Improving Assistive Technology Governance for Inclusive Educati on: A COBIT 2019 Evaluation of NVDA Implementation in Indonesia

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Abstract.
The effective governance of assistive technology is essential for promoting equitable access to digital learning in inclusive education, particularly for students with visual impairments. NonVisual Desktop Access (NVDA), an open-source screen reader, enables visually impaired students to interact with digital content and computer-based learning environments. However, the effectiveness of its implementation depends not only on the technical functionality of the software but also on institutional governance, teacher competencies, infrastructure readiness, and the availability of appropriate support mechanisms. This study aims to evaluate the governance of NVDA implementation in Informatics learning for visually impaired students at SMP Negeri 2 Lubuk Pakam, Indonesia, using the COBIT 2019 framework. A case study approach is employed through document analysis, observation of learning activities, and semi-structured interviews with relevant stakeholders, including school administrators, Informatics teachers, and personnel involved in supporting inclusive education. Selected COBIT 2019 governance and management objectives are examined in accordance with the institutional context, with particular attention to capability levels, governance gaps, and opportunities for improvement. The analysis is designed to identify organizational and operational factors that influence the accessibility and sustainability of NVDA-supported learning. The expected outcome is a set of evidence-based recommendations and prioritized improvement strategies for strengthening assistive technology governance, enhancing institutional readiness, and supporting more accessible Informatics education. This study contributes a governance-oriented perspective to the implementation of screen-reader technology in inclusive schools and demonstrates how COBIT 2019 can be adapted as an evaluative framework for aligning assistive technology practices with educational accessibility objectives.
Keywords: Assistive Technology Governance; COBIT 2019; NVDA; Inclusive Education; Visual Impairment; Digital Learning Accessibility.

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2nd International Cofference on the Epicentrum of Economic Global Framework (ICEEGLOF)
Theme: Navigating The Future: Business and Social Paradigms in a Transformative Era.
https://proceeding.pancabudi.ac.id/index.php/ICEEGLOF

Introduction.

The increasing integration of digital technologies into educational environments has created new opportunities to improve access to learning resources, facilitate independent learning, and support inclusive education. However, the benefits of digital transformation are not distributed equally among all learners, particularly students with visual impairments who depend on assistive technologies to access computer-based learning materials. The UNESCO Global Education Monitoring Report emphasizes that the contribution of technology to education depends not only on the availability of digital tools but also on equitable access, appropriate governance, and adequate teacher preparation [1]. Therefore, inclusive digital education requires a comprehensive approach that integrates technological accessibility with institutional readiness and effective management practices.

Assistive technology plays an important role in enabling students with visual impairments to participate in digital learning activities. One widely used solution is NonVisual Desktop Access (NVDA), an open-source screen reader that converts on-screen information into speech and supports interaction with computer applications through keyboard commands. Recent empirical research by Amin et al. investigated NVDA and JAWS among students with severe visual impairments and reported differences in reading performance and user experiences, highlighting the educational relevance of screen-reader technology [2]. Nevertheless, the availability of a screen reader alone does not guarantee that learning activities will be accessible. The effectiveness of NVDA implementation may also depend on the accessibility of instructional materials, compatibility with learning applications, teachers' technical competencies, the availability of supporting infrastructure, and institutional procedures for addressing accessibility-related problems.

The importance of assistive technology extends beyond software availability to the accessibility of digital information systems and the capacity of users to interact effectively with digital content. Kiambati et al. examined digital information accessibility among 117 students with visual impairments in selected public universities in Kenya. Their findings indicated that previous assistive technology training and the frequency of digital library use were associated with screen-reader compatibility and navigation experiences [3]. Although this study was conducted in higher education, its findings provide a relevant basis for examining the relationship between user competency, accessible digital content, and institutional support in school-level education. In Informatics learning, these factors are particularly important because students may need to navigate menus, interpret text-based instructions, access programming environments, and interact with digital learning resources. If these activities are not adequately supported, the presence of assistive technology may not translate into meaningful and independent participation.

