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Real-Time Monitoring-Based Computer-Based Testing to Support Digital Assessment Supervision: A Systematic Literature Review

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Abstract:
Digital assessment has made computer-based testing (CBT) more efficient, yet supervisors still need timely, interpretable evidence of examinee activity without intrusive surveillance. This systematic literature review synthesizes research on CBT, digital proctoring, real-time monitoring, learning analytics, and assessment dashboards to identify the requirements for school-oriented assessment supervision. The original screening record categorized 30 candidate records as 20 core, seven supporting, and three not used. The revised article cites 27 identifiable publications, comprising 20 previously listed sources and seven additional verified studies; these bibliographic counts are distinct from the historical screening categories. Evidence indicates that CBT platforms prioritize test delivery, proctoring solutions emphasize examination integrity, and analytics dashboards translate activity data into actionable views, but their integration for school supervisors remains underdeveloped. The review proposes a human-centred architecture connecting bounded event logging, near-real-time status processing, a supervisor-facing dashboard, and contextual verification of flagged activity. Its contribution is an evidence-based integration framework, not a claim that an implemented system has been experimentally validated. The framework prioritizes functional interoperability, resilience to connectivity changes, usable alerts, role-based access, data minimization, and human oversight.

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Introduction (مقدمة)

Digital technologies have changed not only how learning materials are delivered but also how educational assessment is administered, stored, scored, and interpreted. Computer Based Test (CBT) represents one of the most visible forms of this change because it moves the presentation of questions, response capture, timing, and result processing into a digital environment. In school settings, this shift can improve administrative efficiency and provide more structured assessment records. Web-based assessment studies also show that digital

platforms can support diagnostic and cognitive assessment functions rather than merely reproducing paper tests on a screen (Maison et al., 2022; Cahyaningsih et al., 2024).

The same digital environment, however, creates a practical supervision problem. In face-to-face examinations, invigilators can interpret behaviour in a shared physical setting. In computer-mediated assessment, the useful evidence is fragmented across session authentication, submission records, participant connection status, timing, and selected interface events. A conventional CBT platform may reliably administer questions and calculate scores while giving invigilators little consolidated information about what happens during an active session. Conversely, a remote-proctoring tool may collect high-volume screen or webcam data without presenting a concise school-level overview. Han et al. (2023) identified student authentication, cheating detection, implementation, and user uptake as major strands of digital proctoring research; real-time WebRTC proctoring also demonstrates the technical feasibility of live supervision but creates bandwidth and implementation demands (Engel & Agustinus, 2023).

Yet digital proctoring should not be treated as a purely technical solution. Prior studies raise concerns about privacy, fairness, data sensitivity, institutional responsibility, and the educational meaning of surveillance. Lee and Fanguy (2022) show that the adoption of proctoring technologies can reshape pedagogical relationships and perceptions of fairness, while Coghlan et al. (2021) emphasize the ethical risks of intensive online exam supervision. More recent work likewise reports stakeholder concerns about personal information, transparency, and responsibility for privacy practices (Mutimukwe et al., 2026). These findings indicate that a monitoring system should provide evidence for human judgment rather than automatically equate digital events with misconduct.

In parallel, learning analytics and dashboard research provides approaches for turning system traces into interpretable information. Paulsen and Lindsay (2024) document a shift towards more pedagogically informed dashboards, while Kaliisa et al. (2023) find that many teacher-facing systems increase awareness without providing sufficiently actionable interventions. Studies of teachers using platform data in schools remain exploratory (Hase & Kuhl, 2024). A dashboard designed for everyday teaching is therefore not automatically suited to time-sensitive invigilation: it must distinguish an examinee who has not started, one who is temporarily disconnected, one who has submitted, and one whose session merits human checking. The missing design connection is between exam-specific events and an operationally useful, privacy-conscious supervisory view rather than another display of raw data (Ajayi et al., 2025; Alfredo et al., 2024).

Taken together, the literature reveals three complementary yet insufficiently integrated streams: CBT and web-based assessment, digital or online proctoring, and learning analytics/dashboard design. Their boundaries matter in schools, where varying devices, unstable connections, limited technical support, and student privacy requirements can make intensive surveillance difficult to justify. The problem addressed here is therefore precise: how a single school-oriented assessment workflow could deliver test items, summarize bounded session events in near real time, and help supervisors review exceptions without equating anomalous events with misconduct. Unlike reviews focused on the accuracy of automated cheating detection or the affordances of general learning dashboards, this synthesis makes the interface among event capture, dashboard interpretation, and human verification its central contribution (Balash et al., 2023; Mutimukwe et al., 2026).

