

User-Centric Mobile Application Design for Hall Management in Higher Education Institutions in Benue State

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Abstract – Hall allocation in higher education institutions in Nigeria, particularly in Benue State, remains predominantly manual, inefficient, and error-prone. These challenges lead to scheduling conflicts, poor transparency, and significant administrative burden. This paper presents a user-centric needs assessment and preliminary design framework for a proposed mobile hall-management application tailored to higher education institutions in Benue State. Rather than reporting a completed implementation, this study focuses on establishing the empirical need for such a system and outlining the user-driven design principles that will guide its future development. A mixed-methods approach was used, involving surveys, interviews, and focus group discussions with students, academic staff, and hall administrators across seven institutions. Results indicate unanimous agreement on the inefficiency of current hall management processes and a strong stakeholder willingness to adopt a mobile, real-time, transparent digital system. Based on these findings, a user-centric design framework is proposed, detailing key requirements, UX/UI considerations, and architectural recommendations for the next phase of system development. This study contributes a validated design roadmap for future implementation and provides a foundation for a subsequent development-focused paper.

Keywords – User-centric design, hall management, mobile application, higher education, needs assessment, UX/UI design, Benue State.

1. INTRODUCTION

Hall spaces in higher education serve critical functions in examinations, lectures, seminars, and various other institutional activities. In Nigerian institutions, hall allocations have often been managed through manual records or fragmented digital tools, which can lead to human errors and delays in reflecting real-time changes. These inefficiencies can result in scheduling conflicts, underutilization, and a lack of clarity in how resources are distributed [1]. This situation exists within a broader context of ICT-driven reforms in Nigerian higher education, where the digitization of administrative functions like asset tracking and web-based information systems can enhance transparency and oversight. However, challenges such as infrastructure readiness and capacity constraints necessitate adjustments in policy and practice for successful implementation [2], [3].

There is growing recognition of the importance of user-centered design in the development of educational technologies. Collaborative, stakeholder-driven processes and iterative refinements are essential in translating design requirements into practical and appropriate solutions that aim to improve both service delivery and accountability within university operations [4], [5]. While mobile-enabled administrative systems have demonstrated promise in several educational contexts, successful deployment requires that design processes be grounded in an accurate understanding of user needs, contextual constraints, and institutional workflows. In the case of hall management in Benue State institutions, these considerations are particularly salient given the persistent operational bottlenecks and infrastructural limitations.

Despite efforts at reform, many Nigerian institutions still face significant challenges in hall management, including overbooking, misallocation, and limited visibility in real-time operations. These issues contribute to substantial administrative burdens and diminish user trust in existing scheduling processes. Compounding these problems are infrastructural constraints and varying levels of digital literacy that challenge the effective deployment of digital hall-management systems [8], [2], [3]. Employing a user-centered, context-aware design can address these challenges by ensuring that proposed functionalities align with the administrative workflows and roles of all stakeholders involved—students, administrators, and external partners. This approach is complemented by collaborative assessment and decentralized facilities-management strategies, which can enhance adoption and service quality in complex university environments [4], [5], [3].

In the context of Nigeria, ICT-enabled educational initiatives are contingent upon investments in digital literacy, infrastructure, and governance structures that facilitate the attainment of meaningful benefits. Thus, exploring a stakeholder-driven mobile design for hall management is particularly relevant for Benue State and similar contexts [8], [3]. However, before any effective solution can be developed or deployed, it is essential to empirically establish the extent of user challenges, assess stakeholder readiness for digital transformation, and articulate design requirements informed by actual institutional needs.

Accordingly, this study does not present a developed or piloted mobile application. Instead, it focuses on (i) empirically assessing stakeholder perceptions of the current hall management processes in Benue State higher education institutions; (ii) identifying functional and non-functional requirements for a proposed user-centric mobile hall-management solution; and (iii) presenting a preliminary design framework that will guide subsequent system development and implementation in future research. This approach ensures that the eventual mobile application is grounded in validated user needs and tailored to the realities of the institutional context.

The remainder of the paper discusses the literature relevant to this study, outlines the research design and methodology, presents the results of the needs assessment, and proposes a user-centric system design framework. The paper concludes with implications for future system development and recommendations for scaling digital hall-management solutions in Benue State and other analogous institutions across Nigeria.

