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A Governance-Oriented Smart Library Pod Reservation System: A Design Science Research Approach

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Abstract

The growing demand for flexible, focused learning spaces led universities to introduce individual study pods in academic libraries. However, the absence of structured reservation mechanisms led to inefficient utilization, no-shows, and limited accountability. This study aimed to address these challenges by employing a Design Science Research approach to develop a governance-oriented smart library pod reservation system as a design artifact. The research followed a pre-implementation design process encompassing problem identification, requirement elicitation, system design, and conceptual evaluation. Data were collected using a mixed-methods approach, including a survey of undergraduate students and semi-structured interviews with administrative stakeholders. The findings revealed that although students perceived study pods as effective for focused academic activities, their usage was constrained by accessibility issues, misuse, and lack of transparency. These insights informed the development of a rule-based reservation system incorporating real-time availability, user check-in validation, automated cancellation, and administrative monitoring. The study demonstrated that embedding governance mechanisms directly into reservation workflows enhanced fairness, accountability, and efficiency in the management of shared learning spaces.

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INTRODUCTION

University libraries have evolved from information repositories into learning environments supporting individual study, collaboration, and academic engagement. Smart campus initiatives encourage the integration of digital technologies to improve service accessibility, efficiency, and quality (Cao et al., 2018; Chan & Chan, 2018). Smart libraries combine information systems, user-centred design, and data-driven services to manage resources and enhance user experience (Adewojo & Monjolaoluwa, 2025; Asim & Arif, 2026). Within these interconnected physical and digital environments, technology-enhanced systems may support learning and academic success (Arévalo-Cordovilla & Peña, 2024; Rowe et al., 2021; Scoulas et al., 2024).

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Big Data and learning analytics further extend libraries' capacity to understand user behaviour, access preferences, and space utilisation (Garoufallou & Gaitanou, 2021; Majidah & Rullyana, 2024; Ncube & Ngulube, 2025). Such information can inform service planning and potentially enable more responsive allocation of resources (Azam & Ahmad, 2024; Shahzad et al., 2026). Yet the value of an intelligent library also depends on the management of its physical learning spaces. Individual study pods can offer focused environments, and library-space research associates appropriate design with satisfaction, engagement, and perceived productivity (Kim & Yang, 2022; Li et al., 2018; Montgomery, 2014; Scoulas & de Groote, 2019). Where demand exceeds capacity, however, access and allocation become persistent operational concerns (O'Donnell & Anderson, 2022).

Manual or informal arrangements for reserving shared study spaces can make availability difficult to determine, permit prolonged occupancy without active use, and create uncertainty about equitable access. No-shows and unregulated bookings may further reduce the effective use of limited facilities (Amberger & Schreyer, 2024; Wang et al., 2020). Consequently, improving the booking interface alone may not resolve misuse or ensure that an unused pod becomes available to another student.

Existing digital interventions address important parts of this problem in institutional settings. Internet of Things (IoT) approaches monitor occupancy and provide information about seat availability (Maepa & Moeti, 2021, 2024). Mobile and web-based systems make reservations more accessible and convenient (Ajab Mohideen et al., 2022; Rivo & Žumer, 2022). However, occupancy detection and booking convenience do not necessarily establish how a system should respond to non-attendance, extended occupation, or breaches of reservation rules (Rimbeck et al., 2025; Sedrati et al., 2022). This distinction matters because awareness of an unused seat is different from having a transparent procedure to release it.

The issue can be understood as a socio-technical problem of governing a shared, capacity-constrained resource. Viewed through a Common-Pool Resource (CPR) governance lens, study pods are finite shared facilities: one student's reserved but unused slot may prevent another from accessing the space, making allocation rules consequential. Greater visibility of availability does not by itself establish accountability, enforce usage rules, or encourage compliance (Asim & Arif, 2026; Kurka & Pitt, 2017). For instance, a reservation system without validated check-in and automatic cancellation may continue to display bookings for spaces whose users never arrive (Adewojo & Monjolaoluwa, 2025; Chaudhari et al., 2024). Although IoT-based monitoring and automated booking have advanced real-time visibility, and digital platforms have improved accessibility (Ajab Mohideen et al., 2022; Rivo & Žumer, 2022), the integration of enforceable allocation procedures requires closer attention.

Related research indicates that library users' experiences depend on usability, transparency, trust, and service quality (Khan et al., 2023). User-centred approaches may facilitate system adoption (Rivo & Žumer, 2022), while research on no-show behaviour and technology acceptance offers complementary perspectives on adherence and adoption (Venkatesh et al., 2012). Research on smart systems also highlights the need to align data management, institutional policies, and technological design (Alotaibi, 2024; Bogonko et al., 2025; Polat & Eroğlu, 2021). Nevertheless, the reviewed approaches provide limited guidance on embedding behavioural accountability and rule enforcement directly into the reservation workflow. The resulting gap concerns not whether a system can detect or

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reserve space, but how it can govern access consistently when users do not comply with booking conditions.