The review is organized around five explicit research questions. RQ1 examines the dominant trajectories in CBT and computer-based assessment research; RQ2 identifies technologies used for digital assessment supervision; RQ3 considers how live event capture and real-time monitoring have been operationalized; RQ4 compares reported benefits, usability

issues, privacy concerns, and implementation constraints; and RQ5 specifies the remaining integration requirements for a school-based CBT website with a supervisor dashboard. Together, these questions connect the technical evidence to a bounded, human-centred design proposition rather than to claims about an already deployed product.

Method (منهج)

This study employed a structured literature review with descriptive and thematic synthesis to examine computer-based testing, digital assessment, proctoring, event monitoring, learning analytics, and supervisor-facing dashboards. The focal publication window was 2022-2026. Two works from 2021 (Coghlan et al., 2021; Nigam et al., 2021) were retained solely as conceptual context for proctoring ethics and AI-based supervision; they were not counted as evidence of publication trends within the focal window. The analysis addresses differences in study design and educational setting, rather than assuming that findings from universities can be transferred directly to school examinations.

The recorded search vocabulary joined assessment terms with supervision terms: ("Computer Based Test" OR "Computer-Based Assessment" OR "Digital Assessment" OR "Online Assessment") AND ("Real-Time Monitoring" OR "Online Proctoring" OR "Digital Proctoring" OR "Assessment Supervision"). The additional concepts "learning analytics", "assessment dashboard", and "event log" were considered during thematic screening. For reproducibility, the same Boolean groups can be applied to title, abstract, and keyword fields of educational or interdisciplinary databases, with a separate record of platform, search date, query syntax, hits, duplicates, and eligibility decisions. Crucially, the surviving initial screening record does not identify the database platforms or original execution dates. Those details are not retroactively attributed to the original search.

The documented screening summary identifies 30 candidate records. Titles and abstracts were assessed for relevance to assessment delivery or supervision; eligible records were considered for research method, educational setting, technical mechanism, and relevance to at least one research question. The historical classification lists 20 records in the primary analytical group, seven in a supporting group, and three not used in the principal synthesis. This is an aggregate source-selection account, not a fully reconstructable PRISMA record: the individual exclusion reasons, platform-level hit counts, duplicate-removal records, and reviewer-by-reviewer selection decisions were not retained. Figure 1 reproduces the documented historical totals while distinguishing them from the bibliography audit completed for the revised manuscript.

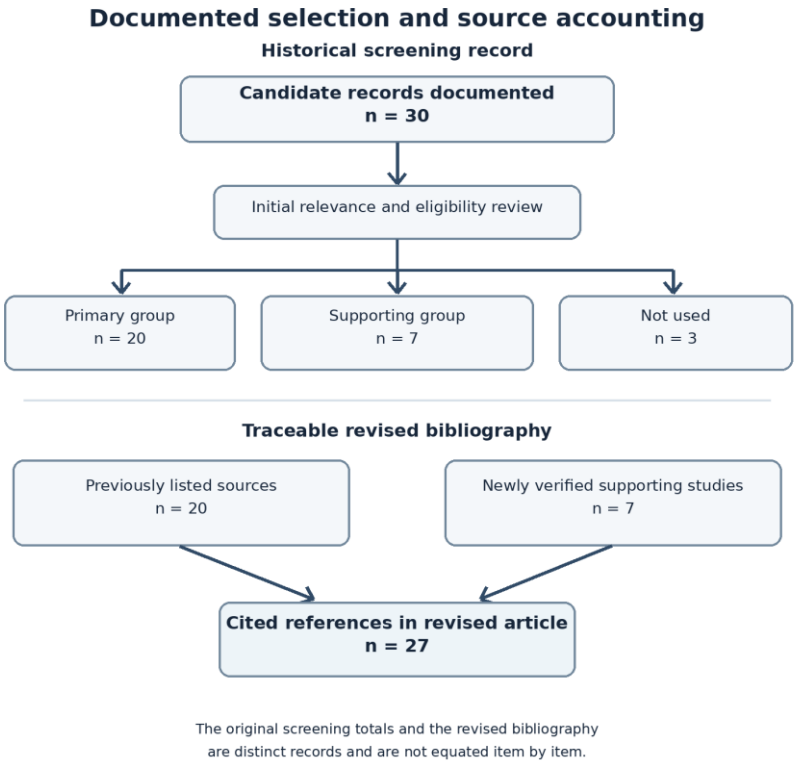
The original manuscript bibliography contained 20 identifiable works, including the two 2021 contextual papers. Seven additional publications with verifiable publication records were incorporated to strengthen comparisons of school-level data use, WebRTC-based proctoring, screen-event monitoring, online proctoring experiences, and human-centred dashboard design (Alfredo et al., 2024; Davis & Rahim, 2025; Engel & Agustinus, 2023; Hase & Kuhl, 2024; Kaliisa et al., 2023; Marano et al., 2024; Pan et al., 2024). The revised bibliography therefore contains 27 cited works: 25 published in 2022-2026 and two contextual papers from 2021. These seven verifiable additions are reported separately and are not presented as a reconstruction of the identities of the seven historical supporting records.

