



[Digital Transformation, Sustainable Innovations and Development in the African Continent]

[Thursday 31st July and Friday 1st August 2025]

[KWUST 2025 Conference Proceedings]

ABSTRACT NO. 41

Scalable QR Attendance Systems: Empowering Hybrid Learning for Global Competitiveness

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ABSTRACT

The rapid adoption of hybrid learning has exposed critical gaps in attendance tracking, particularly in low-resource settings where biometric systems are costly and manual methods are insecure. This paper proposes a novel, context-adaptive QR-based attendance system, leveraging low-cost technology (lightweight infrastructure, rural-accessible authentication methods, and modular analytics dashboards) to enhance accountability and data-driven decision-making. Our solution generates dynamic, time-expired QR codes scanned via smartphones, ensuring real-time validation and eliminating proxy attendance. Key innovations include: Security: AES-encrypted codes with timestamp validation. Equity: Offline functionality for rural/urban parity. Analytics: Automated dashboards track engagement and flag at-risk students. A pilot at JKUAT (N=174 students) demonstrated 92% attendance accuracy (vs. 68% manual) and 35% administrative time savings. The system advances global education competitiveness by: Policy Insights: Data informs hybrid learning investments (e.g., course scheduling). SDG Alignment: Supports SDG 4 (Quality Education) and SDG 9 (Industry Innovation). Full paper will detail: Cryptographic protocols, comparative analysis with RFID, and policy frameworks for national adoption. This work aligns with the scientific conference's theme of digital transformation, sustainable innovations and Development in the African context

Key Words:

QR codes, hybrid learning, educational equity, attendance analytics, SDG 4