2. LITERATURE REVIEW

Mobile application development in higher education has evolved from supporting isolated learning activities to enabling core administrative functions such as scheduling, hall allocations, asset tracking, and the governance of space use. In Africa and other developing regions, widespread smartphone adoption and improving mobile network penetration have facilitated a shift toward mobile-enabled administrative tools that promise real-time updates, improved accessibility, and greater transparency [10], [11]. This trend is increasingly evident in Nigeria, where institutions are exploring digitization of examination scheduling, timetable coordination, and facilities management. However, progress is often hindered by infrastructural limitations, inconsistent policy support, and varying levels of digital readiness across institutions [12], [8], [13]. These challenges underscore the need for context-responsive digital solutions that account for governance structures, institutional capacity, and user literacy levels [17], [18]. Within this broader landscape, a user-centered mobile hall-management solution for Benue State represents a logical progression in the ongoing digital transformation initiatives within Nigerian higher education [12], [14].

User-centered and participatory design principles have consistently demonstrated value in the development of educational and administrative technologies. Literature emphasizes that stakeholder engagement—through interviews, iterative feedback cycles, usability testing, and collaborative refinement—ensures that proposed digital solutions align with real administrative workflows and enhance both usability and accountability [1], [4]. Studies of mobile information environments show that user involvement leads to more intuitive design choices and supports higher adoption rates and satisfaction [5], [15], [17]. Research guided by the Unified Theory of Acceptance and Use of Technology (UTAUT) further highlights that performance expectancy, effort expectancy, social influence, and facilitating conditions significantly shape technology acceptance in higher education, particularly in developing-country contexts [18], [21]. Findings across African institutions repeatedly stress that digital literacy, connectivity, and policy alignment must be addressed for any user-centered system to succeed at scale [19], [14]. These insights collectively suggest that understanding user needs and institutional constraints is an essential prerequisite for designing an effective hall-management application.

Although research specifically focused on hall management solutions in Nigerian higher education is limited, related studies provide important guidance on digitized facilities management. Investigations into hall-registration systems and automated exeat management demonstrate that digital consolidation of residency or facility data can reduce delays, improve security, and enhance administrative efficiency [20]. Similarly, studies of asset and facilities-management systems highlight the value of centralized, web-based platforms in improving transparency and enabling auditable usage of institutional spaces [22], [1]. Research on university-management applications further emphasizes the importance of usability, cognitive load reduction, and interface clarity in ensuring user acceptance of mobile administrative systems [6], [12]. These findings suggest that a well-designed mobile hall-management solution—grounded in usability best practices and supported by appropriate facilities-management principles—could meaningfully improve hall utilization and stakeholder trust in Benue State institutions.

Broader literature on mobile learning and educational technologies in Africa reinforces the relevance of user-centered approaches. Studies indicate that learner and staff readiness, acceptance, and behavioral intention to use mobile tools depend heavily on perceptions of usefulness, ease of use, and supportive institutional environments [23], [24]. Empirical evidence confirms that performance expectations and enabling conditions are strong predictors of technology adoption in developing-country contexts [18], [25]. Across Africa, scholars consistently highlight the need for policy integration, digital literacy support, and context-sensitive strategies to ensure that mobile technologies achieve meaningful educational and administrative impact [26]. These insights point

to the importance of assessing local needs, institutional challenges, and user readiness before implementing mobile administrative systems.

Despite ongoing digitization efforts in Nigerian higher education, there remains a notable gap in empirical research focusing specifically on user-centered mobile hall-management solutions tailored to Benue State institutions. Existing studies provide valuable lessons on facilities management and mobile system usability, yet few have systematically examined stakeholder perceptions of hall-management challenges or documented user-driven requirements for a dedicated mobile solution. Moreover, limited research has connected these insights to the specific infrastructural and administrative realities of Benue State.

This study addresses these gaps by conducting a detailed needs assessment across seven higher education institutions, identifying the inefficiencies of current hall-management practices, evaluating stakeholder readiness for digital transformation, and proposing a user-centered design framework for a future mobile hall-management system. The findings of this literature review emphasize that any viable solution must be grounded in stakeholder needs, institutional constraints, and evidence-based design principles, thus guiding the conceptual design presented later in this paper.

