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Digitalizing Teaching At The Right Level (TARL): An Online Assessment System for Mapping Literacy Competencies in Primary Education

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Abstract: This study aims to develop and validate ASI ASLI (Aplikasi Sistem Asesmen Literasi), an online-based literacy assessment and decision-support system designed to map elementary school students' reading competencies and support differentiated instruction aligned with the Teaching at the Right Level (TaRL) framework. This study employed a research and development (R&D) approach adapted from Borg and Gall, with the development process conducted up to the main field testing stage through large-scale implementation in primary schools in Central Lombok Regency. A total of 4,058 students in Grades III–V participated, selected using a multi-stage cluster sampling strategy across urban, coastal, and rural contexts. Data were collected through literacy assessments embedded in the ASI ASLI system, expert validation instruments, teacher response questionnaires, and classroom observations, then analyzed using a mixed-methods approach. Findings indicate that ASI ASLI demonstrates strong technical feasibility, usability, and instructional relevance. Competency mapping revealed gradual improvement across grade levels; however, a substantial proportion of students remained at the Special Intervention and Basic levels, with pronounced disparities in rural areas. These findings highlight the urgent need for differentiated, data-informed instructional interventions and targeted policy support to address foundational literacy gaps.

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Introduction

Reading literacy is widely recognized as a foundational competence that underpins academic achievement, lifelong learning, and meaningful participation in society. At the global level, literacy enables learners to access knowledge across disciplines, engage in critical thinking, and adapt to the demands of increasingly complex social and economic contexts. Consequently, improving reading literacy—particularly at the primary education level—has become a central priority for education systems worldwide (OECD, 2019).

Despite its importance, reading literacy achievement remains uneven across and within countries. Many students fail to acquire foundational reading skills during the early years of schooling, and these difficulties often persist as students' progress to higher grade levels. Research has shown that literacy outcomes are shaped not only by instructional quality but also by the effectiveness of assessment systems that identify learning needs and guide instructional responses (OECD, 2019). When assessment systems function poorly, learning gaps may remain undetected, delaying intervention and exacerbating inequality.

In the Indonesian context, reading literacy achievement among primary school students continues to present significant challenges. National and international evidence

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indicates that a substantial proportion of students struggle with basic reading comprehension, fluency, and higher-order literacy skills. At the classroom level, literacy assessment practices are often characterized by inefficiency, subjectivity, and limited instructional relevance. Many assessments rely on manual administration and scoring procedures, which consume instructional time and provide limited diagnostic information for teachers (Andikayana et al., 2021). As a result, assessment outcomes are frequently used for reporting purposes rather than as a basis for improving teaching and learning.

These limitations are particularly consequential in classrooms with heterogeneous learning levels, a common feature of Indonesian primary schools. In such contexts, inadequate assessment tools may inadvertently reinforce educational inequities. When students' actual literacy competencies are not accurately identified, instruction tends to remain uniform and grade-based, benefiting learners who are already closer to expected standards while marginalizing those who require foundational support. Students from rural areas and low-resource schools are especially vulnerable to this dynamic, as delayed or inaccurate diagnosis allows early learning gaps to widen over time (Anggraeni & Mukhlis, 2023).

In response to these challenges, digital assessment tools have been increasingly introduced to improve efficiency and scalability. While digital platforms can automate scoring and streamline data collection, many existing tools primarily replicate traditional testing models in digital form. Such systems often emphasize score reporting rather than diagnostic depth and provide limited guidance for instructional action. Consequently, assessment data remain weakly connected to classroom practice and do not adequately support differentiated instruction or equity-oriented interventions (Lakshman, 2019).

These constraints point to the need for an integrated, data-driven literacy assessment system that not only measures learning outcomes but also supports instructional decision-making. An effective system should generate fine-grained competency data, provide timely feedback, and translate assessment results into actionable instructional guidance. This need is particularly salient in education systems characterized by wide learning disparities, where assessment practices can either mitigate or reinforce inequity depending on how data are generated and used.