To address this gap, the study adopts Design Science Research (DSR) to design and evaluate a governance-oriented reservation-system artifact for university library study pods. DSR supports the development and evaluation of artifacts in response to identified practical problems (Gregor & Hevner, 2013; Hevner et al., 2004; Peffers et al., 2007). Its emphasis on artifact design and problem relevance provides a basis for aligning technical features with operational requirements (Weigand & Johannesson, 2023). The study follows an iterative process of problem identification, objective definition, design and development, demonstration, evaluation, and communication (Drechsler, 2015; Lu et al., 2025). This approach permits assessment of both system functionality and the extent to which governance requirements are addressed in the design.

The study's proposed contribution is to embed rule acknowledgement, verified check-in, automatic cancellation, and administrative monitoring into the reservation workflow from the outset. Unlike approaches centred mainly on automation or occupancy visibility, the proposed design explicitly connects information about bookings with procedures for managing non-compliance. Theoretically, it brings governance considerations into smart-library space management; practically, it offers a design intended to improve fairness, transparency, and resource utilisation; and methodologically, it demonstrates DSR in the pre-implementation design of an educational information system. The objective is to design and evaluate this governance-oriented artifact, rather than claim demonstrated changes in user behaviour before implementation.

METHODS

This study adopted a DSR approach to develop a governance-oriented smart library pod reservation system in a higher education setting. As an early-stage, pre-implementation study, the research focused on problem identification, requirement elicitation, conceptual system design, and early evaluation rather than full deployment and performance testing. The primary artifact developed in this study is a governance-oriented design for a smart library pod reservation system.

The research process was guided by established DSR principles and methodological stages (Hevner et al., 2004; Peffers et al., 2007). Problem identification was conducted through preliminary observations of library operations and informal discussions with library staff. These activities identified key operational challenges, including limited study pod availability, no-show behaviour, inappropriate use of facilities, and reliance on manual monitoring.

Requirement elicitation employed a mixed-methods design. For the quantitative strand, a structured online survey was developed and administered to undergraduate students who actively use library study spaces. The survey instrument consisted of Likert-scale items measuring perceptions of pod usefulness, availability, fairness, and desired system features, along with open-ended questions for additional feedback. A total of 100 valid responses were obtained using purposive sampling. Participants were selected based on their direct experience with study pods across multiple study programs to ensure relevance to the research context.

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For the qualitative strand, semi-structured interviews were conducted with two key administrative stakeholders responsible for library operations and information technology management. The interview guide focused on operational challenges, governance requirements, policy enforcement difficulties, and administrative expectations for the proposed system. Both survey and interview protocols received ethical approval, and informed consent was obtained from all participants.

In the design and development stage, the elicited requirements were translated into a conceptual system architecture and rule-based system workflow. The proposed artifact includes a user-facing reservation interface with real-time availability display, mandatory rule acknowledgment, check-in validation, automated cancellation logic for unattended bookings, and an administrative monitoring dashboard. These features were iteratively sketched and refined based on combined user and stakeholder input.

Early evaluation was conducted through conceptual validation using an observational and descriptive approach. Quantitative survey data were analyzed using descriptive statistics (frequencies and percentages) to identify dominant trends in user perceptions. Qualitative data from open-ended survey responses and interview transcripts were analyzed thematically to extract recurring patterns related to pain points and desired governance features. The findings were mapped directly to specific design decisions to ensure traceability between empirical insights and the proposed artifact. All data were handled confidentially, with identifying information removed during analysis. Participation was voluntary, and informed consent was obtained from all participants.

RESULTS AND DISCUSSION

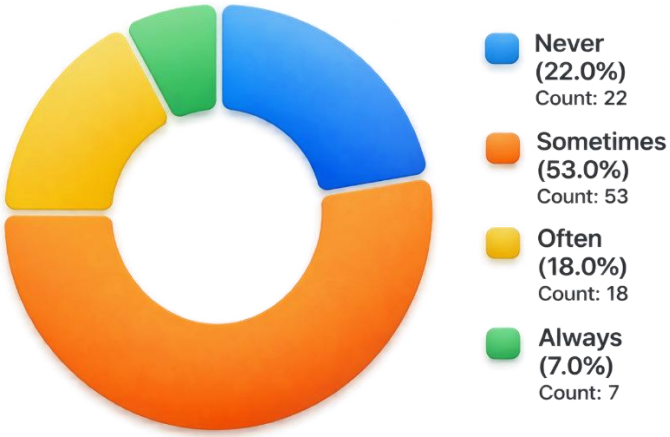
Result

Problem Identification and User Perceptions

The survey of 100 undergraduate students revealed differences in the frequency of study pod usage. As illustrated in Figure 1, many respondents reported using study pods occasionally, while fewer indicated frequent use. These findings suggest that study pods were used at varying frequencies across respondents, providing an initial indication of differences in students' engagement with the available learning spaces.

