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Digital Class Schedule and Tullab Performance Management System for Mahad Nurul Yaqeen Al-Islamiy

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Abstract

This study aimed to develop and evaluate the Digital Class Schedule and Tullab Performance Management System (DCSTPMS) to address manual academic and administrative processes at Mahad Nurul-Yaqeen Al-Islamiy, a private Islamic elementary school in Asturias, Jolo, Sulu, Philippines. Using the Waterfall Software Development Life Cycle, system requirements were identified through surveys of school personnel, interviews with the school head and registrar, observations, and document reviews. The web-based system was developed using PHP 8.3, MySQL/MariaDB, and Bootstrap 5, and evaluated through functional, security, performance, and ISO/IEC 25010-based user acceptance testing. Results demonstrated successful integration of enrollment management, conflict-aware class scheduling, attendance monitoring, automated weighted grading, Tahfiz progress tracking across 114 surahs, and QR code-based certificate verification. Seven user roles and 32 permissions supported controlled access, while all 21 functional test cases passed and major pages satisfied the established loading-time requirements. The findings indicate that DCSTPMS achieved its development objectives and provides an integrated platform responsive to the school's academic and Islamic educational requirements. Full implementation, staff training, regular database backups, and continued system evaluation are recommended. The principal limitation was the absence of evaluation across a complete academic term. The study contributes a context-specific digital management solution supporting institutional efficiency, educational record integrity, and sustainable school administration, aligning with Sustainable Development Goals 4 (Quality Education) and 9 (Industry, Innovation and Infrastructure).

Keywords: Academic Management; Class Scheduling; Digital Transformation; Islamic Education; Role-Based Access; Tahfiz Monitoring; Web-Based System

1. Introduction

Digital information systems have improved educational administration by simplifying enrollment, scheduling, attendance, grading, and record management (Abd Wahab & Abdullah, 2025; OECD, 2023). However, Islamic schools require specialized systems that integrate conventional academic functions with religious instruction, particularly Qur'an memorization (Tahfiz). This study developed the Digital Class Schedule and Tullab Performance Management System (DCSTPMS) for Mahad Nurul-Yaqeen Al-Islamiy in Jolo, Sulu, to address manual administrative processes through a centralized, secure, and curriculum-responsive web-based platform.

Educational digitalization improves record accuracy, accessibility, and administrative efficiency. Islamic schools, however, must manage conventional academic subjects alongside Arabic Language, Islamic Values Education, and Tahfiz (Department of Education [DepEd], 2013). Limited resources often complicate these responsibilities (UNESCO, 2023). At Mahad Nurul-Yaqeen Al-Islamiy, manual enrollment, scheduling, attendance, grading, and certificate processing resulted in record management difficulties, calculation errors, and limited monitoring of learners' memorization progress. These challenges established the need for an integrated academic management system. UNESCO (2023) emphasizes that education technology should be selected according to institutional needs and evaluated for equitable access, sustainability, and its contribution to education management; this reinforces the importance of a context-specific system for the school. Recent digital education guidance also emphasizes accessible, inclusive interfaces and the importance of staff capacity-building in educational technology adoption (World Wide Web Consortium, 2023; UNESCO, 2024).

Abd Wahab and Abdullah (2025) demonstrated the effectiveness of web-based systems in managing school schedules, assessments, attendance, and user access. Mustafa et al. (2021) developed a Qur'an memorization application that supported individualized learning but lacked institutional progress monitoring. Meanwhile, Abd Rahman and Ahmed (2026) emphasized the importance of data integrity, privacy, and security in QR code-based academic credential verification. Philippine studies established the benefits of automated grading (OECD, 2023), online registration (OECD, 2023), and scheduling conflict detection (Abd Wahab & Abdullah, 2025). However, these systems addressed separate administrative functions without integrating comprehensive Tahfiz monitoring, academic management, and certificate verification.

International developments demonstrate the applicability of digital platforms to school administration and Qur'anic education (Abd Wahab & Abdullah, 2025; Mustafa et al., 2021). In the Philippines, the Madrasah Education Program integrates Arabic Language and Islamic Values Education into basic education (DepEd, 2013). Sali (2021) identified curriculum implementation concerns, while UNESCO (2023) documented financial and institutional limitations among traditional madaris. These conditions highlight the need for affordable, culturally responsive digital systems, particularly in schools such as Mahad Nurul-Yaqeen Al-Islamiy.

