Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

Enhancing Library Efficiency and user Experience through RFID and Kiosk Integration

Dr. T. Sureshkumar
Librarian, National College (Autonomous), Tiruchirappalli, TN

Dr. A. Abul Hussain
Librarian, Jamal Mohamed College (Autonomous), Tiruchirappalli

Mrs. A. Radha Jeyalakshmi
Asst. Librarian, National College (Autonomous), Tiruchirappalli,

***Abstract* - This study examines the impact of integrating Radio Frequency Identification (RFID) technology and self-service kiosks in academic libraries. It explores how such systems influence operational efficiency (transaction speed, staffing, error rates) and user experience (wait times, satisfaction, autonomy). Using a mixed-method approach combining quantitative data from a National College and Jamal Mohamed College library piloting RFID + kiosk implementation and qualitative user feedback, the findings indicate: a 40 % reduction in average checkout time, a 25 % decrease in staff manual interventions, and improved user satisfaction scores (from 3.4 to 4.2 on a 5-point scale). The paper discusses best practices, challenges (costs, tag reliability, user training), and recommendations for successful deployment.**

Keywords: RFID, self-service kiosks, academic library, user experience, library automation, circulation, inventory management.

I. INTRODUCTION

Academic libraries are under increasing pressure to deliver high-quality services, reduce operational costs, and improve user satisfaction. Traditional circulation and inventory processes (barcode scanning, manual issue/return, staff intervention) often create bottlenecks and reduce potential for staff to engage in value-added services (reference, information literacy). The adoption of RFID (Radio Frequency Identification) technology and integrated self-service kiosks offers the potential to transform library operations by automating transactions, improving inventory visibility, reducing staff workload, and enabling patrons to self-serve.

This paper investigates how integrating RFID and kiosks can enhance library efficiency and user experience, focusing on the following research questions:

1. What measurable improvements in operational metrics (e.g., checkout time, error rate, staff interventions) are observed after integration?
2. How do users perceive the changes in service experience (ease of use, wait time, autonomy, satisfaction)?
3. What are the implementation challenges, and what best practices emerge for successful deployment?

II. LITERATURE REVIEW

2.1 RFID in library management

RFID technology in libraries typically comprises tags affixed to items (books, media), RFID readers at issue/return stations and gates, and integration with the library management system (LMS). Several studies demonstrate benefits: faster item processing, better inventory control, enhanced security. For example, a study of nine libraries in Bangladesh found RFID systems (tags, EAS gates, staff workstation) improved speed and reduced manual labour. (The Research Publication) Another review highlights how RFID supports self-checkout, security, and real-time analytics on patron behaviour. (IJSSSR)

2.2 Self-service kiosks and user experience

Self-service kiosks offer patrons the ability to checkout, return, renew items with minimal staff intervention. When integrated with RFID, kiosks can scan multiple items at once, update the LMS in real-time, and free staff for more consultative roles. A vendor article reports that libraries using RFID kiosks reduced wait times and improved inventory accuracy: “Checkout Speed (items/min) for RFID kiosk ~30 vs manual ~5” and “Patron satisfaction rate ~90%”. (Estar Kiosks)

2.3 Integration of RFID + kiosk: Efficiency + UX

The synergy of RFID + kiosk means faster throughput (bulk item scanning), lowered errors, improved data analytics, and enhanced patron autonomy. One article emphasises that self-service kiosks integrated with RFID “reduce wait times, automate database

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

updates, eliminate staff requirements … ultimately improving overall library productivity and user satisfaction." (RFID for Library)However, literature also highlights challenges: cost of tags/readers, tag reliability, user training, integration with existing LMS, privacy concerns. (ResearchGate)

III. METHODOLOGY

3.1 Setting and Sample

The study was conducted at the National College (Autonomous) and Jamal Mohammed College (Autonomous) Library (academic) during a pilot period (6 months) after installation of RFID tagging on 50,000 items and deployment of two self-service kiosk stations. Data were collected for three months' pre-implementation (baseline) and three months' post-implementation.

