DECISION-MAKING IN THE DIGITALIZATION OF LIBRARY REFERENCE SERVICES THROUGH SOCIAL MEDIA: A CASE STUDY OF THE NATIONAL LIBRARY OF INDONESIA

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ABSTRACT

The digitalization of library reference services through social media remains under-researched, particularly regarding how socio-technical factors and institutional policy processes intersect in national libraries. This study addresses this gap by examining the case of the National Library of Indonesia (Perpusnas), where virtual reference services (VRS) have evolved amid infrastructural reforms and the COVID-19 pandemic. Adopting a qualitative case study within a constructivist paradigm, the research combines semi-structured interviews with librarians and managers (n=5) and a Social Network Analysis (SNA) of @perpusnas1 interactions on X (formerly Twitter) during 2023. The analytical framework integrates the Policy Cycle with the Social Construction of Technology (SCOT), enabling a multi-layered exploration of agenda-setting, policy formulation, interpretive flexibility, and network structures. Findings show that VRS development was shaped by problem recognition (inefficiencies in email services), adaptive policy formulation (iterative SOP revisions and platform selection), and improvisational implementation constrained by staff capacity and infrastructure. SCOT analysis revealed competing interpretations of social media—promotion, reference tool, or user shortcut—eventually stabilised through closure. SNA results confirmed a centralised hub-and-spoke model dominated by @perpusnas1, enhancing responsiveness but limiting distributed participation. This study contributes theoretically by linking SCOT, policy process models, and SNA in library science; practically by highlighting training, evaluation, and integration needs for managers; and for policy by illustrating adaptive pathways to digitalisation in developing-country contexts.

Keywords : Virtual Reference Services, Social Network Analysis, Social Construction of Technology, Policy Cycle, National Library of Indonesia

1. Introduction

The digital transformation of public institutions, particularly national libraries, has become a global trend. This shift has been significantly accelerated by advances in information and communication technology and the widespread integration of social media platforms (Eckerdal, et al., 2024). One of the most significant outcomes of this transformation has been the emergence of virtual reference services (VRS), defined as the provision of reference assistance through digital channels such as email, chat, or social media platforms (Bussell, 2022; Kibbee, 2006). VRS has redefined how libraries deliver assistance, interact with users, and maintain their role as knowledge facilitators in increasingly digital societies (Grams, 2023). The urgency of this transition was further underscored by the COVID-19 pandemic, during which libraries worldwide were compelled to rapidly expand their VRS initiatives and redesign service delivery models to ensure accessibility and relevance in a predominantly virtual landscape (Bettivia & Stainforth, 2022).

Social media has evolved beyond its initial function as a communication channel to become a dynamic interactive space (Ausat, 2023; Laradi et al., 2023). It enables user engagement, facilitates feedback collection, and fosters community-building. In doing so, it provides valuable insights for strategic planning and service development in libraries (Paul et al., 2024; Worthington et al., 2023). However, translating such insights into effective decision-making remains challenging, particularly for large and complex organizations such as national libraries (Serholt et al., 2018; Trunk et al., 2020).Unique challenges include managing diverse stakeholder interests, integrating heterogeneous data sources, and ensuring that technology aligns with both institutional goals and user needs (Trunk et al., 2020).

Previous studies have extensively explored the adoption of digital technologies in libraries (Deja et al., 2021; Jafari et al., 2023), as well as the benefits and challenges of using social media for outreach and service delivery (Riady et al., 2023; Indrák & Pokorná, 2021). Some research has also examined models of decision-making in public administration (Cantarelli et al., 2023; Mulyani, 2024). For example, Winata et al. (2020) highlighted the importance of digital platforms for information dissemination during the pandemic (Winata et al., 2020; Sakti et al., 2023) while Latupeirissa (2024) analyzed social media adoption by academic libraries in Indonesia (Latupeirissa et al., 2024).

Despite these contributions, a critical gap remains in understanding the complex interplay between socio-technical factors and policy processes within national libraries, particularly regarding how social media data can be used to inform and strengthen VRS. Much of the literature focuses either on the technical aspects of digital services or on the social dimension of user interaction, with insufficient integration of how these elements collaboratively shape institutional policy. Specifically, few studies have comprehensively examined how different social groups (librarians, managers, users, and policymakers) interpret and construct the role of social media in VRS, and how these constructions influence the formal policy cycle in nuanced and evidence-based ways. This gap is especially salient in the context of national libraries in developing countries, where distinctive challenges emerge.

To address this gap, this study focuses on the National Library of Indonesia (Perpusnas) as a critical case. As both a national repository and a leading institution in library development, Perpusnas provides a valuable context for such an investigation. Its significant infrastructure upgrade in 2017 and ongoing efforts to enhance digital services, particularly in response to the demands of the COVID-19 era, highlight its transformation journey. Moreover, as a national library in a developing country, Perpusnas operates in a complex landscape characterised by diverse user demographics, varying levels of digital literacy, and unique policy challenges, which differ markedly from those of developed nations. These conditions make its experience highly instructive for broader academic and practical insights into VRS and library digitalisation in the Global South (Aguilar-Forero & Salazar, 2023; Yan & Schroeder 2021).

Accordingly, this study investigates how social media, through its social construction and subsequent influence, informs and shapes decision-making processes in Perpusnas's VRS, particularly within the framework of the policy cycle. Specifically, it seeks to answer the following research questions:

1. How are decision-making processes regarding the digitalization of reference services through social media formulated and implemented at Perpusnas?
2. What social and technological factors influence these processes?

To pursue these questions, the study integrates the *Social Construction of Technology* (SCOT) theory with the *Policy Cycle* framework. SCOT provides a powerful lens to analyze how relevant social groups (e.g., librarians, policymakers, users) interpret, adapt, and assign meaning to social media technology in Perpusnas's digital services, revealing processes of interpretive flexibility and closure that shape the role of technology. Complementing this, the Policy Cycle framework offers a structured analytical model for tracing how these socio-technical understandings—particularly insights derived from social media interactions—systematically penetrate and influence the various stages of policy formulation and implementation. This dual-framework approach enables a comprehensive analysis that connects micro-level social dynamics with macro-level institutional policy outcomes.

By bridging these theoretical perspectives and applying them to Perpusnas's unique context, the study offers several significant contributions. Academically, it enriches the literature on digital libraries, social media use in public institutions, and decision-making theory by providing an integrated analytical framework. Practically, it delivers valuable insights for national libraries and similar public organizations, particularly in developing countries, on how to leverage social media data to inform policy and enhance digital reference services, thereby strengthening user engagement and institutional responsiveness.

