



Full Research Report

การพัฒนาทักษะการเขียนเชิงวิชาการผ่านเส้นทางการเรียนแบบปรับเหมาะใน
ระบบการจัดการเรียนรู้

Developing Academic Writing Skills through LMS Adaptive Learning Paths

By

Atima Kaewsa-ard, Ph. D., SFHEA
Pitak Tragoolsawang, FHEA

**This research was funded by Mae Fah Luang University
Fiscal Year B.E. 2568 (2025)**





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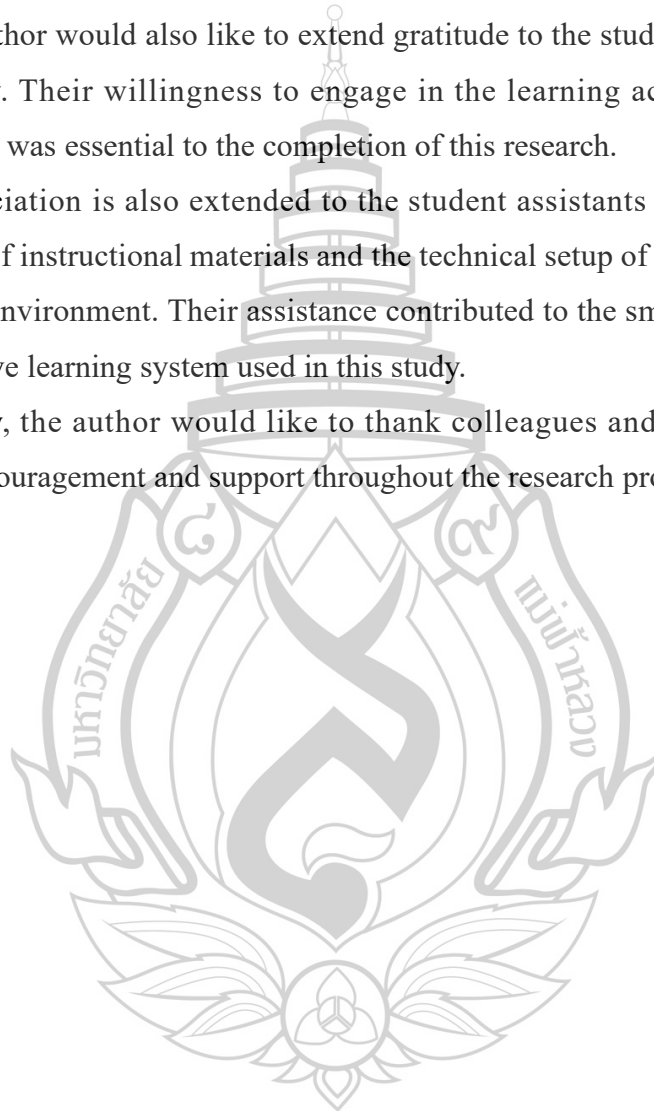
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Executive Summary

Significance of the Research Problem

Academic writing is a fundamental skill for university students, particularly in English as a Foreign Language (EFL) context where learners must simultaneously develop language proficiency, critical thinking, and academic communication abilities. However, many students struggle with paraphrasing, synthesizing sources, and organizing ideas in academic writing. Traditional classroom instruction often provides the same learning materials and pace for all students, which may not adequately address differences in learners' abilities, learning needs, and writing challenges.

With the increasing availability of digital learning technologies, Learning Management Systems (LMS) offer opportunities to design more personalized learning experiences. Adaptive learning pathways allow instructional content, tasks, and feedback to adjust according to students' learning progress and performance. Despite the growing interest in adaptive learning technologies, empirical research examining how such systems support academic writing development in EFL higher education remains limited.

This study addresses this gap by investigating the use of LMS-based adaptive learning pathways to support the development of academic writing skills among university students. The research aims to examine not only whether adaptive learning improves writing performance, but also what behavioral and pedagogical factors contribute to successful learning within the adaptive environment.

Research Objectives

This study was conducted with three main objectives:

1. To examine the extent to which LMS-based adaptive learning pathways improve students' academic writing performance.
2. To identify behavioral and pedagogical factors associated with writing improvement within the adaptive learning environment.
3. To explore students' experiences and challenges in engaging with the adaptive learning pathway.

Scope of the Study

The study was conducted in the course Advanced English Reading and Writing at Mae Fah Luang University. Approximately 180 undergraduate students participated in the research during one academic semester.

The adaptive learning system was implemented within the LMS platform and consisted of structured learning units designed to address common academic writing challenges. The system included diagnostic placement, adaptive task sequencing, automated feedback, mastery-based progression, and optional extension activities. These features allowed students to progress through learning tasks at different levels according to their performance and mastery.

The study focused on evaluating changes in students' academic writing performance, analyzing behavioral engagement patterns recorded in the LMS system, and collecting students' perceptions and experiences through questionnaires and interviews.

Research Methodology and Key Findings

This research employed a mixed-methods approach, combining quantitative and qualitative data to provide a comprehensive understanding of how adaptive learning supports writing development.

Quantitative data were collected through pre-test and post-test writing assessments as well as learning analytics from the LMS system. Qualitative data were obtained from student questionnaires and interviews to capture learners' experiences and perspectives.

The findings revealed several important outcomes. First, students' academic writing performance showed significant improvement after participating in the adaptive learning pathway. The results indicate that structured learning sequences, iterative revision opportunities, and mastery-based progression helped students gradually improve their writing skills.

Second, the analysis of LMS behavioral data showed that optional task completion was positively associated with writing improvement. Students who voluntarily engaged in additional practice activities tended to demonstrate greater

progress in writing performance. This finding highlights the importance of learner self-regulation and active engagement in the learning process.

Third, qualitative findings suggested that the diagnostic placement system helped reduce learning anxiety. Students reported feeling more comfortable when they could begin learning at a level appropriate to their abilities without being directly compared to other classmates. This feature created a supportive learning environment that encouraged students to revise their writing and experiment with different writing strategies.

However, students also reported that some advanced tasks required substantial effort and concentration, particularly in higher-level writing activities involving paragraph-level integration and source use. Some learners experienced challenges in managing their time during the later stages of the semester when academic workload increased.

Overall, the findings suggest that adaptive LMS design can support writing development not only by improving performance outcomes but also by shaping students' learning behaviors and writing processes.

Benefits and Impact of the Research

This research contributes to both academic knowledge and educational practice.

From an academic perspective, the study expands existing knowledge on the application of adaptive learning technologies in EFL writing instruction. It demonstrates how adaptive instructional design, learner engagement behaviors, and writing development interact within a digital learning environment. The findings provide empirical evidence supporting the integration of adaptive learning approaches in higher education language instruction.

From a practical perspective, the research offers valuable insights for educators and institutions seeking to improve writing instruction through digital technologies. The study highlights the importance of incorporating optional learning opportunities that encourage self-regulated learning, as well as designing adaptive systems that provide personalized learning pathways for students with diverse proficiency levels.

In addition, the findings suggest that adaptive learning systems can create more supportive learning environments by reducing anxiety and enabling students to

progress according to their own learning pace. These outcomes may contribute to improving the quality of English language education and promoting more effective learning experiences for university students.

Overall, this research demonstrates the potential of LMS-based adaptive learning pathways as an innovative approach to enhancing academic writing development in higher education.



บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษาประสิทธิผลของเส้นทางการเรียนรู้แบบปรับตามระดับความสามารถ (Adaptive Learning Pathway) ที่พัฒนาบนระบบการจัดการเรียนรู้ (Learning Management System: LMS) ต่อการพัฒนาทักษะการเขียนเชิงวิชาการของนักศึกษาในบริบทการเรียนภาษาอังกฤษเป็นภาษาต่างประเทศ (EFL) การวิจัยดำเนินการในรายวิชา Advanced English Reading and Writing ณ มหาวิทยาลัยแม่ฟ้าหลวง โดยมีวัตถุประสงค์ของการวิจัย ได้แก่ (1) เพื่อศึกษาระดับการพัฒนาทักษะการเขียนเชิงวิชาการของนักศึกษาหลังจากใช้เส้นทางการเรียนรู้แบบปรับตามระดับความสามารถบน LMS (2) เพื่อระบุปัจจัยด้านพฤติกรรมการเรียนรู้และปัจจัยเชิงการสอนที่สัมพันธ์กับการพัฒนาทักษะการเขียนในสภาพแวดล้อมการเรียนรู้แบบปรับตามระดับความสามารถ และ (3) เพื่อศึกษาประสบการณ์และความท้าทายของนักศึกษาในการมีส่วนร่วมเส้นทางการเรียนรู้ดังกล่าว