Table 1. Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Publication year	2022-2026 as focal period; 2021 only for contextual benchmark	Outside the focal period without contextual justification

Criterion	Inclusion	Exclusion
Topic	CBT, computer-based/digital/online assessment, monitoring, proctoring, learning analytics	Unrelated to digital assessment
Technology focus	CBT, monitoring, proctoring, dashboard, learning analytics	Technology unrelated to assessment
Source type	Scholarly journal article or relevant research publication	Popular article, news item, or non-scholarly source
Language	English or Indonesian	Other language without analyzable information
Relevance	Supports at least one research question	No relevant information for the review questions
Full text / verification	Research information can be checked	Research information cannot be verified

Figure 1. Documented Screening and Revised Reference Accounting



Eligibility required scholarly research relevant to one or more review questions; inspectable descriptions of assessment or monitoring approaches; and sufficient methodological or conceptual detail for thematic extraction. English-language and Indonesian-language studies were eligible. Screening considered topic and publication date first, followed by technology focus and analytical contribution. Sources outside the focal period were restricted to the two clearly identified contextual benchmarks. The historical 20/7/3 split in Figure 1 and the current 27-reference bibliography serve different accounting purposes and should not be treated as interchangeable selection denominators.

Data extraction addressed author and year, educational level, research design, principal technology, source and granularity of digital events, monitoring or dashboard mechanism, user role, reported benefit, reported limitation, and relevance to the five research questions. A first coding pass grouped claims under seven non-exclusive analytical themes: CBT/computer-based

assessment, online assessment, proctoring, real-time monitoring, learning analytics, dashboards, and privacy/security. A second interpretive pass compared each technological stream against five cross-cutting design questions: what events are captured, how promptly information can be accessed, how understandable its presentation is, what actions a supervisor can take, and what privacy safeguards are reported. Because individual studies can inform more than one theme, the mappings in Table 3 are analytical associations rather than mutually exclusive frequency counts.

The interpretation was checked for consistency between cited claims, the thematic categories, and the evidence-to-question mapping in Table 3. The screening and initial coding were undertaken by a single reviewer, and there is no independently documented second-screening round or inter-rater agreement statistic. Accordingly, the present synthesis does not claim dual-reviewer reliability or exhaustive database coverage. The added supporting studies improve contextual triangulation, but they do not eliminate the limitation created by the unavailable original database-specific search and screening logs.

Result (نتائج)

Study profile and methodological pattern

The identifiable evidence covers systematic and scoping reviews, user and educator perspectives, institutional implementation accounts, prototype development, and empirical evaluations. School-based CBT investigations mainly address feasible test delivery and local readiness, whereas university proctoring studies emphasize examination integrity and scalable monitoring arrangements (Cahyaningsih et al., 2024; Imanda et al., 2024; Patael et al., 2022). Dashboard reviews and case studies instead address how educators interpret data and whether visualizations support meaningful decisions (Kaliisa et al., 2023; Paulsen & Lindsay, 2024; Alfredo et al., 2024). The sources therefore offer complementary evidence about infrastructure, oversight, and interpretation; they do not constitute a homogeneous intervention set suitable for pooled effect-size analysis.