DCSTPMS applies Role-Based Access Control (RBAC), which assigns permissions according to institutional responsibilities (Sandhu et al., 1996). Its seven user roles and 32 permissions support secure access and administrative accountability. Automated weighted grading follows established assessment principles (DepEd, 2015), while QR code-based verification supports certificate authentication (Abd Rahman & Ahmed, 2026). The system follows an Input-Process-Output framework, transforming enrollment, attendance, assessment, and Tahfiz data into organized academic records and reports. Developed using PHP, MySQL/MariaDB, and Bootstrap, it incorporates security practices consistent with the OWASP Foundation (2021). Secure software development guidance further recommends integrating risk-reduction practices throughout development and deployment (National Institute of Standards and Technology, 2022).

Existing systems primarily address enrollment, grading, scheduling, or Qur'an memorization independently (Abd Wahab & Abdullah, 2025; Mustafa et al., 2021; OECD, 2023). The reviewed literature reveals limited integration of these functions within a single platform designed for Islamic elementary education. To address this gap, DCSTPMS combines enrollment validation, conflict-aware scheduling, attendance monitoring, automated grading, per-surah Tahfiz tracking, role-based security, audit logging, and QR-verifiable certificates. The study aimed to develop and evaluate this system to improve administrative efficiency, record reliability, and academic monitoring at Mahad Nurul-Yaqeen Al-Islamiy.

The study supports SDG 4 (Quality Education) by improving academic record management, learner monitoring, and parental access to educational information. It contributes to SDG 9 (Industry, Innovation and Infrastructure) through the adoption of digital technologies in school administration. Furthermore, SDG 16 (Peace, Justice and Strong Institutions) is supported through secure information management, audit trails, role-based permissions, and certificate authentication (UNESCO, 2023).

DCSTPMS promotes educational sustainability through systematic academic and Tahfiz monitoring, technological sustainability through centralized digital administration, and cultural sustainability by accommodating Islamic educational practices. It also strengthens institutional sustainability through secure records, standardized procedures, and transparent administrative transactions. Overall, the system provides a practical digital management approach for Islamic elementary schools seeking improved efficiency, accountability, and continuity of educational services. Digital education transformation also depends on institutional leadership and equitable access to technology (UNESCO, 2024; UNICEF, 2021).

2. Material and methods

2.1 Research Design

The study adopted the Waterfall Model of the Software Development Life Cycle (National Institute of Standards and Technology, 2022), which follows sequential phases of planning, requirements analysis, system design, implementation, testing, deployment, and maintenance. This approach was appropriate because the school's enrollment procedures, grading policies, curriculum, and certificate requirements were established before development. The development process began with identifying institutional problems and documenting requirements, followed by designing the system architecture, database, user interfaces, and processing algorithms. The application was developed using PHP 8.3, MySQL/MariaDB, and Bootstrap 5, then subjected to functional, security, performance, and user acceptance testing before deployment. Each phase was completed and reviewed before proceeding to the next.

2.2 Locale of the Study

The study was conducted at Mahad Nurul-Yaqeen Al-Islamiy, a private Islamic elementary school in Asturias, Jolo, Sulu, Philippines, serving learners from Grade 0 to Grade 6. The institution provides conventional academic instruction alongside Islamic education, including Qur'an memorization or Tahfiz. Its existing manual administrative procedures provided the operational setting for developing and evaluating DCSTPMS.

2.3 Respondents of the Study

The respondents comprised school administrators, the registrar, the academic coordinator, and teachers involved in academic and administrative operations. The school head and registrar participated in interviews concerning enrollment, scheduling, grading, Tahfiz monitoring, and certificate issuance. For user acceptance testing, intended users included administrators, the registrar, academic coordinator, teachers, and students or parents/guardians.

2.4 Sample and Sampling Procedure

The study involved school personnel directly associated with the administrative processes and intended functions of DCSTPMS. Respondents provided information about existing procedures, operational difficulties, and system requirements. Intended users also participated in evaluating the developed system. The manuscript did not specify the total number of respondents or a formal sampling technique; therefore, these details were not assumed.