Teaching at the Right Level (TaRL) offers a pedagogical framework that addresses heterogeneous learning needs by aligning instruction with students' actual competency levels rather than their grade placement. Central to TaRL is the use of diagnostic assessment to inform grouping and instructional planning (Banerji et al., 2020). Empirical studies in Indonesia have shown that TaRL-oriented approaches can improve literacy outcomes when supported by accurate and timely assessment data (Kusumaningrum, Fitrianawati, & Nurulhuda, 2024). However, implementing TaRL at scale remains challenging in contexts where teachers lack access to efficient and practical diagnostic tools.

Within this context, ASI ASLI (Aplikasi Sistem Asesmen Literasi) is positioned as an integrated digital solution that addresses both assessment and instructional challenges. ASI ASLI is designed not merely as an online testing application, but as a decision-support system that links real-time assessment data to instructional planning. By providing competency mapping aligned with the TaRL framework, the system enables teachers to identify students' learning levels, organize differentiated instruction, and respond more effectively to learning diversity. At the same time, the granular data generated by ASI ASLI support policymakers in identifying geographic disparities and designing targeted literacy interventions.

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Despite growing interest in digital literacy assessment and differentiated instruction, a research gap remains in the empirical validation of systems that integrate diagnostic assessment, instructional guidance, and equity-oriented design principles within real school contexts. Existing studies often examine assessment tools, pedagogical frameworks, or technology adoption in isolation, offering limited insight into how these elements can be combined to support classroom practice and policy planning simultaneously (Davis, 1989; Andikayana et al., 2021). Accordingly, this study aims to develop and validate ASI ASLI as an online-based literacy assessment and decision-support system for mapping elementary school students' reading competencies and supporting differentiated instruction aligned with the Teaching at the Right Level (TaRL) framework.

Research Method

This study employed a Research and Development (R&D) design adapted from Borg and Gall (1983) to develop and validate ASI ASLI as an online-based literacy assessment and instructional decision-support system. The development process was conducted up to the main field testing stage, focusing on large-scale implementation in authentic classroom settings across Central Lombok Regency. Earlier stages—needs analysis, prototype refinement, expert validation, and limited pilot testing—had been completed in prior phases to ensure technical functionality and pedagogical alignment. Subsequent stages (e.g., operational field testing and dissemination) were not included because this study prioritized feasibility, usability, and instructional relevance during district-wide implementation and are planned for future research and policy deployment.

The study was conducted in public primary schools across Central Lombok Regency, West Nusa Tenggara, Indonesia, in collaboration with the District Education Office and supported by the INOVASI NTB Program. Participants were purposively selected to reflect geographic diversity. A total of 4,058 students in Grades 3–5 participated from schools located in urban, peri-urban, and rural contexts. In addition, 60 classroom teachers served as direct users of the application. Expert validation involved two literacy experts and two educational technology specialists, while representatives from the District Education Office contributed oversight and policy perspectives to strengthen relevance for scale-up.

The study followed four stages adapted from Borg and Gall (1983). First, an implementation analysis was conducted to assess school readiness, sampling distribution, and technical constraints (e.g., connectivity, device availability, and teacher capacity) in coordination with local stakeholders. Second, teachers received orientation and training on operating ASI ASLI and interpreting results using the Teaching at the Right Level (TaRL) framework. Third, during large-scale implementation, teachers administered literacy assessments for Grades 3–5 using ASI ASLI, which automatically generated competency maps at school and district levels. Fourth, evaluation and reflection were carried out through system outputs, questionnaires, interviews, and classroom observations to assess feasibility, usability, and acceptability, and to inform further refinement and recommendations.

Multiple instruments were employed to ensure comprehensive data collection and to capture both the technical feasibility and pedagogical relevance of ASI ASLI in authentic classroom contexts. The main instrument was the literacy test embedded in ASI ASLI (https://ee-eu.kobotoolbox.org/x/QtdEtKba). The test items were designed to align with Teaching at the Right Level (TaRL) categories, ranging from basic decoding and fluency to higher-order comprehension tasks. Because the assessment was integrated into the application, results were automatically processed and converted into competency levels, reducing the likelihood of human error in scoring and ensuring consistency across schools.

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Technically, the system was developed using KoboToolbox due to its offline-first capability, open-source design, and cost-effectiveness, which enabled flexible and scalable data collection in schools with varying levels of digital infrastructure.

