UTILIZATION OF SINGLE SIGN-ON (SSO) TO SUPPORT DISTANCE LEARNING SYSTEMS : CASE STUDY AT LIBRARY UNIVERSITAS TERBUKA

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ABSTRAK: *Penelitian ini mengkaji efektivitas implementasi Single Sign-On (SSO) di Perpustakaan Universitas Terbuka (UT) untuk memfasilitasi sistem pembelajaran jarak jauh. Studi ini menggunakan pendekatan penelitian deskriptif, dengan menggunakan analisis dokumen dan survei pengguna untuk menyelidiki penggunaan layanan perpustakaan digital dari Desember 2024 – Mei 2025. Hasil penelitian menyoroti pentingnya SSO dalam memungkinkan akses yang lancar dan terintegrasi ke sumber daya elektronik, secara signifikan meningkatkan pengalaman pengguna dengan mengurangi hambatan teknologi seperti login berulang dan tantangan pemulihan kata sandi di banyak platform sumber daya elektronik. Setelah implementasi kebijakan akses gratis pada Desember 2024, UT mencatat 5.742 kunjungan ke 14 platform sumber daya elektronik terkemuka, termasuk Scopus, Taylor & Francis, EBSCO, ScienceDirect, dan JSTOR, dll., selain 3.465 login, 2.914 unduhan PDF, dan 342 unduhan seluruh koleksi digital. Temuan survei menunjukkan tingkat kepuasan pengguna yang signifikan, menyoroti pentingnya SSO dalam meningkatkan manajemen identitas yang terpusat dan aman. Persepsi ini diperkuat oleh log sistem kuantitatif: dari Desember 2024 hingga Mei 2025, Perpustakaan UT mendokumentasikan 5.742 kunjungan platform dan 3.465 otentikasi yang berhasil melalui sesi SSO. Penelitian menunjukkan bahwa SSO secara signifikan meningkatkan aksesibilitas dan efektivitas layanan perpustakaan digital dalam pendidikan tinggi terbuka dan jarak jauh. Rekomendasi diajukan untuk memperkuat infrastruktur digital, meningkatkan pengembangan layanan, dan*

menerapkan kebijakan berkelanjutan untuk memfasilitasi transformasi digital berkelanjutan Perpustakaan UT di UT.

***Kata Kunci** : Single Sign-On (SSO), e-reseource, pendidikan jarak jauh,*

***ABSTRACT:** This research examines the efficacy of Single Sign-On (SSO) implementation at the Universitas Terbuka (UT) Library to facilitate distance learning systems. The study uses a descriptive research approach, using document analysis and user surveys to investigate the usage of digital library services from December 2024 to Mei 2025. The results highlight the importance of SSO in enabling smooth and integrated access to electronic resources, significantly enhancing user experience by reducing technological obstacles such as redundant logins and password recovery challenges in many e-resources platforms. Upon the implementation of a free-access policy in December 2024, UT documented 5,742 visits to 14 prominent e-resource platforms, including Scopus, Taylor & Francis, EBSCO, ScienceDirect, and JSTOR, etc, in addition to 3,465 logins, 2,914 PDF downloads, and 342 entire digital collection downloads. Survey findings demonstrate a significant level of user satisfaction, highlighting the importance of SSO in improving centralised and secure identity management. This perception is corroborated by quantitative system logs: from December 2024 to May 2025, the UT Library documented 5,742 platform visits and 3,465 successful authentications via SSO sessions. The research shows that SSO significantly enhances the accessibility and effectiveness of digital library services in open and remote higher education. Recommendations are suggested to strengthen the digital infrastructure, improve service development, and implement sustainable policies to facilitate the UT Library's continuous digital transformation in UT.*

***Keyword**: Single Sign-On (SSO), e-resource, distance learning*

INTRODUCTION

Digital libraries represent a critical infrastructure within the distance learning ecosystem, particularly for large-scale institutions such as Universitas Terbuka (UT). The effectiveness of these libraries heavily depends on their ability to provide seamless access to academic resources. However, the federated authentication model—where each e-resource platform (e.g., Scopus, Taylor & Francis, EBSCO, ScienceDirect, and JSTOR) requires separate credentials—inherently creates access friction. This circumstance creates a novel phenomenon in which the lecturers become fatigued when searching for resources that require many passwords and usernames. This issue, commonly referred to in the literature as "password fatigue", frequently becomes a major obstacle to making the best use of digital resources. Studies on password management indicate that the cognitive load of remembering and managing multiple credentials can decrease user productivity and increase stress (Al-Slais & El-Medany, 2022; Balayogi & K. S., 2024; Mujeye et al., 2016)