Thematic synthesis

Seven connected themes emerged from the evidence. First, CBT and web-based assessment provide question delivery, response capture, timing, scoring, and auditable session records (Maison et al., 2022; Asrial et al., 2023; Cahyaningsih et al., 2024; Sadhana & Freire, 2025). Second, online assessment broadens this functionality to feedback and diagnostic purposes (Heil & Ifenthaler, 2023). Third, digital proctoring focuses on identity, integrity and the review of irregular events, although webcam- and screen-centred approaches also raise implementation and privacy concerns (Han et al., 2023; Chand & Hussein, 2022; Marano et al., 2024). Fourth, real-time monitoring emphasizes near-immediate awareness of connection, tab changes and examination status rather than a single mandatory technical solution (Engel & Agustinus, 2023; Davis & Rahim, 2025). Fifth, learning analytics explains how digital traces may support interpretation, not merely storage (Palanci et al., 2024; Pan et al., 2024). Sixth, dashboards translate that interpretation into views accessible to educators, with human-centred iteration and actionable decisions shaping usefulness (Kaliisa et al., 2023; Alfredo et al., 2024; Cabral et al., 2025). Seventh, privacy and security constrain the amount, sensitivity, access and retention of assessment data (Balash et al., 2023; Mutimukwe et al., 2026). Table 2 summarizes these streams and the trade-offs that motivate integration.

Table 2. Thematic Synthesis of the Reviewed Literature

Theme	Primary focus	Main contribution	Recurring limitation
CBT / computer-based assessment	Digital delivery of items, responses, timing, scoring	Efficient assessment infrastructure; structured data	Monitoring process often secondary
Online assessment	Broader digital evaluation ecosystem	Feedback, flexibility, analytics potential	Mostly higher-education evidence
Digital proctoring	Authentication and integrity-oriented supervision	Extends supervision to remote/digital settings	Privacy, fairness, technical and ethical concerns
Real-time monitoring	Status and activity-event visibility during assessment	Timely awareness for supervisors	Indicators can be ambiguous without context
Learning analytics	Processing digital activity traces	Turns raw data into interpretable information	Not usually designed specifically for exams
Dashboard	Condensed presentation of complex activity data	Supports oversight of many users	Needs task-oriented design for invigilators
Privacy and security	Protection and governance of participant data	Builds trust and responsible use	Intrusive collection can outweigh utility

Evidence mapped to the research questions

Table 3 links selected studies to review questions and to their specific thematic contribution. The map distinguishes school CBT evidence, real-time proctoring demonstrations, supervisor or educator experience, and analytics/dashboard research. This structure makes the inferential bridge explicit: evidence that a monitoring event can be captured is not, by itself, evidence that it can be interpreted fairly, displayed effectively, or used to justify a sanction.

Table 3. Representative Evidence Mapped to the Research Questions

Study	Technology / theme	Review question(s)	Evidence and design implication
Chai et al. (2024)	Computer-based assessment	RQ1, RQ4, RQ5	Assessment capabilities require validity and reliability evidence.
Heil & Ifenthaler (2023)	Online assessment; analytics	RQ1, RQ2, RQ4	Assessment extends beyond test delivery to feedback and engagement.
Han et al. (2023)	Digital proctoring	RQ2, RQ3, RQ4	Authentication and detection must be evaluated against implementation challenges.
Mutimukwe et al. (2026)	Privacy; proctoring	RQ2, RQ4, RQ5	Transparency, role responsibility and data governance affect adoption.
Cahyaningsih et al. (2024)	School-based CBT	RQ1, RQ4	School assessment can benefit from CBT without intensive proctoring.
Imanda et al. (2024)	CBT; school readiness	RQ1, RQ4, RQ5	Local infrastructure and user readiness condition feasibility.
Patael et al. (2022)	Institutional remote proctoring	RQ2, RQ3, RQ4	Large-scale oversight requires procedures, reliability and human support.
Palanci et al. (2024)	Learning analytics	RQ2, RQ4, RQ5	Digital activity data become useful through context-sensitive interpretation.
Paulsen & Lindsay (2024)	Analytics dashboards	RQ2, RQ4, RQ5	Interface design should prioritize user decisions rather than raw metrics.

Study	Technology / theme	Review question(s)	Evidence and design implication
Balash et al. (2023)	Proctoring; privacy	RQ2, RQ4, RQ5	Educator concerns caution against excessive data collection.
Engel & Agustinus (2023)	Live/WebRTC proctoring	RQ2, RQ3, RQ5	Real-time supervision is technically possible but must fit network constraints.
Hase & Kuhl (2024)	School data use	RQ1, RQ4, RQ5	Teacher-facing insights need to be translated into feasible school actions.
Kaliisa et al. (2023)	Dashboard actionability	RQ2, RQ4, RQ5	Awareness alone is insufficient; design and privacy require explicit criteria.
Alfredo et al. (2024)	Human-centred dashboard	RQ4, RQ5	In-use iteration can simplify complex displays for actual educator tasks.

