

# BRIDGING THE GAP: A PRELIMINARY NEEDS ASSESSMENT OF ACADEMIC LITERACY AND THE URGENCY OF AI-AUGMENTED E-TEXTBOOKS FOR STUDENTS IN EDUCATION DEPARTMENTS

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## Abstract

The rapid proliferation of generative artificial intelligence has precipitated a systemic pedagogical misalignment within higher education. While automated tools offer sophisticated text generation, a critical deficit remains in students' discursive agency and analytical depth. This research conducts a preliminary needs assessment across three academic institutions in Semarang: UNNES, UPGRIS, and UNISSULA to identify instructional interactivity gaps. Grounded in the Deep Learning framework, which prioritizes meaningful understanding over rote memorization, the study employs a discrepancy analysis model with one hundred and fifty respondents. Results delineate a significant aggregate gap of plus zero point nine two, with the most pronounced priority deficit in rhetorical data synthesis at plus one point one three. These findings reflect a profound student desire for systematic and gradual instructional structures that guide them from basic concepts to complex problem-solving. Despite high technological receptiveness, traditional static materials continue to hinder academic literacy. The study concludes that these gaps provide the essential empirical foundation for developing AI-augmented E-textbooks as a structural necessity for maintaining professional relevance in the twenty-first century.

**Keywords:** Discrepancy Analysis, Academic Literacy, AI-Augmented E-Textbooks, Education

## Introduction

Education in the 21st century is defined by disruptive technological shifts and an increasingly volatile labor market, necessitating a move toward high-level professional competencies (Rajaram, 2023; Shefiu & Rasheed Adegbenro, 2024). In the field of teacher training and pedagogical research, the mastery of scientific writing serves as a critical proxy for the analytical proficiency required for future educators' global success (Abo-Khalil, 2024; Garcia-Chitiva & Correa, 2024; Kannikar & Sangnak, 2026). However, a persistent "learning crisis" often results in "schooling without learning" (Richards, 2023) where students struggle to synthesize literature or communicate empirical findings with depth

(Bourne, 2025; Hall & O'Hare, 2024; Hoadley, 2024). This crisis is particularly evident in the Indonesian higher education landscape (Suwono & Prasetyo, 2025), where a significant disconnect persists between theoretical knowledge and the practical application of scientific discourse (Fatkhi & Firdausy, 2026; Samala et al., 2024). The primary challenge for students in education departments is a systemic inability to adapt to frequent curriculum shifts and global disruptions (Blasco et al., 2022; Chatzipanagiotou & Katsarou, 2023; Spond et al., 2022), often rooted in a resistance to intensive reading and higher-order thinking (Fitria & Nafiah, 2025; Wilson & Defianty, 2024). This deficit is shown by the fact that students particularly

struggle to bridge the divide between theoretical knowledge and the numerical or analytical literacy required for modern scientific narration (Brabazon et al., 2023). Consequently, AI-augmented e-textbooks serve as a critical intervention to foster the cognitive agility needed to transform passive schooling into meaningful, future-proof professional competence (Huda et al., 2025; Zhu et al., 2026).

This challenge is further intensified by the Generative AI era, which presents a distinct paradox: while machines can produce text with ease, students often bypass the deep cognitive reasoning essential for rigorous academic and pedagogical discourse (Ongesa Nyamboga, 2026). Current research suggests that technology integration must transcend mere digital substitution, focusing instead on higher-order learning outcomes (Lu et al., 2025; Vu, 2025). Traditional and static instructional methods frequently fail to bridge the gap between academic theory and real-world industrial standards (Xinghua, 2024). The emergence of automated text generators has often led to a decrease in discursive agency (Benites et al., 2023; Goyal et al., 2023), as students rely on AI for output rather than utilizing it to enhance their analytical depth (Vieriu & Petrea, 2025; Zhao et al., 2025). Consequently, there is an urgent need for Deep Learning-based electronic textbooks (E-textbooks) that are interactive, adaptive, and designed to foster higher-order cognition, shifting student engagement from rote memorization toward meaningful, reflective understanding (Li, 2025; Liu et al., 2022; Safarov et al., 2023; Subhan et al., 2025).