3. METHODOLOGY

This study employed a mixed-methods, user-centered design (UCD) approach to investigate the challenges associated with hall management in higher education institutions in Benue State and to establish the functional and non-functional requirements for a proposed mobile hall-management system. The research design was guided by the pre-implementation phases of the Design Science Research (DSR) methodology, focusing specifically on problem identification, contextual analysis, stakeholder engagement, and the development of a conceptual design framework. No system was implemented at this stage; instead, the emphasis was on understanding user needs and defining a design direction that would support future development.

Stakeholder engagement served as the foundation of the methodological process. Because hall management involves diverse user groups, the study engaged students, academic staff, and administrative personnel responsible for scheduling, allocation, and oversight of halls. This engagement took place across seven higher education institutions in Benue State to capture a wide range of experiences and ensure relevance across institutional contexts. Through informal consultations, discussions, and observation of existing workflows, the study sought to capture the everyday realities and constraints that shape hall utilization and resource allocation.

To obtain more systematic insights, data were collected using a structured questionnaire supplemented by semi-structured interviews and focused group discussions. The questionnaire captured perceptions of current hall-management practices, inefficiencies encountered, transparency concerns, user satisfaction, and readiness for digital transformation. Responses were gathered from 350 participants and were analyzed descriptively to identify prevailing trends and areas of consensus. Qualitative feedback from interviews and focus groups provided deeper explanations for quantitative patterns, shedding light on recurrent issues such as double-booking, delayed approvals, limited visibility of hall availability, and administrative workloads. Together, these data sources enabled a coherent understanding of both operational challenges and user expectations.

The design component of the methodology involved translating the empirical findings into conceptual system requirements. Using principles from ISO 9241-210 and established UCD practices, the study developed preliminary interface sketches and workflow diagrams to illustrate how a mobile solution could address the identified problems. These conceptual artefacts were not implemented or tested but served as representations of how the proposed system might function in practice. They also enabled reflection on the feasibility and usability considerations necessary for the next phase of development.

Ethical considerations were integrated throughout the research process. Participation was voluntary, informed consent was obtained, and no personally identifiable information was collected beyond what was necessary for analysis. The study received approval through the Institutional-Based Research (IBR) framework of the Federal College of Education Odugbu, ensuring compliance with research ethics and data protection standards.

4. PROPOSED FRAMEWORK

Based on the empirical findings and stakeholder feedback gathered across the participating institutions, a conceptual framework is proposed to guide the development of a user-centered mobile hall-management system for higher education institutions in Benue State. The framework emphasizes usability, transparency, and real-time coordination, addressing the specific constraints and operational patterns identified during the needs assessment. Rather than presenting a fully implemented system, the framework outlines the architectural, functional, and interaction design principles necessary for subsequent development and prototyping.

At its foundation, the framework adopts a user-centered design (UCD) philosophy, ensuring that system features evolve from clearly defined user needs and contextual realities. This approach positions students, lectures, and administrative personnel at the center of all design considerations, acknowledging that hall management is a cross-cutting function requiring coordinated interaction between multiple stakeholders. The framework therefore emphasizes intuitive interfaces, simplified workflows, and clearly defined user roles tailored to varying levels of digital literacy and administrative responsibility.

The proposed system architecture follows a modular, service-oriented structure designed to support scalability and institutional diversity within Benue State. In its conceptual form, the architecture consists of three integrated layers. The presentation layer is envisioned as a cross-platform mobile interface that provides role-based access to hall schedules, booking options, allocation approvals, and notifications. The application layer manages core functionalities such as hall availability tracking, booking validation, conflict resolution, and audit logging. Finally, the data layer is responsible for securely storing metadata on halls, schedules, user roles, booking histories, and system logs. This layered architecture ensures separability of concerns and lays a foundation for future integration with institutional information systems.