Figure 1

Self-reported Frequency of Library Pod Usage



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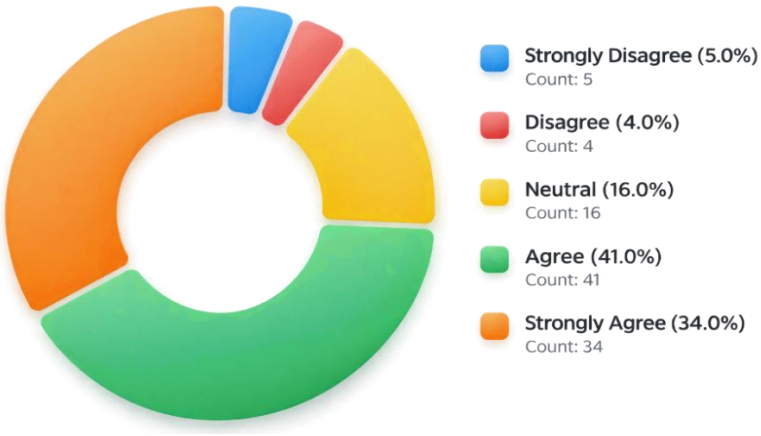
Students generally perceived study pods as beneficial environments for focused academic activities. As shown in Figure 2, most respondents agreed that study pods supported concentration and productivity compared with open learning spaces. Specifically, 75% agreed or strongly agreed that study pods improved their focus, while 68% reported higher productivity when using these facilities.

Figure 2

Student Perceptions of Study Pod Usefulness for Academic Activities



Despite these positive perceptions, accessibility remained a concern. Figure 3 presents respondents' perceptions of the ease of locating an available study pod. More than half of the respondents (54%) agreed that finding an available pod when needed was difficult. Additionally, 72% believed that introducing a reservation system would improve fairness and access.

Figure 3

Perceived Ease of Locating an Available Study Pod

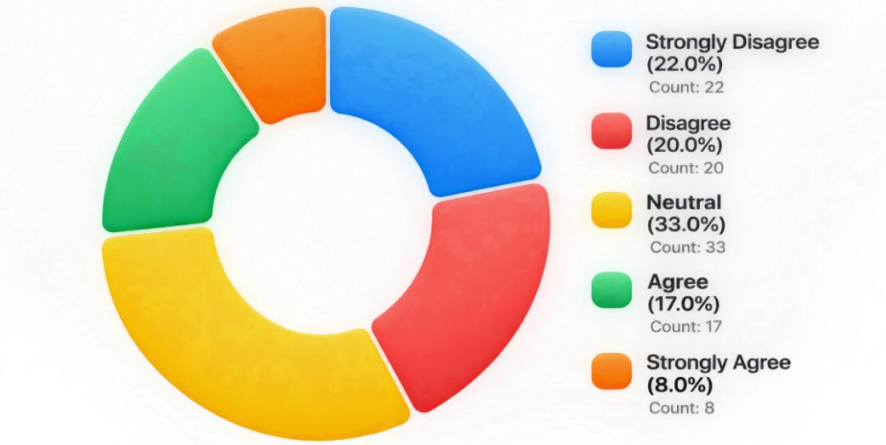


Table 1 summarizes the four key indicators of students' perceptions. The findings reveal a distinction between the perceived academic value of study pods and students' experiences of accessing them. Although most respondents acknowledged the benefits of study pods for concentration and productivity, a substantial proportion reported difficulty finding available spaces and supported the introduction of a more structured reservation mechanism.

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Table 1

Summary of Key Student Perceptions Regarding Study Pods (N = 100)

Survey Item	Agree/ trongly Agree (%)
Study pods help improve focus while studying	75%
Productivity is higher in study pods than in open spaces	68%
It is not easy to find an available pod when needed	54%
A reservation system would improve fairness and access	72%

User-Reported Issues in Study Pod Management

Open-ended survey responses provided further information about students' experiences of using study pods. The responses included concerns about limited availability, inappropriate use of facilities, noise disturbances, insufficient privacy, unattended belongings, and physical limitations of the existing spaces. As presented in Table 2, limited pod availability was among the most frequently reported concerns, appearing in 27 coded responses. Fourteen responses identified inadequate enclosure or the absence of doors, while 11 referred to misuse, including occupying pods without active use or using them for non-academic activities. Noise disturbances and lack of privacy were reported in 10 and eight responses, respectively. However, 29 responses reported no issues, while nine indicated that the respondents had never used a study pod.