Figure 1. QR Code of the ASI ASLI Application

Teachers completed a structured questionnaire using a 4-point Likert scale to assess the acceptability of ASI ASLI. The questionnaire measured three main dimensions—usability, practicality, and usefulness—to capture teachers' perceptions of the system in supporting literacy assessment and instructional planning. The design of the questionnaire was informed by the Technology Acceptance Model (TAM), which emphasizes perceived ease of use and perceived usefulness as key determinants of technology adoption (Davis, 1989).

Semi-structured interviews were conducted with teachers, principals, and education officials to obtain deeper insights into implementation experiences, technical challenges encountered during field use, and the potential use of assessment data for school improvement and policy formulation. The semi-structured format allowed flexibility for participants to elaborate on context-specific issues that they considered most relevant, thereby enriching the interpretation of system feasibility and instructional usability.

Direct classroom observations were conducted during implementation to document how students interacted with the application, how teachers facilitated the assessment process, and what practical challenges emerged in real time. Observational data strengthened the study by providing behavioral evidence that complemented self-reported responses from questionnaires and interviews, particularly in relation to usability, implementation fidelity, and classroom dynamics. The study employed a mixed-methods approach, combining quantitative and qualitative analyses to triangulate findings and strengthen the validity of conclusions (Creswell & Plano Clark, 2018).

Student assessment results were analyzed using descriptive statistics to generate literacy competency distributions across grade levels and geographic contexts. Students were categorized into four competency levels—Advanced, Proficient, Basic, and Special Intervention—with Special Intervention further subdivided into Beginner, Letter, Word, Paragraph, and Story categories. Teacher questionnaire responses were averaged, and mean scores for each dimension were interpreted into feasibility categories (Highly Feasible, Feasible, Less Feasible, and Not Feasible), following common R&D evaluation practices (Borg & Gall, 1983).

Qualitative data from semi-structured interviews and classroom observations were analyzed using Braun and Clarke's (2006) thematic analysis procedure. This six-step process involved (1) familiarization with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the final

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report. Thematic analysis enabled the researchers to identify patterns across participants' experiences while also capturing context-specific insights. All qualitative data were analyzed manually without the use of qualitative analysis software. To ensure robustness, triangulation was applied across data sources (students, teachers, experts, and policymakers) and methods (tests, questionnaires, interviews, and observations). This multi-perspective approach minimized single-source bias and strengthened the credibility and reliability of the study findings.

Results and Discussion

Results

The validation process by literacy and technology experts was an important first step in determining whether ASI ASLI could be implemented at scale. Literacy experts confirmed that the test items in the application were well-aligned with the Teaching at the Right Level (TaRL) framework, which emphasizes matching instruction to the learner's actual competency rather than their grade level (Banerji, Agarwal, & Lakshman, 2020; UNICEF, 2021). This alignment was particularly relevant for the Indonesian context, where many students in higher grades still struggle with basic reading comprehension (Supriyanto, Rahayu, & Handayani, 2021). However, experts also pointed out that the test items, while effective in assessing literal and basic inferential understanding, needed additional scaffolding for Higher-Order Thinking Skills (HOTS).

This feedback reflects findings in Indonesian research. For instance, Andikayana, Dantes, and Kertih (2021) developed a literacy assessment instrument for Grade 4 students within the framework of the national *Asesmen Kompetensi Minimum* (AKM). They found that while literal and interpretive items were relatively accessible to most students, evaluative items designed to measure HOTS posed significant challenges. The recommendation from literacy experts to incorporate structured scaffolding into ASI ASLI is therefore consistent with evidence from other Indonesian literacy assessments, which demonstrate the need to gradually build students' capacity for critical and evaluative comprehension.

Technology experts, meanwhile, praised the application for its intuitive interface and fast data processing capabilities. The automatic transformation of raw test results into student literacy maps at the class, school, and district levels was seen as a major innovation, particularly for supporting data-driven educational planning. At the same time, the experts noted that the application's dependence on internet connectivity could be a barrier in rural schools, where infrastructure is often limited. They suggested developing an offline mode to allow teachers to administer the assessment without constant connectivity. Similar concerns have been identified in Indonesian educational technology studies, where rural schools frequently report challenges in implementing digital platforms due to connectivity gaps (Anggraeni & Mukhlis, 2023).