In the context of distance learning, where students and faculty are highly dependent on self-directed access to learning and research materials, any technical barriers, such as multi-platform login processes, can directly impact the quality of learning. Therefore, addressing this authentication challenge is a strategic step toward enhancing the effectiveness of digital library services. As a widely adopted technological architecture solution, Single Sign-On (SSO) is designed

to mitigate access friction by unifying the authentication process into an integrated system. By adopting the principle of centralized identity management, SSO enables users to access multiple services with a single credential verification(Shaikh et al., 2022; Vitla, 2023) .

From a theoretical perspective, the implementation of SSO has the potential to enhance both system usability and the overall User Experience (UX). SSO is positioned as both a technological solution and a user-centred innovation by lowering the number of login occurrences and streamlining entry points. Empirical studies in academic settings have shown that SSO adoption is positively correlated with increased user satisfaction, higher frequency of resource access, and improved efficiency of academic workflows (James et al., 2020; Jayakanth et al., 2021). By simplifying the entry point into the digital ecosystem, SSO not only offers convenience but also helps institutions maintain a stronger security posture through more centralized access control.

To comprehensively evaluate the impact of SSO within the UT environment, this study focuses on four key variables. The first is accessibility, defined as the extent to which SSO facilitates integrated access to diverse e-resources for users. The second is efficiency, which measures time savings and the reduction of cognitive load during the login process. The third is user satisfaction, reflecting users' perceptions and acceptance of the new authentication system. The fourth is the contribution to distance learning, which analyzes how streamlined access through SSO supports academic productivity, research activities, and the overall quality of student learning at UT. Although the usability benefits of SSO are well-documented, there remains a research gap in evaluating its role in large-scale distance learning environments, particularly in developing countries such as Indonesia. Most existing studies emphasize either technical metrics or general satisfaction, while few integrate actual usage logs with user perception data to assess broader academic contributions.

Therefore, the novelty of this study lies in evaluating SSO implementation in a large-scale open and distance learning institution in Indonesia through integration of behavioral system logs and user perception data. Based on this background, the study aims to evaluate the implementation of SSO at the Universitas Terbuka library, analyzing its contributions to accessibility, efficiency, and user satisfaction to support the success of distance learning which UT has potential lectures for – 733 lecturers in central office and branch areas (https://www.ut.ac.id/tenaga-akademik/). The results should offer evidence-based suggestions for UT's digital infrastructure development and act as a model for other universities going through comparable changes to their digital libraries. This study aims to assess the deployment of SSO at the Universitas Terbuka library by examining its contributions to accessibility, efficiency, and user satisfaction.

METHOD

This study employed a descriptive mixed-methods design to provide a comprehensive evaluation of the Single Sign-On (SSO) implementation at Universitas Terbuka (UT). Mixed-methods design is commonly used to comprehensively explore the effectiveness of knowledge services in libraries (Li G et al., 2026). This methodological framework was chosen to capture both objective behavioural data and subjective user perceptions, thereby aligning with the study's aim of assessing SSO from multiple perspectives.

Two primary data sources were integrated. First, aggregated usage log data were extracted from the UT library's 14 primary e-resource platforms covering the period of December 2024 to May 2025. These records included platform visits, successful authentications attributable to SSO sessions, and resource download counts, offering an objective measure of user engagement post-implementation. Second, to capture subjective experiences, a structured online questionnaire was developed. The instrument was designed to measure four key variables consistent with the study's objectives: accessibility, efficiency, user satisfaction, and the system's contribution to distance learning. Most items were measured on a 5-point Likert scale (1 =