From an organizational perspective, the implementation of NVDA should be considered part of a broader information technology (IT) governance system. Effective governance establishes responsibilities, decision-making mechanisms, resource allocation priorities, risk management practices, and performance monitoring procedures. Without appropriate governance arrangements, assistive technology implementation may depend heavily on individual teachers, informal technical support, or the availability of particular devices. Such dependence can create inconsistencies in implementation and make accessibility initiatives difficult to sustain. Consequently, evaluating assistive technology governance requires attention to both technical implementation and the organizational processes that support accessible learning.

COBIT 2019 provides a structured framework for evaluating IT governance and management by aligning organizational objectives with relevant governance and management objectives. Its application in educational institutions has demonstrated the potential to identify capability gaps and organizational challenges. Wattimury and Faza applied COBIT 2019 to an educational institution in Indonesia and identified governance and operational issues associated

with decentralized implementation, service disruptions, and unmet institutional needs [4]. More broadly, Idrus et al. reviewed COBIT 2019 implementation studies published across multiple organizational sectors and identified its use in education, healthcare, government, and banking, while highlighting the importance of stakeholder engagement, resource allocation, and contextual adaptation [5]. These studies support the relevance of COBIT 2019 for structured governance evaluation, although they do not directly establish its effectiveness in governing screen-reader implementation in inclusive schools.

Despite the growing use of assistive technologies and IT governance frameworks, an important research gap remains at the intersection of these two areas. Research on screen readers has primarily examined software performance, reading outcomes, accessibility, and user experience, while COBIT-based studies have generally concentrated on organizational IT systems, operational processes, and institutional governance. The governance of screen-reader implementation as a component of inclusive Informatics education remains insufficiently examined within the specific context of Indonesian lower-secondary schools. In particular, there is a need to investigate how institutional responsibilities, teacher competencies, technical support, accessibility requirements, and monitoring mechanisms can be evaluated systematically to support the sustainable use of NVDA.

To address this gap, this study evaluates the governance of NVDA implementation for Informatics learning among students with visual impairments at SMP Negeri 2 Lubuk Pakam, Indonesia, using the COBIT 2019 framework. The study focuses on identifying relevant governance and management objectives, assessing existing implementation practices, examining capability gaps against institutional targets, and formulating prioritized improvement recommendations. The selection of COBIT 2019 objectives should be guided by the institutional context and evidence collected from school stakeholders rather than by applying all framework objectives indiscriminately. The evaluation is intended to connect IT governance practices with the practical requirements of accessible learning, including organizational accountability, human resource readiness, operational support, and continuous monitoring.

The contribution of this research is twofold. First, it extends the application of IT governance evaluation to the implementation of assistive technology in inclusive school education. Second, it provides a context-specific assessment approach for identifying governance improvements that may support the accessibility and sustainability of NVDA-assisted learning. Rather than assuming that improved governance automatically produces better learning outcomes, the study distinguishes governance capability from educational accessibility outcomes and treats the relationship between them as an issue to be examined through empirical evidence. The findings are expected to inform school-level decision-making and provide a foundation for further research on technology governance in disability-inclusive education.

Literature Review.

2.1. Assistive Technology in Inclusive Education

Assistive technology refers to technological products, software, systems, and related services that support individuals with disabilities in performing activities that might otherwise be difficult or inaccessible. In educational settings, assistive technology enables learners with disabilities to access instructional materials, interact with digital platforms, and participate in learning activities according to their individual needs. Its contribution to inclusive education depends not only on the availability of the technology but also on the compatibility of digital resources, the competencies of users, and the support provided by educational institutions. For students with visual impairments, assistive technology is particularly important because conventional graphical interfaces frequently communicate information through visual elements. Screen readers provide an alternative means of interaction by converting accessible textual

information into synthesized speech or refreshable Braille. Amin et al. [1] examined the use of NVDA and JAWS among students with severe visual impairments, demonstrating the relevance of screen-reader technology to educational performance and user experience. However, screen-reader availability should not be treated as equivalent to complete accessibility, since learning outcomes may also depend on the structure of instructional content, application compatibility, keyboard navigation, and users' familiarity with assistive technology. From a governance perspective, assistive technology should be understood as an institutional capability rather than an isolated software installation. Its sustainable implementation requires clear responsibilities, suitable infrastructure, staff training, technical support, and procedures for identifying and resolving accessibility barriers. These requirements provide a theoretical basis for evaluating NVDA implementation through an IT governance framework.