การวิจัยใช้ระเบียบวิธีวิจัยแบบผสมผสาน (Mixed-Methods Research Design) โดยข้อมูลเชิงปริมาณได้มาจากผลการทดสอบก่อนเรียนและหลังเรียนด้านการเขียน รวมถึงข้อมูลพฤติกรรมการเรียนรู้ที่บันทึกจากระบบ LMS ส่วนข้อมูลเชิงคุณภาพได้มาจากแบบสอบถามและการสัมภาษณ์นักศึกษา เพื่อให้เข้าใจประสบการณ์การเรียนรู้ของผู้เรียนอย่างลึกซึ้ง กลุ่มตัวอย่างในการวิจัยประกอบด้วยนักศึกษาระดับปริญญาตรีจำนวน 180 คน ที่เข้าร่วมการศึกษาเป็นระยะเวลา 1 ภาคการศึกษา

ผลการวิจัยพบว่า ทักษะการเขียนเชิงวิชาการของนักศึกษามีพัฒนาการเพิ่มขึ้นอย่างมีนัยสำคัญหลังจากเข้าร่วมการเรียนรู้ผ่านเส้นทางการเรียนรู้แบบปรับตามระดับความสามารถ การวิเคราะห์ข้อมูลพฤติกรรมการเรียนรู้พบว่า การมีส่วนร่วมโดยสมัครใจในการทำแบบฝึกหัดเพิ่มเติม (Optional Learning Tasks) มีความสัมพันธ์เชิงบวกกับการพัฒนาทักษะการเขียน นอกจากนี้ ผลการวิเคราะห์เชิงคุณภาพยังชี้ให้เห็นว่า การจัดระดับผู้เรียนด้วยแบบทดสอบวินิจฉัยและโครงสร้างการเรียนรู้แบบปรับตามระดับความสามารถช่วยลดความวิตกกังวลในการเขียนของนักศึกษา และสร้างสภาพแวดล้อมการเรียนรู้ที่สนับสนุนให้ผู้เรียนกล้าปรับแก้และพัฒนางานเขียนของตนเอง อย่างไรก็ตาม นักศึกษาบางส่วนรายงานว่ากิจกรรมการเขียนในระดับที่สูงขึ้นมีความท้าทายด้านภาระงานและการบริหารจัดการเวลา

โดยสรุป ผลการวิจัยชี้ให้เห็นว่า เส้นทางการเรียนรู้แบบปรับตามระดับความสามารถบนระบบ LMS สามารถสนับสนุนการพัฒนาทักษะการเขียนเชิงวิชาการได้อย่างมีประสิทธิภาพ โดยการผสมผสานการออกแบบการสอนที่เป็นระบบเข้ากับโอกาสในการมีส่วนร่วมของผู้เรียนและการเรียนรู้แบบกำกับตนเอง

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Abstract

This study investigates the effectiveness of an LMS-based adaptive learning pathway in improving academic writing skills among university students in an English as a Foreign Language (EFL) context. The study was conducted in the Advanced English Reading and Writing course at Mae Fah Luang University. The objectives of the research were: (1) to examine the extent to which LMS-based adaptive learning pathways improve students' academic writing performance, (2) to identify behavioral and pedagogical factors associated with writing improvement within the adaptive learning environment, and (3) to explore students' experiences and challenges in engaging with the adaptive learning pathway.

The study employed a mixed-methods research design. Quantitative data were collected from pre-test and post-test writing assessments and behavioral log data recorded in the Learning Management System (LMS). Qualitative data were obtained through student questionnaires and interviews to gain deeper insights into learners' experiences. A total of 180 undergraduate students participated in the study over one academic semester. The results indicated that students' academic writing performance improved significantly after participating in the adaptive learning pathway. Analysis of behavioral data revealed that voluntary engagement in optional learning tasks was positively associated with writing improvement. Qualitative findings further indicated that the diagnostic placement and adaptive learning structure helped reduce students' writing anxiety and provided a supportive learning environment that encouraged revision and active engagement in writing activities. However, some students reported challenges related to workload and time management when engaging with higher-level writing tasks. Overall, the findings suggest that LMS-based adaptive learning pathways can effectively support academic writing development by combining structured instructional design with opportunities for learner engagement and self-regulated learning.

Keywords:

Adaptive Learning, Learning Management System, Academic Writing, EFL Writing Instruction, Behavioral Engagement

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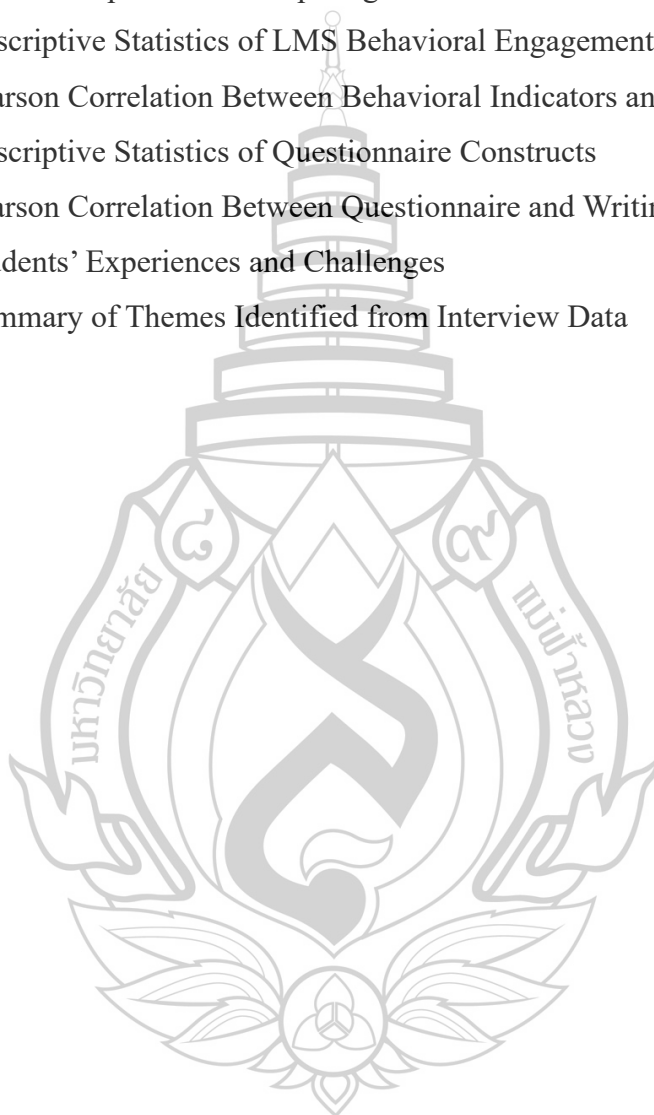
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Chapter 1

Introduction

1.1 Background of the Study

Academic writing is widely regarded as a core competence in higher education because it reflects students' ability to think critically, organize ideas logically, and communicate effectively within academic communities. It extends beyond grammatical accuracy and demonstrates intellectual development as well as disciplinary understanding. As noted by Munir (2025), academic writing competence represents students' reasoning ability and their readiness to engage in scholarly inquiry. Students who can produce coherent, well-structured, and properly referenced texts are better prepared to participate in academic discussions and research-related activities. Writing tasks require learners to analyze information, compare perspectives, and synthesize multiple sources, all of which contribute to the development of higher-order thinking skills. For these reasons, academic writing is closely associated with academic achievement and long-term professional growth.

Despite its recognized importance, many university students continue to experience persistent challenges in academic writing. Students frequently struggle with organizing arguments, maintaining coherence across paragraphs, and integrating sources appropriately (Munir, 2025). As a result, their writing often lacks clear structure and consistent referencing, which weakens both clarity and academic credibility. Schillings et al. (2018) emphasize that students benefit from structured guidance and dialogic feedback to improve their writing processes. Among the most demanding aspects of academic writing is the effective use of evidence. Students must paraphrase and summarize ideas accurately while avoiding plagiarism, which requires deep comprehension and careful restructuring of information. These challenges are even more significant in EFL contexts, where learners must manage linguistic accuracy and complex reasoning simultaneously. Without systematic instructional support, students may rely excessively on source texts or struggle to express ideas independently.

In the Thai higher education context, these challenges are particularly significant because English academic writing is learned and practiced primarily in an EFL environment where students often have limited exposure to authentic academic communication in English outside the classroom. Previous research on Thai EFL learners has shown that writing is one of the most serious difficulties among Thai undergraduate students, with problems involving not only grammar but also rhetoric, conventions, organization, word choice, sentence structure, transitions, and discourse-level control (Thongchalerms & Jarunthawatchai, 2020). These findings are consistent with broader ESL/EFL academic writing research, which indicates that learners commonly struggle with limited vocabulary, grammatical accuracy, sentence structure, idea development, coherence, argument organization, paraphrasing, citation practices, and source integration (Esperanzate, 2025; Singh, 2019). Academic writing therefore requires students to manage several demanding processes simultaneously, including understanding source texts, selecting appropriate academic vocabulary, restructuring sentences, maintaining coherence, applying citation conventions, and integrating source information into their own writing. These demands can be especially challenging for learners whose English proficiency is still developing, particularly in heterogeneous classrooms where students have different levels of readiness and require different degrees of instructional support.