The quantitative results of expert validation confirmed these qualitative impressions. Literacy experts gave an average score of 3.80 for content validity, while technology experts rated technical aspects at 3.60. Both ratings fall within the "Highly Feasible" category, providing strong evidence that ASI ASLI was ready for large-scale implementation.

Teacher Responses

Teachers, as the frontline implementers of educational innovations, play a critical role in determining whether a new system will be adopted in practice. In this study, 60 classroom teachers from diverse school contexts provided feedback on their experience using ASI ASLI. Their responses highlighted high levels of acceptance across three dimensions: ease of

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use (mean score = 3.45), usefulness (3.58), and practicality (3.40). All three dimensions placed the system within the "Highly Feasible" category.

One of the strongest points raised by teachers was the system's ability to reduce the time and workload associated with manual assessment. Under traditional practices, teachers typically design or select reading passages, administer them to students, and then manually score and tabulate results. This process is time-consuming and often delays feedback. ASI ASLI automated these steps, generating immediate competency maps that allowed teachers to focus on instructional planning. Several teachers noted that this feature significantly improved their ability to design differentiated instruction within limited classroom time.

In addition, 81.7% of teachers described the interface as easy to use, and 78.3% expressed willingness to continue using the application beyond the study. These adoption rates resonate with findings from Indonesian research on digital literacy tools. For example, Anggraeni and Mukhlis (2023), in a study of AKM literacy implementation in rural primary schools, found that teachers were willing to adopt digital systems when they perceived them as both practical and supportive of their daily tasks. Teachers' responses in the present study confirm that ASI ASLI achieved this balance, offering an interface that was simple, responsive, and designed around their needs. ASI ASLI was implemented among 4,058 students in Grades 3 to 5 across Central Lombok Regency, generating a large dataset that made it possible to map literacy levels by grade and by geographic context.

Results by Grade Level

Analysis by grade level revealed a consistent pattern: while literacy levels improved as students moved from Grade 3 to Grade 5, a majority remained in the Special Intervention category. Specifically, 74.9% of Grade 3 students required special intervention, compared to 51.7% in Grade 5. Although the proportion of students requiring intervention decreased with grade progression, the persistence of such a high percentage at Grade 5 highlights a systemic problem in early literacy instruction. To simplify reporting and improve readability, the Advanced and Proficient categories were combined as a single group (Advanced + Proficient) in the results section.

Table 1. Distribution of Students' Literacy Levels

Grade	Advanced + Proficient	Basic	Special Intervention	Beginner
3	16.9%	5.7%	74.9%	2.5%
4	22.9%	9.3%	66.8%	1.0%
5	35.0%	12.6%	51.7%	0.6%

These findings align with other Indonesian studies. Andikayana et al. (2021) observed that many Grade 4 students in their study were still struggling with comprehension tasks that required more than literal recall, even when instruments were carefully adapted to age-appropriate levels. Similarly, Anggraeni and Mukhlis (2023) found that a large proportion of students in their rural study site performed below the expected competency level for their grade, suggesting that progression through grades did not necessarily translate into mastery of core reading skills.

To further illustrate this pattern, Figure 2 presents a bar chart showing the percentage of students classified under the Special Intervention category across Grade 3 to Grade 5. The visualization highlights a clear declining trend, indicating gradual improvement in reading competencies as students progress through grade levels, although the proportion of students requiring special intervention remains substantial.

Figure 2 illustrates the declining trend in the proportion of students classified under the Special Intervention category from Grade 3 to Grade 5. The bar chart shows a consistent decrease, from 74.9% in Grade 3 to 51.7% in Grade 5, indicating a gradual improvement in

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reading competencies as students progress through grade levels. However, the persistence of a substantial proportion of students requiring special intervention even at Grade 5 highlights systemic challenges in early literacy instruction.