Conducting a rigorous front-end needs assessment is a crucial prerequisite to map user access, tech-attitudes, and systemic barriers before deploying such digital innovations (McInnes et al., 2015; Subhan et al., 2025). Preliminary needs assessments conducted across regional academic institutions in Semarang, specifically

Universitas Negeri Semarang (UNNES), Universitas PGRI Semarang (UPGRIS), and Universitas Islam Sultan Agung (UNISSULA), reveal a high-priority instructional interactivity gap of +0.92. This discrepancy underscores the necessity for pedagogical evolution toward student-centered learning via digital platforms. This study addresses this urgent need by establishing the empirical baseline and diagnostic framework for an AI-augmented E-textbook grounded in "mindful-meaningful-joyful" principles and constructive alignment (J. Biggs et al., 2022; Wiggins & McTighe, 2005). The "mindful" aspect encourages students to remain conscious of their ethical responsibilities in the AI era, while "meaningful" and "joyful" elements ensure that the learning process is both professionally relevant and engaging (Eriani et al., 2025; Nafi'ah & Faruq, 2025).

By utilizing an R&D framework adapted from the ADDIE model (Branch, 2009), this phase of the research focuses entirely on the critical analysis stage, creating a diagnostic blueprint that moves beyond surface-level writing (Patty, 2022; Spillane & Jennings, 1997). The integration of AI as a "co-pilot" for critical reasoning aims to enhance students' scientific writing skills, ensuring they remain the "pilot" of their intellectual work (Tseng et al., 2025; Zheng & Chen, 2025). Ultimately, this project seeks to equip graduates with the "future-proof" competencies required to strengthen global competitiveness and ensure professional relevance in an increasingly automated world (Bhattacharjya, 2025; Bühler et al., 2022). By fostering academic literacy that is resilient to technological disruption, this study serves as a strategic blueprint for educational transformation in the digital age (Alenezi & Akour, 2023; Al-Shamsi, 2025; Singun, 2025).

## **Method**

This study employs a Research and Development (R&D) approach, specifically utilizing the first phase (Analysis) of the systematic and recursive ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model to produce a valid, practical, and effective educational product (Branch, 2009). While the overarching longitudinal project follows the complete five-stage ADDIE cycle, this specific paper restricts its scope to the front-end needs assessment to establish a rigorous empirical foundation before product design.

The research was conducted across three distinct higher education institutions in Semarang: Universitas Negeri Semarang (UNNES), representing a pedagogically cultured comprehensive state university; Universitas Islam Sultan Agung (UNISSULA), an Islamically anchored private university characterized by its multicultural academic and pedagogical environment; and Universitas PGRI Semarang (UPGRIS), a professionally-affiliated private campus. This institutional variety ensures that the diagnostic framework addresses the specific pedagogical nuances of diverse educational cultures, thereby strengthening its cross-institutional applicability.

The primary participants for this needs assessment phase consisted of a balanced sample of  $N=150$  undergraduate education students ( $n=50$  per institution) who were in the final stages of their undergraduate thesis preparation and actively utilizing generative AI tools in their writing workflows. A proportionate stratified random sampling technique was implemented to ensure equal institutional representativeness and external validity across the varying academic cultures.

Research instruments utilized in this study were meticulously developed to capture both quantitative and qualitative data regarding literacy gaps and user technology receptiveness. A dual-response needs

assessment survey, comprising 15 validated Likert-scale items, was employed to measure the discrepancy between the perceived necessity of digital tools ( $\mu N$ ) and their current availability ( $\mu A$ ). The validity and reliability of these items were established through expert judgment and a Cronbach's alpha reliability test ( $\alpha > 0.7$ ), ensuring that the instrument accurately quantified the aggregate instructional interactivity gap. Additionally, semi-structured interview guides and documentation studies of current scientific writing syllabi were deployed to extract qualitative insights regarding students' discursive agency and structural barriers in AI-augmented learning environments.

The research procedure strictly focused on the operationalization of the Analysis phase. Quantitative data from the dual-response survey were processed through Kaufman's Discrepancy Analysis to compute the formula for the gap score ( $\Delta = \mu N - \mu A$ ), mapping the priority deficits in academic literacy. Concurrently, qualitative data obtained from interviews and open-ended items were analyzed using thematic analysis techniques (Miles et al., 2018) involving data reduction, data presentation, and conclusion drawing to extract the core thematic markers of the "schooling without learning" crisis. The convergence of these mixed-method datasets provides the essential design specifications for future Deep Learning-based E-textbook prototypes.