Monitoring outputs require contextual interpretation. A brief disconnection, a page change, an unusually short response interval, or a tab-switch event can arise from technical conditions, legitimate navigation, accessibility needs, or human error; none is conclusive evidence of misconduct. Small-scale screen-monitoring pilots show that such events can be captured, but do not establish the accuracy of behavioural inferences or scalability across school environments (Davis & Rahim, 2025). Reviews of remote proctoring likewise document privacy, trust and student-experience concerns (Marano et al., 2024; Coghlan et al., 2021). The evidence consequently supports event-based decision assistance, with an accessible audit trail and explicit supervisor confirmation, rather than automatic guilt classification.

Discussion (مناقشة)

The comparative evidence shows a functional division between three families of tools. CBT systems are strongest at test administration and response management, but these records alone provide limited situational awareness while an examination is underway. Live and automated proctoring can expand visibility through webcam, screen or activity monitoring; for example, WebRTC-based supervision offers an interactive stream but may increase operational complexity and network demands (Engel & Agustinus, 2023). Learning analytics dashboards aggregate and visualize digital traces, yet their usual objectives concern longer-term teaching decisions rather than second-by-second invigilation (Paulsen & Lindsay, 2024; Kaliisa et al., 2023). The gap is therefore not a missing technology in isolation. It is a bounded school-oriented integration of reliable exam delivery, timely event-state aggregation, an actionable supervisor view, and fair human verification.

The school context sharpens this requirement. Compared with tertiary remote-proctoring deployments, schools can differ in device access, network consistency, user training, assessment stakes, and capacity to administer biometric or continuous-media data. Studies in Indonesian schools show the feasibility of CBT alongside practical challenges in equipment readiness and implementation (Prissly & Hidayat, 2023; Imanda et al., 2024). Evidence from digital-learning platforms further suggests that transferring analytics into everyday decisions remains an exploratory practice even for teachers (Hase & Kuhl, 2024). A proportionate school solution should therefore prioritize examinable operational facts, such as session start and submission, connection interruptions, elapsed time, and a restricted set of application-state changes, rather than continuous recording of students.

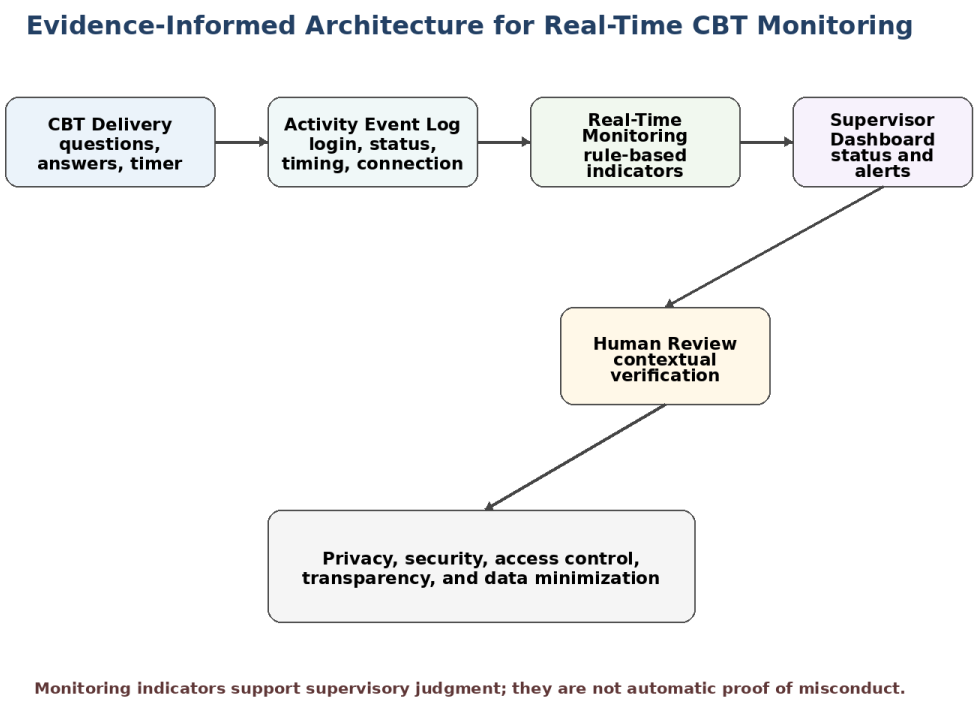
The dashboard should support a supervisor workflow rather than maximize the volume of surveillance. A summary panel can display active, disconnected, not-started and submitted participants; filters can highlight sessions requiring a connection check; and an expandable event

