



RESEARCH ARTICLE

Section: *Literature, Linguistics & Criticism***Design and implementation of a Moodle-based adaptive hypermedia system for Indonesian vocabulary learning and character education**Rafika Muspita Sari^{1*}, Atikah Rahmah Nasution¹, Fartika Ifriqia², Sutikno Sutikno³, Asnawi Asnawi⁴, Rahmat Kartolo⁵, Herman Herman⁶ & Nabil Al-Awawdeh⁷¹Department of Indonesian Language and Literature Education, Universitas Asahan, Indonesia²Madrasah Ibtidaiyah Teacher Education, Universitas Islam Negeri (UIN) Syekh Wasil, Indonesia³Doctoral Program in Education, Universitas Muslim Nusantara Al-Washliyah, Indonesia⁴Magister of English Education, Universitas Muslim Nusantara Al-Washliyah, Indonesia⁵Magister of Indonesian Education, Universitas Muslim Nusantara Al-Washliyah, Indonesia⁶Department of English Education, Universitas HKBP Nommensen Pematangsiantar, Indonesia⁷Department of Modern Languages, Yarmouk University, Jordan*Correspondence: rafikamsari89@gmail.com**ABSTRACT**

This study explores the implementation of a Moodle-based adaptive hypermedia system to enhance Indonesian vocabulary comprehension and support character development among senior high school (SMA) students. The research employed a qualitative approach, collecting data through observations, student assessments via Google Forms, and reflective notes from classroom interactions. The study focused on how adaptive learning strategies, multimedia resources, and personalized learning pathways influence students' understanding of vocabulary and their self-directed learning behaviors. The results indicate that the Moodle-based adaptive hypermedia system significantly improved students' vocabulary mastery, with average scores increasing from 61.5% in the initial assessment to 84% in the final assessment. Additionally, students exhibited greater responsibility, discipline, and engagement throughout the learning process. The system's adaptive features, combined with multimedia support and interactive tasks, provided individualized learning experiences that accommodated diverse learning needs. Observations also highlighted the positive impact of the system on collaborative learning, as students actively assisted each other in understanding vocabulary items. These findings suggest that integrating Moodle-based adaptive hypermedia into Indonesian language instruction can simultaneously foster cognitive and character development, making learning more effective and student-centered. The study contributes to both educational theory and practice by demonstrating the benefits of adaptive e-learning environments in enhancing language proficiency and promoting self-regulated learning among secondary school students.

KEYWORDS: adaptive hypermedia, Moodle, Indonesian vocabulary, character development, secondary education**Research Journal in Advanced Humanities**

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Introduction

Language plays a crucial role in education, not only as a medium of communication but also as a tool for shaping students' thinking, attitudes, and character. In the Indonesian educational context, Bahasa Indonesia is a compulsory subject at the senior high school (SMA) level and serves as a foundation for academic success across disciplines. Vocabulary mastery is a core component of language competence, as it directly influences students' reading comprehension, writing ability, and overall language performance (Nation, 2013). However, many SMA students still experience difficulties in understanding and using Indonesian vocabulary effectively, particularly academic and contextual vocabulary required for higher-order learning.

One of the major challenges in vocabulary learning is the diversity of students' prior knowledge, learning pace, and motivation. Conventional teaching methods often apply uniform instructional strategies, which may not adequately address individual differences among learners (Dhillon et al., 2025; Sitepu et al., 2026). As a result, students with lower vocabulary proficiency may struggle to keep up, while more advanced learners may not be sufficiently challenged. This issue highlights the need for learning systems that can adapt to students' individual characteristics and learning needs, especially in technology-enhanced learning environments (Tomlinson, 2014; Herman et al., 2025).

Adaptive hypermedia systems have emerged as a promising approach to personalized learning. These systems dynamically adjust learning content, navigation, and presentation based on user models such as prior knowledge, learning goals, and performance (Brusilovsky, 2001). In language learning, adaptive hypermedia can provide customized vocabulary materials, feedback, and learning paths, enabling students to engage with content that matches their proficiency level. Such adaptability is particularly relevant for SMA students, who exhibit significant variation in language competence and learning readiness.