2. Literature Review

2.1. Critical Review of Decision-Making in Technology Adoption

The digitalization of library services is not merely a technical transformation but also a complex decision-making process involving multiple actors and organizational consideration (Dei, 2020). Although the policy cycle framework provides a structured approach, recent research highlights its limitations in dynamic digital contexts (Banha et al., 2022; Scrivenet al., 2024). The linear nature of the model often underemphasizes how human and strategic factors interact under conditions of uncertainty. Contemporary studies, such as Burstein et al. argue that effective decision-making systems must account for institutional and social contexts rather than focusing solely on information provision (Burstein *et al.*, 2024). This suggests a shift from top-down views of technology adoption toward more holistic approaches.

Librarians often report tensions between technological readiness and the organizational capacity to make decisions. Several studies contend that successful technology adoption depends heavily on staff preparedness and policy flexibility (Webster & Gardner, 2019). Yet, research rarely explains how such readiness is achieved, particularly in rigid public institutions (Raimonds, 2018). For example, Hamilton (2015) noted uneven internal preparedness as a barrier but did not sufficiently elaborate on how differing stakeholder interpretations shape implementation outcomes (Hamilton, 2015). Therefore, this review critically examines how decision-making at Perpusnas is influenced by social interpretations and interactive dynamics, moving beyond traditional policy frameworks.

2.2. The Role of Policy and the Social Construction of Technology in Digital Transformation

Policy processes play a critical role in guiding technological transitions in public institutions. Classic public policy frameworks (Dye, 2017) outline clear stages from problem identification to evaluation. However, other scholars (Young & Quinn, 2002) stress that the effectiveness of digital policies depends on inclusivity and adaptability to a constantly evolving technological landscape. Standard Operating Procedures (SOPs) translate strategic decisions into daily practices, but studies by Nicol and Crook (2013) and Hamilton (2015) highlight the need for regular revisions to remain relevant.

To complement these models, the SCOT theory (Bijker, 2012) provides a more nuanced lens. SCOT challenges the assumption of technological neutrality, emphasizing instead that technological development is shaped by social interactions, interpretive flexibility, and negotiations among relevant social groups. This interpretive flexibility allows stakeholders—such as managers, librarians, and users—to assign different meanings to digital platforms, leading to negotiations over their use. For instance, studies (Murphy & Liew, 2016; Kushniryk & Orlov, 2021) observed how librarians reinterpreted social media from a promotional tool into an interactive service mechanism.

By integrating SCOT with the policy cycle, this study examines how formal policies (e.g., National Library Regulation No. 19 of 2017) provide a foundation, while social interpretations shape implementation on the ground. This combination is particularly relevant in the Indonesian context, where gaps frequently exist between formal policies and everyday practices.
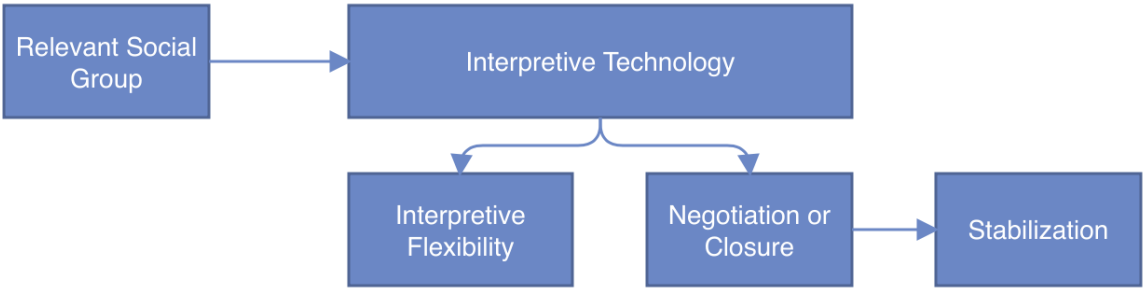

Fig. 1. Theoretical framework of SCOT
(Bijker *et al.*, 2012)

SCOT theory (Bijker, 2012) views technology not as a neutral tool but as a socially constructed system shaped by multiple interpretations. Stakeholders may assign different meanings to the same platform (Murphy & Liew, 2016). For instance, management may view social media as a promotional channel, while librarians reinterpret it as a tool for user support (Wardell & Kelly, 2022). Such interpretive flexibility generates negotiation processes that shape adoption outcomes and, over time, lead to closure and stabilization.

In library contexts, this perspective has been applied to virtual reference services, showing how technologies evolve through social negotiation and organizational adaptation (Oliva et al., 2024; Mariano, 2024). However, few studies explicitly integrate SCOT with policy frameworks to explain how interpretive differences influence not only day-to-day practices but also formal decision-making structures. The Perpusnas case illustrates this intersection: while policies provided a framework, it was librarians' and users' reinterpretations that redefined social media as a legitimate reference channel.

2.3. Digitalization in National Libraries: Regional and Global Insights

The transformation of national libraries into digital information hubs is a global trend. Initiatives such as collection digitization and virtual reference services have redefined their institutional role. These changes demand strategic decision-making that extends beyond platform selection and service restructuring to include staff capacity-building.

Recent studies (2019–2024) highlight diverse challenges and opportunities. For instance, despite significant investment in cutting-edge Information and Communication Technologies, the readiness for smart library adoption in Indonesian public libraries is primarily hampered by data awareness, organizational issues, and insufficient policies rather than technological capability (Sayogo et al., 2020). Similarly, a study on Malaysia found that while digital transformation policies were in place, their effective implementation was often hindered by a lack of robust data infrastructure and significant cultural resistance, echoing findings from other developing economies (Worthington et al., 2023) in Philippines. The challenges observed in these Southeast Asian contexts underscore a broader pattern where policy frameworks may exist but are often disconnected from the operational realities and cultural nuances of the respective regions, thereby impeding effective digitalization (Harisanty et al., 2023) . This highlights the need for a more nuanced understanding of how national libraries, particularly in contexts like Vietnam, navigate the complexities of digital transformation, which often involves integrating global frameworks with local organizational realities and cultural specificities(Worthington et al., 2023) (Wall et al., 2023). However, there remains a scarcity of literature specifically addressing how public institutions in Southeast Asia, such as Perpusnas, navigate unique challenges such as team coordination, infrastructural gaps, and cultural differences in digital interaction.