Functionally, the framework incorporates several capabilities identified as critical during the needs assessment. These include a real-time hall availability module that reflects updates as they occur, an automated conflict-detection mechanism for preventing double-booking, a role-based approval workflow for administrators, and a feedback component enabling users to report issues such as equipment needs, seating problems, or environmental concerns. By placing these functions at the core of the proposed system, the framework addresses the recurring challenges documented across institutions, including manual errors, delayed communication, and limited transparency in hall utilization.

Central to the framework is an iterative design and validation cycle. Feedback obtained from stakeholders during the needs assessment informed the initial conceptual sketches and workflow diagrams. These design artefacts are intended for further refinement in subsequent phases of the research, where iterative prototyping and usability evaluations would ensure alignment with user expectations. This process echoes established best practices in design science and UCD, which emphasize continuous stakeholder involvement to achieve improved usability and system acceptance.

The framework also accounts for contextual constraints identified across institutions, such as intermittent internet connectivity, inconsistent digital literacy levels, and administrative resource limitations. To mitigate these challenges, system requirements include lightweight interface designs, offline caching for selected features, minimal cognitive load, and clear navigation pathways. In addition, role-based access and security considerations were incorporated to ensure that sensitive administrative operations remain protected while still providing transparent access to hall information for authorized users.

5. RESULTS

5.1 Respondent Demographic

A total of 350 respondents participated in this study, drawn from seven higher education institutions in Benue State. The sample included academic staff, administrative staff (including hall officers), and students, with all groups almost evenly represented: academic staff constituted 33.1%, administrative/hall officers 34.0%, and students 32.9%. Each institution contributed between 44 and 56 respondents, ensuring a well-balanced distribution and enhancing the representativeness of the data across the State.

5.2 Description of Measurement Scale

Two composite scales were measured in the questionnaire:

- **B-scale (Hall Management Challenges):**

These items capture challenges with the existing hall allocation and scheduling systems.

- B1 – Difficulty accessing hall schedules
- B2 – Frequent scheduling conflicts
- B3 – Double booking of halls
- B4 – Lack of transparency in allocation
- B5 – Delayed communication of schedule changes
- B6 – Time-consuming manual booking processes
- B7 – Inaccurate or outdated hall information
- B8 – Unclear responsibility or reporting structure

- **C-scale (Perceived Need for a Mobile Hall-Management System):**

These items capture the perceived usefulness of a mobile solution.

- C1 – Need for real-time hall availability updates
- C2 – Preference for mobile accessibility
- C3 – Need for automated scheduling
- C4 – Need for transparency in hall allocation
- C5 – Need for quicker communication
- C6 – Need for notification/alert systems
- C7 – Need for streamlined approval workflows

Reliability analysis (Cronbach's alpha) showed very strong internal consistency for both scales:

- **B-scale: $\alpha = 0.86$**
- **C-scale: $\alpha = 0.91$**

Both exceed the recommended 0.70 threshold, indicating that the questionnaire items reliably measure the constructs.

5.3 Assessment of Current Hall Management Challenges

Descriptive analysis of the B items showed critical problem areas in the existing hall management process. Table 1 presents the means, standard deviations, and percentage of respondents who agreed (i.e., scored ≥ 4 on a 5-point Likert scale).

Table 1: Hall Management Challenges (B Items)

Item	Description	Mean	SD	% Agree
B2	Frequent scheduling conflicts	4.47	0.50	100%
B3	Double booking of halls	4.50	0.50	100%
B7	Inaccurate/outdated hall information	4.50	0.50	100%
B6	Time-consuming manual process	3.02	0.84	35.7%
B1	Difficulty accessing schedules	2.96	0.81	30.6%
B8	Unclear responsibilities	2.09	0.84	0%
B4	Lack of transparency	2.04	0.86	0%
B5	Delayed communication	1.97	0.80	0%

The overall B-scale mean was 3.19 (SD = 0.25).

The highest-rated challenges, B2, B3, and B7 had 100% agreement, indicating universal recognition of severe scheduling inefficiencies and data inaccuracies in the current system. Lower-scoring items reflect problems perceived as less severe or more institution-specific but still relevant.

These findings clearly establish that the existing hall management process is inefficient, inconsistent, and prone to avoidable errors, a strong justification for system redesign.