The integration of adaptive hypermedia into Learning Management Systems (LMS) has further expanded its potential in formal education. Moodle, as one of the most widely used open-source LMS platforms, offers flexibility, scalability, and a variety of plugins that support adaptive learning design (Dougiamas & Taylor, 2003). Moodle-based adaptive hypermedia systems allow teachers to organize learning resources, monitor student progress, and deliver personalized instructional content efficiently. In the context of Indonesian language learning, Moodle can function as a digital environment that supports vocabulary acquisition beyond the limitations of classroom time.

In addition to cognitive outcomes, Indonesian education places strong emphasis on character education. Character development, including values such as responsibility, discipline, cooperation, and integrity, is a key objective of the national curriculum and is expected to be integrated into all subjects, including language learning. Language instruction provides meaningful opportunities to foster character values through texts, discussions, and learning activities that promote ethical reflection and social awareness (Lickona, 1991). Therefore, instructional innovations should not only aim to improve academic achievement but also contribute to students' character formation.

Technology-enhanced learning environments, when designed appropriately, can support both academic and character development. Online learning systems encourage students to take responsibility for their learning, manage time effectively, and engage in collaborative activities, which are essential aspects of character education (Koehler & Mishra, 2009). A Moodle-based adaptive hypermedia system can embed character values into vocabulary learning activities by incorporating reflective tasks, contextual texts, and interactive feedback that promote positive learning behaviors (Sulistiyanto et al., 2022).

Despite the growing use of Moodle in Indonesian schools, its potential as an adaptive hypermedia system for vocabulary learning and character development has not been fully explored, particularly at the SMA level. Many implementations still rely on static content delivery, limiting the system's ability to respond to individual learner differences. There is a need for empirical research that examines how adaptive hypermedia features within Moodle can enhance Indonesian vocabulary comprehension while simultaneously supporting character education.

Therefore, this study aims to implement and examine a Moodle-based adaptive hypermedia system designed to improve Indonesian vocabulary mastery and student character development among SMA students. By integrating adaptive learning principles with character-oriented instructional design, this research is expected to contribute both theoretically and practically to the fields of language education, educational technology, and character education.

Literature Review

1. Vocabulary Learning in Indonesian Language Education

Vocabulary knowledge is a fundamental element of language proficiency and plays a decisive role in students' ability to comprehend texts, express ideas, and participate in academic discourse. In Indonesian language education at the senior high school (SMA) level, vocabulary learning is closely related to students' success in reading comprehension, argumentative writing, and critical analysis of texts. According to Schmitt (2008), vocabulary acquisition involves not only knowing word meanings but also understanding word usage, collocation, and contextual appropriateness (Hulu et al., 2023; Juanda et al., 2025). This complexity often presents challenges for secondary school students who are expected to engage with increasingly abstract and academic texts.

Several studies have indicated that students' limited vocabulary knowledge can hinder their comprehension and reduce motivation to engage in learning activities (Grabe & Stoller, 2011; Sinaga et al., 2025). In the Indonesian context, vocabulary instruction is frequently embedded implicitly within reading and writing tasks, which may disadvantage students with lower language proficiency (Resmi et al., 2023). As a result, there is a need for instructional approaches that provide systematic, contextualized, and learner-centered vocabulary support, particularly for SMA students who are preparing for higher education.

2. Adaptive Learning and Adaptive Hypermedia Systems

Adaptive learning refers to instructional systems that dynamically adjust learning content and strategies based on learners' characteristics, performance, and needs. Adaptive hypermedia systems extend this concept by tailoring both content presentation and navigation within digital environments (De Bra, Aroyo, & Chepegin, 2004). These systems rely on user models that represent learners' knowledge levels, preferences, and learning behaviors, allowing the system to provide personalized learning experiences (Hakim et al., 2023).