## **Finding and Discussion**

To ensure currency within the rapidly shifting landscape of generative artificial intelligence, the 15-item dual-response questionnaire was explicitly operationalized from high-impact educational literature published within a strict five-year window (2021–2026). Specifically, the dimensions of AI interactivity and ethical integrity were grounded in the autonomous pedagogical frameworks of (Su & Zhong, 2022) and (C. Chan, 2023) while the parameters for

rhetorical synthesis and professional discourse alignment were adapted from modern disciplinary literacy models (Garcia-Chitiva & Correa, 2024; Moorhouse et al., 2023). Finally, infrastructural equity metrics were integrated using modern technology acceptance parameters mapped by (Bond et al., 2024) ensuring the tool maintains high validity for multi-institutional diagnoses. Methodologically, the instrument's architecture bridges timeless foundational paradigms with cutting-edge empirical frameworks across five distinct operational dimensions.

Specifically, the dimension of AI-Augmented Interactivity transcends traditional sociocultural scaffolding and cognitive presence models (Garrison, 2000; Vygotsky & Cole, 1978) by aligning them with contemporary "AI as Partner" pedagogical tutoring systems (Su & Zhong, 2022), reflecting modern empirical findings that university students actively require interactive, dialogue-based scaffolding over static content (Subhan et al., 2025).

The Rhetorical Data Synthesis parameter elevates classic genre analysis and advanced relational cognitive structures (J. B. Biggs, 1987; Swales, 1990) to address modern disciplinary literacy friction, where generative AI automates text production but leaves students with an acute deficit in independent empirical data narration (Moorhouse et al., 2023).

To safeguard Academic Ethics and AI Integrity, the abstract notions of critical pedagogy and human discursive agency (Freire, 1970) are updated using (C. Chan & Zhou, 2023) modern co-creational literacy parameters, directly measuring the student's capacity to audit automated hallucinations and prevent cognitive passivity.

Furthermore, Professional Discourse Alignment anchors the classic principle of constructive alignment (J. Biggs, 2003) to face real-world industrial expectations,

ensuring that student scientific writing habits are calibrated with the high-level genre registers demanded by the automated global labor market (Garcia-Chitiva & Correa, 2024).

Finally, the infrastructural and environmental barriers originally mapped by the Technology Acceptance Model (TAM) and Universal Design for Learning (UDL) (Davis, 1989; Rose & Meyer, 2002) are modernized using digital equity and technological friction metrics (Bond et al., 2024) This diagnostic approach directly mirrors established multi-site needs assessment architectures used to isolate user attitudes, financial constraints, and access limitations prior to digital product deployment (McInnes et al., 2015), thereby ensuring the instrument maintains robust internal validity and precision for multi-institutional diagnoses within regional academic networks. This analytical breakdown is delineated in the table below.

Table 1. Methodological Workflow for Questionnaire Development and Validation

| Stage | Process Phase                             | Operational Activities & Technical Indicators                                                                                     | Theoretical & Empirical Anchors                                                     |
|-------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1     | Theoretical Grounding & Construct Mapping | Identifying core academic literacy deficits and isolating five key research variables based on foundational educational problems. | (Vygotsky & Cole, 1978); (Swales, 1990); (Freire, 1970); Biggs (2003); Davis (1989) |
| 2     | Contemporary Contextualization            | Modernizing constructs to address the post-generative AI landscape,                                                               | (Ouyang et al., 2022); (Moorhouse et al., 2023); Chan (2023);                       |

|   |                                    |                                                                                                                                                                  |                                                   |
|---|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
|   |                                    | digital equity, and automated writing friction.                                                                                                                  | (Bond et al., 2024)                               |
| 3 | Dual-Response Operationalization   | Drafting 15 structural items distributed equally across 5 variables, structured into parallel Likert scales: Necessity ( $\mu N$ ) and Availability ( $\mu A$ ). | Kaufman's Discrepancy Model Framework             |
| 4 | Content Validity & Expert Judgment | Submitting the initial draft to a panel of expert judges to evaluate language, pedagogical discourse accuracy, and item relevance.                               | Instrument Grid Validation Rubrics                |
| 5 | Empirical Reliability Testing      | Conducting a pilot test to measure internal consistency using SPSS, ensuring the instrument meets the strict statistical reliability threshold.                  | Cronbach's Alpha Verification ( $\alpha > 0.70$ ) |
| 6 | Field Deployment & Gap Computation | Administering the finalized instrument to N=150 respondents across three                                                                                         | Multi-Site Descriptive Mixed-Methods Analysis     |

Semarang campuses to compute the target operational gap ( $\Delta = \mu N - \mu A = +0.92$ ).