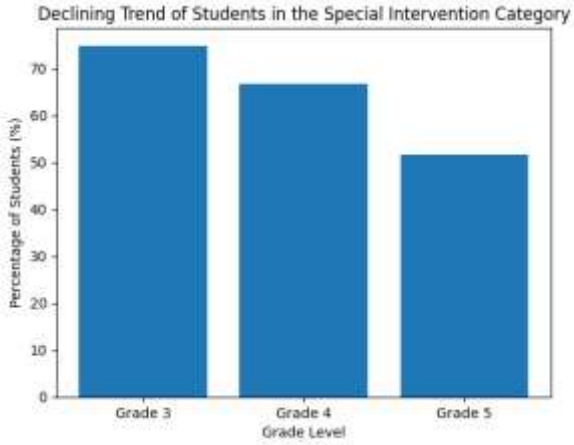

Figure 2. Declining Trend of Students in the Special Intervention Category Across Grade Levels

Results by Region

Geographic disparities were also clearly visible in the data. Urban schools in Praya reported the highest proportion of students at the Advanced and Proficient levels (28.3%), while rural schools in Batukliang Utara recorded the highest proportion of students requiring Special Intervention (58.7%). These findings confirm long-standing concerns about educational inequities between urban and rural areas in Indonesia.

Table 2. Percentage of Literacy Levels by Region

District	Advanced + Proficient	Basic + Beginner	Special Intervention
Praya (Urban)	28.3%	27.1%	44.6%
Pujut (Coastal)	23.2%	22.1%	54.7%
Batukliang Utara	22.0%	19.2%	58.7%

The observed regional gaps are not attributable solely to digital infrastructure constraints. Consistent with PISA findings, differences in socioeconomic status and cultural capital—such as parental support and access to reading materials at home—likely play a significant role in shaping literacy outcomes. These factors may compound school-level limitations in rural areas, resulting in a higher proportion of students requiring special intervention.

Local evidence supports these patterns. Anggraeni and Mukhlis (2023) documented significant literacy gaps between rural and urban schools, attributing these disparities to differences in access to trained teachers, availability of reading materials, and parental involvement in children's education. The ASI ASLI data thus provide further evidence that literacy outcomes in rural areas are disproportionately constrained by systemic challenges (Purwati, Afifah, & Kumara, 2023).

Discussion

The high level of teacher acceptance indicates that ASI ASLI has strong potential for scalability in Indonesian primary education. Teachers' positive responses are consistent with technology adoption research, which emphasizes perceived usefulness and ease of use as key determinants of successful implementation (Davis, 1989). Similar findings have been reported in the Indonesian context, where teachers are more likely to adopt literacy assessment innovations when systems reduce administrative workload and generate

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actionable instructional data (Andikayana et al., 2021). These results suggest that ASI ASLI aligns well with teachers' practical needs and existing classroom realities.

Beyond usability, ASI ASLI addresses a critical limitation of conventional literacy assessment practices, namely the weak connection between assessment outcomes and instructional response. Traditional assessments often involve delays between testing, scoring, and pedagogical action, limiting teachers' ability to intervene in a timely manner. By automating scoring and generating real-time competency maps, ASI ASLI reduces this temporal gap and enables immediate instructional decision-making.

ASI ASLI enables a feedback loop in which assessment results are immediately translated into diagnostic information, instructional adjustments, and subsequent learning strategies. Through this process, teachers move from the role of graders to instructional designers who use real-time data to plan and refine differentiated instruction aligned with students' actual competency levels. This feedback loop operates sequentially: students complete literacy tasks embedded in the system; assessment data are interpreted through TaRL-aligned competency maps; teachers adjust grouping, materials, and learning activities based on diagnosed needs; and subsequent instruction generates new evidence that informs the next cycle of instructional planning. In this way, assessment becomes an integral component of learning design rather than a terminal evaluative act.

The observed decline in the proportion of students classified under the Special Intervention category from Grade 3 to Grade 5 has important pedagogical implications. While this trend suggests cumulative learning progress resulting from sustained instructional exposure, it does not indicate full mastery of foundational literacy skills. The persistence of a substantial proportion of students in the Special Intervention and Basic categories highlights the limitations of grade-based instruction and underscores the importance of early diagnosis and targeted intervention. Without differentiated support, students who begin with weak foundational skills risk remaining behind as curricular demands increase.