In educational settings, adaptive hypermedia has been shown to improve learning efficiency and learner engagement by reducing cognitive overload and providing appropriate levels of challenge (Park & Lee, 2004). For vocabulary learning, adaptive systems can offer differentiated word lists, contextual explanations, and practice activities based on students' mastery levels. This adaptability is particularly beneficial for heterogeneous classrooms, such as those commonly found at the SMA level, where students' language abilities vary significantly.

3. Moodle as a Platform for Adaptive Learning

Moodle is a widely adopted Learning Management System (LMS) used in secondary and higher education due to its flexibility and open-source nature. Although Moodle was originally designed as a content management and communication platform, it can support adaptive learning through conditional activities, learning analytics, and integration with adaptive plugins (Graf & Kinshuk, 2007; Mampadi et al., 2011). These features allow instructors to design learning paths that respond to students' performance and learning progress.

Research has shown that Moodle-based learning environments can enhance students' autonomy and engagement when combined with adaptive instructional strategies (Costa, Alvelos, & Teixeira, 2012). In language learning contexts, Moodle enables the integration of multimedia resources, interactive quizzes, and feedback mechanisms that support vocabulary acquisition. For SMA students, Moodle-based adaptive hypermedia systems can extend learning beyond the classroom and provide personalized support that aligns with individual learning needs.

4. Character Education in Technology-Enhanced Learning

Character education is an essential component of holistic education and aims to develop students' moral values, attitudes, and social responsibility. In secondary education, character formation is closely linked to students' learning experiences and interactions within both formal and digital learning environments. Berkowitz and Bier (2005) emphasize that effective character education should be integrated into academic instruction rather than taught as a separate subject (Herman et al., 2022).

Technology-enhanced learning environments offer opportunities to foster character development through collaborative activities, self-regulated learning tasks, and reflective practices (Hanif et al., 2023; Irwansyah et al., 2025; Purba et al., 2026). Online learning systems can promote values such as responsibility, discipline, and perseverance by encouraging students to manage their learning activities and meet deadlines independently.

(Hung et al., 2012; Munthe et al., 2021; Cahyani et al., 2025). When adaptive hypermedia systems are designed with character-oriented learning objectives, they can support not only cognitive development but also positive learning behaviors among SMA students.

5. Empirical Studies on Adaptive Systems in Language Learning

Previous empirical studies have demonstrated the effectiveness of adaptive learning systems in improving language learning outcomes. Chen and Hsu (2008) found that adaptive e-learning systems significantly improved learners' vocabulary acquisition and retention compared to non-adaptive systems. Similarly, Liu, Chu, and Hwang (2011) reported that adaptive digital learning environments enhanced students' motivation and learning achievement in language courses.

However, most existing studies focus on foreign language learning or higher education contexts, with limited research conducted at the senior high school level and within the Indonesian language learning domain. Moreover, few studies explicitly address the integration of character education within adaptive hypermedia systems. This gap indicates the need for further research that explores how Moodle-based adaptive hypermedia systems can simultaneously enhance vocabulary comprehension and support character development among SMA students.

Research Methods

A. Research Design

This study employed a qualitative research design with a descriptive case study approach. Qualitative research is appropriate when the objective is to gain an in-depth understanding of participants' experiences, perceptions, and learning processes within a specific educational context. According to Creswell (2014), qualitative research allows researchers to explore complex phenomena by examining them holistically and within their natural settings (Panjaitan et al., 2025). In this study, the qualitative approach was used to explore how the implementation of a Moodle-based adaptive hypermedia system supports Indonesian vocabulary comprehension and character development among senior high school (SMA) students.

A case study design was selected because the research focused on a single bounded system, namely one class in a private senior high school that implemented adaptive hypermedia learning through Moodle. This design enabled the researcher to investigate instructional practices, student interactions, and learning outcomes in depth without manipulating variables, emphasizing natural classroom implementation rather than experimental control (Yin, 2018).