This study seeks to address this gap by providing an in-depth case study of Perpusnas. By comparing global insights with local realities, it contributes uniquely to the literature on technology adoption in public institutions, particularly in developing-country contexts.

2.4. Social Network Analysis (SNA) as a Diagnostic Lens

While SCOT and the policy cycle explain formal and social processes, neither fully captures actual interaction patterns. Here, Social Network Analysis (SNA) complements the analysis by mapping communication networks (Camacho et al., 2020). Metrics such as degree, betweenness, closeness, and eigenvector centrality help identify dominant actors, information flows, and potential bottlenecks (Valdez et al., 2021).

Recent studies demonstrate the relevance of SNA for analyzing user participation in digital library services (Kushniryk & Orlov, 2021) and virtual services during the pandemic (Radford et al., 2022). Yet similar research remains limited in Southeast Asia, making network analysis of @perpusnas1 a valuable contribution to understanding how online interactions reflect both policy structures and socio-technical dynamics.

2.5. Library Reference Services in Digital Spaces

The shift from face-to-face to digital reference environments has transformed how libraries interact with users. VRS, including those supported by social media, offer enhanced accessibility, speed, and user engagement. At the same time, they create new challenges related to communication style, content management, and service quality evaluation.

Research on social media in libraries has expanded considerably. Wardell and Kelly (2022) and Oliva et al. (2024) highlighted how social media platforms were reinterpreted from promotional tools into valid sources for information literacy (Wardell & Kelly, 2022; Olivia et al., 2024). Similarly, Cole and Raish (2020) found that users often perceive social media as the fastest way to obtain assistance, regardless of the platform's original intent (Cole & Raish, 2020). These findings are consistent globally, but little work has examined interactions between users and public institutions in Indonesia.

This study employs SNA to quantitatively map digital interaction patterns and identify key "actors." This method complements the qualitative approach by providing empirical evidence of how digital services operate in practice. By combining qualitative analysis of internal motivations (why decisions are made) with quantitative analysis of external behaviors (how interactions occur), the study provides a more comprehensive account than prior research that tends to focus on only one dimension.

2.6. Synthesis and Research Gap

The reviewed literature reveals three major strands: (1) policy processes as formal frameworks, (2) social interpretations of technology through SCOT, and (3) digital interaction patterns captured by SNA. However, most studies treat these strands separately. Few have attempted to integrate the policy cycle, SCOT, and SNA to analyze library digitalization.

Furthermore, existing studies are dominated by Western, resource-rich contexts (Radford et al., 2021; Wardell & Kelly, 2022), while Southeast Asian cases remain underrepresented. By focusing on Perpusnas, this study addresses these gaps by contributing to scholarship on library digitalization in developing-country contexts, while extending the application of SCOT and the policy cycle through empirical network evidence.

3. Research Methods

This study adopts a qualitative case study design within a constructivist paradigm, complemented by SNA for explanatory depth. The case study approach allows an in-depth examination of Perpusnas as a bounded socio-technical system, while the constructivist lens highlights how digital service realities are socially constructed through the interpretations of managers, librarians, and users. An explanatory sequential mixed-method approach (Creswell & Clark, 2017) was adopted. First, interaction data from X (formerly Twitter) were collected and analysed using SNA to map structural patterns. Second, semi-structured interviews were conducted to interpret these patterns within the frameworks of SCOT and the Policy Cycle. This integration provided both macro-level insights into network structures and micro-level explanations of decision-making practices.

3.1. Data Sources and Sampling

The dataset consisted of public interactions mentioning or replying to @perpusnas1 between January 1 and December 31, 2023. Data were extracted using the Twitter Search Export (TWSE) API, with keywords such as "Tanya Pustakawan," "layanan referensi," and "reference services." Due to technical restrictions of the TWSE API, which at the time only permitted data retrieval within a single calendar year, the collection was limited to 2023. Tweets were included if they (1) contained explicit reference-related questions or (2) received a direct reply from @perpusnas1. After cleaning, the dataset yielded 635 nodes and 1,089 edges, which were processed for SNA. Five informants were purposively selected based on their direct involvement in Perpusnas's digital service decision-making: the head of library services, two social media officers, one digital reference service administrator, and one supervisor (see Table 1).

Table 1 - Informant's profile

Informants	Position	Years in Perpusnas
H	Head of Library Service	25
M1	Social Media	15
M2	Social Media	6
R1	Digital Reference Service Administrator	6
R2	Digital Reference Service Supervisor	25

Although the sample was small, data saturation was achieved, as no new themes emerged after the fifth interview. Semi-structured interviews were conducted over two months, using a flexible protocol to allow exploration of emergent issues while maintaining comparability across respondents.

3.2. Data Processing and Analysis
Cleaned tweets were transformed into a directed edge list (user → @perpusnas1; @perpusnas1 → user) and analysed in Gephi 0.10. Structural metrics included degree centrality, betweenness, closeness, eigenvector centrality, network density, modularity, and average path length. These measures identified dominant actors, information flows, and potential bottlenecks in the communication network.

Interview transcripts were analysed inductively to capture themes related to agenda-setting, policy formulation, interpretive flexibility, and implementation challenges. ChatGPT-4o was used as a supportive tool for clustering codes and refining linguistic patterns. To mitigate risks of bias or misclassification, all AI-assisted outputs were manually verified by the researcher and validated through peer debriefing and member checking.

3.3. Validity, Reliability, and Ethical Considerations
To ensure research rigor, this study applied strategies for validity, reliability, and ethics. *Validity* was strengthened through methodological triangulation, where themes from interviews were cross-validated with patterns from SNA, ensuring qualitative insights were supported by quantitative evidence (Ahmed, 2024). *Reliability* was maintained by following a transparent protocol for data collection and coding; tweets were selected using predefined criteria and independently coded by two researchers, achieving over 85% agreement (Vicente, 2023. *Ethical safeguards* included informed consent, anonymisation of interviewees, and the use of only publicly accessible tweets with personal identifiers removed, in line with established guidelines for digital research (Thelwall & Thelwall, 2020). These measures ensured methodological transparency while protecting participants' rights.