2.2. NonVisual Desktop Access (NVDA)

NonVisual Desktop Access (NVDA) is a free and open-source screen reader for Microsoft Windows developed by NV Access. It enables blind and visually impaired users to access computer operating systems and compatible applications through synthesized speech and Braille output [2]. NVDA supports interaction with applications such as web browsers and office software, making it potentially relevant to digital learning activities that involve reading learning materials, navigating websites, preparing documents, and accessing educational information.

In Informatics education, NVDA can support access to text-based instructions, learning management systems, digital documents, and selected programming environments. Nevertheless, the accessibility of these activities depends on whether the underlying software and educational content expose meaningful information to assistive technology. Images without appropriate text alternatives, poorly structured documents, inaccessible controls, and interfaces that require mouse-only interaction may restrict independent access.

Consequently, evaluating NVDA implementation should distinguish between three dimensions:

1. Technical accessibility: whether digital learning materials and applications can be accessed through screen-reader functions.
2. User readiness: whether students and teachers possess the knowledge and skills required to use NVDA effectively.
3. Institutional support: whether the school provides policies, infrastructure, technical assistance, and monitoring to sustain its implementation.

These dimensions form a conceptual basis for investigating the governance of NVDA-supported learning. They are proposed analytical dimensions for this study, not predefined COBIT 2019 capability levels.

2.3. Digital Learning Accessibility and WCAG 2.2

Digital learning accessibility refers to the extent to which digital educational content, applications, and learning activities can be perceived, operated, understood, and accessed by learners with different abilities. Accessibility is not determined solely by the presence of assistive software; it also depends on the design of the digital environment in which that software operates. The Web Content Accessibility Guidelines (WCAG) 2.2, published by the World Wide Web Consortium (W3C) in October 2023, provides internationally recognized criteria for making web content more accessible [3]. WCAG 2.2 organizes accessibility requirements around four principles: perceivable, operable, understandable, and robust. These principles are relevant to screen-reader users because they address issues such as text

alternatives for non-text content, keyboard accessibility, understandable instructions, and compatibility with assistive technologies. For the present study, WCAG 2.2 can serve as a complementary technical reference for examining the accessibility of digital learning resources used with NVDA. The relationship between these principles and the proposed evaluation is summarized in Table I.

Table 1. Digital Accessibility Dimensions For Nvda-Supported Learning

WCAG principle	Relevance to Informatics learning	Potential evaluation evidence
Perceivable	Learning information can be accessed throu gh speech or Braille output.	Text alternatives, document structure, meanin gful labels, and screen-reader output.
Operable	Learning applications can be navigated with out relying exclusively on a mouse.	Keyboard navigation, logical focus order, and accessible controls.
Understanda ble	Instructions and learning activities can be int erpreted consistently.	Clear instructions, consistent navigation, and u nderstandable error messages.
Robust	Digital content remains compatible with sup ported assistive technologies.	Screenreader compatibility and consistent inte raction with relevant applications.

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These dimensions can guide technical observations and accessibility testing. However, WCAG is an accessibility standard rather than an IT governance framework. Therefore, its criteria should complement, not replace, the organizational assessment conducted using COBIT 2019.

2.4. Information Technology Governance

IT governance refers to the structures, processes, responsibilities, and decision-making mechanisms through which an organization directs and monitors its use of information and technology to achieve organizational objectives. Effective governance establishes accountability for technology-related decisions, supports appropriate resource allocation, manages risks, and monitors whether technology services deliver the intended value.

The COBIT framework developed by ISACA provides a comprehensive approach to governing and managing enterprise information and technology. COBIT 2019 emphasizes stakeholder value, a holistic governance approach, adaptability, the separation of governance from management, organizational customization, and end-to-end coverage of enterprise IT [4]. Its governance system considers more than technical processes: organizational structures, policies, information, culture, competencies, services, infrastructure, and applications are also relevant components. In the context of inclusive education, IT governance can be used to examine whether assistive technology implementation is supported by defined responsibilities, institutional procedures, trained personnel, appropriate infrastructure, and continuous monitoring. These factors are important because the sustainable provision of accessible learning depends on coordination among school leadership, Informatics teachers, technical support personnel, and other stakeholders.