timeline can distinguish recurring technical interruptions from isolated events. Each alert should display its event type, timestamp, relevant session context and a clear path to human follow-up. The design should avoid presenting a numerical suspicion score as a disciplinary verdict. This recommendation follows dashboard research emphasizing actionable data and iterative user-centred design (Ajayi et al., 2025; Alfredo et al., 2024; Kaliisa et al., 2023). The proposed interface features are design implications from the synthesis, not features already evaluated in the present study.

Privacy and security are architectural requirements rather than additions to a completed interface. Proctoring literature identifies risks from camera recordings, biometric identifiers, unanticipated secondary uses and opaque monitoring rules (Balash et al., 2023; Mutimukwe et al., 2026; Marano et al., 2024). The proposed school workflow limits event capture to a published, purpose-specific list; applies role-based access, secure transmission and protected storage; separates participant identifiers from analytical displays where feasible; and specifies institutional retention, review and deletion rules. Participants and supervisors should be informed what is logged and why. An event warning must remain reviewable and contestable, because privacy protection and interpretive fairness cannot be delegated solely to automated thresholds.

Figure 2 represents five conceptual layers. The delivery layer manages authenticated exam sessions, items, responses and submission. A bounded event layer stores events such as session-start, heartbeat or connection loss, submission, and selected application-state changes, with a session identifier, event type and timestamp. A monitoring layer validates incoming events, suppresses duplicate notifications, associates them with the correct session, and derives supervisor-facing statuses. The dashboard layer displays a consolidated view and supports inspection of an individual event timeline. The human-review layer allows an invigilator to verify context and record a proportionate follow-up. Data protection, access control and auditability apply across every layer; the model does not require persistent camera recording or biometric identification.

Figure 2. Evidence-Informed Architecture for Real-Time CBT Monitoring



The process should tolerate ordinary technical faults. In a future implementation, authenticated event transmission could use a lightweight push channel or periodic requests; periodic connection checks could flag a possibly offline participant without assuming that the student left the examination. Reconnection should reconcile event order and avoid repeating alerts. The supervisor can then inspect the event sequence, confirm the student or device state when appropriate, and distinguish a technical incident from a concern requiring further review. Such verification is important because online supervision tools can produce ambiguous signals and affect learner trust (Lee & Fanguy, 2022; Marano et al., 2024). Monitoring is thus an early-warning and documentation aid, not an automated sanction engine.

Two contrasting implementations help establish the contribution. Engel and Agustinus (2023) demonstrate the feasibility of real-time interactive proctoring using WebRTC, while Davis and Rahim (2025) document screen-activity alerts in a small pilot but report only four participants. These studies support the feasibility of timely signal collection; they do not establish that continuous screen capture is necessary for school examinations or that an alert is proof of cheating. Likewise, dashboard studies show that visualizations become useful through context, clarity, and adaptation to educators' work (Kaliisa et al., 2023; Alfredo et al., 2024). The proposed model combines these lessons selectively: it monitors operationally relevant events, turns them into interpretable status information, and reserves adjudication for a human supervisor.

Four design principles translate the synthesis into a development agenda. Functional integration requires a shared session record connecting the examination engine, event logging and dashboard views; user-centred operation requires clear alert labels, accessible layouts and interaction testing with actual invigilators; responsible governance requires minimal collection, controlled disclosure, secure logs and defined retention; and interpretive restraint requires human confirmation before any consequential action. Future evaluation should report end-to-end event latency, delivery under unstable connectivity, false or duplicate alert rates, dashboard task-completion time, supervisor agreement on event interpretation, and participant perceptions of fairness. These measures would test whether the integration improves supervision without normalizing intrusive monitoring.