Following this theoretical synthesis, the survey instrument was meticulously operationalized to align with the operational research requirements. The items are systematically categorized into distinct sections, each corresponding to a specific core variable identified in the literature review. This structured approach ensures a logical flow for respondents while maintaining a strict focus on the empirical indicators, resulting in the questionnaire structure outlined below.

| Table 2. Survey Instrument Items           |                                                                                                                           |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| No.                                        | Instructional Feature / Capability Items                                                                                  |
| Variable 1: AI-Augmented Interactivity     |                                                                                                                           |
| 1.                                         | Textbooks that provide interactive, dialogue-based AI prompts to give instant feedback on my writing structure.           |
| 2.                                         | Digital reading materials featuring real-time interactive scaffolding that adapts to my individual writing pace.          |
| 3.                                         | Built-in conversational AI assistants within the instructional interface to clarify complex scholarly concepts instantly. |
| Variable 2: Rhetorical Data Synthesis      |                                                                                                                           |
| 4.                                         | Systematic step-by-step guidance/wizards that model how to translate syntax into fluent scientific prose.                 |
| 5.                                         | Instructional scaffolding that guides me from basic conceptual definitions to solving complex data narration problems.    |
| 6.                                         | Advanced models that teach me how to synthesize conflicting literature findings instead of merely copying text blindly.   |
| Variable 3: Academic Ethics & AI Integrity |                                                                                                                           |
| 7.                                         | Clear guidelines within the text detailing how to use generative AI ethically without crossing into academic plagiarism.  |
| 8.                                         | Self-reflection checklists designed to maintain my original voice (discursive                                             |

|                                                     |                                                                                                                                             |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                                                     | agency) while co-writing with AI text tools.                                                                                                |
| 9.                                                  | Exercises that train me to identify and correct "AI hallucinations" or incorrect citations generated by automated systems.                  |
| <b>Variable 4: Professional Education Discourse</b> |                                                                                                                                             |
| 10.                                                 | Learning content that incorporates authentic writing cases aligned with modern international standards of education research.               |
| 11.                                                 | Specific vocabulary banks and linguistic structures tailored for high-level scientific communication in education.                          |
| 12.                                                 | Scaffolding designed to align undergraduate academic writing habits with the rigorous expectations of the professional global labor market. |
| <b>Variable 5: Digital Platform Accessibility</b>   |                                                                                                                                             |
| 13.                                                 | Electronic textbooks optimized for smooth cross-platform compatibility across computers, tablets, and smartphones.                          |
| 14.                                                 | Cloud-based writing tools that safely save my drafts and notes automatically, reducing the risk of data loss.                               |
| 15.                                                 | User interfaces engineered to function efficiently without lag under unstable internet conditions or restricted data limitations.           |

## Results: Identification of the Instructional Interactivity Gap

The findings of this study begin with the empirical results of the Analysis phase, which aimed to quantify the educational deficit within the education departments of the three research sites in Semarang. The needs assessment revealed a pronounced discrepancy between students' pedagogical expectations and the existing instructional reality. As summarized in Table 3, the calculated grand mean gap score of plus zero point nine two signifies a high-priority instructional need, particularly in the realm of digital interactivity.

Table 3. Kaufman's Discrepancy Analysis Results

| N | Variable     | Necessity Mean (μN) | Availability Mean (μA) | Gap Score (Δ) |
|---|--------------|---------------------|------------------------|---------------|
| 1 | AI-Augmented | 4.72                | 3.65                   | +1.07         |

|   | Interactivity                    |      |      |       |
|---|----------------------------------|------|------|-------|
| 2 | Rhetorical Data Synthesis        | 4.68 | 3.55 | +1.13 |
| 3 | Academic Ethics & AI Integrity   | 4.60 | 3.90 | +0.70 |
| 4 | Professional Education Discourse | 4.55 | 3.80 | +0.75 |
| 5 | Digital Platform Accessibility   | 4.70 | 3.75 | +0.95 |
|   | Grand Mean                       | 4.65 | 3.73 | +0.92 |

Note: Results derived from N=150 respondents across three campuses.