B. Data Source

The research was conducted at SMA Swasta Nasional, located at Jl. Simpang Teluk Bayur, Desa Petatal, Kecamatan Datuk Tanah Datar, Kabupaten Batubara. The study took place during the odd semester of the 2024/2025 academic year. The participants consisted of 40 students of Grade X, who were enrolled in Indonesian language learning activities using a Moodle-based adaptive hypermedia system. The selection of participants was based on purposive sampling, as the class had actively implemented Moodle as part of the learning process. The students represented diverse levels of vocabulary mastery and learning engagement, making them suitable for examining adaptive learning experiences and character-related behaviors in a real instructional setting.

C. Research Instruments

The researcher acted as the main research instrument, as commonly practiced in qualitative research (Merriam & Tisdell, 2016). To support systematic data collection, several supporting instruments were used, including:

1. Observation guidelines, used to record students' learning behaviors, engagement, and character-related attitudes such as responsibility, discipline, and collaboration during Moodle-based activities.
2. Semi-structured interview guides, designed for interviewing selected students and the teacher to explore perceptions of vocabulary learning and character development through adaptive hypermedia.
3. Document analysis checklists, used to examine learning materials, student assignments, discussion forum posts, and Moodle activity records.

All instruments were designed to align with the research objectives and were reviewed to ensure clarity and relevance.

D. Data Collection Methods

Data collection was conducted over two instructional meetings during the implementation of the Moodle-based adaptive hypermedia system. The methods used included:

1. Classroom and online observations, focusing on student participation, interaction patterns, and learning behaviors during Moodle-based vocabulary activities.
2. Interviews, conducted with the Indonesian language teacher and selected students after the learning sessions to obtain reflective insights into learning experiences and perceived character development.
3. Documentation analysis, involving the examination of Moodle activity logs, students' vocabulary tasks, Google Form responses, and discussion forum contributions.

The use of multiple data collection methods enabled triangulation, enhancing the trustworthiness of the findings.

E. Data Analysis Method

Data analysis was carried out using thematic analysis, following the stages proposed by Miles, Huberman, and Saldaña (2014). The analysis process consisted of:

1. Data condensation, involving selecting, focusing, and simplifying raw data obtained from observations, interviews, and documents.
2. Data display, where organized data were presented in the form of descriptive narratives and thematic matrices.
3. Conclusion drawing and verification, in which patterns and themes related to vocabulary comprehension and character development were identified and validated through cross-checking data sources.

To ensure data validity, the study applied triangulation of data sources and methods, as well as member checking by confirming key findings with the teacher. These strategies enhanced the credibility and reliability of the qualitative findings.

Results

This section presents the results of the study derived from observations, documentation analysis, Moodle learning records, Google Form responses, and students' vocabulary task outcomes. The findings are organized into thematic subsections and are supported by tables and figures to provide a comprehensive representation of students' vocabulary comprehension and learning behaviors after the implementation of the Moodle-based adaptive hypermedia system.

1. Implementation of the Moodle-Based Adaptive Hypermedia System

The Moodle-based adaptive hypermedia system was implemented in an Indonesian language learning context for Grade X SMA students over two instructional meetings. Learning materials were delivered through multimedia content, including textual explanations, instructional videos, and contextual reading passages. Vocabulary comprehension tasks were administered through Google Form integrated into Moodle, allowing students to access learning activities via their personal mobile devices. Observational data indicated that the majority of students were able to access learning materials independently and complete the assigned tasks within the allocated time. The adaptive structure of the learning activities enabled students to engage with vocabulary items contextually and receive immediate feedback, which supported individualized learning progress.

2. Students' Vocabulary Comprehension Outcomes

Students' vocabulary comprehension outcomes were examined through descriptive analysis of task scores obtained from Google Form assessments. The results demonstrate a substantial improvement in students' vocabulary mastery following the implementation of the Moodle-based adaptive hypermedia system.