Table 4. Design Implications for a Real-Time Monitoring CBT Website

Component	Recommended feature	Purpose
CBT delivery	Authenticated session, items, autosave, timing, submission	Maintain a consistent assessment record
Event logging	Bounded events with session ID, type, timestamp and validation	Support auditable operational context
Real-time status	Heartbeat or status update, deduplication and reconnect handling	Prevent duplicated or misleading alerts
Supervisor dashboard	Participant overview, sortable states, alert timeline	Enable timely and interpretable follow-up
Human verification	Event inspection, context check, documented response	Avoid automatic punitive interpretation
Privacy and security	Minimum necessary data, roles, protected storage, retention	Support proportionate and accountable supervision

Limitations include missing original database names, search dates, platform-level retrieval counts, duplicate-removal records, and item-level exclusion decisions; Figure 1 therefore does not represent a complete PRISMA reconstruction. The original screening involved one reviewer without a documented inter-rater reliability statistic. Evidence spans school and university contexts with disparate designs, limiting direct transferability. Seven verified supporting publications strengthen the comparisons without restoring the historical search log. The

proposed architecture remains conceptual: event latency, false alerts, dashboard usability, security, privacy, and fairness require validation during real school examinations.

Conclusion (خاتمة)

This review identifies a school-oriented integration gap between CBT delivery, digital proctoring, and analytics dashboards. The evidence supports a proportionate architecture that logs selected examination events, updates participant status promptly, presents actionable timelines to invigilators, and requires contextual human review before consequential decisions. Such integration prioritizes operational clarity rather than intensive surveillance. Privacy safeguards, role-based access, transparent data governance, and resilience to connectivity interruptions are essential design conditions. The proposed model is evidence-informed and has not yet been empirically validated. Future research should test event-delivery reliability, warning accuracy, dashboard usability, accessibility, and perceived fairness in actual school examinations. These evaluations can establish whether integrated monitoring improves supervision while respecting students' trust and rights.

Bibliography (مراجع)

Ajayi, A. B., Emenike, M. I., Enobakhare, B. O., Chukwuka, O. A., Rwandashi, E., & Awah, L. C. (2025). From data to decisions: A scoping review of actionable learning analytics for teaching and assessment. Asian Journal of Education and Social Studies, 51(11), 673-685. https://doi.org/10.9734/ajess/2025/v51i112643

Alfredo, R., Echeverria, V., Zhao, L., Lawrence, L., Fan, J. X., Yan, L., Li, X., Swiecki, Z., Gašević, D., & Martinez-Maldonado, R. (2024). Designing a human-centred learning analytics dashboard in-use. Journal of Learning Analytics, 11(3), 62-81. https://doi.org/10.18608/jla.2024.8487

Asrial, A., Syahrial, S., Sabil, H., Kurniawan, D. A., Perdana, R., Nawahdani, A. M., Widodi, B., Rahmi, R., & Nyirahabimana, P. (2023). Quantitative analysis of elementary school students' curiosity and web-based assessment responses. Indonesian Journal on Learning and Advanced Education, 5(2), 107-119. https://doi.org/10.23917/ijolae.v5i2.21646

Balash, D. G., Korkes, E., Grant, M., Aviv, A. J., Fainchtein, R. A., & Sherr, M. (2023). Educators' perspectives of using (or not using) online exam proctoring. In 32nd USENIX Security Symposium (USENIX Security 23) (pp. 5091-5108). USENIX Association.

Cabral, L., Pinto, R., & Gonçalves, G. (2025). AI-powered learning analytics dashboards: A systematic review of applications, techniques, and research gaps. Discover Education, 4, 525. https://doi.org/10.1007/s44217-025-00964-y

Cahyaningsih, E., Shaleh, S., & Fitriyanti, A. (2024). Utilization of computer-based testing technology to optimize cognitive-based assessment literacy in the learning of Islamic elementary school students. Journal of Integrated Elementary Education, 4(2), 151-172. https://doi.org/10.21580/jieed.v4i2.21943

Chai, H., Hu, T., & Wu, L. (2024). Computer-based assessment of collaborative problem solving skills: A systematic review of empirical research. Educational Research Review, 43, 100591. https://doi.org/10.1016/j.edurev.2023.100591

Chand, R. K., & Hussein, M. J. (2022). E-proctoring exams at a regional university during COVID-19: Understanding the challenges. Conference proceedings, University of the South Pacific.