Recent studies provide supporting evidence for applying COBIT 2019 in educational institutions. Purnama and Akbar [5] compared COBIT 5 and COBIT 2019 in an Indonesian higher education setting and reported that COBIT 2019 offers greater flexibility for adapting governance practices to institutional conditions. Harahap and Wasilah [6] also applied COBIT 2019 to evaluate IT governance in a school environment, illustrating its applicability to school-level technology management. Nevertheless, these studies do not directly establish that COBIT 2019 improves NVDA accessibility outcomes; that relationship remains to be investigated

empirically in the present case study. \Accordingly, this study conceptualizes assistive technology governance as the institutional capacity to plan, support, monitor, and improve NVDA implementation in ways that respond to the accessibility needs of visually impaired students.

2.5. COBIT 2019 Framework

COBIT 2019 is a framework for enterprise information and technology governance and management. Its core model consists of 40 governance and management objectives organized into five domains: EDM, APO, BAI, DSS, and MEA [4].

The domains address different aspects of governance and management:

- EDM — Evaluate, Direct and Monitor: evaluates stakeholder needs, provides strategic direction, and monitors governance performance.
- APO — Align, Plan and Organize: addresses planning, organizational arrangements, resource management, and alignment between IT and organizational objectives.
- BAI — Build, Acquire and Implement: covers the definition of requirements, acquisition or development of solutions, and implementation of technology.
- DSS — Deliver, Service and Support: addresses service delivery, operational support, and incident management.
- MEA — Monitor, Evaluate and Assess: focuses on performance monitoring, internal controls, and compliance assessment.

For this study, these domains provide a structured starting point for identifying the governance and management activities relevant to NVDA implementation. The selection of specific objectives must be based on the school's institutional needs, observed practices, stakeholder evidence, and relevant design factors. The framework should not be applied indiscriminately to all 40 objectives. The following objectives are potential candidates for the assessment. Their final inclusion should be justified by the results of the governance design and scoping process.

Table 2. Potential Cobit 2019 Objectives For Nvda Governance

COBIT objective	Governance or management focus	Relevance to the case study
EDM03 — Ensured Risk Optimization	IT-related risk governance	Identifying risks that could interrupt accessible learning or limit NVDA availability.
APO07 — Managed Human Resources	Personnel competencies and resource management	Examining teacher readiness, training, and the availability of personnel who can support NVDA.
BAI02 — Managed Requirements Definition	Requirements identification and analysis	Establishing accessibility requirements for digital learning resources and applications.
DSS01 — Managed Operations	Operational management	Examining the availability and routine operation of devices, software, and supporting services.
DSS02 — Managed Service Requests and Incidents	Service requests and incident handling	Evaluating how accessibility problems are reported, documented, prioritized, and resolved.

MEA01 — Managed Performance and Conformance Monitoring	Performance and conformance monitoring	Assessing whether the school monitors technology performance against established objectives. documented, prioritized, and resolved.

The objectives in Table 2 represent a provisional selection, not a claim that every objective is necessarily required. For example, APO07 may be relevant if staff competency is a major governance concern, while DSS02 may be appropriate if the school has an identifiable mechanism for recording and resolving support requests. The final scope should be determined through stakeholder interviews, initial observations, document analysis, and the COBIT 2019 design process. This approach is consistent with the principle that governance systems should be tailored to the needs and circumstances of each organization [4], [7].

2.6. Capability Assessment and Gap Analysis

COBIT 2019 includes a performance management approach for assessing the capability of governance and management processes. Capability assessment evaluates the extent to which a process is implemented and achieves its intended purpose. It can be used to identify differences between current practices and the level of performance required by an organization. The capability scale ranges from Level 0 to Level 5, as summarized in Table 3 [4].