Table 1. Average Vocabulary Comprehension Scores

Learning Phase	Number of Students	Average Score	Category
Initial Implementation	40	0.615	Sufficient
After Full Implementation	40	0.840	Good

As shown in Table 1, the average vocabulary comprehension score increased from 0.615 to 0.840. This

improvement indicates that students demonstrated higher levels of understanding of Indonesian vocabulary after participating in adaptive hypermedia-based learning activities. The increase suggests that repeated exposure to contextualized vocabulary tasks and multimedia resources supported students' comprehension development.

3. Distribution of Vocabulary Mastery Levels

To further examine students' learning outcomes, vocabulary scores were categorized into mastery levels based on predetermined criteria. The distribution of students across mastery categories before and after implementation is presented below.

Table 2. Distribution of Vocabulary Mastery Levels (Initial Implementation)

Score Interval	Frequency	Category
85–100	0	Very Good
75–84	6	Good
60–74	23	Sufficient
40–59	10	Low
0–39	1	Very Low

During the initial implementation, most students (23 out of 40) were categorized in the “sufficient” level, while several students remained in the “low” and “very low” categories. This distribution reflects varied vocabulary proficiency levels among students at the beginning of the learning process.

Table 3. Distribution of Vocabulary Mastery Levels (After Full Implementation)

Score Interval	Frequency	Category
85–100	16	Very Good
75–84	24	Good
60–74	0	Sufficient
40–59	0	Low
0–39	0	Very Low

Table 3 shows a clear shift in students' vocabulary mastery levels. After the implementation of the Moodle-based adaptive hypermedia system, all students achieved scores within the “good” and “very good” categories. No students remained in the lower mastery levels, indicating a more equitable learning outcome across the class.

4. Observed Learning Behaviors and Character Development

Qualitative findings from classroom and online observations revealed positive changes in students' learning behaviors. Students demonstrated increased responsibility by independently accessing Moodle, completing vocabulary tasks, and submitting assignments on time. Discipline was reflected in students' adherence to learning procedures and sustained engagement during online activities. Additionally, students exhibited self-directed learning behaviors, such as reviewing materials independently and attempting tasks multiple times to improve their understanding. Informal peer interactions were also observed, where students assisted classmates in understanding vocabulary items and navigating the learning platform. These behaviors reflect the development of character values such as responsibility, persistence, cooperation, and independence.

5. Student Perceptions of Adaptive Hypermedia Learning

Data from student responses collected through Google Form questionnaires indicated positive perceptions of the Moodle-based learning environment. Students reported that multimedia materials made vocabulary learning more engaging and that immediate feedback helped them recognize and correct errors. Many students expressed increased motivation to participate in Indonesian language learning activities through the adaptive hypermedia system. Overall, the results indicate that the Moodle-based adaptive hypermedia system supported both cognitive outcomes, as evidenced by improved vocabulary comprehension, and affective outcomes, as reflected in positive learning behaviors and character development among SMA students.

Discussion

The present study explored the implementation of a Moodle-based adaptive hypermedia system to enhance Indonesian vocabulary comprehension and support character development among senior high school (SMA) students. The findings indicate that the integration of adaptive hypermedia into Indonesian language learning contributed positively to both cognitive and affective learning outcomes. This section discusses the results in relation to relevant theories and prior research and outlines the implications of the findings.

The observed improvement in students' vocabulary comprehension suggests that adaptive hypermedia learning environments can effectively support language development by presenting vocabulary in contextualized and multimedia-rich formats. The adaptive structure of the learning activities enabled students to engage with learning materials at their own pace and level of understanding. This finding aligns with multimedia learning theory, which emphasizes that well-designed combinations of text, visuals, and interactive elements can enhance learners' comprehension and retention (Mayer, 2009). For SMA students, who are required to master academic vocabulary for complex reading and writing tasks, such learning environments appear particularly beneficial. The shift in vocabulary mastery distribution, where all students achieved satisfactory performance levels after the implementation, highlights the potential of adaptive learning systems to reduce disparities in learning outcomes. By accommodating individual differences in prior knowledge and learning speed, the Moodle-based adaptive hypermedia system supported more inclusive learning experiences. This result supports previous research indicating that adaptive digital learning environments can improve learning equity by providing personalized instructional pathways (Shute & Towle, 2003).