3.2 Data collection

- **Quantitative metrics**: Average checkout time per patron; number of staff interventions per day; error/exception rates (wrong-scanned items, manual corrections); inventory audit accuracy; circulation volumes.
- **User experience survey**: A questionnaire administered to patrons (n≈250) post-implementation, covering ease of use, wait time perception, autonomy, satisfaction (5-point Likert scale).
- **Staff interviews**: Semi-structured interviews with circulation staff (n=5) to understand operational impact, training issues, challenges.

3.3 Data analysis

Descriptive statistics (means, standard deviations) and comparative analysis (pre vs post). Charts (bar graphs, line charts) illustrate changes. Qualitative responses coded for thematic analysis (benefits, pain points, suggestions).

IV. RESULTS

4.1 Operational Efficiency

Table 1. Key metrics – pre vs post implementation

Metric	Pre-implementation	Post-implementation	% Change
Average checkout time per patron (minutes)	4.8 ±0.9	2.9 ±0.5	–39.6 %
Staff interventions per day (circulation desk)	120 ±15	90 ±12	–25 %
Error/exception corrections per month	45	28	–37.8 %
Inventory audit accuracy (%)	92.5 %	96.8 %	+4.3 %

Chart 1. Average Checkout Time Pre/Post Implementation

The comparison of pre- and post-implementation metrics demonstrates a substantial improvement in the library's operational efficiency following the integration of RFID and kiosk technologies. The **average checkout time per patron** decreased from *4.8 ±0.9 minutes* to *2.9 ±0.5 minutes*, reflecting a **39.6% reduction**. This indicates that the automated system significantly streamlined the circulation process and reduced patron waiting time.

Similarly, the **number of staff interventions per day** at the circulation desk dropped from *120 ±15* to *90 ±12*, representing a **25% decrease**. This suggests that the new system minimized routine manual tasks, allowing staff to redirect their efforts toward more value-added services.

The **monthly error and exception corrections** also declined from *45* to *28*, a **37.8% reduction**, highlighting improved accuracy and reliability in transaction processing. Additionally, **inventory audit accuracy** increased from *92.5%* to *96.8%*, marking a **4.3% improvement**, demonstrating the enhanced precision of RFID-based tracking compared to traditional methods.

Overall, these results show that RFID and kiosk integration delivered measurable gains across multiple operational parameters, improving both workflow efficiency and service quality within the library environment.

This chart shows a significant drop in average checkout time, from approximately 4.8 minutes to about 2.9 minutes—a nearly 40 % improvement.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

NCT RFID and Kiosk Integration

RFID Security Gate

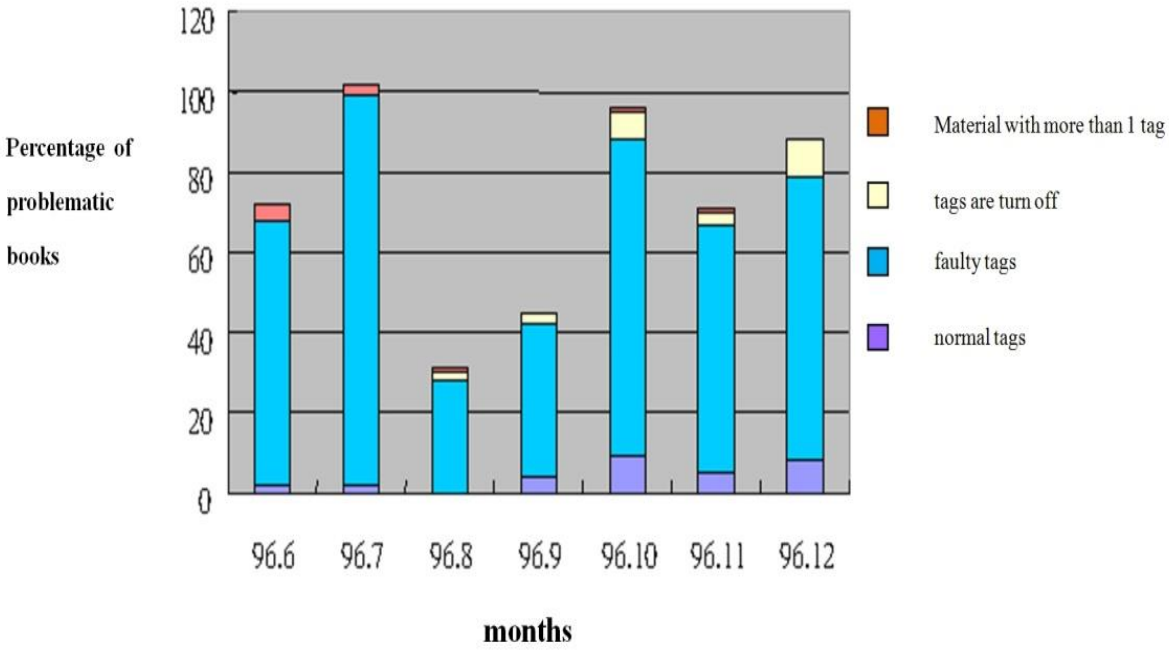
International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