2.5 Research Instrument

Data were collected using an interview guide, a survey questionnaire, direct observation, and institutional document review. The initial questionnaire assessed difficulties associated with manual processes using a five-point Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). Institutional documents, including enrollment checklists, class schedules, report cards, curriculum records, and certificate templates, were examined to establish system requirements. System evaluation employed an ISO/IEC 25010-based questionnaire covering functionality, usability, reliability, efficiency, and security (International Organization for Standardization, 2023). Functional test cases, security checks, and browser-based performance measurements provided additional evidence of system performance.

2.6 Data Gathering Procedure

Data gathering involved interviews with the school head and registrar, surveys of school personnel, direct observation of administrative activities, and examination of institutional documents. The collected information identified difficulties in enrollment requirement tracking, scheduling conflicts, attendance recording, grade computation, Tahfiz monitoring, certificate authentication, and administrative accountability. These findings were translated into functional and non-functional requirements, reviewed and approved by the school. The system design followed the Input-Process-Output framework, in which student profiles, enrollment applications, schedules, attendance, assessment scores, Tahfiz evaluations, and certificate requests served as inputs. Processing involved access control, enrollment validation, scheduling, automated grading, Tahfiz tracking, certificate generation, and audit logging. Outputs included enrollment records, class schedules, academic reports, Tahfiz progress summaries, and verifiable certificates. These outputs also supported subsequent academic planning. The system architecture consisted of presentation, application, and data layers. The browser-based interface used Bootstrap 5, JavaScript, AJAX, Chart.js, and DataTables, while PHP processed user requests through Apache and communicated with a normalized 49-table MySQL/MariaDB database using prepared statements. The interface included role-specific navigation, administrative dashboards, academic assignment pages, and a publicly accessible certificate verification function. Administrative workflows differentiated the responsibilities of the Super Administrator, Principal, Registrar, Academic Coordinator, Teacher, Student, and Parent/Guardian. The Registrar validated enrollment requirements, approved applications, and assigned sections, after which approved learners were automatically enrolled in corresponding subjects. The Academic Coordinator managed curriculum assignments and class schedules, with automatic warnings for teacher, classroom, or section conflicts. Teachers recorded attendance, grades, Tahfiz progress, and learning materials, while students and parents had view-only access to authorized records. All users followed authentication and permission-checking procedures before

accessing system functions. The database maintained relationships among student profiles, enrollments, academic records, Tahfiz progress, and certificates, supporting data consistency and traceability. Three principal algorithms supported system operations. Enrollment processing verified requirements before approving or rejecting applications and automatically assigning subjects. Weighted grade computation calculated final grades from assessment components and converted results into letter grades, GPA equivalents, and remarks. Certificate processing generated unique identification and verification codes, allowing public authentication through QR codes while checking certificate validity and revocation status. Important transactions were recorded in audit logs. Following implementation, the system was installed using its built-in installer, which configured the database and initial administrator account. Functional, security, performance, and user acceptance evaluations were subsequently conducted to determine whether the system satisfied institutional requirements.

2.7 Data Analysis Techniques

Data analysis involved descriptive assessment of survey responses, requirements analysis, functional testing, security evaluation, performance measurement, and user acceptance testing. Survey responses were examined using the five-point rating scale to identify recurring difficulties in manual administrative processes. Functional testing employed 21 black-box test cases, comparing actual system behavior with expected outcomes. Security testing examined SQL injection, cross-site scripting, unauthorized access, and potentially unsafe file uploads. Performance testing measured the loading times of principal system pages through browser developer tools, with each page tested three times and the average loading time calculated. User acceptance testing assessed functionality, usability, reliability, efficiency, and security using an ISO/IEC 25010-based evaluation instrument (International Organization for Standardization, 2023). Mean ratings were calculated for each quality characteristic and interpreted using the established five-point scale. An overall mean of at least 3.41, corresponding to Agree, served as the target acceptance criterion. These procedures provided the basis for evaluating the system's compliance with its functional requirements and intended institutional application.

3. Results and Discussion

3.1 Development and Implementation of DCSTPMS

3.1.1 System Interface and Administrative Functions

The developed system provides role-specific dashboards displaying student and staff information, attendance summaries, class schedules, enrollment status, Tahfiz engagement, announcements, and recent activities. The enrollment module supports application processing, requirement verification, and record searching. Class scheduling enables teacher assignments and weekly timetable generation, while attendance recording classifies learners as present, late, absent, or excused. These functions address the school's reliance on manual records by centralizing academic information and standardizing administrative procedures. The integrated interface facilitates record retrieval, monitoring, and coordination among authorized school personnel.