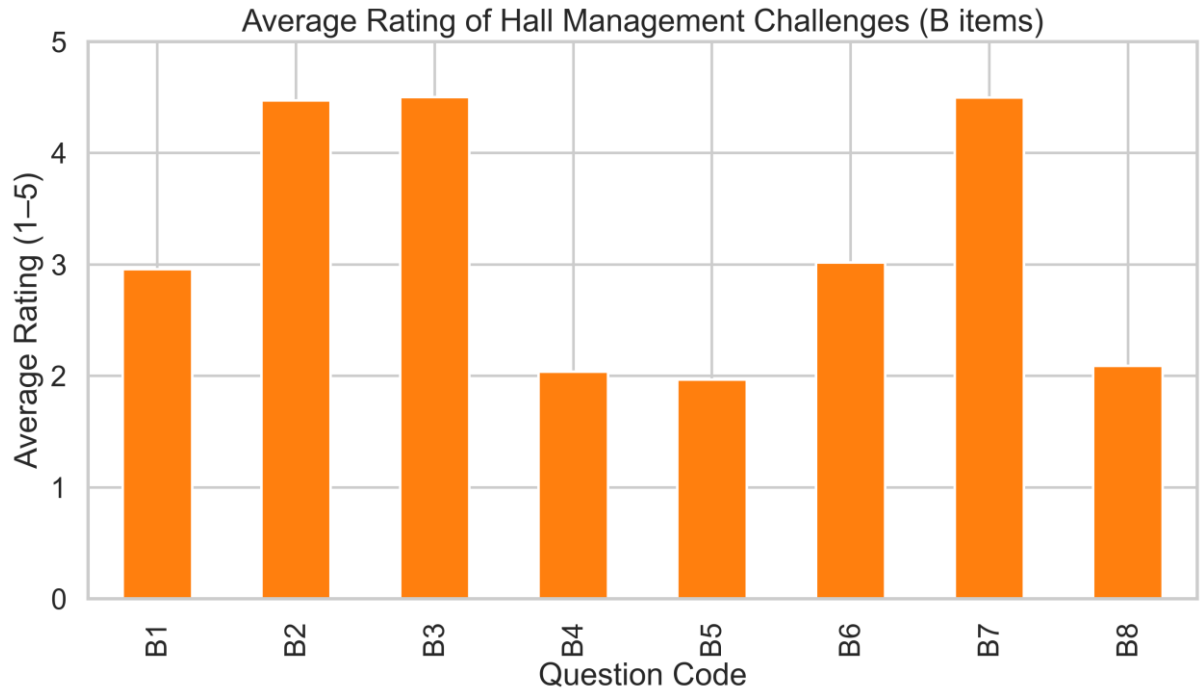


Figure 1: Average Ratings for Hall Management Challenges (B Items)