From a pedagogical standpoint, these findings reinforce the relevance of the Teaching at the Right Level (TaRL) framework. TaRL emphasizes instruction based on students' actual competency levels rather than their formal grade placement, an approach that has been shown to improve foundational literacy outcomes when supported by accurate diagnostic assessment (Banerji et al., 2020; Kusumaningrum, Fitrianawati, & Nurulhuda, 2024). ASI ASLI supports the operationalization of TaRL by providing teachers with concrete, data-based evidence to guide instructional grouping and task selection in heterogeneous classrooms.

The regional disparities revealed through literacy mapping further underscore the equity implications of assessment practices. Schools in rural and underserved areas continue to face structural constraints, including limited infrastructure and uneven access to qualified instructional support. When assessment systems fail to provide granular diagnostic information, these disparities may be reinforced rather than mitigated (Anggraeni & Mukhlis, 2023). By making learning gaps visible across geographic contexts, ASI ASLI contributes to a more equitable approach to literacy intervention.

At the policy level, the findings highlight the value of ASI ASLI as a source of evidence for data-driven decision-making. Disaggregated literacy data can inform zone-based teacher training programs, targeted instructional support, and needs-based resource allocation. Such approaches align with broader evidence suggesting that education systems are more effective when policy decisions are informed by timely and context-specific learning data (Lakshman, 2019; OECD, 2019). In this respect, ASI ASLI bridges classroom practice and education policy by transforming assessment data into actionable insights.

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Conclusion

1) Key Findings Related to the Feasibility of ASI ASLI. This study demonstrates that ASI ASLI is a feasible and well-accepted online-based literacy assessment and decision-support system for primary education. Expert validation and large-scale implementation indicate that the system functions reliably in authentic classroom settings across diverse geographic contexts. Teachers reported strong usability and practicality, particularly due to automated scoring, real-time competency mapping, and reduced administrative workload, confirming ASI ASLI's potential for scalable implementation.
2) Overview of the Literacy Mapping Results. The literacy competency mapping generated through ASI ASLI revealed clear grade-level patterns and regional disparities. Although the proportion of students requiring Special Intervention decreased from Grade 3 to Grade 5, a substantial number of students remained at the Special Intervention and Basic levels, with gaps most pronounced in rural areas. These findings indicate gradual progression alongside persistent foundational literacy challenges and highlight the importance of early diagnosis and differentiated instruction.
3) Key Contributions to Learning Practice and Education Policy. ASI ASLI contributes to learning practice by transforming assessment into a formative and data-driven process. Through an immediate feedback loop, the system supports teachers in shifting from graders to instructional designers who use real-time data to plan and refine differentiated instruction aligned with the Teaching at the Right Level (TaRL) framework. At the policy level, ASI ASLI provides granular evidence to inform needs-based planning, including targeted teacher training and resource allocation. Overall, ASI ASLI addresses national literacy assessment needs by bridging classroom-level instructional practice and education policy through data-driven decision-making and equity-oriented literacy interventions.

Recommendation

Based on the research findings confirming the high feasibility and positive reception of ASI ASLI, alongside the persistent challenges in elementary students' reading literacy, this study proposes several strategic recommendations. Teachers are encouraged to utilize the reading competency map generated by ASI ASLI as the foundation for implementing differentiated instruction aligned with each student's ability level, following the Teaching at the Right Level (TARL) approach. Emphasis should also be placed on strengthening Higher Order Thinking Skills (HOTS) through structured question design and focused training to enhance students' critical thinking. The use of instant feedback and personalized remedial programs from ASI ASLI can serve as key drivers in improving literacy outcomes.

At the policy level, data from ASI ASLI's literacy mapping should inform evidence-based literacy policies, particularly in addressing regional disparities by directing resources and targeted interventions to rural areas with the lowest literacy levels. Strengthening teacher training in differentiated instruction and HOTS strategies, along with developing contextually relevant learning materials, is essential. Given the successful implementation in Central Lombok Regency and support from the INOVASI NTB Program, expanding the use of ASI ASLI to a broader scale, such as the provincial level, is highly recommended. For developers and researchers, continuous improvement—especially in calibrating HOTS items and developing an offline mode—is vital to ensure broader accessibility and sustainable literacy advancement across Indonesia.

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