The study employed AI-assisted tools (ChatGPT-4o) cautiously to support thematic coding, limited to clustering codes and refining linguistic patterns while preserving researcher interpretive judgement (Bryda & Sadowski, 2024 ; Nyaaba et al., 2025). All outputs were manually verified, and discrepancies were resolved through peer debriefing and member checking, ensuring credibility and trustworthiness (Kim et al., 2024). Following recent calls for transparency in AI-assisted qualitative analysis, such integration enhanced efficiency without compromising interpretive depth ((Bennis & Mouwafaq, 2025; Nyaaba et al., 2025)

4. Results and Discussions
4.1. Decision-Making Process in the Digitalization of Reference Services at Perpusnas
Agenda-Setting and Problem Recognition
The digitalization of reference services at Perpusnas did not emerge spontaneously but from a confluence of institutional shortcomings, shifting patterns of user demand, and broader socio-political pressures. Conventional email-based services, once central to Perpusnas's communication with users, proved increasingly inadequate. Users frequently complained about delays and unanswered queries, echoing findings that traditional reference channels often fail to meet modern expectations of speed and accessibility (Stewart & Newman, 2017; Gusman, 2024; Jumino & Mu'alifah, 2022). As one librarian recalled:

> *"Before we had virtual services, many emails went unanswered. A user once asked why their email hadn't received a reply, and that became a turning point for us to improve the service." (Informant H)*

Such internal frustrations represented more than operational inefficiency—they became a catalyst for organizational learning. According to Kingdon's (1995) policy window model, problem recognition is central to agenda-setting, and here the accumulation of service failures created institutional awareness that reform was unavoidable (Wen, 2023). User behaviour simultaneously shifted toward more complex inquiries. Whereas earlier demands were often administrative, such as membership registration, they increasingly included collection searches and remote-access assistance:

> *"Previously, most questions were about membership. But now they range from collection searches to remote user assistance." (Informant R1)*

This transition reflected not only the changing expectations of digitally literate users but also wider global trends. Mariano (2024) and Radford et al. (2021) demonstrate that libraries worldwide experienced a similar broadening of user needs during the pandemic era, with reference services evolving from clerical assistance to dynamic, personalised support (Mariano, 2024; Radford *et al.,* 2024*)*. In the Indonesian context, this shift also highlighted geographic inequities: users outside Jakarta demanded equal access, positioning digitalisation as a socio-technical equaliser (Owusu-Ansah et al., 2019).

The COVID-19 pandemic served as the decisive accelerant. Lockdowns and physical access restrictions forced Perpusnas to confront the limitations of its pre-digital model. In alignment with international findings (Winata et al., 2020; Soladoye-Adewole, 2024), Perpusnas had to reconfigure its service delivery around virtual platforms. Staff narratives reveal both urgency and opportunity:

> *"We want Perpusnas services to reach all communities in Indonesia, not just those who can come to the building." (Informant R1)*

These accounts illustrate how external shocks can amplify existing institutional weaknesses, generating momentum for reform. This dynamic aligns with Dye's (2002) observation that crises often transform tentative ideas into urgent priorities

> *"The pandemic brought many challenges, but it also had a silver lining—it accelerated our digitalization and service expansion." (Informant R1)*

The agenda-setting phase at Perpusnas thus cannot be reduced to managerial decision-making alone. It was shaped by three interrelated forces: (1) internal recognition of email failures, (2) evolving user expectations for inclusive and efficient services, and (3) the external shock of COVID-19 that forced digitalisation onto the institutional agenda. The convergence of these streams demonstrates how problem recognition, institutional readiness, and external urgency coalesced into a policy window, propelling digitalisation from peripheral experimentation into a strategic imperative.

Yet, this process also reveals critical trade-offs. Unlike national libraries in resource-rich contexts that had gradual trajectories toward digitalisation (Wardell & Kelly, 2022; Bettivia & Stainforth, 2022), Perpusnas was pushed into reactive adaptation. This urgency produced gains in speed but left gaps in comprehensiveness, such as limited planning for training and evaluation. The agenda-setting phase, therefore, simultaneously highlights Perpusnas's responsiveness and its structural vulnerabilities—underscoring the complexity of digital transformation in developing-country contexts.

Policy Formulation and Decision-Making

Following agenda-setting, Perpusnas entered the policy formulation stage, where institutional responses were formalised and refined. Consistent with the Policy Cycle framework, this phase was not a linear drafting of documents but an adaptive negotiation between bureaucratic requirements, technological options, and user demands. The first critical instrument was the introduction of Standard Operating Procedures (SOPs), designed to ensure timeliness and consistency in librarian responses. However, the initial SOP version failed to explicitly address social media, revealing a disconnect between formal regulation and the practical realities of service provision (Nafi'ah, 2022; Susilowati, 2021). As one librarian explained:

> *"There was already a digital service SOP, but initially it did not contain specific guidance for social media interactions. The SOP helps ensure that librarians respond within a defined time frame and deliver consistent answers." (Informant H)*

This gap illustrates a common challenge in public sector digitalisation: formal rules often lag behind evolving socio-technical practices (Mariano, 2024). Librarians continued to experiment informally, effectively pushing institutional adaptation from the bottom up. This dynamic reflects SCOT's notion of interpretive flexibility (Bijker et al., 2012), where frontline staff redefine the meaning and function of technology prior to its institutionalisation.

Over time, Perpusnas refined the SOPs, gradually incorporating explicit provisions for social media engagement. This iterative process exemplifies policy learning and adaptation, consistent with Nicol and Crook (2013), who argue that digital service regulations must evolve to remain relevant in shifting technological environments. As one staff member reflected, these refinements were crucial to professionalising librarian-user interactions:

> *"The SOP gave us clarity. Once social media interactions were included, it made our work more credible and consistent across different platforms." (Informant R2)*

Platform selection further revealed the pragmatism of Perpusnas's decision-making. Through internal evaluation, the institution prioritised cost-effectiveness, integration capacity, and user familiarity. Tawk.to was selected for LiveChat due to affordability and seamless integration with the Perpusnas website, while X platform was chosen to reflect user preferences for familiar communication channels (García et al., 2021; Alhabash et al., 2024).

> *"Tawk.to was chosen because it's more economical and simpler to operate than other platforms we evaluated, like Xendbase and Sendible. When selecting platforms, we considered whether they could integrate with our website and how flexible they were for account management." (Informant R2)*

This pragmatic approach aligns with findings by Guo et al. (2022), who argue that digitalisation in public institutions is often shaped less by long-term strategic vision and more by short-term trade-offs between cost, accessibility, and operational feasibility (Guo *et al.,* 2022). Social media's role also underwent reinterpretation. Initially confined to promotional functions, it was gradually reframed as an interactive channel for reference services (Wardell & Kelly, 2022). Librarians described this transformation:

> *"At first, we only used social media for promotions, but gradually we started using it to answer user questions as well—though it required some adjustment." (Informant M2)*

This shift demonstrates SCOT's interpretive flexibility in action: librarians, users, and managers contested and redefined the purpose of digital platforms, eventually embedding them within the institution's policy framework. Closure occurred once SOP revisions and managerial endorsement formalised social media as part of the service identity, stabilising practices that had begun informally.