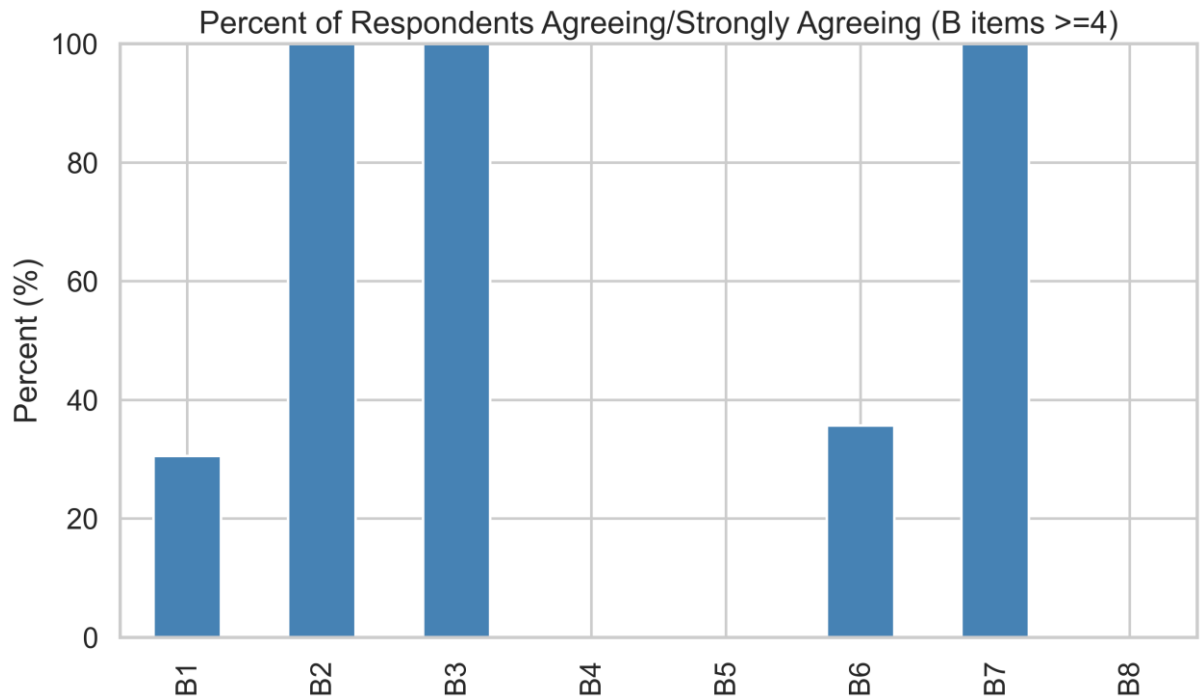


Figure 2: Percentage of Respondents Agreeing with Each Challenge Item (B Items)

5.4 Perceived Need for a Mobile Hall-Management System

Across all seven items measuring perceived need, scores were markedly high. Table 2 presents the descriptive statistics.

Table 2: Perceived Need for Mobile Hall-Management (C Items)

Item	Description	Mean	SD	Median
C3	Need for automated scheduling	4.54	0.50	5
C7	Need for streamlined approval workflows	4.51	0.50	5
C4	Need for transparency	4.50	0.50	5
C2	Mobile accessibility	4.49	0.50	4
C1	Real-time updates	4.49	0.50	4
C5	Faster communication	4.47	0.50	4
C6	Notifications/alerts	4.46	0.50	4

The overall C-scale mean was 4.50 (SD = 0.20).

Importantly, 100% of respondents fell within the High Need category (mean ≥ 4.0), demonstrating unanimous willingness and strong justification for the development of a mobile, automated hall-management solution.

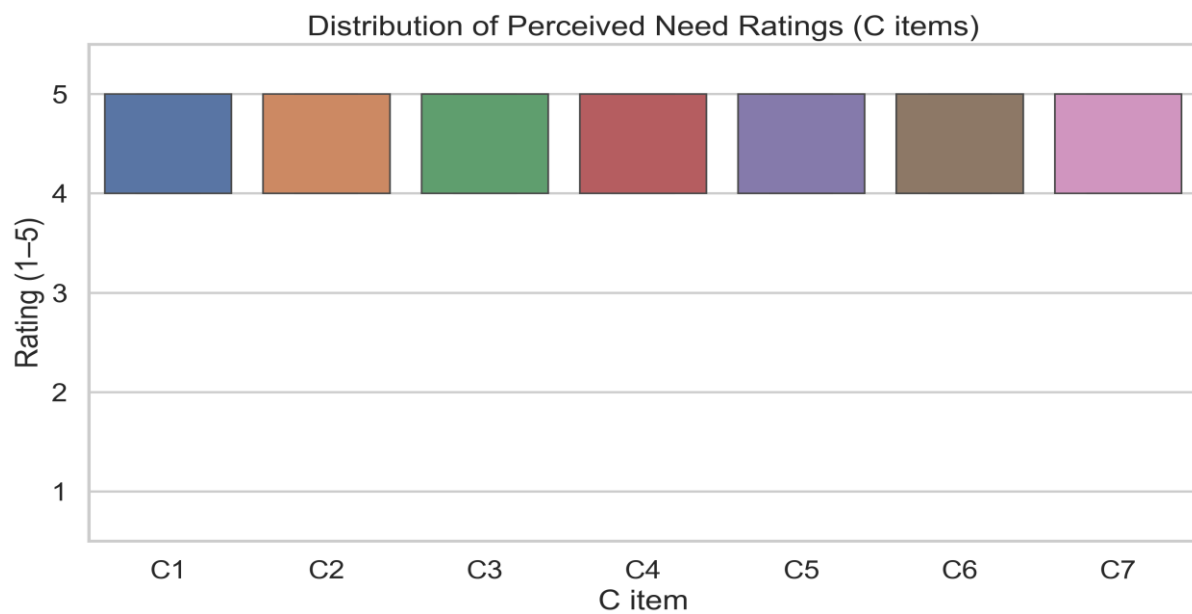


Figure 3: Distribution of Ratings for Perceived Need (C Items).