Table 2

Summary of User-Reported Issues Related to Study Pod Usage

User-Reported Issue / Response Category	No Responses
No Issues reported	29
Never used the study pod	9
Study pods are perceived as too small	1
Limited pod availability	27
Misuse of pods (occupied without active use, non-academic use)	11
Limited electrical sockets	5
Poor physical condition (e.g., painting, maintenance issues)	1
Plug-related inconvenience (others using sockets)	1
Lack of privacy (transparent walls)	8
Noise disturbance	10
Absence of door / Inadequate enclosure	14
Uncomfortable seating	1
Lack of air conditioning	5
Booking or Information validity issues	1

The reported issues can be distinguished according to their implications for system design. Problems involving electrical outlets, seating, enclosure, air conditioning, and physical maintenance concern the facilities themselves. In contrast, limited visibility of availability, inappropriate reservations, prolonged occupancy, and ineffective turnover concern the processes used to allocate and manage shared spaces. This distinction informed the scope of the proposed system. Rather than attempting to resolve every physical limitation of the study pods, the design focused on improving reservation transparency, accountability, and the management of access to shared learning facilities.

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Stakeholder Insights and Requirement Derivation

Semi-structured interviews with two administrative stakeholders responsible for library operations and information technology management complemented the student survey by providing an operational perspective. The interviews identified recurring challenges involving no-show behaviour, prolonged occupancy without active use, inappropriate use of study pods, and the need for manual monitoring. According to the stakeholders, reservations or occupancy arrangements that were not followed by actual use could prevent other students from accessing available facilities.

Stakeholders also identified difficulties in monitoring pod utilisation, particularly during periods of high demand. Manual supervision required staff attention and could be difficult to maintain consistently when other library responsibilities needed to be performed. These accounts complemented the survey findings. While students primarily reported difficulties obtaining access to available spaces, administrative stakeholders emphasised the challenges of enforcing rules, monitoring reservations, and maintaining orderly resource allocation.

The combined findings informed the identification of functional and non-functional system requirements. Functional requirements included digital reservations with defined booking periods, visibility of reservation availability, mandatory acknowledgement of usage rules, check-in validation, automatic cancellation of reservations without a valid check-in, and administrative monitoring. Non-functional requirements included usability, transparency, fairness, reliability, and basic protection of user information. Table 3 presents the relationship between the identified problems, corresponding requirements, and proposed design features.

Table 3

Traceability Between Identified Problems, System Requirements, and Proposed Design Features

Identified problem	System requirement	Proposed design feature
Difficulty identifying available pods	Availability information	Real-time display of reservation-based availability
Unstructured booking arrangements	Consistent reservation procedures	Digital booking with defined time limits
No-show reservations	Validation of reservation use	Mandatory check-in and automated cancellation
Misuse and inconsistent compliance	Clear and enforceable rules	Rule acknowledgement and configurable booking restrictions
Limited staff capacity for manual monitoring	Administrative oversight	Monitoring dashboard and reservation records
Uncertainty about allocation fairness	Transparent allocation procedures	Consistent booking and cancellation rules
Concerns about data handling	Protection of user information	Basic access controls and data protection requirements

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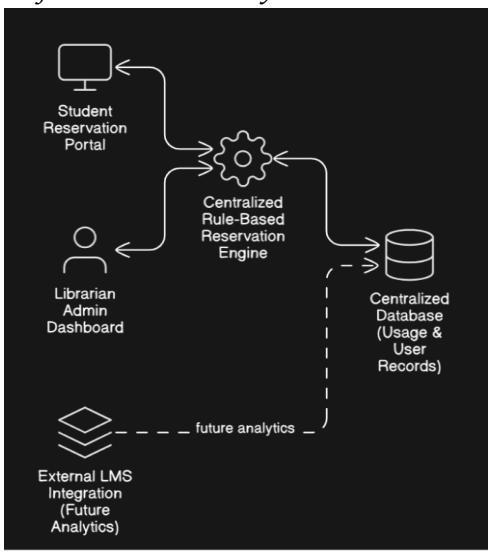
System Design and Proposed Solution

The requirements were translated into a conceptual smart library pod reservation system incorporating governance mechanisms within its operational workflow. The proposed architecture consists of three principal components: a user-facing reservation interface, a central database and rule-processing component, and an administrative monitoring dashboard. Figure 4 illustrates the high-level architecture and the relationship between these components.