Given these ongoing challenges, it becomes necessary to reconsider how academic writing can be effectively developed in higher education. Writing improvement is inherently gradual and cannot be achieved through product-oriented instruction or single-draft submission alone. Instead, it requires sustained practice supported by iterative revision cycles that allow learners to reflect on and refine their work over time. Research on personalized and adaptive learning underscores the importance of structured feedback systems in enhancing both academic performance and learner engagement (du Plooy et al., 2024; Yaseen et al., 2025). When feedback is timely, specific, and aligned with clear criteria, students are more likely to revise purposefully and develop awareness of their strengths and weaknesses. These findings suggest that effective academic writing instruction must prioritize continuous revision, reflection, and differentiated feedback rather than relying solely on one-time evaluation.

However, traditional classroom instruction does not always provide the conditions necessary for sustained revision-based learning. Academic writing courses frequently adopt a one-size-fits-all model in which identical tasks, materials, and evaluation criteria are applied to all students regardless of their individual differences. University classrooms typically consist of learners with diverse linguistic backgrounds, writing proficiency levels, and prior academic experiences. Many students enter higher education without a clear understanding of disciplinary writing conventions, and such expectations are not always explicitly addressed (Schillings et al., 2018). As a result, both advanced and struggling learners may be affected. Stronger students may not receive sufficient cognitive challenge to extend their academic writing abilities, while weaker students may lack the scaffolded support necessary to develop foundational skills in organization, coherence, and academic language use (Hurko & Novikova, 2025). When instruction does not differentiate between learner profiles, opportunities for meaningful development become limited, potentially reducing engagement and slowing writing improvement.

In addition to the lack of differentiation, feedback practices in traditional classrooms are often constrained by time and workload. Providing detailed and individualized feedback across multiple drafts is demanding, particularly in large classes. Consequently, feedback may focus primarily on surface-level issues such as grammar and mechanics rather than deeper elements including argument development, coherence, and critical analysis (Nobakht, 2025). Although written feedback is widely recognized as essential for writing development, research indicates that comments alone are insufficient if students do not fully understand or actively engage with them (Schillings et al., 2018). Without structured opportunities for dialogue or guided revision, feedback may become corrective rather than developmental, limiting its long-term impact.

These constraints are intensified in large EFL writing classes where students require different types and levels of support. In the present instructional context, students studied the target academic writing skills within a limited four-week period. This restricted timeframe made it difficult to provide repeated individualized feedback, extended guided practice, and multiple revision opportunities for every learner. Although classroom instruction introduced key concepts and strategies, the diversity

of student proficiency levels meant that some students needed more foundational support, while others required more cognitively demanding tasks to further develop their academic writing abilities. Therefore, the combination of large class size, mixed proficiency levels, limited instructional time, and the difficulty of providing repeated individual feedback created a strong need for a more flexible and responsive instructional model.

Another structural limitation of traditional classroom settings concerns restricted opportunities for iterative revision. Academic writing competence develops gradually through repeated drafting, reflection, and meaningful engagement with feedback (Nobakht, 2025). Process-oriented approaches and peer-supported revision have been shown to enhance student performance more effectively than product-oriented instruction that emphasizes final submissions (Wu et al., 2023). Nevertheless, fixed course timelines and assessment systems often prioritize final products rather than revision cycles. Students may submit a single draft, receive a grade, and move on without revisiting or refining their work. This structure limits deeper learning and constrains the development of higher-order writing skills. Collectively, these limitations indicate the need for instructional models that allow flexible pacing, continuous feedback, and differentiated support.

These structural constraints are clearly reflected in the Advanced English Reading and Writing course. A noticeable gap exists between the course's intended learning outcomes and students' actual academic writing proficiency. While some students can meet course expectations under conventional instruction, many others require extended practice, detailed explanation, and personalized feedback to develop essential competencies. The high variation in proficiency creates a pedagogical dilemma. Slowing instructional pacing to accommodate struggling learners may reduce cognitive challenge for advanced students, whereas accelerating instruction to challenge stronger learners may overwhelm those still developing foundational skills. Such tensions are commonly observed in heterogeneous learning environments where uniform instructional approaches are applied (Gurjar et al., 2025). Within this specific course context, the limitations of traditional instructional structures become particularly evident.

To address these pedagogical and structural challenges, alternative instructional models must be explored. Learning Management Systems (LMS) offer a promising foundation for supporting diverse learners in academic writing courses. Unlike fixed classroom structures, LMS platforms provide flexible digital environments in which learning materials, assessments, and feedback can be systematically organized and monitored (Gurjar et al., 2025). Integrated analytics enable instructors to track student performance in real time and make data-informed instructional decisions.

Recent advancements in adaptive and AI-driven learning technologies have further expanded the potential of LMS platforms. Adaptive systems use performance data to dynamically modify content difficulty, pacing, and feedback mechanisms according to learners' interaction patterns (Er-Radi et al., 2023; Afolabi et al., 2025). Rather than presenting identical tasks to all students, these systems maintain an appropriate level of challenge by adjusting instructional support continuously. Students who demonstrate mastery may progress to more complex writing tasks, whereas those requiring additional assistance can receive scaffolded exercises and targeted explanations. AI-integrated LMS environments can also recommend relevant resources, generate automated formative feedback, and support individualized learning pathways (Subbulakshmi et al., 2025; Naseer et al., 2025).

Beyond structural flexibility, adaptive learning environments have been associated with improved engagement and learning outcomes. Systems that personalize difficulty and feedback have shown positive effects on learner participation, performance, and persistence (Er-Radi et al., 2023; Escobar & Monzon, 2025). Appropriately challenging activities reduce frustration among weaker students while preventing boredom among advanced learners, thereby sustaining attention and encouraging deeper cognitive processing. Moreover, self-paced learning enhances autonomy and motivation by allowing students to allocate time according to their needs. Through continuous performance monitoring and formative feedback, learners gain clearer insight into their strengths and areas for improvement, strengthening metacognitive awareness and strategic revision skills (Subbulakshmi et al., 2025).

Within the Advanced English Reading and Writing course, integrating adaptive learning paths within the LMS offers a structured mechanism for addressing the observed proficiency gap. By leveraging performance analytics, the system can

differentiate tasks in practice, assigning higher-order analytical writing challenges to advanced learners while providing scaffolded revision exercises for students developing foundational skills in coherence, organization, and source integration. Continuous monitoring and feedback cycles enable learners to track their progress and engage in meaningful revision. In this way, adaptive learning operationalizes differentiation, supports inclusivity, and aligns instructional pacing with individual learner readiness. Rather than replacing pedagogy, adaptive learning functions as a structured instructional enhancement that strengthens revision-based writing development.

Despite the demonstrated potential of adaptive learning systems to enhance learner performance across various educational domains (Er-Radi et al., 2023; Escobar & Monzon, 2025), empirical evidence examining their impact on academic writing development in EFL higher education contexts remains limited. Academic writing in EFL settings involves distinct linguistic and cognitive demands that require the integration of language proficiency, rhetorical awareness, and critical thinking skills. Accordingly, this study aims to evaluate the effectiveness of LMS-based adaptive learning paths in improving students' academic writing performance in the Advanced English Reading and Writing course. Specifically, the study seeks to (1) examine the extent to which LMS-based adaptive learning paths improve students' academic writing performance, (2) identify behavioral and pedagogical factors associated with writing improvement within the adaptive learning environment, and (3) explore students' experiences and challenges in engaging with the adaptive learning pathway. By addressing these objectives, this study contributes empirical evidence to adaptive learning research while helping to address a significant gap in the EFL academic writing context.

1.2 Research Objectives

1. To examine the extent to which LMS-based adaptive learning paths improve students' academic writing performance.
2. To identify behavioral and pedagogical factors associated with writing improvement within the adaptive learning environment.

3. To explore students' experiences and challenges in engaging with the adaptive learning pathway.

1.3 Significance of the Study

This study is significant in both theoretical and practical dimensions. It contributes to the advancement of knowledge in adaptive learning research and offers practical implications for improving academic writing instruction in EFL higher education contexts.

1.3.1 Theoretical Significance

From a theoretical perspective, this study contributes to the expanding body of research on adaptive learning by examining its application within the specific domain of academic writing development in an EFL higher education context. Although previous studies have demonstrated the potential of adaptive learning systems to enhance learner engagement and academic performance across various disciplines, empirical research that focuses specifically on revision-based academic writing instruction remains limited.

By investigating the effectiveness of LMS-based adaptive learning paths in improving academic writing skills, this study extends adaptive learning research beyond general academic performance indicators to domain-specific literacy development. The findings may provide a clearer conceptual understanding of how personalization mechanisms such as dynamic content adjustment, automated formative feedback, and data-informed differentiation support iterative writing development.