In comparative perspective, Perpusnas's incremental approach reflects both strengths and limitations. Unlike some national libraries in Europe that pursued comprehensive digitalisation

strategies prior to COVID-19 (Bettivia & Stainforth, 2022), Perpusnas relied on reactive, piecemeal adjustments. This enabled rapid responsiveness but left gaps in long-term planning, training, and systematic evaluation. The case highlights the dual nature of adaptive policymaking in developing contexts: flexibility fosters innovation, but it can also entrench vulnerabilities when strategic coherence is lacking.

Policy Implementation and Evalution

The implementation of digital reference services at Perpusnas revealed both institutional achievements and persistent operational challenges. Consistent with the Policy Cycle framework, this stage highlighted the tensions between formal regulatory frameworks and on-the-ground realities of service delivery. One of the most pressing challenges was the absence of structured training for librarians in digital communication. Many staff relied on informal, trial-and-error approaches to learn how to interact with users via LiveChat and social media:

> *"There hasn't been any formal training on how to serve users through live chat or social media. Most of us learn as we go." (Informant M2)*

This reliance on self-learning limited the consistency and professionalism of responses, echoing Soladoye-Adewole's (2024) findings that staff preparedness remains uneven in many post-pandemic digital transitions. The lack of training also exposed librarians to uncertainties about tone, style, and accuracy in online interactions—issues that are particularly critical in reference services, where trust and reliability are paramount. Technical and infrastructural gaps compounded these challenges. Several librarians reported having to rely on personal devices due to shortages of institutional equipment:

> *"Sometimes we have to use personal laptops, which aren't always optimal. That can slow things down or cause disruptions." (Informant M1)*

Such constraints undermined efficiency and revealed the fragility of digital service provision in resource-limited contexts. Comparable cases in Southeast Asia demonstrate that while digital tools can extend reach, insufficient infrastructure can entrench inequities in service quality (Owusu-Ansah et al., 2019; Mariano, 2024).

Despite these limitations, Perpusnas demonstrated notable strengths in responsiveness. Internal evaluations showed that LiveChat response times averaged 23 seconds, significantly surpassing the ISO benchmark of 3 minutes 45 seconds (SNI-ISO 9001:2015). As one staff member noted:

> *"Right now, we only track how many chats are answered and how fast, but we haven't evaluated whether the answers are accurate." (Informant R2)*

This focus on speed reflects a global trend where quantitative benchmarks are prioritised over qualitative measures such as accuracy or user satisfaction (Radford *et al.*, 2021). While Perpusnas's responsiveness exceeded international standards, the absence of systematic evaluation frameworks limited the institution's ability to ensure service reliability and long-term impact.

Another implementation challenge was the fragmentation between the reference services unit and the social media team. Librarians emphasised the need for better integration to avoid inconsistent messaging:

> *"The social media and reference teams aren't always aligned. We need better integration so users get consistent information." (Informant M2)*

This lack of coordination highlights the difficulty of embedding cross-functional collaboration in bureaucratic structures, a challenge also observed in studies of public sector digitalisation elsewhere (Guo *et al.*, 2022).

Overall, the implementation process at Perpusnas illustrates an iterative and adaptive approach rather than a linear progression. Formal SOPs established structure, but practice was shaped by improvisation, resource constraints, and evolving user expectations. From the perspective of the Policy Cycle, evaluation mechanisms remain underdeveloped, focusing narrowly on speed while neglecting broader dimensions of service quality. This imbalance underscores the importance of refining evaluation frameworks that integrate both quantitative and qualitative indicators. Comparatively, national libraries in Europe and North America often employ multi-dimensional evaluation tools—measuring user satisfaction, accuracy, and impact alongside responsiveness (Wardell & Kelly, 2022; Bettivia & Stainforth, 2022). Perpusnas's experience shows that while rapid responsiveness can be achieved even in resource-limited environments, sustaining quality requires greater investment in training, infrastructure, and evaluation systems.

4.2. Social Interpretation of Technology

The social interpretation of technology at Perpusnas reveals how the meaning and role of social media as a platform for VRS were not fixed, but instead negotiated among different stakeholder groups. In line with the SCOT framework, the concept of interpretive flexibility is evident in how librarians, managers, and users attributed distinct functions to the same tools (Veldhoven & Vanthienen, 2021; Hernández-Pérez et al., 2020). At the managerial level, social media was initially framed primarily as a promotional channel, reflecting a conservative institutional stance that regarded it as too informal for reference services:

> *"The main function of social media was promotion. It wasn't directed toward reference services at all." (Informant M1)*

Librarians, however, increasingly recognised the interactive potential of these platforms for providing reference services and engaging with users in more dynamic ways. They interpreted social media as complementary to formal LiveChat services, enabling broader outreach and aligning with evolving user preferences (Oliva et al., 2024; Wardell & Kelly, 2022). This adaptation required adjustments to communication practices and workflows:

> *"We are always on standby in LiveChat, but now we're also receiving many questions via social media. So we've started handling those as well." (Informant M2)*

Users, in contrast, perceived social media as the fastest and most convenient way to obtain assistance—regardless of whether Perpusnas formally designated it for reference services. For them, social media was valued for immediacy and accessibility, often used for practical concerns such as accessing collections or navigating facilities (Radford et al., 2021; Cole & Raish, 2020). This pragmatic interpretation often clashed with the more cautious managerial framing and created service inconsistencies:

> *"The social media and reference teams aren't always integrated. We need better coordination so users receive consistent information." (Informant H)*

These divergent interpretations illustrate the socio-technical negotiations underlying Perpusnas's digitalization. Over time, closure processes began to emerge as interpretive differences narrowed. Initially, some librarians expressed scepticism about the appropriateness of social media for formal services:

> *"There was hesitation at first—some thought social media wasn't the right channel for formal library services. It felt too casual, too exposed." (Informant M2)*

Yet, repeated exposure to user demand, managerial endorsement, and measurable performance indicators facilitated stabilisation. For example, during peak user registration periods, the efficiency of digital platforms became undeniable, leading even sceptical staff to acknowledge their effectiveness:

"During peak periods—especially when new students flood the service—these platforms help us respond more quickly than traditional methods. Even the sceptics eventually admitted it works better." (Informant M1)

Stabilisation was further reinforced when performance indicators such as response speed and chat volumes were institutionalised into reporting systems, embedding digital platforms into the organisational logic of service delivery (Mondragon-Estrada et al., 2023; Mothafar et al., 2024):

"Once we started tracking performance—like response speed and chat volume—the platform became part of our service identity. No one questioned it anymore." (Informant R2)

From a SCOT perspective, the Perpusnas case demonstrates how social negotiation, institutional adaptation, and evidence-based legitimisation produced closure around the role of social media in reference services. What began as fragmented and contested interpretations evolved into a stable socio-technical arrangement, formalised through SOP revisions, managerial support, and integration into organisational evaluation frameworks.