Figure 4

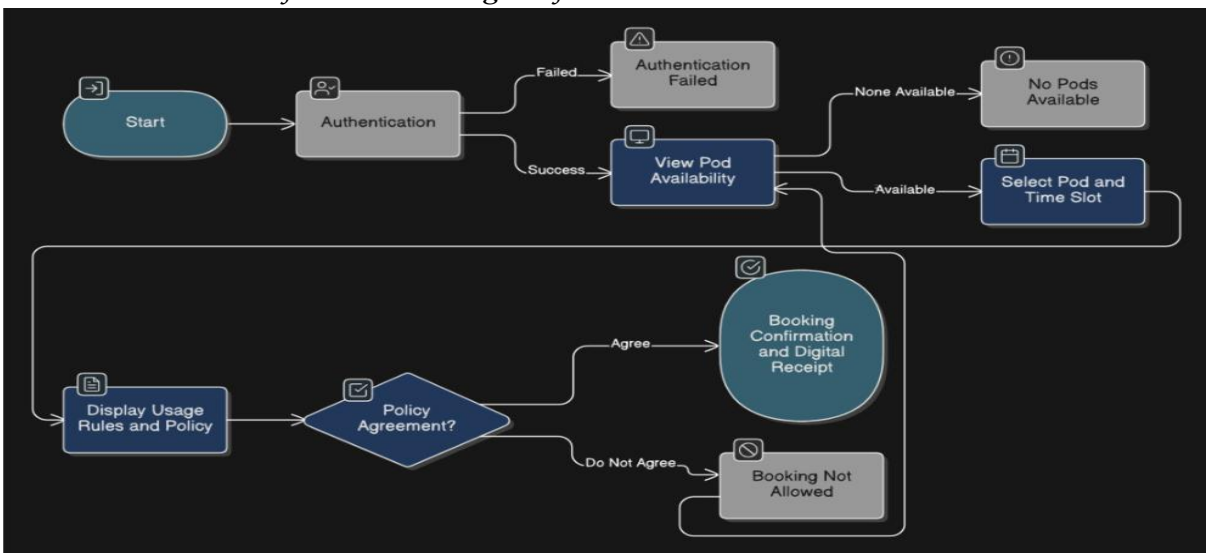
High-level System Architecture of the Smart Library Pod Reservation System



The user-facing interface is designed to display current reservation availability and enable students to select study pods and available time slots. Before confirming a reservation, users are required to acknowledge the applicable usage rules. Figure 5 illustrates the proposed reservation workflow, including pod selection, rule acknowledgement, and booking confirmation.

Figure 5

User Reservation Workflow and Booking Confirmation Process



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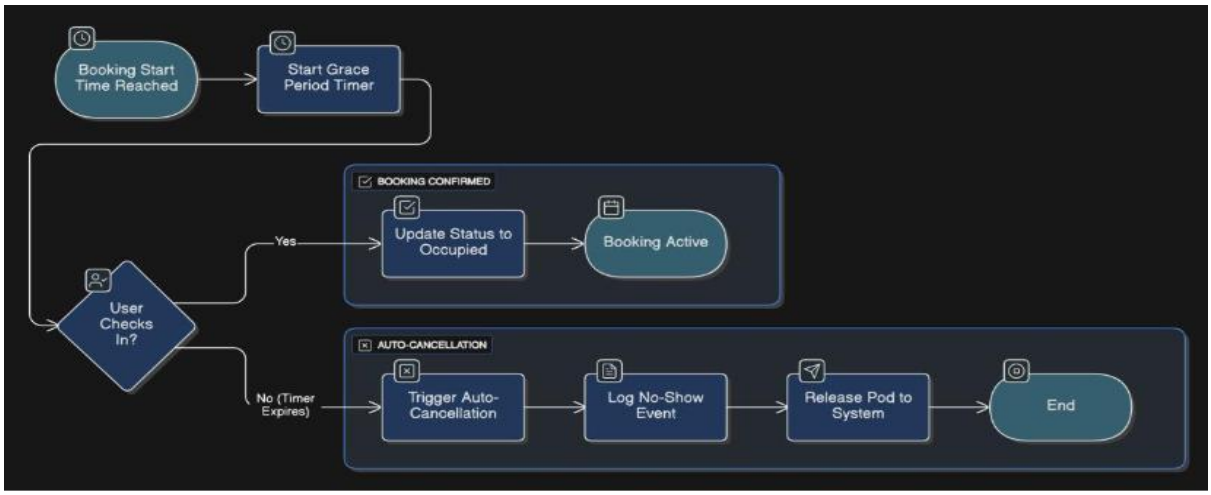
A central governance mechanism is the requirement for users to complete check-in within a defined grace period. Reservations without a valid check-in are subject to automatic cancellation, allowing the corresponding booking slots to be released for other users. As illustrated in Figure 6, this conditional workflow links the continuation of a reservation to compliance with the specified check-in requirement.