Stakeholder Perceived Need for Mobile Hall-Management System

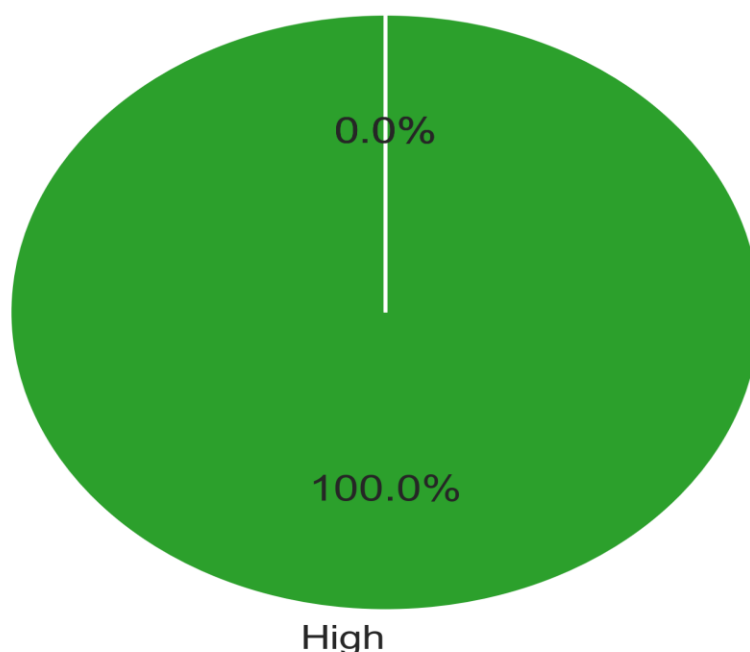


Figure 4: Overall Perceived Need for Mobile Hall-Management System Among Respondents.

5.5 Comparison Across Stakeholder Groups

Differences in B-scale and C-scale scores were examined across academic staff, administrative staff/hall officers, and students.

Table 4.3: Comparison by Roles

Role	n	B-Scale Mean (SD)	C-Scale Mean (SD)
Academic Staff	116	3.21 (0.26)	4.52 (0.19)
Administrative Staff	119	3.18 (0.24)	4.48 (0.21)
Students	115	3.19 (0.26)	4.48 (0.19)

ANOVA showed no statistically significant differences across roles (B-scale: $p > 0.05$; C-scale: $p > 0.05$). This indicates that the challenges and needs identified are shared uniformly across all stakeholder groups, strengthening the generalizability of the findings.

5.6 Comparison Across Institutions

Institution-based comparisons revealed very consistent patterns:

- B-scale means ranged from 3.15 to 3.26
- C-scale means ranged from 4.47 to 4.52

This narrow range demonstrates that all institutions face similar hall-scheduling challenges, and all institutions share a strong need for a mobile hall-management system.

Correlation heatmap analysis further confirmed strong relationships between specific challenges (particularly B2, B3, and B7) and perceived need items (C1–C4), suggesting that institutions with higher levels of scheduling conflict also exhibit a stronger desire for features like real-time updates and transparency.