Table 3. Cobit 2019 Capability Levels

Level	Designation	General interpretation
0	Incomplete	The process is absent or fails to achieve its intended purpose.
1	Performed	The process achieves its intended purpose.
2	Managed	The process is planned, monitored, and managed, with appropriate work products.
3	Established	A defined process is established and consistently implemented.
4	Predictable	The process operates within defined limits and produces predictable results.
5	Optimizing	The process is continuously improved to meet current and future organizational needs.

For NVDA governance, capability assessment can be used to examine whether responsibilities are defined, training activities are documented, support procedures are implemented, and monitoring practices are established. The evaluation should rely on evidence rather than perceptions alone. Relevant evidence may include institutional policies, training records, interview responses, operational documents, observation results, and records of accessibility-related incidents.

2.7. Conceptual Relationship Between COBIT 2019 and NVDA Accessibility.

The theoretical relationship proposed in this research is that governance practices provide organizational conditions that can support the sustainable implementation of assistive technology. These conditions include defined responsibilities, personnel competency, accessible digital resources, operational support, and performance monitoring.

COBIT 2019 is used to assess governance and management practices, while WCAG 2.2 provides complementary technical criteria for examining digital accessibility. NVDA is the assistive technology under investigation, and Informatics learning for visually impaired students is the educational context in which implementation is examined.

The conceptual model is summarized as follows:

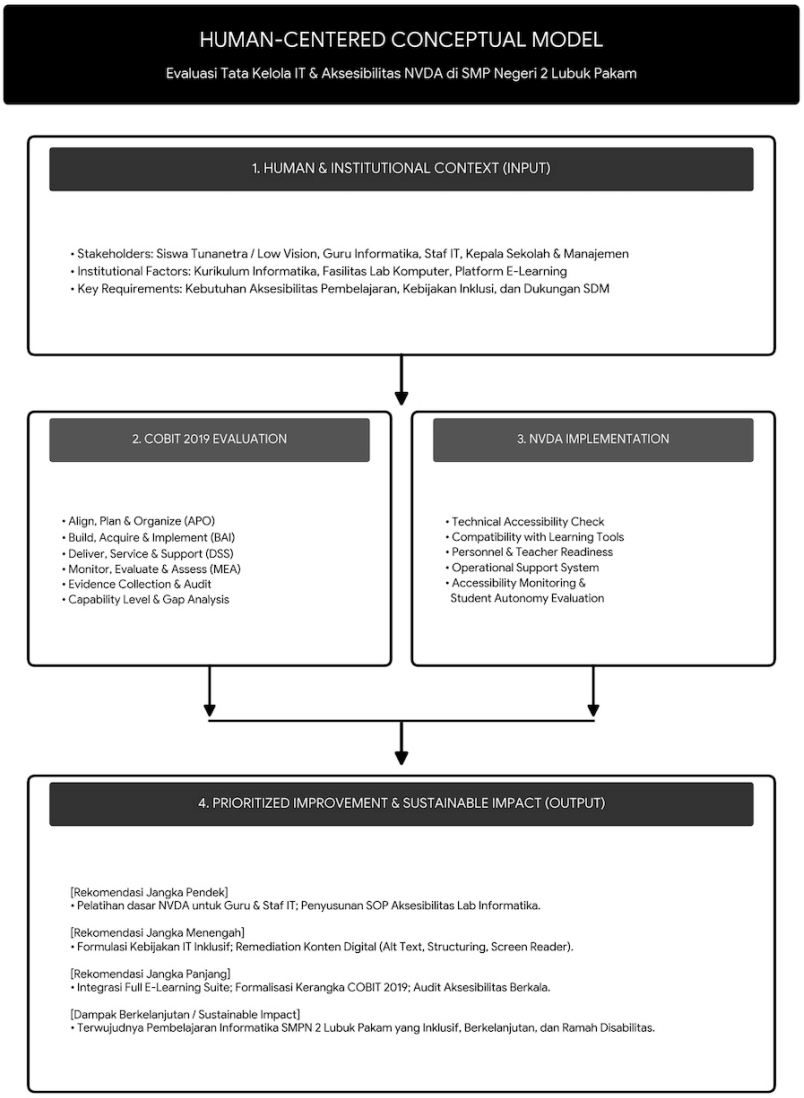


Figure 1. Research Flowchart for Evaluating Assistive Technology Governance Using COBIT 2019.