Figure 6

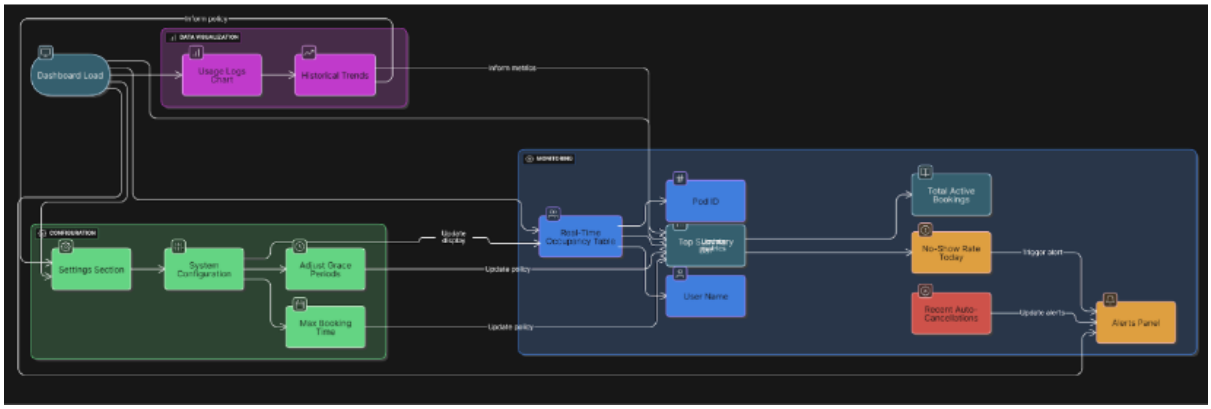
Check-in Validation and Automated Cancellation Flow



The administrative component provides an interface through which authorised staff can review reservation records, monitor booking patterns, identify repeated non-compliance with recorded reservation rules, and manage selected system parameters. These parameters include booking duration, check-in grace periods, and limits on reservations. The proposed dashboard is illustrated in Figure 7.

Figure 7

Administrative Dashboard and Monitoring Features



The proposed features are intended to work together. Reservation visibility addresses uncertainty about access, booking rules establish expectations for users, check-in validation addresses unattended reservations, and automated cancellation provides a mechanism for releasing booking slots when check-in requirements are not met. The administrative dashboard complements these functions by providing institutional oversight without requiring every reservation to be supervised manually.

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Conceptual Evaluation of the Proposed Artifact

The proposed artifact was examined at the conceptual design stage by mapping its functional components against the problems and requirements identified through the empirical investigation.This early evaluation focused on whether the proposed architecture and workflows addressed the identified design requirements. The mapping indicated that the principal concerns raised by students and administrative stakeholders were represented within the proposed system.

In particular, the reservation interface addressed the need for availability information, the rule-processing component incorporated check-in and automatic cancellation procedures, and the administrative dashboard provided a mechanism for monitoring reservation activities. The design also considered the need to balance ease of use with accountability. Reservation procedures were kept relatively straightforward, while essential controls were incorporated into booking confirmation, check-in, cancellation, and administrative oversight.

These results establish the conceptual alignment between the identified problems and the design features of the proposed artifact. However, because the study was conducted before full implementation, the evaluation did not measure actual changes in user behaviour, booking compliance, resource utilisation, administrative workload, or student satisfaction following deployment.

Discussion

Study Pod Value, Accessibility, and Resource Allocation

The findings indicate that students generally perceived study pods as valuable environments for focused academic activities. The positive perceptions are consistent with previous research examining the contribution of library learning spaces to student satisfaction, engagement, and academic activities (Li et al., 2018; Montgomery, 2014; Scoulas & de Groote, 2019). However, the present findings suggest that providing an appropriate physical environment may be insufficient when students cannot reliably access it. Broader research on university learning spaces and shared resource utilisation provides a useful perspective on how spatial arrangements, demand, and access influence the use of shared facilities (ODonnell & Anderson, 2022; Villarreal et al., 2025).

The finding that 72% of respondents believed a reservation system would improve fairness and access indicates support for more structured allocation procedures. Nevertheless, this result reflects anticipated benefits rather than demonstrated improvements in fairness. Students' expectations should therefore be distinguished from the outcomes that may emerge following system implementation.

Open-ended responses further revealed that accessibility problems were accompanied by concerns about inadequate enclosure, noise, privacy, and physical maintenance. These issues indicate that study pod management involves both infrastructure and operational dimensions. While reservation technology cannot directly address physical limitations, it may provide a structured means of managing availability, booking conditions, and the allocation of limited spaces. This distinction has practical implications for institutional planning. Improvements in reservation procedures should complement, rather than replace, investments in the physical quality of learning environments.