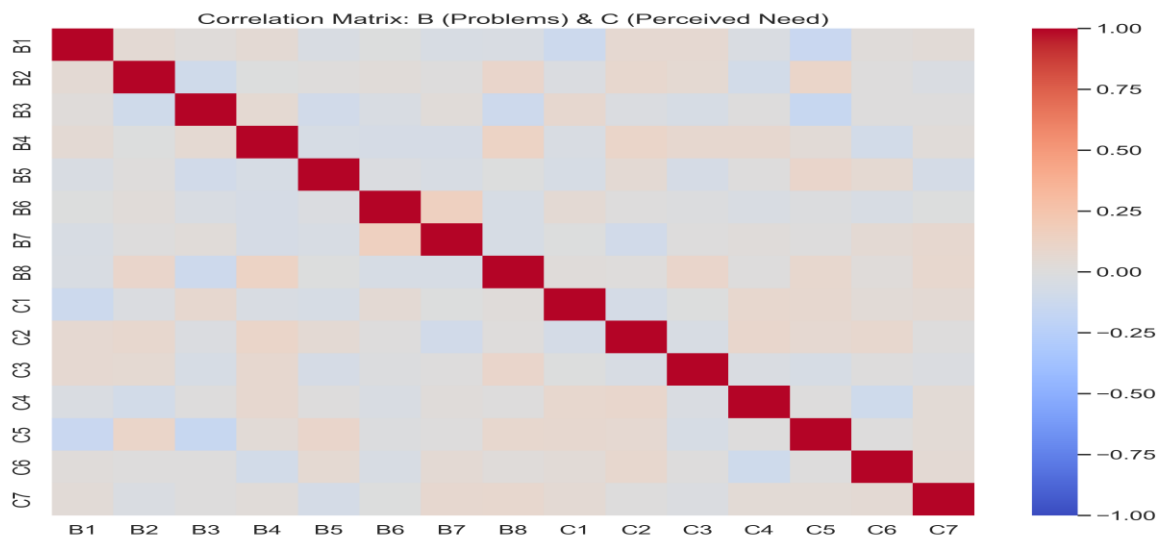


Figure 4: Correlation Heat Map

6. DISCUSSION

The results provide clear, evidence-based justification for the need to develop a mobile hall-management application for higher education institutions in Benue State.

6.1 Summary of Key Findings

The study revealed unanimous recognition of existing inefficiencies in hall allocation systems across institutions. Challenges such as double booking, inaccurate hall data, and frequent scheduling conflicts were universally acknowledged. At the same time, all respondents (100%) expressed a strong need for a mobile, transparent, and real-time hall management system, demonstrating overwhelming support for a digital solution. Importantly, the consistency across roles and institutions indicates that the system should be designed as a general-purpose, scalable solution, not institution specific.

6.2 Interpretation of Challenge Ratings

The severity of challenges such as B2 (scheduling conflicts) and B3 (double booking) strongly reinforces findings from existing literature, which highlight manual scheduling as a major source of administrative delays, student dissatisfaction, and lost instructional time. These challenges also lead to operational inefficiencies, fragmented communication, and resource underutilization. Lower-rated items (e.g., B4, B5) suggest that while transparency and delayed communication are seen as problems, the most immediate bottlenecks revolve around accuracy and conflict resolution.

6.3 Implications for System Design

Based on the strongest user needs (C3, C7, C4), the proposed system should prioritize:

- Real-time synchronization to eliminate double bookings
- Automated scheduling logic to reduce human error
- Transparent allocation dashboards accessible to all stakeholders
- Mobile-first design, reflecting users' preference for accessibility
- Notifications and alerts to enhance communication speed
- Role-based access, though differences across roles were minimal

These features align directly with user expectations and will address the precise pain-points evidenced by the data.

6.4 User Centric Design Framework

The design framework emerging from the findings emphasizes:

- Simplicity and clarity to ensure usability across staff and student groups
- Real-time data flow, ensuring hall information is always current
- Decision-support features, such as conflict alerts and booking history
- Cross-platform mobile availability, considering the strong preference for mobile interaction
- Workflow streamlining, supporting hall officers and administrators

This framework ensures that the eventual system aligns with the expectations and lived experiences of end-users.

6.5 Limitations

The study is based on self-reported data, which may be subject to subjective interpretation. It is also geographically limited to institutions within Benue State. Furthermore, as a cross-sectional study, it captures perceptions at one point in time and cannot measure long-term changes in acceptance.

6.6 Future Research Directions

Future studies should extend the research to additional Nigerian states and incorporate system development, usability testing, pilot deployment, and longitudinal adoption studies to understand how user satisfaction evolves over time. These next steps will provide further validation of the system's effectiveness once implemented.

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