In addition, the study may offer insights into the key factors that influence the successful implementation of adaptive learning in language education contexts. These findings can help refine existing theoretical discussions related to adaptive learning, learner engagement, and process-oriented writing pedagogy. As a result, the study contributes to a deeper understanding of how adaptive technologies can be meaningfully integrated with revision-based instructional approaches in EFL higher education.

1.3.2 Practical Significance

From a practical perspective, this study provides evidence-based guidance for the design and implementation of adaptive learning pathways in academic writing courses. The findings may inform instructional practices by demonstrating how LMS-integrated adaptive mechanisms can support differentiated instruction in heterogeneous classrooms.

More specifically, the study addresses common pedagogical challenges in academic writing instruction, including variations in student proficiency, limited opportunities for revision, and constraints on individualized feedback. By identifying effective strategies for integrating adaptive learning within existing course structures, the study may support instructors in creating more inclusive and responsive learning environments.

Furthermore, the results may inform curriculum development and institutional decision-making related to digital transformation in higher education. Insights into implementation challenges and key success factors can guide planning processes concerning the adoption of adaptive technologies, professional development for instructors, and resource allocation for LMS enhancement.

Overall, the study contributes to improving academic writing outcomes by promoting instructional models that align technological innovation with sound pedagogical principles. The integration of adaptive learning paths within LMS platforms has the potential to enhance student engagement, strengthen revision practices, and support equitable learning opportunities in EFL academic writing contexts.

1.4 Scope of the Study

This study was conducted within clearly defined boundaries in order to specify the population, setting, duration, variables, content coverage, and limitations under which the findings should be interpreted.

1.4.1 Population and Sample

The population of this study consisted of undergraduate students enrolled in the Advanced English Reading and Writing course at the university where the research was conducted.

The sample comprised 180 undergraduate students who were registered in the course during Semester 1 of the 2026 academic year. The study adopted a quasi-experimental one-group pretest–posttest design, using intact classroom cohorts as the research sample due to institutional and instructional constraints. All participating students engaged in the LMS-based adaptive learning paths implemented throughout the semester.

1.4.2 Research Setting

The study was conducted within the context of the Advanced English Reading and Writing course at the tertiary level. The university's Learning Management System served as the primary platform for delivering instructional materials, adaptive learning paths, learning analytics, and formative feedback. The adaptive learning intervention was integrated into regular course instruction rather than implemented as a separate experimental module.

1.4.3 Duration of the Study

The research was carried out during Semester 1 of the 2026 academic year. Data were collected at three stages:

1. Before the implementation of adaptive learning paths (pre-intervention stage)
2. During the intervention period
3. After the completion of the intervention (post-intervention stage)

Pre-intervention and post-intervention assessments were used to evaluate changes in students' academic writing performance and learner engagement.

1.4.4 Variables of the Study

The study focused on the following variables:

Independent Variable

Implementation of LMS-based adaptive learning paths.

Dependent Variables

Students' academic writing performance.

1.4.5 Content Scope

The adaptive learning paths were designed to address specific academic writing challenges identified in the Advanced English Reading and Writing course.

The instructional content was organized into six structured units, each targeting key areas of academic writing development:

- **Unit 1: Synonym Use in Academic Writing**
Focused on lexical variation, word choice precision, and avoidance of repetition to improve paraphrasing accuracy and academic tone.
- **Unit 2: Sentence Structure**
Emphasized sentence restructuring, syntactic flexibility, and avoidance of overly similar sentence patterns in paraphrasing.
- **Unit 3: Identifying Main Idea**
Developed students' ability to distinguish main ideas from supporting details to enhance summarizing and accurate representation of source meaning.
- **Unit 4: Overuse of Common Reporting Verbs**
Addressed the overreliance on basic reporting verbs and promoted varied and context-appropriate academic reporting language.
- **Unit 5: Citation Format and Integration of Citation**
Focused on accurate citation practices and effective integration of sources within academic paragraphs.
- **Unit 6: Source Integration**
Developed students' skills in synthesizing, paraphrasing, and integrating multiple sources coherently within academic writing.

Across all units, the adaptive learning system provided differentiated tasks based on learner performance, structured revision opportunities, and continuous formative feedback. The instructional design was grounded in adaptive learning principles and process-oriented writing approaches, emphasizing personalized progression, targeted support, and iterative drafting cycles.

1.4.6 Limitations of the Study

This research employed a quasi-experimental one-group pretest–posttest design within a specific course context involving 180 undergraduate students during Semester 1 of the 2026 academic year. The absence of a comparison group limits the ability to draw strong causal conclusions regarding the observed improvements. Therefore, the generalization of findings to other institutions or educational contexts

should be approached with caution, particularly in settings with different technological infrastructure, instructional models, or learner characteristics.

In addition, learner engagement was measured partly through self-reported instruments, which may have been influenced by individual perception and response bias. Furthermore, the researcher also served as the course instructor, which may introduce instructional influence despite efforts to maintain consistency and objectivity.

Despite these limitations, the study provides meaningful insights into the implementation of LMS-based adaptive learning paths in EFL academic writing courses at the tertiary level and contributes empirical evidence relevant to similar higher education contexts.

1.5 Definition of Terms

Academic Writing refers to structured, formal written work produced by undergraduate students in the Advanced English Reading and Writing course. In this study, academic writing specifically involves paragraph and short essay writing that demonstrates organization, coherence, appropriate tone, paraphrasing accuracy, and effective source integration.

Adaptive Learning Paths refer to structured instructional sequences within the Learning Management System (LMS) that dynamically adjust content difficulty, task progression, and feedback mechanisms based on students' diagnostic results and mastery performance. In this study, adaptive learning paths operate through rule-based branching, mastery thresholds, and iterative practice cycles designed to support differentiated writing development.

Learning Management System (LMS) refers to the institutional digital platform used to organize instructional materials, administer assessments, monitor learner progress, and deliver adaptive learning activities. In this study, the LMS functions as the technological environment through which adaptive writing modules are implemented and performance analytics are collected.

Mastery Threshold refers to the minimum performance criterion required for students to progress to higher-level tasks within the adaptive learning path. In this

study, mastery is operationalized as achieving at least 80 percent on designated mastery checks before advancing to subsequent levels.

Diagnostic Quiz refers to the initial assessment administered prior to the adaptive intervention to identify students' proficiency levels in lexical precision, sentence structure, tone, and rhetorical awareness. The results of the diagnostic quiz determine students' entry points within the adaptive learning path.

Learner Engagement refers to students' cognitive, behavioral, and emotional involvement in the adaptive learning activities. In this study, engagement is measured through self-reported survey responses and learning analytics data reflecting participation, completion, and interaction patterns within the LMS.

Metacognitive Awareness refers to students' ability to monitor, evaluate, and regulate their own writing processes. In this study, it is reflected through students' engagement with feedback, revision behaviors, and reflective interactions within the adaptive learning system.

Revision Cycle refers to the iterative process of drafting, receiving feedback, revising, and reattempting writing tasks within the adaptive learning environment. This study emphasizes structured revision opportunities as a core mechanism for academic writing improvement.

Differentiated Instruction refers to the pedagogical approach that adjusts learning tasks, content complexity, and instructional support according to students' varying proficiency levels. In this study, differentiation is operationalized through adaptive sequencing and performance-based task allocation within the LMS.

Chapter 2

Literature Review

This chapter presents a comprehensive review of theoretical perspectives and empirical research relevant to the development of academic writing skills within an EFL context and the integration of adaptive learning through Learning Management Systems (LMS). The purpose of this chapter is to establish the conceptual and theoretical foundation underpinning the present study. It begins by examining the nature and characteristics of academic writing, particularly within higher education and EFL settings. The chapter then explores the concept of adaptive learning and its distinctions from related approaches such as personalized learning and differentiated instruction. Subsequently, the role of Learning Management Systems as instructional infrastructure is discussed, followed by a review of key theoretical frameworks, including Process Writing Theory, Self-Regulated Learning Theory, and Differentiated Instruction Theory. The chapter concludes with an analysis of empirical studies on adaptive learning and academic writing, leading to the identification of research gaps and the development of the conceptual framework guiding this study.

2.1 Academic Writing: Definitions, Components, and Challenges

2.1.1 Definition of Academic Writing

Academic writing in higher education is widely understood as a formal and structured mode of communication through which knowledge is constructed, examined, and disseminated within scholarly communities. It operates under established disciplinary conventions that regulate argument organization, evidence integration, and evaluation of claims. Unlike informal writing, academic writing requires logical development of ideas, credible source support, and adherence to recognized citation practices (Schillings et al., 2023). In this sense, academic writing reflects not only linguistic competence but also alignment with institutional and disciplinary standards.