Strongly Disagree to 5 = Strongly Agree), supplemented by open-ended questions that invited qualitative feedback on system improvements. To ensure rigor, the content validity of the survey was reviewed by two experts in library and information systems, while internal consistency testing yielded a strong Cronbach's alpha coefficient of 0.89. The survey was distributed through UT's official communication channels using a convenience sampling method. A total of 416 lecturers were invited to participate; however, only 163 complete and valid submissions were retained for analysis. Exclusions were applied to incomplete entries and to respondents who reported not having used the SSO service. Data analysis proceeded in two stages. Quantitative data from both system logs and survey responses were analysed using descriptive statistics (frequencies, means, and percentages). Given the ordinal nature of the survey data, Spearman's rho correlation was applied to examine the relationships among the four variables. In parallel, qualitative data derived from the open-ended survey items were subjected to thematic analysis, allowing the identification of recurring patterns in user feedback and suggestions for system development. All ethical standards were strictly observed. Participants provided informed consent prior to beginning the survey, and personally identifiable information was anonymized at the analysis stage to ensure confidentiality. The study protocol received formal approval from the Universitas Terbuka Institutional Review Board.

RESULTS AND DISCUSSION

Accessibility

Survey data indicated that the implementation of Single Sign-On (SSO) substantially improved accessibility to Universitas Terbuka's (UT) digital library resources. Respondents consistently emphasized that the single login process eliminated the need for repeated authentications across multiple platforms, thereby simplifying access to scholarly databases such as Scopus, Taylor & Francis, EBSCO, ScienceDirect, and JSTOR. Quantitative system logs reinforced this perception: between December 2024 and May 2025, the UT Library recorded 5,742 platform visits and 3,465 successful authentications through SSO sessions. Qualitative feedback further confirmed that SSO "removed the most frustrating step" of logging in separately for each database. Taken together, both quantitative and qualitative findings highlight that centralized authentication has lowered entry barriers and enabled more seamless engagement with e-resources.

Efficiency

Efficiency was another prominent improvement reported by users. A majority of respondents agreed that SSO reduced the time required for authentication and alleviated the cognitive load of managing multiple passwords. This was supported by log data showing 2,914 PDF downloads and 342 complete collection downloads during the study period—evidence of increased intensity of use once barriers were minimized. Open-ended responses provided further nuance, with users frequently describing SSO as "time-saving," "more practical," and "a system that lets us focus on study rather than login." This integration of log data with user perceptions underscores how efficiency gains translated into tangible increases in academic resource utilization.

User Satisfaction

Levels of satisfaction with the SSO system were generally high. In the overall satisfaction item, 81.6% of respondents expressed positive evaluations (25.8% strongly agreed; 55.8% agreed), while only 3.7% reported dissatisfaction and 14.7% remained neutral. Satisfaction was strongly linked to the ease of login and the intuitive interface, as reflected in qualitative responses that praised SSO for being "simple and stable." Nonetheless, some participants recommended technical improvements, particularly in relation to system responsiveness during peak usage. The convergence between quantitative satisfaction scores and qualitative feedback suggests that users not only valued the technical function of SSO but also perceived it as an enhancement to the overall quality of UT's digital services.

Contribution to Distance Learning

Respondents highlighted the broader role of SSO in enabling distance learning. Survey data confirmed that users perceived SSO as contributing positively to research productivity, assignment completion, and uninterrupted access to references. This was echoed in open-ended responses, where recurring themes included "greater consistency in access," "reduced frustration," and "increased efficiency in research." By combining survey evaluations with actual usage evidence, it becomes clear that SSO was not merely a technical convenience but a critical enabler of distance education, ensuring that both students and faculty could engage with academic resources effectively in a fully online learning environment.

Correlation Analysis

To examine the interrelationships among the four variables, Spearman's rho correlation analysis was conducted. As presented in Table 1, the analysis revealed consistently positive and statistically meaningful associations. Particularly strong correlations were observed between efficiency and user satisfaction (ñ = 0.778), as well as between satisfaction and the perceived contribution to distance learning (ñ = 0.783). Moderate but meaningful associations were also found between accessibility and efficiency (ñ = 0.602) and between accessibility and contribution (ñ = 0.571).