3.1.2 Role-Based Access Control and User Permissions

DCSTPMS implemented seven user roles and 32 permissions across 19 modules, comprising 86 role-permission assignments. The Super Administrator holds all 32 permissions, while other accounts have restricted access according to institutional responsibilities. For example, the Registrar cannot encode grades, and teachers cannot approve enrollment applications. The permission structure enforces separation of duties and protects institutional records from unauthorized modification. By restricting access according to user responsibilities, the system strengthens administrative accountability and information security, consistent with Role-Based Access Control principles (Sandhu et al., 1996).

3.1.3 Academic Structure and Class Scheduling

The system configured seven grade levels, from Grade 0 to Grade 6, with one section per level for School Year 2025–2026. Thirteen Islamic Studies and Tahfiz-related subjects were established, with 49 curriculum assignments distributed across the seven grade levels. Weekly scheduling incorporated teacher, classroom, and section conflict detection, which successfully identified overlapping assignments during testing. These findings demonstrate the system's capacity to organize the school's academic structure and prevent scheduling conflicts. Automated conflict checking supports more consistent timetable preparation and reduces the administrative difficulties associated with manual scheduling.

3.1.4 Automated Weighted Grade Computation

The grading module implemented six assessment components: quizzes (15%), activities (15%), assignments (10%), projects (10%), midterm examinations (20%), and final examinations (30%). The combined weights totaled 100%. A sample computation produced a final grade of 88.80, equivalent to B+, a GPA of 3.0, and a remark of Very Satisfactory. The automated computation minimizes manual arithmetic and ensures consistent conversion of assessment scores into final grades, letter grades, GPA equivalents, and performance remarks. The descriptive remarks follow the established grading classifications (DepEd, 2015), while letter grades and GPA equivalents reflect the school's grading policy.

3.1.5 Tahfiz Progress Monitoring

The Tahfiz module incorporated all 114 surahs of the Qur'an, including Arabic and English names, transliterations, ayah counts, starting juz', and revelation classifications. Teachers can document memorization stages, record revisions, and assign quality ratings from 1 to 5. A sample progress report recorded one completed entry covering seven ayahs with an average quality rating of 5.0. This module provides systematic documentation of Qur'an memorization alongside conventional academic assessment. It addresses the absence of centralized per-surah monitoring and supports the school's specialized Islamic educational requirements.

3.1.6 Enrollment Management and QR Code-Based Certificate Verification

The system incorporated six enrollment requirements and eight certificate types with corresponding English and Arabic titles. Enrollment approval requires verification of applicable documents, followed by automatic subject enrollment. Issued certificates contain unique certificate numbers, QR codes, and separate verification codes, allowing public authentication without requiring user accounts. These features improve enrollment documentation and support the authenticity of institutional credentials. Public verification enables receiving institutions to confirm certificate validity while limiting access to sensitive student information.

3.2 Database Management and System Security

3.2.1 Database Organization and Record Management

The system utilized a normalized 49-table MySQL/MariaDB database containing academic structures, user permissions, student profiles, enrollment records, grading components, Tahfiz information, and certificate details. The initial database snapshot included two students, three teachers, and nine user accounts, alongside institutional configuration records. The database structure supports centralized record management, data consistency, and information retrieval. However, the snapshot represented preliminary system data rather than full operational records, as the school had not yet completed an academic term using DCSTPMS.

3.2.2 Security Controls and Data Protection

Security measures included prepared SQL statements, password hashing, cross-site request forgery protection, output escaping, file upload validation, session management, and audit logging. Source code inspection and manual security testing were conducted to examine these controls. These mechanisms support confidentiality, data integrity, and administrative accountability by restricting unauthorized access and recording important system transactions. Their implementation addresses security concerns associated with centralized academic information management. These safeguards are consistent with the information security management principles described in ISO/IEC 27001:2022 (International Organization for Standardization & International Electrotechnical Commission, 2022), although the study did not assess formal certification or compliance with that standard.

3.3 System Testing and Evaluation

3.3.1 Functional Testing Results

The system successfully passed all 21 functional test cases covering authentication, user permissions, enrollment, grade computation, Tahfiz monitoring, certificate verification, scheduling, attendance, learning materials, reports, database backup, session timeout, and password management. The successful functional tests demonstrate that the implemented modules performed their expected operations under the tested conditions. These results support the system's compliance with its documented functional requirements.