This conceptual model distinguishes governance capability from educational outcomes. COBIT 2019 can assess the quality of institutional governance processes, while accessibility testing can examine whether selected learning resources can be operated using NVDA. Demonstrating an actual improvement in student participation or learning achievement would require additional outcome measures and empirical evidence.

The model therefore supports three analytical questions:

1. To what extent are the selected COBIT 2019 governance and management objectives implemented in NVDA-supported learning?
2. What capability gaps and technical accessibility barriers are identified through institutional evidence and accessibility testing?
3. What prioritized governance improvements are appropriate for strengthening the sustainable delivery of accessible Informatics education?

Research Methodology

This study employs a qualitative case study approach supported by structured capability assessment and digital accessibility evaluation. The research is conducted at SMP Negeri 2 Lubuk Pakam, Indonesia, with a focus on the governance of NonVisual Desktop Access (NVDA) implementation in Informatics learning for students with visual impairments. A case study approach is appropriate because the research investigates assistive technology governance within its actual educational context, where technical implementation is influenced by institutional policies, human resources, infrastructure, teaching practices, and support mechanisms. The study combines qualitative evidence from interviews, observations, and document analysis with a structured assessment of selected COBIT 2019 governance and management objectives.

The research is designed to answer three questions:

1. How are IT governance and management practices implemented to support NVDA-assisted Informatics learning at SMP Negeri 2 Lubuk Pakam?
2. What capability gaps and digital accessibility barriers can be identified in the current implementation?
3. What prioritized governance improvements can support more accessible and sustainable Informatics learning for students with visual impairments?

The unit of analysis is the governance and institutional support of NVDA implementation, rather than the NVDA software itself. The study does not assume that better governance automatically leads to improved student learning outcomes; instead, it examines how governance practices support the conditions required for accessible learning. The research is conducted at SMP Negeri 2 Lubuk Pakam, located in Indonesia. The institution is selected as a case study because the research focuses on the relationship between assistive technology governance and the accessibility requirements of Informatics education for students with visual impairments.

Participants will be selected purposively according to their involvement in school management, Informatics teaching, NVDA use, technical support, and inclusive education. Potential participants include:

- School leaders or administrators responsible for institutional policies and resource allocation.
- Informatics teachers involved in planning and delivering digital learning activities.
- Students with visual impairments who use, or are intended to use, NVDA in learning activities.
- Technical personnel or staff responsible for computers, software, and technical assistance.
- Other relevant stakeholders involved in supporting inclusive education.

The number of participants will be determined by their relevance to the research questions, their availability, and the adequacy of evidence obtained. Interviews will continue as necessary until the principal research themes are sufficiently understood. The final paper must report the actual number and roles of participants after fieldwork; these details should not be assumed before data collection. Participation by students with visual impairments requires accessible research information, informed consent, appropriate assent procedures where applicable, and safeguards for privacy and voluntary participation.

The research methodology integrates COBIT 2019 governance evaluation with an assessment of NVDA implementation and digital learning accessibility. COBIT 2019 is used to assess organizational governance and management practices, while the Web Content Accessibility Guidelines (WCAG) 2.2 provides complementary criteria for examining relevant digital content and interfaces. The assessment is organized into four stages, as summarized in Table 4.

Table 4. Research Stages And Assessment Activities

Stage	Main activities	Expected output

1. Institutional context analysis	Identify stakeholders, resources, learning requirements, and existing NVDA practices.	Institutional profile and governance requirements.
2. COBIT 2019 evaluation	Select relevant objectives, collect evidence, assess capability, and identify gaps.	Current capability assessment and governance gaps.
3. NVDA implementation assessment	Examine technical accessibility, personnel readiness, operational support, and monitoring.	Identified accessibility barriers and implementation constraints.
4. Improvement prioritization	Analyze findings, validate recommendations, and prioritize actions.	Context-specific governance improvement roadmap.