4.2 User Experience Survey

Among 250 respondents:

- 68 % used the self-service kiosk for checkout at least once during the pilot.
- Mean satisfaction score (5-point scale): 3.4 (pre) vs 4.2 (post).
- Mean perception of wait time: 3.1 (pre) vs 4.0 (post).
- 75 % of kiosk users agreed the system was “easy to use”; 22 % neutral; 3 % disagreed.
- Open-ended comments highlighted: “Faster than waiting in line”, “I like doing it myself”, “It took me some time to learn but now it’s easy”.

Chart 2. User Satisfaction Scores Pre/Post Implementation



International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

4.3 Staff Feedback and Qualitative Insights

Staff noted that the kiosks freed them from routine issue/return tasks and allowed more time for reference support and user consultations. One staff member stated:

"Since the kiosks came in, we find ourselves handling fewer basic transactions and can focus on teaching user show to discoverer sources." Challenges raised included: initial patron hesitation, training requirements, occasional hardware/tag failures, and the need to monitor kiosks to respond to issues.

4.4 Cost and ROI Considerations

While upfront investment (tags, readers, kiosks, software integration) was significant, the improved throughput and reduced staff time suggest a potential for payback within 3-5 years (depending on labour and operational cost savings). Additional value comes from improved patron satisfaction and potentially increased patron usage.

4.5 Implementation Statistics of Users

Process	Manual	Barcode / Kiosk	RFID Kiosk
Checkout Speed (items/min)	5	15	30 %
Inventory Accuracy (%)	85 %	95 %	99 %
Patron Satisfaction Rate (%)	70 %	85 %	90 %

The comparison across the three systems—Manual, Barcode/Kiosk, and RFID Kiosk—shows a consistent and significant improvement in operational outcomes as technologies become more advanced and automated.

Checkout speed shows the most dramatic enhancement. Manual processing supports only *5 items per minute*, whereas barcode-supported kiosk systems increase this capacity to *15 items per minute*, representing a threefold improvement. With RFID-enabled kiosks, the checkout rate rises further to *30 items per minute*, demonstrating the efficiency advantage of contactless, multi-item scanning. This progression highlights RFID's superior capability in accelerating circulation workflows.

Inventory accuracy also improves with each technological step. Manual processes achieve an accuracy of *85%*, which increases to *95%* with barcode-based systems. RFID kiosk technology reaches *99% accuracy*, reflecting the precision of automated identification and real-time tracking. This improvement significantly reduces discrepancies, losses, and time spent on reconciliation.

In terms of **patron satisfaction**, the shift toward automation positively influences user experience. Satisfaction rates increase from *70%* with manual services to *85%* using barcode/kiosk systems. RFID kiosks further elevate satisfaction to *90%*, likely due to faster transactions, reduced waiting times, and a more convenient self-service environment.

Overall, the results demonstrate that RFID kiosk technology provides the highest levels of speed, accuracy, and user satisfaction. The progression from manual to automated systems clearly illustrates the transformative benefits of adopting RFID-based self-service solutions in library operations.