Critically, this process also reflects broader global findings: while national libraries in developed contexts often institutionalised VRS earlier (Wardell & Kelly, 2022; Mariano, 2024), Perpusnas's trajectory underscores how interpretive flexibility and closure are particularly salient in developing countries where infrastructural, cultural, and managerial challenges intensify negotiation processes (Owusu-Ansah et al., 2019). By documenting these dynamics, this study situates Perpusnas not only as a local case but also as an instructive example of how socio-technical constructions shape digital transformation in public knowledge institutions.

4.3. Social Network Analysis (SNA) of @perpusnas1 VRS

The SNA of @perpusnas1 interactions in 2023 offers critical insights into how digital reference services were shaped by network structures and power asymmetries. Using degree, betweenness, closeness, and eigenvector centrality, the analysis highlights the institutional centrality of Perpusnas, the limited role of external actors, and the implications for decision-making and service equity. To gain deeper insights into the interaction dynamics of digital reference services at Perpusnas, an SNA was conducted on interaction data from the X platform using Gephi software.
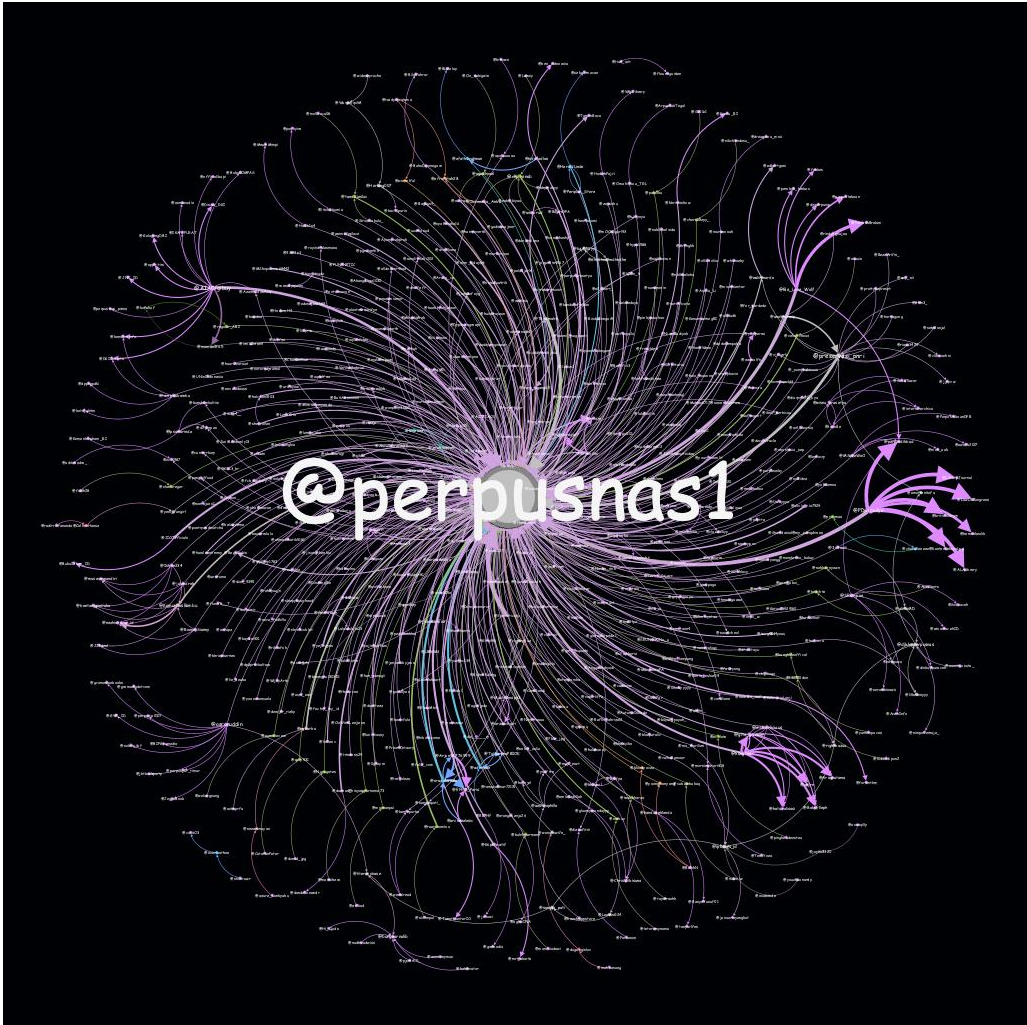
Fig. 2. Visualization of network interaction patterns through X

Table 2 - Network Attribute Value of X Network

Network Attributes	X Network
Total Nodes	635
Total Edges	1,089 edges
Average Degree	1,254
Average Weighted Degree	715
Network Diameter	6
Average Path Length	113
Density	0,002
Number of Communities	11

This analysis enabled the visualization and measurement of the positional influence of various actors within the network (Camacho et al., 2020). The network comprised 635 nodes (user accounts) and 1,089 edges (interaction links). On average, each account had 1.25 connections (average degree), although the interaction intensity was slightly higher, with an average weighted degree of 1.715. The network's diameter was 6, indicating that the longest distance between any two nodes was six steps, while the average path length was 3.113. The network density was notably low, with only 0.2% of all possible connections being realized. Additionally, the network was segmented into 11 distinct communities, in which nodes tended to interact more frequently within their respective clusters.

Network Centralisation and Degree Centrality

The network exhibited a highly centralised structure, with the official @perpusnas1 account dominating user interactions. The account registered the highest degree centrality, indicating that most conversations—whether replies or mentions—were directly connected to the institutional account. This finding confirms the persistence of a "command node" model (Lankes, 2016), where users depend on a single institutional gatekeeper for information.

