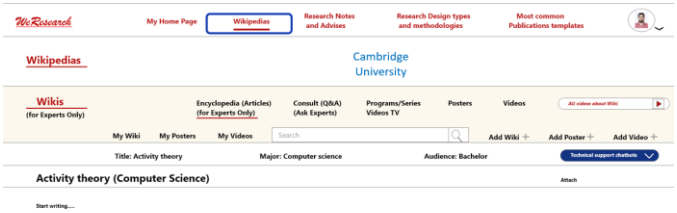

Fig. 13 Encyclopedia of general articles of researchers for students and researchers

V. Evaluation and User Feedback

A. Participants

The evaluation involved the same ten researchers who contributed to the needs assessment stage. Their participation ensured continuity and allowed for a direct comparison between their identified needs and their perceptions of the proposed design.

B. Procedure

Participants engaged in a usability session with the interactive prototype of WeResearch. The sessions lasted 30–45 minutes and were conducted either in person or via online screen-sharing. Participants were first introduced to the purpose of the prototype and then asked to complete representative tasks as shown in Figures 4-12.

The researcher observed participants' interactions with the prototype, noting points of confusion, ease of navigation, and successful task completion. Think-aloud prompts were used to encourage participants to verbalize their reasoning and impressions while completing tasks. At the end of each session, a short debriefing was held to gather overall feedback on usability, feature relevance, and alignment with actual research practices.

C. Data Collection

Feedback was collected through a combination of semi-structured interviews, direct observation, and open discussion during prototype testing sessions. Participants

were encouraged to think aloud while interacting with the prototype, verbalizing aspects they found intuitive, confusing, or particularly useful. The researcher documented task completion, navigation challenges, and spontaneous reactions. Follow-up questions were asked to clarify participants' perspectives on specific features and workflows.

D. Findings and feedback

The prototype testing revealed several key themes: Usability and Clarity: Most participants found the interface intuitive and easy to navigate. However, some suggested simplifying certain menus and reducing the number of steps for common actions, such as uploading files. The usability evaluation was exploratory and primarily perception-based, relying on participant feedback and observational insights rather than standardized quantitative metrics such as SUS scores or task completion time.

Relevance of Features: Core tools—particularly the Workbox for file management, collaborative task assignments, and communication functions—were considered highly relevant and directly applicable to participants' ongoing research workflows.

Enhancements and Desired Features: Participants recommended additional integrations (e.g., with citation managers and external databases), more personalized dashboards, and improved reference handling features.

Overall Satisfaction: Researchers expressed strong satisfaction with the prototype's direction, noting that it successfully addressed many of the gaps they had previously identified in existing research tools.

E. Implications for Design

The feedback validated several core design decisions while highlighting opportunities for refinement. Usability adjustments and requested features will inform the next iteration of the platform. Importantly, the evaluation confirmed that the interactive prototype aligned with researchers' real-world needs, demonstrating the effectiveness of applying SDLC principles to guide user-centered design and development.

VI. CONCLUSION

This study presented WeResearch, a unified research collaboration platform designed to strengthen connections among universities and researchers worldwide. By integrating a qualitative needs assessment with the Software Development Life Cycle (SDLC), the system was shaped according to both user requirements and software design principles. Through interviews with researchers, their needs were identified, analyzed, and transformed into functional specifications, which guided the modeling, design, and prototyping of the platform. UML diagrams were employed to structure the system, clarify relationships, and ensure alignment with user expectations.

The design and prototyping of WeResearch demonstrates how participatory approaches can enhance the relevance and usability of academic software systems. The findings suggest that combining qualitative insights with systematic modeling not only bridges the gap between researchers' needs and technical solutions but also supports the creation of a robust and scalable platform. Ultimately, WeResearch contributes to advancing global academic collaboration by presenting a structured, user-centered, and sustainable prototyped research platform.

The proposed design is intended to be scalable and adaptable to different institutional contexts; however, scalability and performance characteristics have not yet been empirically validated.

This study relied on interviews and observational feedback from ten researchers. Future work is proposed to include quantitative measures, document analysis, and independent evaluators. Future studies are proposed to adopt independent or blinded evaluation strategies.

As is common in early-stage, user-centered design studies, the same group of participants contributed to both the requirements elicitation and the prototype evaluation. This approach supported continuity and coherence in assessing the alignment between user needs and the proposed design. Accordingly, the findings are best interpreted as evidence of the proposed design's alignment with identified user requirements, while comprehensive evaluations of system effectiveness, performance, and scalability are deferred to future stages of implementation and investigation.

This study focuses specifically on the early phases of the Software Development Life Cycle, namely planning, requirements analysis, design, and prototyping. Implementation, deployment, and maintenance phases are beyond the scope of the current work and are planned as future research directions.

ACKNOWLEDGMENT

The author would like to thank the researchers who participated in the usability testing by interacting with the prototype interface and providing valuable feedback and suggestions that helped improve the system.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR(S) CONTRIBUTION STATEMENT

The author was responsible for the conceptualization and design of the study, methodology, data collection, system modeling and prototyping, data analysis, and manuscript preparation. The author reviewed and approved the final version of the manuscript.

https://doi.org/10.31436/ijpcc.v12i1.634

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

This study involved human participants and was conducted in accordance with ethical research standards.

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