Clarifying the definition of academic writing is essential because it establishes the criteria by which writing performance is evaluated in university contexts. Effective academic writing is characterized by clear structural organization, coherence across sentences and paragraphs, appropriate academic tone, accurate paraphrasing, and meaningful source integration (Hardianti & Sabata, 2025). These features ensure that arguments are systematically developed and supported by evidence rather than personal opinion.

Beyond its formal characteristics, academic writing is widely conceptualized as a recursive process of knowledge construction. Writing is not merely a means of presenting fully formed ideas; rather, it functions as a cognitive tool through which learners analyze information, synthesize perspectives, and refine arguments through drafting and revision. From a process-oriented perspective, academic writing involves iterative cycles of planning, composing, evaluating, and revising. Structured instruction and guided practice support students in internalizing disciplinary conventions and strengthening analytical thinking (Schillings et al., 2023; Hardianti & Sabata, 2025). Academic writing therefore represents both a communicative product and an ongoing intellectual activity.

The demands of academic writing also involve substantial cognitive processing. Writers must simultaneously generate ideas, organize arguments logically, maintain coherence, evaluate evidence, and monitor linguistic accuracy. Source integration introduces additional complexity, requiring comprehension of original texts, transformation of meaning through paraphrasing or summarizing, and accurate citation. For learners operating in a second language environment, these linguistic and cognitive processes often occur concurrently, increasing the difficulty of producing academically acceptable texts.

Taken together, academic writing can be understood as a multidimensional activity that combines formal conventions, recursive revision processes, and intensive cognitive coordination. These characteristics help explain why students in EFL contexts frequently demonstrate varied levels of writing proficiency and why uniform instructional pacing may not adequately support all learners.

In the context of the present study, academic writing refers specifically to structured paragraph and short essay writing produced by undergraduate students enrolled in the Advanced English Reading and Writing course. The focus is on organization, coherence, academic tone, paraphrasing accuracy, and effective source integration. These components represent core structural and cognitive demands at the undergraduate level and form the foundation for the adaptive instructional design examined in this research.

2.1.2 Key Characteristics of Academic Writing

Building on the conceptual understanding presented in the previous section, effective academic writing in higher education can be examined through several defining characteristics. These include structural organization, coherence and cohesion, responsible source integration, and analytical argumentation. Rather than functioning as isolated features, these dimensions operate interdependently and collectively establish the criteria by which academic texts are evaluated in university contexts.

2.1.2.1 Structure and Organization

A central feature of academic writing is deliberate structural organization. Academic texts are expected to present ideas in a clear and systematic manner, typically beginning with a focused claim or central argument, followed by logically sequenced supporting points. Effective organization enables readers to identify the purpose of the text and follow the progression of reasoning without ambiguity (Britton, 2025).

Research further highlights the importance of paragraph-level organization. Each paragraph should develop a single controlling idea supported by relevant explanation or evidence. Weak structural control often leads to fragmented writing in which ideas lack clear hierarchical relationships (Ahmad et al., 2019). Structure therefore functions not merely as a formal requirement but as a cognitive framework that supports clarity, logical development, and reader comprehension.

2.1.2.2 Coherence and Cohesion

While structure concerns the macro-level organization of ideas, coherence refers to the logical relationships among those ideas, and cohesion involves the linguistic devices that signal these relationships. Effective academic writing requires integration of both elements. Coherence ensures conceptual continuity, whereas cohesion provides explicit linguistic markers that guide readers through the argument.

Empirical research examining academic abstracts and student writing indicates that insufficient use of cohesive devices and unclear thematic progression frequently weaken textual clarity (Ahmad et al., 2019). Even when ideas are relevant, a lack of clear connections can produce writing that appears disjointed. Effective academic writing therefore demands careful management of transitions, reference words, and logical connectors to sustain continuity across sentences and paragraphs (Britton, 2025).

2.1.2.3 Citation and Source Integration

Another defining characteristic of academic writing is responsible engagement with external sources. Academic discourse requires writers to position their arguments within existing scholarship and demonstrate how their claims relate to prior research. This process involves more than inserting citations; it requires accurate interpretation, selective use of relevant information, and meaningful integration into the writer's own argument.

Studies on source-based writing show that both L1 and L2 writers often experience difficulty integrating sources effectively. Common challenges include patchwriting, overreliance on lexical substitution, and failure to clarify the relationship between source material and original claims (Doolan, 2021). Effective source integration therefore demands linguistic transformation, rhetorical awareness, and critical engagement. Proper citation practices further reflect academic integrity. Clear referencing serves ethical and rhetorical purposes by ensuring transparency and reinforcing credibility within scholarly communities (Britton, 2025).

2.1.2.4 Analytical Argumentation

Academic writing also requires analytical depth. Writers are expected to construct claims supported by evidence, evaluate alternative perspectives, and demonstrate reasoned judgment. Argumentation involves presenting a clear position, justifying it through scholarly support or data, and explaining logical relationships among ideas (Britton, 2025).

Critical thinking is evident in how writers interpret and synthesize sources. Rather than reproducing information, effective academic writers evaluate the significance of evidence and integrate it into a coherent argumentative framework. Weak argumentation often manifests as descriptive listing without analytical development, thereby reducing the intellectual quality of the text (Doolan, 2021).

Taken together, structure, coherence, source integration, and argumentation represent core evaluative dimensions of academic writing in higher education. These interrelated characteristics underscore the multidimensional and cognitively demanding nature of academic writing and provide a foundation for understanding the instructional challenges discussed in the following section.

2.1.3 Challenges in the EFL Context

Although academic writing serves as a central means of knowledge construction in higher education, students in English as a Foreign Language contexts frequently encounter substantial barriers in developing this competence. These difficulties extend beyond grammatical inaccuracies and reflect interconnected linguistic, rhetorical, cognitive, and affective dimensions. Research consistently indicates that challenges in EFL academic writing are multidimensional and require systematic instructional responses (Alzahrani, 2025; Esperanzate, 2024; Fadhly, 2022).

2.1.3.1 Linguistic Challenges

One of the most frequently reported obstacles involves linguistic limitations. EFL learners often demonstrate restricted academic vocabulary range, inaccurate grammatical constructions, and difficulty producing complex sentence structures. Such limitations constrain their ability to articulate abstract ideas and nuanced arguments effectively (Alzahrani, 2025).

Research further suggests that students frequently rely on simple syntactic patterns and repetitive lexical choices, reducing textual sophistication and precision (Marlina, 2024). In addition, first language influence may affect syntactic organization and rhetorical expression, resulting in structures that do not fully align with English academic conventions (Fadhly, 2022). These linguistic constraints influence not only surface-level accuracy but also the clarity and credibility of academic arguments.

2.1.3.2 Organizational and Rhetorical Issues

Beyond grammar and vocabulary, many EFL learners struggle with discourse-level organization. Students may produce relevant content but fail to maintain logical progression across sentences and paragraphs, leading to fragmented or loosely connected texts (Fadhly, 2022; Marlina, 2024).

In some cases, learners have difficulty establishing rhetorical relationships such as cause and effect, comparison, or justification. This reflects limited awareness of academic discourse conventions. Esperanzate (2024) identifies coherence and organization as recurring areas of difficulty across ESL and EFL contexts, emphasizing that instructional strategies must address discourse structuring rather than focusing exclusively on sentence-level accuracy. Organizational weaknesses therefore reflect gaps in rhetorical competence rather than purely linguistic deficiency.

2.1.3.3 Paraphrasing and Source Integration Difficulties

Paraphrasing and citation practices represent another significant area of challenge. EFL learners often attempt to restate source material primarily through lexical substitution without sufficiently transforming sentence structure or conceptual framing (Alzahrani, 2025). This approach frequently results in paraphrases that remain structurally similar to the source text and may increase the risk of unintentional plagiarism.

Students may also misinterpret source meaning due to limited contextual understanding, leading to inaccurate representation of ideas (Esperanzate, 2024). Insufficient training in source integration strategies and limited exposure to academic discourse contribute to these difficulties (Fadhly, 2022). Effective source integration

therefore requires not only linguistic modification but also interpretive accuracy and rhetorical positioning within a broader scholarly conversation.

2.1.3.4 Affective Factors and Writing Anxiety

In addition to linguistic and rhetorical challenges, affective variables significantly influence writing development. Writing anxiety, fear of negative evaluation, and low self-efficacy can reduce students' willingness to revise drafts and engage deeply with feedback (Marlina, 2024).

Esperanzate (2024) observes that in many ESL and EFL contexts, writing is often perceived as a one-time product rather than a recursive process involving drafting and revision. Such perceptions discourage experimentation and risk-taking, which are essential for improvement. When learners lack confidence, they may avoid complex structures or analytical engagement, thereby limiting cognitive development.

Taken together, linguistic competence, rhetorical awareness, paraphrasing ability, and affective factors function as interrelated influences on academic writing performance. These dimensions interact to produce variability in learners' writing readiness within the same classroom. Such heterogeneity suggests that uniform instructional pacing may not sufficiently address diverse learner needs, thereby reinforcing the need for structured and differentiated support mechanisms.