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Governance Mechanisms and the Management of Shared Resources

The findings indicate that difficulties in accessing study pods were associated not only with limited availability but also with reservation-related practices, including no-shows, prolonged occupancy, and inappropriate use. These problems suggest that digital booking functionality alone may not ensure effective allocation of shared learning facilities. Research on no-show behaviour across service settings has identified operational consequences arising when reserved resources are not used as intended. Such behaviour can create inefficiencies and restrict access for other potential users, although its causes and appropriate countermeasures vary across contexts (Amberger & Schreyer, 2024; Wang et al., 2020). In the present study, student responses and stakeholder interviews provided a basis for incorporating accountability mechanisms into the proposed reservation workflow.

The resulting artifact combines availability information with mandatory rule acknowledgement, check-in validation, automatic cancellation, and administrative monitoring. These features establish procedural conditions for maintaining reservations and releasing unattended booking slots. Rather than relying exclusively on manual supervision, the proposed design makes selected allocation rules part of the system workflow.

Existing smart library research has demonstrated the potential of automation and Internet of Things technologies to improve information visibility and the management of library facilities (Adewojo & Monjolaoluwa, 2025; Maepa & Moeti, 2021). The present approach differs in its design emphasis by explicitly connecting reservation functionality with procedures governing how shared facilities are allocated and managed. This does not establish that existing systems universally lack governance functions; instead, it identifies governance integration as the particular design problem addressed in this study.

From an information systems perspective, the proposed approach connects technical functionality with organisational requirements. Information systems success research emphasises system quality, information quality, and user-related outcomes, while Design Science Research provides a framework for developing artifacts in response to identified organisational problems (DeLone & McLean, 2003; Hevner et al., 2004). The proposed artifact applies these principles by linking empirical requirements to specific design features and by incorporating institutional rules into the reservation process.

The governance-oriented approach also has implications for managing shared resources beyond library study pods. Research on digital platform governance highlights the importance of aligning technological arrangements with organisational rules and institutional responsibilities (Chen et al., 2022). Accordingly, the proposed design treats reservation policies as configurable elements requiring institutional oversight rather than fixed technical conditions that operate independently of administrative judgement.

However, embedding rules into a digital system does not necessarily ensure behavioural compliance. Rule acknowledgement may improve awareness of booking conditions, but it does not demonstrate that users will follow those conditions. Similarly, automatic cancellation can release a reservation when check-in is not recorded, but without physical occupancy verification, it cannot establish whether the pod is actually vacant. These limitations are particularly important because the proposed artifact does not depend on extensive sensor infrastructure.

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User-Centred Design, System Quality, and Institutional Management

The proposed design responds to two related requirements identified in the empirical investigation: students' need for clearer access to available facilities and administrators' need for more systematic oversight. Addressing these requirements involves balancing interface simplicity, procedural transparency, and institutional accountability.Previous research has identified usability, service quality, and trust as relevant considerations in the adoption and evaluation of technology-supported library services (Chen & Shen, 2020; Khan et al., 2023; Rivo & Žumer, 2022). Research on mobile applications in libraries also demonstrates how digital interfaces can improve access to service information and facilitate interactions between users and library systems (Ajab Mohideen et al., 2022). Although these studies do not directly evaluate the proposed study pod reservation system, they provide a basis for considering user experience in its design.

The proposed interface incorporates these considerations through visible reservation availability, defined booking periods, rule acknowledgement, and booking confirmation. These features are intended to provide students with accessible information about reservation conditions while limiting unnecessary procedural complexity. The relationship between usability and accountability is particularly relevant. A system containing excessive restrictions may discourage use, while an insufficiently regulated system may permit continued misuse. Research on information systems satisfaction and success supports evaluating technical functionality and user experience together (Antonopoulou & Kotsilieris, 2019; DeLone & McLean, 2003).

Technology acceptance research provides a complementary perspective by identifying perceived usefulness, effort, and trust as relevant considerations in digital service adoption (Gefen et al., 2003; Rullyana & Triandari, 2025; Venkatesh et al., 2012). In the present context, consistent booking procedures and understandable rules may contribute to users' perceptions of system reliability. However, the survey measured expectations regarding a reservation system rather than actual acceptance or continued use of an implemented artifact.

From the administrative perspective, the monitoring dashboard offers a proposed mechanism for reviewing reservation activities and managing configurable system parameters. These functions could support more consistent oversight, particularly during periods of high demand. Nevertheless, reductions in administrative workload cannot be assumed before implementation. Actual benefits would depend on system reliability, the accuracy of reservation records, staff adoption, and institutional procedures for responding to non-compliance.