Table 1. Spearman's Rho Correlation Matrix

Variable	Accessibility	Efficiency	Satisfaction	Contribution
Accessibility	1.000	0.602	0.594	0.571
Efficiency	0.602	1.000	0.778	0.716
Satisfaction	0.594	0.778	1.000	0.783
Contribution	0.571	0.716	0.783	1.000

The integration of quantitative and qualitative findings suggests a pathway in which accessibility provides the necessary foundation, but it is efficiency that drives user satisfaction, and satisfaction in turn is the strongest predictor of perceived contribution to distance learning. This layered relationship underscores the value of combining usage log data with survey perceptions to provide a holistic understanding of SSO's impact.

DISCUSSION

The findings of this study provide valuable insights into the impact of Single Sign-On (SSO) implementation at UT, particularly within the context of distance learning supported by digital libraries. By integrating usage log data with user survey responses, this study highlighted how accessibility, efficiency, user satisfaction, and contribution to distance learning are interconnected in shaping the overall effectiveness of UT's digital infrastructure. The following sections expand upon these results, providing more detailed interpretations, comparisons with prior research, and implications for theory and practice, for which the researcher got the data using a mixed-method design. The data were obtained using a mixed-method design to answer the question

Accessibility and Its Implications

The results indicated that SSO significantly improved accessibility to UT's e-resource platforms by eliminating the need for repeated logins. System log data showing 5,742 platform visits and 3,465 successful authentications reinforced the claim that users were engaging more consistently once barriers to access were reduced. This aligns with earlier studies on federated authentication and password fatigue, which argued that repeated login requirements create access friction that hampers resource utilization (Ezugwu et al., 2023; Papadamou et al., 2020). By centralizing authentication, SSO effectively addressed this challenge, underscoring its importance for distance learners who rely heavily on seamless access to digital resources.

A deeper examination of accessibility reveals that SSO's value lies not only in reducing technical steps but also in addressing broader issues of educational equity(Hansen & Reich, 2021). In Indonesia, where UT serves a geographically dispersed population, accessibility challenges are magnified by infrastructure disparities. Without a centralized login system, students in remote regions often face compounded barriers, such as unstable internet connections paired with complex login requirements. Prior research on digital divides highlights that such compounding obstacles disproportionately affect marginalized learners (AZIONYA & NHEDZI, 2021; Müller et al., 2023; Zhao et al., 2022). In this context, SSO plays a leveling role by simplifying access procedures, ensuring that students with limited technical support are not further disadvantaged.

Qualitative responses from this study reinforce this point, with users noting that SSO "removed the most frustrating step" of engaging with e-resources. This resonates with usability theory, which emphasizes the minimization of unnecessary steps as a central principle of effective system design(Weichbroth, 2020). Moreover, the findings align with the Information Systems Success Model(Alzahrani et al., 2019; Petter et al., 2008), which posits system accessibility as a critical determinant of overall information system success. In UT's case, improved accessibility translates directly into higher engagement, validating the model's relevance in distance education contexts.

Comparisons with global studies also strengthen this interpretation. Research from developed countries often highlights accessibility improvements as conveniences rather than necessities, since infrastructure and bandwidth are rarely major obstacles(Dahm & Reese, 2021; Ezell et al., 2022; Schmetzke, 2001). However, in UT's context, accessibility is foundational, and its absence can severely restrict learning opportunities. This contrast highlights the significance of studying SSO in developing country contexts, where its role extends beyond efficiency to encompass inclusivity and equity in access to higher education in specially in open university

Efficiency as a Key Driver

Efficiency emerged as a pivotal dimension, showing strong correlations with both satisfaction and contribution to distance learning. Users reported that SSO reduced the time spent on authentication and decreased the cognitive burden of remembering multiple passwords, mirroring findings from prior studies in academic and healthcare contexts where SSO adoption improved workflow efficiency (Dahm & Reese, 2021; Ezugwu et al., 2023; Schmetzke, 2001).Log data reinforced these perceptions: 2,914 PDF downloads and 342 full collection downloads were recorded, illustrating that once access barriers were lowered, users engaged more actively with resources.

Survey comments describing SSO as "time-saving" and "practical" align with the perceived ease of use dimension within the Technology Acceptance Model (TAM). From a cognitive load perspective, SSO reduces the mental effort associated with managing multiple login credentials, allowing users to allocate cognitive resources more effectively to academic tasks. This resonates with Sweller's (1988) cognitive load theory, which underscores the importance of minimizing extraneous cognitive demands in order to optimize learning and productivity.