Coghlan, S., Miller, T., & Paterson, J. (2021). Good proctor or "Big Brother"? Ethics of online exam supervision technologies. Philosophy & Technology, 34(4), 1581-1606. https://doi.org/10.1007/s13347-021-00476-1

Davis, R., & Rahim, R. (2025). Design and implementation of a web-based online exam system with screen monitoring for academic integrity. Ceddi Journal of Education, 4(2). https://doi.org/10.56134/cje.v4i2.105

Engel, M. M., & Agustinus, J. T. (2023). Real time online exam proctoring system in higher education using WebRTC technology. Jurnal Teknik Informatika (JUTIF), 4(6), 1575-1587. https://doi.org/10.52436/1.jutif.2023.4.6.1564

Han, S., Nikou, S., & Yilma Ayele, W. (2023). Digital proctoring in higher education: A systematic literature review. International Journal of Educational Management, 38(1), 265-285. https://doi.org/10.1108/IJEM-12-2022-0522

Hase, A., & Kuhl, P. (2024). Teachers' use of data from digital learning platforms for instructional design: A systematic review. Educational Technology Research and Development, 72, 1925-1945. https://doi.org/10.1007/s11423-024-10356-y

Heil, J., & Ifenthaler, D. (2023). Online assessment in higher education: A systematic review. Online Learning, 27(1). https://doi.org/10.24059/olj.v27i1.3398

Imanda, A. P., Apriliyani, D., & Anjani, D. A. S. P. (2024). Challenges and solutions for the implementation of computer-based test learning evaluation at SMKN 2 Bandung. Curricula: Journal of Curriculum Development, 3(1), 17-28. https://doi.org/10.17509/curricula.v3i1.63533

Kaliisa, R., Jivet, I., & Prinsloo, P. (2023). A checklist to guide the planning, designing, implementation, and evaluation of learning analytics dashboards. International Journal of Educational Technology in Higher Education, 20, Article 28. https://doi.org/10.1186/s41239-023-00394-6

Lee, K., & Fanguy, M. (2022). Online exam proctoring technologies: Educational innovation or deterioration? British Journal of Educational Technology, 53(3), 475-490. https://doi.org/10.1111/bjet.13182

Maison, Hidayat, M., Kurniawan, D. A., Sandra, R. O., Yolviansyah, F., & Iqbal, M. (2022). Misconception tool: Web-based assessment of buoyancy materials. Journal of Education Technology, 6(2), 237-246. https://doi.org/10.23887/jet.v6i2.43749

Marano, E., Newton, P. M., Birch, Z., Croombs, M., Gilbert, C., & Draper, M. J. (2024). What is the student experience of remote proctoring? A pragmatic scoping review. Higher Education Quarterly, 78(3), 1031-1047. https://doi.org/10.1111/hequ.12506

Mutimukwe, C., Viberg, O., McGrath, C., & Cerratto-Pargman, T. (2026). Privacy in online proctoring systems in higher education: Stakeholders' perceptions, awareness and responsibility. Journal of Computing in Higher Education, 38, 732-761. https://doi.org/10.1007/s12528-025-09461-5

Nigam, A., Pasricha, R., Singh, T., & Churi, P. (2021). A systematic review on AI-based proctoring systems: Past, present and future. Education and Information Technologies, 26(5), 6421-6445. https://doi.org/10.1007/s10639-021-10597-x

Palanci, A., Yılmaz, R. M., & Turan, Z. (2024). Learning analytics in distance education: A systematic review study. Education and Information Technologies, 29, 22629-22650. https://doi.org/10.1007/s10639-024-12737-5

Pan, Z., Biegley, L., Taylor, A., & Zheng, H. (2024). A systematic review of learning analytics: Incorporated instructional interventions on learning management systems. Journal of Learning Analytics, 11(2), 52-72. https://doi.org/10.18608/jla.2023.8093

Patael, S., Shamir, J., Soffer, T., Livne, E., Fogel-Grinvald, H., & Kishon-Rabin, L. (2022). Remote proctoring: Lessons learned from the COVID-19 pandemic effect on the large scale on-line assessment at Tel Aviv University. Journal of Computer Assisted Learning, 38(6), 1554-1573. https://doi.org/10.1111/jcal.12746

Paulsen, L., & Lindsay, E. (2024). Learning analytics dashboards are increasingly becoming about learning and not just analytics - A systematic review. Education and Information Technologies, 29, 14279-14308. https://doi.org/10.1007/s10639-023-12401-4

Prissly, R., & Hidayat, D. (2023). Penerapan Computer Based Testing (CBT) sebagai bentuk evaluasi hasil belajar siswa tingkat SMA. Faktor: Jurnal Ilmiah Kependidikan, 10(1).

Sadhana, R., & Freire, A. (2025). A web-based student learning outcome assessment system for secondary education: Design, development, and empirical evaluation. Ceddi Journal of Education, 4(2), 33-41. https://doi.org/10.56134/cje.v4i2.157