Table 3 - *Degree Centrality* Value of Actors Affecting on X Network

Nodes	*Degree Centrality*	Rank
@perpusnas1	517	1
@preservasi_pnri	18	2
@AIADigibuy	14	3
@asroruddin	11	4
@PDwimulyo	10	5

The @perpusnas1 account emerged as the most dominant node with a degree centrality of 517, far surpassing other nodes such as @preservasi_pnri (18) and @AIADigibuy (14). This pattern reflects a classic "hub-and-spoke" structure, where @perpusnas1 functions as the primary information centre for the majority of public inquiries. Its high number of direct connections underscores its central role and its position as the library's principal digital touchpoint.

> *"Users are accustomed to tagging or messaging @perpusnas1 for almost everything—from membership to how to find a book—so it naturally becomes the hub for initial questions." (M2)*

From a VRS perspective, this structure enhances service efficiency by ensuring that queries are quickly directed to the central authority. However, it also creates bottlenecks, reinforcing institutional dependency and limiting the organic development of peer-to-peer or community-based knowledge sharing (Radford et al., 2021). In SCOT terms, this reflects a partial closure: while users and librarians converged on @perpusnas1 as the legitimate service hub, alternative interpretations of digital reference as a more distributed, participatory process remain marginalised.

Betweenness Centrality and Gatekeeping Roles

Analysis of betweenness centrality further illustrates the gatekeeping role of @perpusnas1. With the highest betweenness score, the account acts as the primary bridge connecting otherwise fragmented user groups. Librarians effectively mediate information flows, but this also concentrates decision-making authority in a narrow locus.

Table 4 - *Betweenness Centrality* Values of Influential Actors on X Network

Nodes	*Betweenness Centrality*	Rank
@perpusnas1	0,100533	1
@preservasi_pnri	0,002818	2
@amortentiafu	0,001375	3
@Tbodmalra	0,001213	4
@bzzyboyy	0,001211	5

With a betweenness centrality score of 0.100533, @perpusnas1 also acted as the main bridge connecting various clusters in the network, facilitating information flow between otherwise disconnected groups. This gatekeeping function allowed Perpusnas to manage the direction and scope of discourse efficiently. Other accounts like @preservasi_pnri and @amortentiafu held

marginal yet locally significant intermediary roles, particularly within communities interested in preservation and academic resources.

From a Policy Cycle perspective, such centralisation reinforces agenda-setting power, as the institution can privilege certain queries, issues, or narratives while marginalising others (Lemke et al., 2023; Manazir, 2023). Interview data support this interpretation:

"Sometimes we prioritise questions that are easier to answer or that are asked repeatedly, so they don't pile up. More complex ones often take longer." (Informant H)

This suggests that network structure not only reflects communication flows but actively shapes policy priorities by privileging frequent, low-complexity demands over nuanced or challenging issues.

Closeness Centrality and Responsiveness

Table 5 - *Closeness Centrality* Value of Actors Affecting on X Network

Nodes	Closeness Centrality	Rank
@perpusnas1	0,965116	1
@sangga_pati	0,666667	2
@osumiode	0,666667	3
@jayno2320	0,666667	4
@shibiruwr	0,666667	5

@perpusnas1 also recorded the highest closeness centrality score (0.965116), indicating its efficiency in reaching other nodes quickly and serving as the fastest conduit for information distribution. In real-time service contexts, this strategic position reflects Perpusnas's ability to respond swiftly. Secondary actors such as @sangga_pati and @jayno2320 (score = 0.666667) also exhibited strong local reach within their sub-networks, suggesting their potential for playing expanded roles in decentralised or thematic support services.

The analysis also revealed that @perpusnas1 scored highest in closeness centrality, underscoring its capacity to respond quickly to dispersed user groups. This aligns with internal evaluation data showing an average response time of 23 seconds—well below ISO benchmarks. Such proximity to users enhances institutional responsiveness and strengthens the perceived legitimacy of VRS as a viable alternative to face-to-face services.

However, reliance on speed as the primary indicator of success raises questions about service quality. As staff themselves acknowledged, accuracy and user satisfaction were rarely evaluated:

"Right now, we only track how many chats are answered and how fast, but we haven't evaluated whether the answers are accurate." (Informant R2)

This imbalance highlights the limitations of relying solely on closeness as a proxy for effectiveness, pointing to the need for more multidimensional evaluation frameworks in the policy cycle's evaluation stage (Nicol & Crook, 2013).

Eigenvector Centrality and Influence Distribution

Table 6 - Actor *Eigenvector Centrality* Values Affect on X Network

Nodes	Eigenvector Centrality	Rank
@arldm	0,155289	1
@Tbodmalra	0,143334	2
@bayu_agung65	0,143334	3

| @karinaaabluu | 0,142712 | 4 |
| @Skripsi25 | 0,142689 | 5 |

Interestingly, the highest eigenvector centrality was not held by @perpusnas1 but by @arldm (0.155289), suggesting that the account is embedded within a highly influential cluster. Despite having fewer direct connections, its ties to other high-impact users grant it significant reputational influence. Other accounts such as @Tbodmalra and @karinaaabluu also displayed strong eigenvector scores, indicating their influence within specific thematic or demographic segments.

> *"These accounts are active in knowledge sharing and advocacy. They're not official channels, but they hold influence in specific communities we're trying to reach." (Informant M2)*

Overall, the SNA revealed a network that is centralised but fragmented (Valdez et al., 2021). While @perpusnas1 dominated most centrality metrics—except eigenvector—its prominence was complemented by the presence of semi-independent clusters and strong local actors. These findings point to untapped opportunities to diversify the network's focal points. Expanding the network's centres of interaction would allow Perpusnas to become more responsive to specialised user communities and decentralise access to information—an approach that aligns with the principles of an inclusive knowledge ecosystem, particularly in engaging researchers, educators, and regional users. Identifying and empowering additional key nodes could inform more targeted policy development and data-driven service enhancements.

> *"We're already fast at responding, but by understanding who is talking to whom in this network, we can redesign our outreach and staff allocation strategies more adaptively." (Informant M2)*

The structure confirms that @perpusnas1 remains indispensable in digital engagement. However, given increasing user complexity and diversity, Perpusnas could benefit from leveraging secondary influential actors and strengthening cross-unit integration. Such a shift would not only alleviate pressure on a single central node but also democratise information access—aligning with the library's broader vision for an inclusive and distributed knowledge ecosystem.