The stages are analytically connected. Institutional requirements guide the selection of COBIT 2019 objectives, while the assessment of NVDA implementation provides additional evidence for identifying governance weaknesses and defining improvement priorities. The selection of COBIT 2019 objectives follows the principle of tailoring the governance system to institutional needs. Rather than assessing all governance and management objectives, the study focuses on those that are demonstrably relevant to the implementation of assistive technology in the school environment [1]. The initial objectives proposed for consideration are presented in Table 5.

Table 5. Proposed Cobit 2019 Objectives

Objective	Assessment focus	Evidence to be examined
EDM03 — Ensured Risk Optimization	Governance of risks affecting accessible learning.	Identified risks, management decisions, and risk mitigation practices.
APO07 — Managed Human Resources	Staff competency and training.	Training records, teacher interviews, and competency development plans.
BAI02 — Managed Requirements Definition	Identification of accessibility requirements.	Learning requirements, application needs, and accessibility specifications.
DSS01 — Managed Operations	Operational support for NVDA-enabled learning.	Device availability, software maintenance, and operational procedures.
DSS02 — Managed Service Requests and Incidents	Handling accessibility-related problems.	Support records, incident reports, and resolution procedures.
MEA01 — Managed Performance and Conformance Monitoring	Monitoring of implementation performance.	Monitoring records, evaluation procedures, and improvement reports.

These objectives constitute a preliminary selection and must be confirmed through initial observations and stakeholder consultation. Their inclusion does not imply that all six objectives will necessarily be evaluated in the final study. The final selection will depend on the relevance of each objective to the research questions and the availability of sufficient evidence. For each selected objective, the study will examine documented procedures, actual implementation practices, stakeholder understanding, and the consistency between formal arrangements and observed activities. Data will be collected through four complementary techniques to provide a comprehensive understanding of governance practices and NVDA implementation.

RESULTS.

4.1. NVDA Implementation in Informatics Learning.

The evaluation examines how NVDA is implemented to support students with visual impairments in accessing digital learning materials and participating in Informatics learning activities. The analysis focuses on the availability of assistive technology, teacher preparedness, compatibility between NVDA and learning applications, accessibility of digital learning materials, and technical support. The collected evidence should be analyzed to identify whether NVDA is integrated into routine teaching practices or used only when specific assistance is required. Particular attention should be given to students' ability to independently navigate

learning materials, access text-based content, interact with learning platforms, and complete practical Informatics tasks.

Table 6. Organize the findings.

Evaluation aspect	Evidence to examine	Analytical focus
Technology availability	NVDA installation and configuration	Availability and readiness
Teacher preparedness	Interview and training records	Competence and training needs
Learning materials	Documents and accessibility tests	Screen-reader compatibility
Classroom implementation	Direct observation	Integration into teaching
Technical support	Procedures and interview evidence	Troubleshooting and continuity
Student participation	Observation and participant feedback	Independent access and inclusion

4.2. COBIT 2019 Governance Assessment

COBIT 2019 provides a structured approach to assessing the governance and management processes that support NVDA implementation. The selected objectives should be confirmed based on the institution's actual responsibilities, available evidence, and research scope.

Table 7. Objective Cobit 2019 and Governance

COBIT 2019 objective	Focus of assessment	Expected analytical output
EDM03 – Ensured Risk Optimization	Risks associated with inaccessible learning systems	Accessibility risk management
APO07 – Managed Human Resources	Teacher and technical staff competencies	Training and competency gaps
BAI02 – Managed Requirements Definition	Accessibility requirements for learning tools	Requirements and specification gaps
DSS01 – Managed Operations	Day-to-day operation of assistive technology	Operational readiness
DSS02 – Managed Service Requests and Incidents	Handling technical problems and user requests	Support and incident-management gaps
MEA01 – Managed Performance and Conformance Monitoring	Monitoring accessibility and implementation performance	Evaluation and monitoring gaps

The assessment should distinguish between documented procedures and actual practices. For example, the existence of NVDA on a computer does not, by itself, demonstrate effective implementation. Evidence should also establish whether the software works with the learning materials, whether teachers can support its use, and whether students can complete relevant tasks.

4.3. Digital Accessibility Analysis

Digital accessibility is analyzed using applicable WCAG 2.2 principles and practical screen-reader testing. The analysis should consider whether digital learning content can be perceived, operated, understood, and accessed using compatible assistive technologies.