2.1.4 Instructional Implications and Connection to the Advanced English Reading and Writing Course

The challenges identified in the EFL academic writing literature are directly reflected in the Advanced English Reading and Writing course at Mae Fah Luang University. Classroom evidence consistently aligns with previously documented linguistic, rhetorical, and affective difficulties among EFL learners (Alzahrani, 2025; Esperanzate, 2024; Fadhly, 2022). These recurring patterns highlight the need to examine instructional structures within the course context.

2.1.4.1 Observed Challenges in the Course Context

Analysis of diagnostic assessments, classroom observations, and student writing samples reveals several recurring issues. First, many students rely heavily on

lexical substitution when paraphrasing, replacing individual words without restructuring sentence patterns or reinterpreting conceptual meaning. As documented in prior research, this strategy often produces texts that remain structurally similar to source material and demonstrate limited transformation (Alzahrani, 2025).

Second, coherence across sentences and paragraphs remains a persistent concern. Students frequently present relevant ideas but fail to establish clear logical progression or rhetorical relationships. This pattern reflects limited discourse-level awareness, a difficulty widely reported in EFL writing research (Fadhly, 2022; Marlina, 2024).

Third, affective barriers influence writing development. Some students demonstrate hesitation in revising drafts independently and perceive writing tasks as single-attempt assignments rather than iterative processes involving feedback and refinement. Such perceptions mirror findings in broader ESL and EFL contexts (Esperanzate, 2024).

2.1.4.2 Gap Between Learning Objectives and Student Proficiency

The course learning outcomes require students to produce coherent academic paragraphs and short essays that demonstrate accurate paraphrasing, effective source integration, logical organization, and appropriate academic tone. However, diagnostic evidence indicates that many students enter the course without consistent mastery of these competencies.

This discrepancy reveals a structural gap between intended learning outcomes and baseline student readiness. While course objectives emphasize analytical writing and rhetorical sophistication, many students continue to operate at a sentence-level focus. Without structured scaffolding and iterative practice, learners encounter difficulty bridging this developmental gap.

2.1.4.3 Need for Structured Revision Cycles

Research on process-oriented writing highlights the importance of drafting, feedback, and revision cycles in developing academic competence (Fadhly, 2022). In practice, however, large class sizes and time constraints often limit opportunities for individualized feedback. When revision is insufficiently structured, students may prioritize task completion rather than substantive improvement.

Systematic revision mechanisms are therefore necessary to guide learners through progressive refinement of ideas. Structured cycles enable students to identify weaknesses, apply targeted strategies, and gradually internalize academic conventions. Without consistent revision opportunities, writing development remains uneven and dependent on individual initiative.

2.1.4.4 Limitation of Uniform Instruction

Another significant instructional concern involves variation in student proficiency levels. Within a single classroom, learners may differ substantially in vocabulary range, grammatical control, rhetorical awareness, and metacognitive skills. Traditional whole-class instruction assumes a relatively uniform starting point, which may benefit some learners while leaving others either under-challenged or overwhelmed.

The literature suggests that effective writing instruction in heterogeneous EFL classrooms requires differentiated support mechanisms responsive to learner variability (Esperanzate, 2024; Marlina, 2024). A standardized instructional sequence may not adequately address the multidimensional nature of academic writing development.

Therefore, the instructional realities of the Advanced English Reading and Writing course point to the need for a learning environment that can provide more flexible, differentiated, and revision-oriented support. Academic writing development in heterogeneous EFL classrooms requires not only teacher explanation and writing practice, but also mechanisms for diagnosing learner readiness, assigning appropriate levels of task difficulty, providing repeated feedback, and monitoring learning progress over time. Learning Management Systems and adaptive learning mechanisms are therefore reviewed in the next section as potential instructional infrastructures for addressing these pedagogical limitations.

2.2 Learning Management Systems and Adaptive Learning

2.2.1 Learning Management Systems as Instructional Infrastructure

Learning Management Systems function as technological infrastructures that organize, deliver, and monitor instructional processes in higher education. An LMS

can be defined as a web-based or cloud-based system that provides controlled access to course materials, supports assessment management, facilitates communication, and documents learner performance (Paulsen, 2002; Mahnegar, 2012). In contemporary higher education, LMS platforms operate not merely as repositories of materials but as structured environments in which instructional sequences are designed, implemented, and evaluated (Aldiab et al., 2018).

2.2.1.1 Analytics and Learner Tracking

A major advancement in LMS development involves the integration of analytics and learner tracking capabilities. Modern platforms systematically record data related to login frequency, content access patterns, assessment results, and assignment submissions. These data allow instructors to monitor participation and evaluate academic progress (Kaplan-Leiserson, 2000; Mahnegar, 2012).

Learning analytics extends this function by enabling the systematic analysis of learner data to optimize instructional decision-making (Krishnan et al., 2022). Through data visualization and predictive modeling, institutions can identify participation trends, detect potential learning difficulties, and adjust instructional strategies. Analytics therefore move beyond administrative reporting and contribute to evidence-based pedagogy.

2.2.1.2 AI Integration

Recent developments in artificial intelligence have further expanded LMS capabilities. AI technologies are increasingly embedded within LMS environments to support automated feedback, intelligent tutoring functions, recommendation systems, and predictive analysis (Vergara et al., 2024). AI-powered tools can analyze learner responses, detect patterns of misconception, and generate targeted suggestions in real time.

AI integration enables systems to provide individualized feedback and remedial support aligned with learner performance data (Krishnan et al., 2022; Afolabi et al., 2025). Such functionality transforms the LMS from a static content delivery platform into a responsive instructional system capable of dynamic adjustment.

2.2.1.3 LMS as a Structured Learning Environment

Beyond its technological features, the LMS operates as a structured instructional environment. Courses are typically organized into sequenced modules,

scheduled assessments, and performance-based progression systems (Aldiab et al., 2018). This structural organization promotes clarity in learning objectives and supports systematic tracking of mastery development.

By integrating content sequencing, analytics, and AI-supported feedback, the LMS provides the foundational infrastructure necessary for implementing adaptive learning mechanisms. Understanding LMS as an instructional framework is therefore essential for conceptualizing adaptive learning as a structured pedagogical system rather than a standalone technological feature.

2.2.2 Adaptive Learning

2.2.2.1 Definition of Adaptive Learning

Adaptive learning is a technology-enhanced instructional approach designed to address learner variability through data-informed responsiveness. Unlike linear instructional models in which all students progress through identical content sequences, adaptive systems dynamically modify instructional pathways based on demonstrated performance and interaction patterns.

Scholars conceptualize adaptive learning as an algorithm-driven environment that personalizes learning trajectories through continuous analysis of learner data. Munoz et al. (2022) describe adaptive learning systems as environments that adjust task difficulty and sequencing according to learner responses. Jing et al. (2023) further explain that adaptive technologies regulate pacing and progression by analyzing assessment outcomes and engagement indicators. These definitions emphasize the role of computational modeling and analytics in shaping instructional decisions.

From an artificial intelligence perspective, adaptive learning environments employ machine learning and semantic analysis to enhance instructional precision. El-Sabagh (2021) notes that adaptive systems provide individualized feedback and support self-regulated learning. More advanced systems can identify conceptual gaps and retrieve targeted remedial materials based on students response patterns (Afolabi et al., 2025). Adaptive learning therefore represents a data-centered paradigm that integrates algorithmic sequencing, mastery-based progression, and AI-supported feedback to create responsive learning environments.

2.2.2.2 Behavioral Engagement Mechanisms in Adaptive Systems

While adaptive learning is often discussed in technological terms, its effectiveness is closely linked to behavioral engagement mechanisms. Data-driven differentiation influences how learners interact with instructional tasks and how frequently they practice targeted skills.

A central mechanism involves mastery attempts regulated by performance thresholds. Learners are typically required to reach specified benchmarks before advancing to more complex content (Jing et al., 2023). This structure encourages repeated attempts and sustained practice when mastery is not yet achieved. Repeated engagement with targeted tasks increases practice intensity, which has been associated with improved learning outcomes.

Adaptive systems also influence time-on-task by structuring progression according to demonstrated competence. Learners who require additional support may spend extended time engaging with scaffolded materials, while more advanced learners progress to higher-level challenges. Such differentiation affects the amount and distribution of practice across learners.

Persistence is another behavioral dimension supported by adaptive mechanisms. Immediate feedback and incremental progression reduce frustration and support continued engagement (El-Sabagh, 2021). When students perceive attainable progression through clearly defined thresholds, they may demonstrate greater willingness to revise, retry, and refine their work.

Taken together, mastery attempts, time-on-task distribution, repeated revision, and persistence function as behavioral pathways through which adaptive systems influence learning outcomes. These mechanisms provide an explanatory basis for examining how engagement within adaptive environments may contribute to academic writing improvement.