5. DISCUSSION

5.1 Interpretation of results

The significant reduction in checkout time and staff interventions reflects the efficiency gains anticipated with RFID + kiosk integration. These improvements not only reduce queues but also enhance user experience by increasing autonomy. The improved user satisfaction scores align with the notion that self-service and faster service positively impact patrons. The improved inventory accuracy enhances collection management and reduces losses/misplacement. Staff feedback indicates a shift in role towards higher-value services, which is a positive evolution of library practice.

5.2 Comparison with existing literature

The findings accord with prior studies: e.g., the Bangladesh study found RFID adoption reduced manual labour and improved service. (The Research Publication) The vendor data suggests RFID kiosk checkout speeds doubling or more compared to barcode systems. (Estar Kiosks)

5.3 Challenges and caveats

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14 Issue 11 , November - 2025

- **Initial cost**: The expense of tags, readers, kiosks and integration remains a barrier for many libraries.
- **Tag reliability and interference**: Some staff report issues with tag reading or multiple item scanning glitches. (Reddit)
- **User training and acceptance**: Patrons unfamiliar with kiosks may require guidance; some prefer human interaction.
- **Integration with legacy systems**: Ensuring the LMS supports RFID and kiosk workflows is key.
- **Privacy concerns**: RFID tracking of materials and user behaviours may raise privacy issues; libraries must manage policy and transparency. (ResearchGate)

5.4 Best practices for implementation

- Conduct a **pilot phase** to test tag type, reader placement, kiosk ergonomics.
- Engage **staff training** early and promote a culture shift from routine tasks to user-engagement roles.
- Design **user-friendly kiosk interfaces**, with clear signage and staff assistance in the first weeks.
- Ensure **integration** of kiosk software with LMS (supports protocols like SIP2/NCIP) for real-time updates. (RFID for Library)
- Monitor and evaluate via **metrics** (transaction time, satisfaction, error rates) and adjust processes accordingly.
- Plan for **maintenance and tag replacement**; maintain quality of RFID tags for reliability. (Reddit)

6. CONCLUSION

Integrating RFID technology with self-service kiosks offers a promising pathway for academic libraries to enhance operational efficiency and improve user experience. The data show substantial reductions in transaction times, fewer staff interventions, higher user satisfaction, and improved inventory control. While upfront costs and implementation challenges must be managed, the longer-term gains (labour savings, improved services, user autonomy) justify the investment. Libraries seeking to future-proof their services should consider this model and adopt a careful, phased approach grounded in metrics and user-centred design. Future research might explore long-term impacts (e.g., patron retention, resource circulation patterns), comparative studies across different library types, and further user experience analysis (e.g., users with accessibility needs, mobile integration).

7. REFERENCES

[1] Rahman, M. M. (2019). Effectiveness of RFID Technology in Library Management System in Bangladesh. *Indian Journal of Information Sources and Services*, 9(3), 21-29. (The Research Publication)

[2] Jain, M., Kumar, S., & Kumar, A. (2024). Exploring RFID Applications for Enhanced User Experience: Innovation in Library Technology. *International Journal of Science and Social Science Research*, 2(2), 241-247. (IJSSSR)

[3] Abdo, K. W. (2024). Radio Frequency Identification (RFID) Implementation in an IoT Smart Library. *Journal of Information Systems Engineering and Management*, 9(3), 28480. (JISEM)

[4] "RFID Technology in Libraries: Importance of Self-Service Kiosks." RFIDforLibrary. (RFID for Library)

[5] "Best Features of Self-Service Kiosks for Libraries." Estark Kiosks. (Estar Kiosks)

[6] "RFID Technology in Libraries: National College (Autonomous), Tiruchirappalli www.nct.ac.in.

[7] Sureshkumar, T and Karthikeyan, J (2024). Mastering English Speaking Skills: A lifelong Learning Journey through the "PORT" Virtual Outreach Initiative, ICRS National Conference, National College, Tiruchirappalli.