The implications of efficiency for distance learning are significant. For self-directed learners, who often balance academic responsibilities with employment or family obligations, the ability to access resources quickly can influence the depth and frequency of engagement with digital materials. Studies in other distance learning contexts have found that small reductions in procedural barriers can yield large gains in student persistence and performance(Au et al., 2019; Yeh & Tsai, 2022).Thus, efficiency in the authentication process is not merely a technical improvement but a key factor in sustaining long-term learner engagement.

From a broader institutional perspective, efficiency gains translate into measurable benefits for service delivery. By reducing login redundancies, UT can streamline technical support, minimize password reset requests, and allocate IT resources to higher-level service improvements. These organizational-

level outcomes, while indirect, contribute to the sustainability of digital learning ecosystems.

User Satisfaction and Service Quality

Satisfaction levels were overwhelmingly positive, with 81.6% of respondents reporting agreement or strong agreement that SSO improved their experience. This is consistent with prior studies linking SSO to higher user satisfaction due to reduced login friction and improved usability (Jayakanth et al., 2021; Shaikh et al., 2022)In this study, satisfaction was strongly associated with ease of login, intuitive interface, and system stability, though respondents also highlighted areas for further improvement, particularly regarding responsiveness during peak usage.The theoretical significance of these findings can be understood through the Information Systems Success Model, which identifies satisfaction as a key indicator of success. Satisfaction is influenced by system quality (ease of use), information quality (consistent access to content), and service quality (responsiveness and stability). The high satisfaction levels observed suggest that UT's SSO implementation achieved alignment across these dimensions. At the same time, user feedback underscores the dynamic nature of satisfaction; as baseline expectations are met, users begin to identify higher-level improvements, such as faster response times and greater scalability.

Comparative studies also shed light on satisfaction outcomes. In contexts where SSO was implemented without adequate backend support, satisfaction levels plateaued or even declined due to frequent downtime(Al-Slais & El-Medany, 2022; Vitla, 2023). UT's relatively stable implementation, therefore, highlights the importance of not only adopting SSO but also ensuring the robustness of supporting infrastructure. Satisfaction, in this sense, functions as both an outcome and a barometer for ongoing system performance.

Finally, satisfaction is not an isolated construct; it mediates the relationship between efficiency and contribution to learning. The correlation analysis confirmed that satisfaction is strongly predicted by efficiency (ñ = 0.778), which in turn influences perceptions of contribution (ñ = 0.783). This suggests that improvements in efficiency may translate into enhanced satisfaction, ultimately amplifying SSO's educational impact.

Contribution to Distance Learning

The most significant contribution of SSO lies in its role as an enabler of distance learning. Respondents emphasized that streamlined access supported assignment completion, research activities, and uninterrupted engagement with digital resources. Thematic analysis identified recurring themes such as "greater consistency in access," "increased efficiency in research," and "reduced frustration." These findings suggest that SSO serves not only as a technical convenience but as a critical infrastructure supporting the academic mission of UT.

From a theoretical perspective, this contribution can be interpreted within frameworks of educational equity and inclusion. Seamless access ensures that students from diverse backgrounds are not disproportionately disadvantaged by technical barriers, which is particularly relevant in a geographically vast country like Indonesia. Studies on open universities globally, such as the UK's Open University and Athabasca University in Canada, similarly emphasize the importance of reducing barriers to access as a prerequisite for effective distance education . (Lembani et al., 2020)UT's SSO implementation demonstrates how authentication systems can directly support these broader goals of inclusion and equity.
At the institutional level, the contribution of SSO to distance learning extends to research productivity and faculty engagement(Tanis, 2020). Faculty members reported greater ease in accessing references and academic materials, which enhances their ability to conduct research and integrate up-to-date resources into teaching. This creates a positive feedback loop in which improved resource access supports both teaching and research quality, strengthening UT's role as a leader in open and distance education.