2.2.2.3 Pedagogical Design Features in Adaptive Environments

In addition to behavioral mechanisms, the effectiveness of adaptive systems is shaped by pedagogical design features embedded within the instructional architecture.

Diagnostic assessment represents a foundational component. Initial evaluation of learner proficiency allows the system to generate individualized pathways aligned with baseline competence (Munoz et al., 2022). Accurate placement reduces cognitive overload and ensures appropriate challenge levels.

Mastery-based progression, supported by clearly defined performance criteria, regulates advancement and consolidates foundational knowledge before introducing complexity (Jing et al., 2023). This structure aligns with process-oriented writing development by requiring learners to demonstrate competence prior to progression.

Automated feedback further enhances instructional effectiveness. Immediate, individualized feedback supports metacognitive awareness and error correction (El-Sabagh, 2021). Advanced systems provide targeted suggestions derived from analytic models (Afolabi et al., 2025), strengthening the alignment between student performance and instructional response.

Structured remediation distinguishes adaptive learning from repetitive practice models. Instead of presenting identical tasks, adaptive systems provide scaffolded exercises, alternative explanations, and targeted resources aligned with identified gaps (Afolabi et al., 2025). These pedagogical features create iterative revision cycles that mirror the recursive nature of academic writing development.

Collectively, diagnostic placement, mastery thresholds, automated feedback, and scaffolded remediation constitute design features that shape learning effectiveness within adaptive environments. Adaptive learning effectiveness is not solely a function of technological sophistication but of the interaction between behavioral engagement and pedagogical design. Within an LMS environment, adaptive instructional design integrates diagnostic assessment, mastery-based sequencing, analytics tracking, and AI-supported feedback.

These structural features influence behavioral engagement through repeated practice, time-on-task regulation, performance-based progression, and persistence. Through sustained engagement with scaffolded tasks and iterative feedback cycles, students have opportunities to refine organization, coherence, paraphrasing, and

source integration skills. Adaptive systems therefore provide a structured framework for supporting heterogeneous learner development in academic writing contexts.

In the context of EFL academic writing, adaptive learning is particularly relevant because writing development requires individualized support across multiple subskills, including lexical precision, sentence restructuring, coherence, citation accuracy, and source integration. These subskills often develop unevenly among learners, especially in heterogeneous classrooms where students enter the course with different levels of linguistic and rhetorical readiness. Adaptive sequencing, diagnostic placement, and targeted remediation therefore provide a pedagogically appropriate mechanism for supporting writing development in ways that uniform instruction may not fully achieve.

2.3 Behavioral Mechanisms in Adaptive Learning

Adaptive learning effectiveness depends not only on technological differentiation but also on how learners behaviorally engage with instructional tasks. Behavioral mechanisms refer to observable patterns of learner interaction within the system, including time allocation, repetition of tasks, and persistence in response to difficulty. These behavioral dimensions function as mediating processes through which adaptive instructional design influences learning outcomes.

Recent research conceptualizes adaptive learning as a dynamic interaction between system responsiveness and learner behavior. Li and Lu (2025) emphasize that intelligent educational systems rely on multimodal behavioral modeling to monitor and interpret learner engagement patterns. Similarly, He et al. (2025) describe adaptive learning processes as involving continuous adjustment based on learner responses, highlighting that adaptation occurs through active engagement rather than passive exposure. These perspectives suggest that student behavior within adaptive systems is central to instructional effectiveness.

2.3.1 Time-on-Task and Cognitive Engagement

Time-on-task represents the duration learners devote to focused engagement with instructional activities. Within adaptive environments, time allocation is not uniform but varies according to individual progression and mastery requirements.

Learners who require additional practice may spend extended periods engaging with scaffolded materials, whereas others may advance more rapidly.

Empirical work in adaptive learning indicates that time-on-task is associated with depth of processing and skill acquisition (Li & Lu, 2025). Sustained engagement provides opportunities for rehearsal, feedback integration, and refinement of understanding. In academic writing contexts, extended interaction with paraphrasing or organization tasks may support deeper restructuring of ideas rather than superficial lexical substitution.

2.3.2 Mastery Attempts and Repeated Practice

Mastery-based systems regulate progression through performance thresholds. Learners are required to demonstrate competence before accessing subsequent levels (Jing et al., 2023). This structure generates repeated mastery attempts when initial responses do not meet criteria.

Repeated attempts serve as indicators of active engagement and practice intensity. According to Li and Lu (2025), adaptive algorithms adjust difficulty based on learner responses, encouraging iterative interaction with targeted skills. Such repetition supports consolidation of knowledge and procedural fluency. In writing instruction, multiple attempts at revising structure or integrating sources provide opportunities to refine rhetorical control and reduce structural similarity to original texts.

2.3.3 Persistence and Response to Difficulty

Persistence reflects a learner's willingness to continue engaging with tasks despite errors or challenges. Adaptive systems that provide immediate and targeted feedback reduce uncertainty and guide corrective action (El-Sabagh, 2021). When learners perceive that progression is attainable through incremental improvement, they are more likely to remain engaged.

He et al. (2025) describe adaptive learning as a process that depends on ongoing behavioral adjustment in response to feedback. Within this framework, persistence is not merely endurance but adaptive recalibration based on system signals. In academic writing development, persistence may manifest as repeated revision, incorporation of feedback, and sustained refinement of textual coherence.

2.3.4 Revision Frequency and Behavioral Indicators of Learning

Revision behavior represents a particularly relevant mechanism in writing-focused adaptive environments. Because academic writing is inherently recursive, repeated drafting and revision are integral to skill development. Adaptive systems that require performance-based progression naturally generate revision cycles.

Behavioral indicators such as number of attempts, revision frequency, completion rate, and progression level provide measurable evidence of engagement within adaptive pathways. These data allow researchers to examine how interaction patterns correlate with performance gains. As noted by Li and Lu (2025), behavioral data serve as critical inputs for adaptive systems and simultaneously offer insight into learner engagement intensity.

For academic writing development, these behavioral indicators are meaningful because writing improvement depends on repeated engagement with feedback, revision, and practice. Learners do not usually improve their academic writing through exposure to content alone; rather, they develop writing competence by repeatedly attempting tasks, responding to feedback, revising their texts, and sustaining effort across multiple stages of learning. Therefore, LMS log data such as time-on-task, mastery attempts, revision frequency, persistence, progression patterns, and optional task completion can provide useful evidence of how learners engage with writing-focused adaptive tasks and how such engagement may be associated with writing improvement.

2.4 Pedagogical Design Mechanisms in Adaptive Learning

While adaptive systems provide technological capacity for personalization, their effectiveness depends substantially on pedagogical design. Adaptive learning does not improve outcomes solely through algorithmic sequencing; rather, learning gains emerge when instructional structures are deliberately organized to guide revision, feedback use, and progressive skill development. Pedagogical design mechanisms therefore shape how adaptive capabilities are translated into meaningful learning experiences.

Research on adaptive learning in higher education emphasizes that successful implementation requires alignment between technological functionality and instructional planning (Cavanagh et al., 2020). Adaptive pathways must be intentionally structured to support learner development through scaffolded guidance, iterative practice, and ongoing assessment. Similarly, Arsovic and Stefanović (2020) highlight that adaptive models are most effective when instructional tasks are organized to correspond with individual performance profiles and learning needs.

2.4.1 Scaffolded Feedback

Scaffolded feedback constitutes a central pedagogical mechanism in adaptive environments. Rather than providing generic correctness indicators, scaffolded feedback delivers targeted guidance that supports incremental improvement. Such feedback may include clarification of errors, explanation of misconceptions, and suggestions for revision.

Adaptive systems enhance this process by linking feedback to learner performance data. According to Cavanagh et al. (2020), effective adaptive designs incorporate feedback loops that enable learners to understand why responses require modification and how improvement can be achieved. Scaffolded feedback supports metacognitive awareness and promotes active correction rather than passive acknowledgment of errors.

In academic writing contexts, scaffolded feedback is particularly important because revision involves complex coordination of structure, coherence, and source integration. Feedback that directs attention to specific weaknesses facilitates progressive refinement of textual quality.

2.4.2 Revision Cycles and Iterative Learning

Revision cycles represent another key pedagogical feature within adaptive systems. Academic writing development is inherently recursive, requiring multiple stages of drafting and refinement. Adaptive learning environments that integrate mastery-based progression naturally encourage repeated revision before advancement.

Donevska-Todorova et al. (2022) argue that individualized learning pathways are most effective when learners are given opportunities to revisit content based on performance indicators. Structured revision cycles promote deeper processing by

allowing students to apply feedback, reattempt tasks, and monitor improvement across iterations.

In writing-focused adaptive systems, revision cycles align directly with the cognitive demands of text production. Learners refine organization, clarify argumentation, and improve paraphrasing accuracy through successive attempts. Iterative engagement strengthens retention and supports sustained skill development.