3.3.2 System Performance and Efficiency

Performance testing measured the loading times of major system pages through three trials per page. All tested pages loaded within the established performance target for the school network. These results indicate that the system satisfied its specified loading-time requirement under the testing conditions. However, performance during prolonged institutional use and with larger datasets remains to be established.

3.3.3 User Acceptance and System Quality Evaluation

The system was evaluated using an ISO/IEC 25010-based instrument covering functionality, usability, reliability, efficiency, and security. The evaluation framework used a five-point rating scale, with an intended overall acceptance threshold of 3.41. The available results do not provide numerical mean ratings or interpretations for the individual quality characteristics. Consequently, user acceptance cannot be quantitatively established from the reported evaluation data alone.

3.4 Achievement of System Objectives and Institutional Implications

The project reported achievement of its eight specific objectives, including requirements analysis, system architecture design, module development, automated grading, Tahfiz monitoring, certificate verification, system testing, and user evaluation. The developed modules addressed seven identified administrative gaps involving enrollment, scheduling, attendance, grading, memorization records, certificate authentication, and transaction

accountability. Overall, DCSTPMS demonstrates the feasibility of integrating conventional academic management and Islamic educational requirements within a single web-based platform. Its automated processes and access controls provide a foundation for more organized institutional operations. Nevertheless, the system had not yet undergone a complete academic term of operational use, limiting conclusions regarding its long-term effectiveness, sustained user acceptance, and administrative impact. Further evaluation during School Year 2026–2027 is therefore necessary.

4. Conclusion & Recommendations

The study successfully developed the Digital Class Schedule and Tullab Performance Management System (DCSTPMS) to address the manual academic and administrative processes of Mahad Nurul-Yaqeen Al-Islamiy. The system integrated enrollment management, class scheduling, attendance monitoring, automated weighted grading, Tahfiz progress tracking, and QR code-based certificate verification into a centralized web-based platform. Its role-based access controls, structured database, and audit logging supported secure and organized information management. The automated grading module produced consistent academic results, while the Tahfiz module accommodated the school's specialized Islamic curriculum. The system passed all 21 functional test cases, and its security and performance evaluations satisfied the established testing requirements. Intended users also participated in system evaluation using an ISO/IEC 25010-based questionnaire. Collectively, these findings demonstrate that DCSTPMS achieved its principal development objectives and provides a functional digital solution responsive to the school's administrative and educational requirements.

Mahad Nurul-Yaqeen Al-Islamiy should implement DCSTPMS beginning School Year 2026–2027 to strengthen academic record management and administrative efficiency. School administrators should update academic configurations, migrate student records, and ensure consistent use of the system across enrollment, scheduling, attendance, grading, and Tahfiz monitoring. Training should be provided to the registrar, academic coordinator, and teachers to promote accurate data entry and effective system utilization. Regular database backups and designated personnel responsible for information security should be established in accordance with the Data Privacy Act of 2012 (Republic Act No. 10173, 2012). Future system improvements may include automated SMS and email notifications, offline QR code generation, tuition and billing management, mobile accessibility, and support for additional grade levels or school branches. Further studies should evaluate the system after one complete academic year, particularly its effects on administrative processing time, record accuracy, and operational efficiency. During implementation, administrators should periodically review cybersecurity risks and incident-response arrangements using the risk-management guidance of the NIST Cybersecurity Framework 2.0 (Pascoe et al., 2024); this is a future implementation recommendation rather than a claim that the system was evaluated against that framework.

The study was limited to Mahad Nurul-Yaqeen Al-Islamiy and covered only Grade 0 to Grade 6, restricting its direct applicability to other educational institutions. The system excluded tuition and billing functions, standalone mobile applications, and operational SMS and email notifications. QR code generation depended on an external online service, requiring internet connectivity. Furthermore, evaluation focused on system functionality, security, performance, and user acceptance rather than long-term institutional outcomes. Although the system satisfied its reported functional testing requirements, its effectiveness throughout a complete academic year remains unexamined. Future studies may assess sustained system performance and applicability in other madaris.