The proposed artifact also provides a foundation for managing structured reservation data. Records of booking demand, cancellations, check-in activity, and reservation patterns may support future planning and allocation decisions. Research on digital transformation and learning analytics highlights the importance of aligning data use with institutional capabilities and educational objectives (Alotaibi, 2024; Polat & Eroğlu, 2021). For university libraries, this suggests that reservation data may have value beyond individual booking transactions. However, any subsequent integration with institutional information systems would require appropriate data protection, access controls, retention policies, and clearly defined purposes for data processing. Reservation activity should not be treated as a direct measure of academic engagement or learning achievement.

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Methodological Boundaries and Future Validation

The findings must be interpreted within the study's early-stage Design Science Research scope. The investigation involved 100 purposively selected undergraduate survey respondents and two administrative stakeholders. These data supported the identification of operational problems and the derivation of design requirements, but they do not establish how the proposed artifact would perform after deployment.

The early conceptual evaluation primarily examined the alignment between identified problems, system requirements, and proposed design features. It did not involve full-scale system implementation, controlled usability testing, longitudinal observation of user behaviour, or direct measurement of improvements in space utilisation. Consequently, fairness, transparency, accountability, and administrative efficiency remain intended design outcomes rather than demonstrated operational effects.

Future research should evaluate the artifact in functioning university library environments. A pre-implementation and post-implementation comparison could assess reservation completion, check-in compliance, no-show frequency, cancellation rates, resource turnover, perceived fairness, user satisfaction, and administrative workload. Comparative studies involving institutions with different resource capacities and organisational arrangements could also examine the transferability of governance-oriented design principles. Broader research on digital platform governance provides a conceptual basis for considering how organisational context may influence the implementation of technical rules (Chen et al., 2022; Natta, 2025).

The effects of specific governance mechanisms also warrant investigation. Booking limits, reminders, check-in grace periods, automatic cancellations, and graduated penalties may influence user behaviour differently. Research on behavioural interventions in education suggests that the effectiveness of nudges depends on the circumstances and behavioural barriers they are intended to address (Damgaard & Nielsen, 2018). Related educational research provides additional perspectives on how stakeholders experience and respond to behavioural guidance, although findings from classroom settings cannot be directly generalised to library reservations (Mustafa, 2024).

Such evaluations should examine unintended consequences as well as intended benefits. Students with disabilities, unpredictable schedules, or limited access to digital devices may experience automated booking rules differently. Therefore, consistent enforcement should be assessed alongside accessibility and procedural fairness. Future testing could investigate whether alternative grace periods, reminder mechanisms, or exception procedures better accommodate diverse student needs. Further development may also involve integration with Learning Management Systems and broader institutional data environments. Existing research illustrates how learning analytics can support the investigation of student engagement and academic activities, while exploratory work on digitally informed campus occupancy provides a related perspective on managing physical learning environments (Ismail et al., 2021; Kuderbayeva, 2025).

Predictive modelling represents another possible direction. Historical booking data could potentially be used to estimate peak demand, anticipate cancellation patterns, or support adjustments to reservation policies. Research on artificial intelligence and demand forecasting in other operational domains illustrates the methodological possibilities of predictive approaches, but does not establish their effectiveness for library space allocation (Kumar et al., 2024; Nweje & Taiwo, 2025).

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CONCLUSION

This study developed a governance-oriented smart library pod reservation system using a Design Science Research approach. Findings from 100 student survey responses and interviews with two administrative stakeholders revealed that, although study pods were perceived as beneficial for concentration and academic productivity, limited availability, no-show behaviour, misuse, and reliance on manual monitoring remained important challenges. These findings informed the design of a conceptual artifact integrating real-time reservation availability, rule acknowledgement, check-in validation, automated cancellation, and administrative monitoring. The study contributes to smart library research by incorporating governance and accountability mechanisms directly into the reservation workflow, extending the design focus beyond technological functionality and booking convenience.

The proposed design offers a practical framework for higher education libraries seeking to manage shared learning spaces more transparently and systematically, particularly in resource-constrained settings. However, as the study was limited to pre-implementation design and conceptual evaluation, improvements in resource utilisation, fairness, user compliance, and administrative efficiency have not yet been empirically demonstrated. Future research should implement and evaluate the system in operational environments, examining its usability, effectiveness, and long-term sustainability. Such evaluation would provide evidence of whether governance-oriented reservation mechanisms can improve equitable access and the management of shared academic facilities.

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Declaration of AI

During the preparation of this manuscript, the authors used Grammarly and QuillBot solely for language editing, proofreading, and improving linguistic clarity. All content was reviewed and verified by the authors, who take full responsibility for the final manuscript.

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Author contributions statement

JASR: Conceptualization, methodology, supervision, writing – review & editing. JC: Software, investigation, writing – original draft. AWH: Software, data curation, visualization. CNK: Formal analysis, validation, writing – review & editing. SSB: Methodology, investigation, validation. DJN: Data curation, formal analysis, writing – review & editing.

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Conflict of interest statement

Authors state no conflict of interest.

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