In addition to cognitive gains, qualitative findings revealed positive changes in students' learning behaviors and character-related attributes. Students demonstrated increased responsibility, discipline, and self-directed learning when participating in Moodle-based activities. These findings are consistent with self-regulated learning theory, which posits that learners develop autonomy and responsibility when they are actively engaged in managing their learning processes (Zimmerman, 2002). The digital learning environment encouraged students to take ownership of their learning, which is a critical aspect of character development in secondary education.

Furthermore, the learning environment facilitated social interaction and peer support, even though tasks were designed for individual completion. Informal collaboration among students supported vocabulary understanding and problem-solving, reflecting social constructivist principles that emphasize learning as a socially mediated process (Vygotsky, 1978). The Moodle-based platform provided opportunities for both independent and collaborative learning, contributing to students' academic and social development.

Students' positive perceptions of the adaptive hypermedia learning experience further strengthen the findings of this study. Increased engagement and motivation were reported due to the use of multimedia content and immediate feedback. Motivation is a crucial factor in language learning success, particularly for SMA students who may experience declining interest in traditional instructional approaches. These findings support the view that technology-enhanced learning environments can foster learner motivation and sustained engagement (Dörnyei, 2001).

Implications

The findings of this study contribute to the theoretical understanding of adaptive learning and technology-enhanced language education. The results provide empirical support for theories of multimedia learning, self-regulated learning, and social constructivism by demonstrating how adaptive hypermedia systems can simultaneously support cognitive development and character formation. This study extends existing literature by applying these theoretical frameworks within the context of Indonesian language learning at the senior high school level, an area that has received limited attention in previous research.

From a pedagogical perspective, the results suggest that Indonesian language teachers can effectively integrate Moodle-based adaptive hypermedia systems to support vocabulary learning and character education. Teachers are encouraged to design learning activities that incorporate contextualized vocabulary tasks, multimedia resources, and adaptive feedback mechanisms. Such instructional strategies can help address diverse student needs while promoting learner autonomy, responsibility, and discipline. The findings also highlight the importance of aligning digital learning activities with character education goals embedded in the curriculum. Practically, the study demonstrates that Moodle, when supported by tools such as Google Form, can be

implemented effectively in senior high school settings using students' personal devices. Schools and educational institutions may consider providing technical support and professional development programs to help teachers design and implement adaptive hypermedia-based learning environments. Additionally, policymakers and school administrators can use these findings as a reference for integrating technology-enhanced learning models that support both academic achievement and character development in secondary education.

Conclusion

The implementation of a Moodle-based adaptive hypermedia system was shown to effectively enhance Indonesian vocabulary comprehension among SMA students. The study revealed that students' average mastery scores increased significantly from the initial to the final stages, demonstrating that adaptive digital learning environments can provide personalized learning pathways that accommodate individual differences in prior knowledge and learning pace. The integration of multimedia elements, contextualized tasks, and immediate feedback played a key role in supporting cognitive learning outcomes.

Beyond academic achievement, the use of adaptive hypermedia also positively influenced students' character development. Students demonstrated greater self-discipline, responsibility, and self-directed learning behaviors when engaging with Moodle-based learning activities. Additionally, opportunities for informal peer interaction encouraged collaborative problem-solving and social learning, highlighting the system's capacity to support affective and social dimensions of education alongside cognitive development.

Overall, this study suggests that Moodle-based adaptive hypermedia systems represent a promising instructional approach for Indonesian language learning at the senior high school level. The findings underscore the potential of technology-enhanced learning to simultaneously improve language proficiency and foster positive learning behaviors, offering valuable insights for teachers, school administrators, and educational policymakers aiming to integrate digital learning tools into language curricula.

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