A more granular examination of the gap analysis reveals that "Rhetorical Data Synthesis" (+1.13) and "AI-Augmented Interactivity" (+1.07) are the most critical areas of instructional deficit. These high scores indicate that students in the Semarang regional institutions specifically at UNNES, UPGRIS, and UNISSULA experience a profound "digital friction" when attempting to bridge the gap between education theory and scientific writing.

The +1.13 gap in data synthesis specifically highlights the "schooling without learning" crisis, where students possess the raw empirical data but lack the discursive tools to narrate their findings effectively. This empirical baseline provides the direct design specifications for future R&D iterations, establishing the structural necessity for features such as a 'Data Commentary Wizard' and a 'Reflective AI Assistant' to be integrated into the upcoming platform architecture.

To uncover the underlying factors causing this +0.92 aggregate gap, qualitative data from semi-structured interviews were processed using the (Miles et al., 2018) framework. Through systematic data reduction and thematic display, a major pattern emerged: students experience

severe cognitive passivity due to a reliance on generative AI for surface-level text generation rather than deep analytical reasoning. Lecturers noted that while students have high access to digital tools, their capability to construct independent critical arguments remains weak.

This finding aligns with contemporary needs assessments in Indonesian higher education, which demonstrate that students strongly desire structured, step-by-step instructional mediums that actively guide them from basic theoretical concepts to complex, independent problem-solving (Subhan et al., 2025). Consequently, the presence of automated technology does not automatically translate into improved cognitive outcomes; rather, it underscores the urgent need for interactive digital frameworks that reposition AI as a reflective co-pilot rather than a mere substitute for human thought.

## **Conclusions**

This preliminary needs assessment successfully decodes the systemic instructional friction emerging at the intersection of traditional academic literacy and the disruptive era of generative artificial intelligence. By deploying a rigorous mixed-methods discrepancy model across a robust multi-institutional sample of one hundred and fifty respondents, this study transcends superficial observations to map the exact contours of the contemporary "schooling without learning" crisis within higher education. The mathematically verified grand mean gap score of plus zero point nine two exposes a profound misalignment: while students inhabit an environment saturated with automated tools, their actual instructional environment remains largely static, conventional, and disconnected from twenty-first-century labor demands.

The critical peak of this deficit, identified in Rhetorical Data Synthesis at plus one point one three, diagnoses an acute epistemic

vulnerability. Students are highly receptive to digital platforms, yet they experience a severe collapse in discursive agency when attempting to transform raw empirical data into cohesive scientific narratives. Through the lens of the (Miles et al., 2018) qualitative reduction framework, this gap is revealed not as a lack of technical access, but as a crisis of cognitive passivity. Automated text generators have inadvertently incentivized students to bypass the deep reasoning required for rigorous scholarly discourse, utilizing AI as an intellectual substitute rather than an analytical accelerator. Consequently, this study concludes that simply inserting technology into the classroom is insufficient; higher education requires a structured intervention that systematically rebuilds student cognitive engagement from the ground up.

In conclusion, this front-end analysis establishes a critical empirical blueprint for future instructional design by isolating user barriers and technological attitudes prior to deployment, proving that education majors require a gradual, step-by-step pedagogical scaffolding anchored in "mindful-meaningful-joyful" principles where artificial intelligence functions as a reflective co-pilot rather than an intellectual substitute. To operationalize these findings across the regional academic networks of Semarang, specifically UNNES, UPGRIS, and UNISSULA, this study prescribes a systemic curricular overhaul shifting from descriptive writing to higher-order rhetorical synthesis, a proactive transition toward institutional AI integrity through ethical prompt engineering, and a pedagogical re-engineering via active, Deep Learning-based digital platforms. Although procedurally bounded within the initial Analysis phase of the ADDIE framework, this diagnostic baseline builds a compelling trajectory for upcoming longitudinal research; future R&D horizons will focus on constructing and experimentally validating an AI-augmented E-textbook prototype equipped with a

"Data Commentary Wizard" and a "Reflective AI Assistant" to rigorously evaluate its structural impact on students' writing performance, academic self-efficacy, and global competitiveness in an increasingly automated labor market.

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