Table 8. Result Analysis

Accessibility criterion	Testing approach	Indicator
Text alternatives	Examine images and non-text content	Meaningful alternative text is available where required
Keyboard accessibility	Navigate without a mouse	Relevant functions can be operated using the keyboard
Semantic structure	Test headings, labels, and page structure	Content is announced in a meaningful order
Form accessibility	Navigate input fields and controls	Controls have accessible names and instructions

Feedback and errors	Test forms and interactive activities	Status messages and errors can be identified
Task completion	Conduct predefined learning tasks with NVDA	Tasks can be completed independently or with documented assistance

The results should report the number of items tested, the number meeting the relevant criteria, the observed barriers, and their consequences for learning activities. Any task-success rate should be calculated only from actual testing data.

4.4. Capability and Gap Analysis

The COBIT 2019 capability assessment compares current process performance with the institution's defined target. Capability ratings must be supported by evidence rather than inferred solely from interviews or the availability of technology. The capability gap for each assessed objective can be expressed as:

$$G_I = L_{target,i} - L_{current,i} \quad (1)$$

where:
- G_I = capability gap for objective \(i\);
- $L_{target,i}$ = target capability level;
- $L_{current,i}$ = assessed current capability level.

A positive gap indicates that the assessed process has not reached its target. The target level should be justified by institutional needs, risks, and operational requirements.

COBIT objective	Current level	Target level	Gap	Evidence
EDM03	To be assessed	To be defined	To be calculated	Risk records and interviews
APO07	To be assessed	To be defined	To be calculated	Training and competency evidence
BAI02	To be assessed	To be defined	To be calculated	Accessibility requirements
DSS01	To be assessed	To be defined	To be calculated	Operational observations
DSS02	To be assessed	To be defined	To be calculated	Support records and interviews
MEA01	To be assessed	To be defined	To be calculated	Monitoring and evaluation records

The analysis should triangulate interview statements, observations, documents, and accessibility tests. Where the evidence conflicts, the discrepancy should be reported and investigated rather than automatically assigning a capability level.

4.5. Discussion

The integrated analysis is intended to examine NVDA implementation as both an accessibility issue and an IT governance responsibility. Effective use of screen-reading technology depends not only on installing the software but also on accessible digital content, teacher competence, operational support, and systematic monitoring. COBIT 2019 provides a governance structure for identifying responsibilities, assessing process capability, and defining improvement actions. WCAG 2.2 complements this framework by providing accessibility

criteria against which digital content and interfaces can be examined. Their combined application can help distinguish technical barriers from organizational weaknesses. However, the findings must be interpreted within the context of a single-school case study. The results can provide practical insights into institutional improvement but should not be generalized to all Indonesian schools without further investigation.

CONCLUSION.

This study examines the governance of NonVisual Desktop Access (NVDA) implementation in Informatics learning for students with visual impairments at SMP Negeri 2 Lubuk Pakam, Indonesia. By integrating the COBIT 2019 framework with relevant Web Content Accessibility Guidelines (WCAG) 2.2 criteria, the study provides an evaluation approach for examining assistive technology implementation from both organizational governance and digital accessibility perspectivesThe proposed evaluation focuses on governance and management processes, staff competencies, operational support, accessibility requirements, and performance monitoring. Combining capability assessment, gap analysis, and NVDA accessibility testing can help identify areas requiring improvement and establish priorities for strengthening inclusive digital learning. The resulting recommendations are intended to support more accessible learning materials, improved teacher preparedness, reliable technical support, and continuous evaluation of assistive technology services. The study highlights the importance of treating assistive technology as part of a broader institutional governance strategy rather than merely as a software installation. Sustainable implementation requires coordination among school administrators, teachers, technical personnel, and students with visual impairments. However, the final conclusions regarding actual capability levels and implementation effectiveness must be established from empirical findings collected at the research site. Future research should validate the proposed evaluation approach through field-based capability assessments, broader accessibility testing, and longitudinal evaluation of improvements in students' access to and participation in Informatics learning. The approach may also be adapted and tested in other educational institutions to assess its applicability across different inclusive education contexts.

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