Finally, the contribution of SSO must be considered in terms of long-term sustainability and its role as a foundational layer for digital transformation. As digital learning environments expand, authentication systems like SSO become essential for managing scale while maintaining usability and security (Dahlstrom & Brooks, 2014). The integration of SSO with other digital infrastructures, such as learning management systems (LMS), represents a promising avenue for enhancing the overall coherence of digital ecosystems in higher education (Bervell & Umar, 2017). By ensuring a frictionless interface, SSO provides the scalability required for institutions to adapt to the increasing demands of hybrid education models.

Correlation Pathways and Theoretical Integration

The correlation analysis provided deeper insights into the relationships among the four variables. Strong associations between efficiency and satisfaction (ñ = 0.778), as well as between satisfaction and contribution to distance learning (ñ = 0.783), suggest a pathway in which efficiency drives satisfaction, which in turn predicts contribution. Accessibility, while moderately correlated with both efficiency and contribution, serves as the foundational condition enabling the other dimensions to function effectively.

This layered relationship aligns with both the Technology Acceptance Model and the Information Systems Success Model. Perceived ease of use (efficiency) shapes user attitudes (satisfaction), which then translate into behavioral outcomes (contribution to learning). The mixed-methods approach employed in this study strengthens this interpretation by integrating behavioral data (usage logs) with perceptual data (surveys), offering a holistic view of how technical design influences educational outcomes.

This study lies in its mixed-methods approach, which combined usage log data with user perceptions to evaluate SSO in a large-scale distance learning institution. While prior studies have examined SSO from either a technical or perceptual perspective, few have integrated both data streams, especially in the context of developing countries. This provides a unique contribution to the literature by demonstrating how authentication systems can impact not only usability and satisfaction but also broader educational outcomes.

However, limitations must be acknowledged. The reliance on convenience sampling may limit the generalizability of findings across the UT population of lecture in UT. The six-month timeframe of log data may not capture long-term patterns of engagement. Moreover, the correlational design identifies associations but does not establish causality. Future research should consider longitudinal approaches to track changes over time, as well as more advanced statistical methods such as Structural Equation Modeling (SEM) to test causal pathways.

Comparative studies with other open universities, both within Indonesia and internationally, could also provide valuable insights into the scalability and transferability of SSO's impact. Additionally, future research could explore the integration of SSO with emerging technologies such as learning analytics, artificial intelligence-driven personalization, and adaptive learning systems, which may further enhance the role of authentication systems in digital education.

CONCLUSION AND RECOMMENDATION

The implementation of Single Sign-On (SSO) at the Universitas Terbuka (UT) Library represents a pivotal advancement in the institution's digital infrastructure, effectively addressing the systemic challenges of "password fatigue" and access friction within a large-scale distance learning environment. By synthesizing quantitative system logs with qualitative user perceptions, this study confirms that SSO has fundamentally transformed the accessibility of digital resources. The transition from a fragmented federated authentication model to a centralized identity management system resulted in a measurable increase in engagement, as evidenced by the 5,742 platform visits and significant download volumes recorded during the observation period. By lowering technical entry barriers,

SSO ensures that the diverse and geographically dispersed academic community at UT can interact with scholarly databases with greater consistency and ease. Furthermore, the findings underscore the critical role of efficiency as a mediator for user satisfaction and academic productivity. The strong correlation between system efficiency and user satisfaction (ñ = 0.778) suggests that the reduction of extraneous cognitive load—specifically the burden of managing multiple credentials—allows users to redirect their intellectual resources toward research and pedagogical tasks. With a satisfaction rate of 81.6%, the SSO system has proven to be more than a technical utility; it is a user-centered innovation that enhances the overall quality of the digital library experience. This high level of acceptance reflects an alignment between the system's technical stability and the practical needs of self-directed learners and faculty in a remote context.

Ultimately, this research demonstrates that SSO serves as a vital enabler of the distance learning mission at Universitas Terbuka. By facilitating seamless, equitable access to global e-resources, the system directly supports research productivity and the continuity of the learning process. The study validates the pathway where accessibility provides the necessary foundation, efficiency drives satisfaction, and satisfaction reinforces the perceived contribution to the institutional academic goals. To sustain this momentum, it is recommended that UT continues to optimize its backend infrastructure for high-traffic scalability and pursues further integration between the SSO framework and the broader Learning Management System (LMS) to realize a truly seamless and inclusive digital educational ecosystem

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