5. Compliance with ethical standards

The authors affirm that no conflicts of interest exist in relation to this study. The research involved school administrators, the registrar, the academic coordinator, and teachers of Mahad Nurul-Yaqeen Al-Islamiy in Asturias, Jolo, Sulu, Philippines, through interviews, surveys, observations, and document reviews. Institutional permission for data gathering was documented, and the research request specified that collected information would be treated confidentially and used exclusively for the study. The manuscript does not explicitly document informed consent, voluntary participation, withdrawal rights, or formal ethics committee approval.

REFERENCES

Abd Rahman, K., & Ahmed, S. A. (2026). A systematic literature review on QR code–based systems for academic credential verification. e-Jurnal Penyelidikan dan Inovasi, 13(1), 300–315. https://doi.org/10.53840/e-jpi.v13i1.398

Abd Wahab, N. N., & Abdullah, Z. (2025). SIS: Student information system for SMKTMI with RBAC. Applied Information Technology and Computer Science. https://publisher.uthm.edu.my/periodicals/index.php/aitcs/article/view/20597

Department of Education. (2013). Guidelines on the Madrasah Education Program and utilization of the support fund (DepEd Order No. 46, s. 2013). https://www.deped.gov.ph/2013/10/14/do-46-s-2013-guidelines-on-the-madrasah-education-program-and-utilization-of-the-support-fund/

Department of Education. (2015). Policy guidelines on classroom assessment for the K to 12 Basic Education Program (DepEd Order No. 8, s. 2015). https://www.deped.gov.ph/

International Organization for Standardization. (2023). Systems and software engineering—Systems and software quality requirements and evaluation (SQuaRE)—Product quality model (ISO/IEC Standard No. 25010:2023).

International Organization for Standardization & International Electrotechnical Commission. (2022). Information security, cybersecurity and privacy protection—Information security management systems—Requirements (ISO/IEC Standard No. 27001:2022). https://www.iso.org/standard/27001

Mustafa, N. M., Mohd Zaki, Z., Mohamad, K. A., Basri, M., & Ariffin, S. (2021). Development and alpha testing of EzHifz application: Al-Quran memorization tool. Advances in Human-Computer Interaction, 2021, Article 5567001. https://doi.org/10.1155/2021/5567001

National Institute of Standards and Technology. (2022). Secure software development framework (SSDF) version 1.1: Recommendations for mitigating the risk of software vulnerabilities (NIST SP 800-218). https://doi.org/10.6028/NIST.SP.800-218

OECD. (2023). OECD digital education outlook 2023: Towards an effective digital education ecosystem. OECD Publishing. https://doi.org/10.1787/c74f03de-en

OWASP Foundation. (2021). OWASP Top 10: 2021. https://owasp.org/Top10/

Pascoe, C., Quinn, S., & Scarfone, K. (2024). The NIST cybersecurity framework (CSF) 2.0 (NIST CSWP 29). National Institute of Standards and Technology. https://doi.org/10.6028/NIST.CSWP.29

Republic Act No. 10173. (2012). Data Privacy Act of 2012. Official Gazette of the Republic of the Philippines. https://www.officialgazette.gov.ph/2012/08/15/republic-act-no-10173/

Sali, A. H. A. (2021). Posner's curriculum analysis framework towards the development of Philippine madrasah education. JATI: Journal of Southeast Asian Studies, 26(1), 163–185. https://doi.org/10.22452/jati.vol26no1.8

Sandhu, R. S., Coyne, E. J., Feinstein, H. L., & Youman, C. E. (1996). Role-based access control models. Computer, 29(2), 38–47. https://doi.org/10.1109/2.485845

UNESCO. (2024). AI competency framework for teachers. https://unesdoc.unesco.org/ark:/48223/pf0000391104

UNESCO. (2023). Guidance for generative AI in education and research. https://unesdoc.unesco.org/ark:/48223/pf0000386693

UNESCO. (2024). Global education monitoring report 2024/5: Leadership in education—Lead for learning. https://www.unesco.org/gem-report/en/2024-leadership

UNESCO. (2023). Global education monitoring report 2023: Technology in education—A tool on whose terms? https://www.unesco.org/gem-report/en/publication/technology

UNICEF. (2021). Reimagine education: The digital learning transformation. https://www.unicef.org/reimagine-education

World Wide Web Consortium. (2023). Web content accessibility guidelines (WCAG) 2.2. https://www.w3.org/TR/WCAG22/