4.3.2. Implications for Service Improvement

The interaction patterns revealed through SNA offer valuable insights for enhancing Perpusnas's digital reference services. One major issue is the high concentration of user interactions around a single account, particularly @perpusnas1. While this centrality ensures high visibility and rapid response, it also creates the risk of service bottlenecks during peak periods, such as student enrollment seasons. One staff member described the challenge:

> *"During peak periods, especially when new students flood the service, these platforms help us respond faster than traditional methods. Even previously sceptical colleagues admitted that it works more effectively." (Informant R2)*

To address this, a more decentralised structure—where specialised sub-accounts are assigned to specific service categories (e.g., digital collections, preservation, or membership)—could enhance efficiency and reduce delays. This approach aligns with the community clusters identified in the SNA, in which users naturally congregate around topic-specific accounts and interests. Another structural insight relates to the division of labour between the social media and reference teams. Typically, the social media team serves as the initial contact point, filtering general queries and forwarding more complex questions to librarians via X. While functional, this hierarchical model often encounters coordination challenges, especially when user context or

background information is not consistently shared between teams (Guo *et al.*, 2022). As noted by an informant:

> *"The social media and reference teams are not always well-coordinated. We need better integration so that users receive consistent information." (Informant M1)*

To strengthen service consistency, Perpusnas could invest in cross-functional training and revised SOPs that promote seamless communication and handoffs between teams (Tafesse & Korneliussen, 2020). Enhancing internal collaboration would help prevent fragmented responses and improve overall user satisfaction. Moreover, while social media tends to support more informal communication, user expectations remain high regarding speed and accuracy. Many users anticipate real-time, personalised support, which may strain current librarian capacity. Insights from the SNA—such as identifying high-frequency nodes and peak activity periods—should be leveraged proactively to forecast demand surges and allocate staff more efficiently, especially during anticipated high-volume interactions.

Currently, service performance monitoring primarily focuses on response speed, which already exceeds ISO standards. However, a broader evaluation framework is needed—one that includes response accuracy, user satisfaction, and engagement among priority user groups (e.g., researchers, students)—to ensure continuous service improvement (Ross et al., 2019).

4.4. The Interplay Between Policy, Social Interpretation, and Network Dynamics

The findings from this study demonstrate that the digitalization of reference services at Perpusnas cannot be understood solely as a technical upgrade or managerial reform. Instead, it represents a socio-technical construction shaped by the interaction between formal policy processes, social interpretations of technology, and network dynamics.

From a policy perspective, the Policy Cycle framework revealed how digitalisation followed an iterative trajectory: problem recognition emerged from institutional inefficiencies and user dissatisfaction; policy formulation involved the gradual refinement of SOPs and platform selection; and implementation exposed persistent gaps in training, infrastructure, and evaluation. Yet, rather than progressing linearly, the process unfolded through cycles of adaptation and negotiation, reflecting the hybrid and experimental nature of policymaking in developing-country contexts (Dye, 2002; Nicol & Crook, 2013).

From a social construction perspective, SCOT highlighted how librarians, managers, and users attributed competing meanings to social media platforms. Managers initially framed them as promotional tools, while librarians reinterpreted them as reference channels and users appropriated them for immediate problem-solving. Through processes of interpretive flexibility and closure (Bijker *et al.*, 2012), these divergent views were gradually stabilised into an institutional consensus, formalised through SOP revisions and performance indicators. This underscores that technology adoption is not value-neutral but mediated by negotiation and legitimisation among relevant social groups.

From a network perspective, SNA demonstrated how these interpretations were enacted in practice. The dominance of @perpusnas1 as a central hub—confirmed by high degree, betweenness, closeness, and eigenvector centrality—enabled efficiency and control but also created structural bottlenecks and limited distributed participation. This reflects a socio-technical paradox: the centralisation that ensured service continuity during COVID-19 simultaneously constrained the potential for collaborative knowledge exchange and innovation (Radford *et al.*, 2021; Wardell & Kelly, 2022).

Taken together, the interplay between these three dimensions reveals both the strengths and vulnerabilities of Perpusnas's digitalisation journey. Policy frameworks provided structure but lagged behind practice; social interpretations allowed experimentation but required institutional closure to achieve stability; and network dynamics ensured responsiveness but entrenched centralisation. The novelty of this study lies in showing how these dimensions intersect—how agenda-setting decisions are reinforced or constrained by network structures, how interpretive flexibility translates into policy adjustments, and how centralisation both legitimises and limits VRS in a national library context.

In comparative perspective, while national libraries in resource-rich settings often pursue decentralised, multi-nodal digital ecosystems, Perpusnas's case illustrates a model of reactive but adaptive centralisation, shaped by the constraints and opportunities of a developing-country context. This provides not only a nuanced understanding of Perpusnas but also broader insights into how public knowledge institutions in the Global South negotiate the tensions between efficiency, inclusivity, and sustainability in their digital transformation.

5. Conclusion

This study examined VRS at the Perpusnas by integrating the Policy Cycle framework, the SCOT Theory, and SNA. The findings demonstrate that digital transformation is not a linear technical upgrade but a socio-technical process shaped by institutional policy choices, social negotiations over the role of technology, and network structures that centralise or diffuse authority.

Theoretically, the study contributes to library and information science by showing how VRS can be understood through the interplay of formal policy frameworks, socially constructed meanings of technology, and networked communication patterns. For SCOT, it extends the analysis of interpretive flexibility and closure to national libraries in a developing-country context. For policy studies, it illustrates how agenda-setting, formulation, and evaluation are reshaped by digital pressures and crises such as the COVID-19 pandemic.

Practically, the study provides actionable insights for library managers and policymakers. It underscores the need to go beyond response speed as the sole performance metric by incorporating service accuracy, user satisfaction, and cross-team integration. It also highlights the importance of capacity-building for librarians, regular revision of SOPs, and multi-platform strategies that align institutional goals with user expectations. Like all case studies, this research has limitations. The analysis focused on Perpusnas, involved a limited number of interview informants, and relied on X platform data from 2023 only. These boundaries constrain generalisability but provide a foundation for contextualised insights.

Future research should expand comparative analyses across national libraries in different regions, employ longitudinal designs to capture policy evolution over time, and incorporate multi-platform datasets to better understand how digital reference services operate within broader knowledge ecosystems. Such extensions would deepen understanding of how digitalisation is negotiated across diverse institutional and socio-technical environments.

Acknowledgement

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