2.4.3 Differentiated Tasks and Adaptive Pathways

Differentiated task design ensures that learners encounter activities appropriate to their proficiency levels. Adaptive systems operationalize differentiation by adjusting task complexity, sequencing, and support based on diagnostic data and ongoing performance monitoring (Arsovic & Stefanović, 2020).

Rather than presenting identical assignments to all learners, adaptive environments provide varied levels of challenge. Morze et al. (2021) describe how LMS-based adaptive implementations enable personalized progression through modular content, allowing learners to advance upon mastery or receive additional support when necessary.

Differentiated tasks maintain appropriate cognitive challenge, preventing disengagement due to boredom or overload. In heterogeneous writing classrooms, such differentiation is particularly valuable because students often demonstrate varying degrees of linguistic and rhetorical readiness.

2.4.4 Formative Assessment and Continuous Monitoring

Formative assessment functions as a guiding mechanism within adaptive instructional design. Continuous monitoring of learner performance allows instructional pathways to be adjusted dynamically. Rather than relying solely on summative evaluation, adaptive systems integrate ongoing assessment to inform progression decisions.

Donevska-Todorova et al. (2022) emphasize that adaptive learning strategies rely on continuous data collection to individualize instruction. Formative assessment data inform not only system-driven adjustments but also pedagogical refinements in task sequencing and feedback provision.

In writing instruction, formative assessment supports timely identification of weaknesses in organization, coherence, and source integration. By embedding assessment within the learning process, adaptive environments enable responsive adjustment that supports incremental mastery.

2.4.5 Pedagogical Structuring as a Determinant of Effectiveness

Taken together, scaffolded feedback, structured revision cycles, differentiated tasks, and formative assessment constitute core pedagogical design mechanisms within adaptive learning systems. These features ensure that technological personalization is translated into structured instructional guidance.

The literature suggests that adaptive learning is most effective when instructional design principles are intentionally integrated into system architecture (Cavanagh et al., 2020; Morze et al., 2021). Technology alone does not guarantee improvement. Rather, learning gains occur when adaptive capabilities are embedded within pedagogically coherent structures that promote sustained engagement, iterative revision, and progressive skill development.

These pedagogical mechanisms are directly aligned with the recursive and skill-specific nature of EFL academic writing. Scaffolded feedback supports learners in identifying weaknesses in paraphrasing, coherence, citation, and source integration. Revision cycles provide repeated opportunities for learners to transform source ideas, reorganize sentence structures, and improve paragraph-level flow. Differentiated tasks allow students with different levels of readiness to receive appropriate levels of challenge and support, while formative assessment helps determine whether learners are ready to progress to more complex writing tasks. In this way, adaptive pedagogical design connects technological personalization with the actual processes required for academic writing development.

2.5 Theoretical Foundations for Designing Adaptive Learning Pathways

The adaptive learning pathway developed in this study is informed by three interrelated theoretical perspectives: Process Writing Theory, Self-Regulated Learning Theory, and Differentiated Instruction Theory. These perspectives collectively provide

the pedagogical justification for integrating adaptive mechanisms into a Learning Management System to enhance academic writing development. Rather than serving as isolated conceptual lenses, these theories function together to explain why diagnostic assessment, mastery thresholds, iterative feedback, and differentiated task sequencing are necessary in the design of adaptive writing instruction.

2.5.1 Process Writing Theory

Process Writing Theory conceptualizes writing as a developmental and cyclical activity that unfolds over multiple stages. Writing is not treated as a single act of production but as a process that involves idea generation, drafting, reviewing, revising, and refining. This theoretical orientation shifts the focus from evaluating final written products toward supporting learners throughout the composing process.

Bloom's (1968) concept of mastery learning reinforces this developmental perspective by proposing that learners should achieve a sufficient level of understanding before moving to more advanced material. Guskey (2010) further explains that mastery-based instruction requires corrective feedback and reassessment to ensure conceptual consolidation. When applied to academic writing, these principles highlight the importance of structured revision opportunities and repeated practice.

In EFL contexts, students often struggle not because they lack ideas, but because they lack structured opportunities to refine and reorganize those ideas. A process-oriented framework therefore becomes particularly relevant. The adaptive learning pathway in this study reflects this theoretical foundation by embedding structured mastery checkpoints within each instructional unit. Learners complete diagnostic assessments, receive targeted feedback, and revise their writing before progressing to subsequent tasks. Advancement is contingent upon meeting explicit performance criteria, which mirrors mastery learning principles. In this way, the system translates the theoretical assumption that writing improves through revision into an operational mechanism within the LMS environment.

2.5.2 Self-Regulated Learning Theory

Self-Regulated Learning Theory provides a cognitive explanation for how learners manage their own learning processes. It emphasizes metacognitive awareness, goal setting, performance monitoring, and strategic adjustment. Effective learners are

not merely recipients of instruction but active agents who evaluate their understanding and modify their approaches accordingly.

In academic writing, self-regulation plays a central role because composing requires sustained cognitive effort, reflection, and refinement. Learners must evaluate whether their arguments are coherent, whether evidence is integrated effectively, and whether paraphrasing maintains conceptual accuracy. Without metacognitive engagement, revision tends to remain superficial.

Technology-enhanced adaptive environments have been shown to support self-regulated learning behaviors. El-Sabagh (2021) argues that adaptive systems can strengthen engagement by providing individualized and immediate feedback that guides learner reflection. Jing et al. (2023) further note that adaptive technologies promote learner autonomy by adjusting content based on performance data, thereby encouraging students to respond to feedback and refine their understanding. AI-driven adaptive systems can also analyze response patterns to detect specific misconceptions and deliver targeted remedial resources (Afolabi et al., 2025). This targeted feedback loop supports learners in identifying weaknesses and adjusting strategies.

Within the present study, self-regulated learning principles are operationalized through continuous performance tracking and mastery-based progression. Students are required to meet defined thresholds before advancing, which encourages active monitoring of their own progress. The visibility of progress indicators within the LMS environment reinforces metacognitive awareness and fosters responsibility for revision. Thus, adaptive learning functions not only as a content delivery mechanism but also as a scaffold that supports the development of reflective writing practices.

2.5.3 Differentiated Instruction Theory

Differentiated Instruction Theory acknowledges that learners differ in readiness levels, prior knowledge, and learning profiles. Tomlinson (2001) argues that effective instruction requires responsiveness to these differences through adjustments in content, process, and assessment. Instruction that fails to accommodate learner variability risks either overwhelming some students or failing to challenge others.

Heterogeneity is particularly evident in EFL academic writing classrooms. Students may display uneven proficiency across linguistic accuracy, organizational

structure, and argument development. Traditional one-size-fits-all instruction may therefore fail to address individual learning needs adequately.

Adaptive learning systems operationalize differentiation through data-informed task sequencing. Brusilovsky (1996) explains that adaptive hypermedia systems modify content presentation and navigation structures based on user characteristics. VanLehn (2011) demonstrates that intelligent tutoring systems can approximate the benefits of human tutoring by dynamically adjusting instructional support in response to learner performance. Kinshuk (2016) extends this perspective by highlighting cognitive profiling and content-based adaptivity as mechanisms for aligning instructional material with individual learner characteristics.

In the context of this study, differentiation is embedded within the LMS through diagnostic profiling and tiered progression pathways. Learners are implicitly categorized according to writing proficiency without explicit labeling, thereby maintaining learner confidence while ensuring appropriate instructional support. Foundational learners receive scaffolded tasks that emphasize sentence-level accuracy and coherence, whereas advanced learners engage in more complex analytical writing tasks. Through algorithmic sequencing, differentiation becomes systematic rather than discretionary, ensuring consistency in instructional responsiveness.

2.6 Integration of Theoretical Perspectives into Adaptive Pathway Design

The adaptive learning pathway developed in this study is grounded in four complementary theoretical perspectives: Process Writing Theory, Mastery Learning, Self-Regulated Learning Theory, and Differentiated Instruction Theory. Together, these perspectives provide a pedagogical rationale for designing an LMS-based adaptive pathway that incorporates diagnostic assessment, mastery thresholds, iterative feedback, structured remediation, and differentiated task sequencing. Rather than operating as separate conceptual lenses, these theories jointly explain why adaptive learning requires systematic instructional structure, repeated revision opportunities, performance-based progression, learner monitoring, and differentiated support to promote academic writing development.

2.6.1 Process Writing Theory and Mastery-Oriented Revision

Process Writing Theory conceptualizes writing as a recursive activity that develops through planning, drafting, reviewing, revising, and refining. This perspective shifts the focus from evaluating a single final product toward supporting learners through successive improvement cycles. In academic writing development, progress depends on repeated opportunities to revise ideas, reorganize structure, and refine language choices.

Mastery Learning complements this process-oriented view by emphasizing that learners should demonstrate sufficient competence before moving to more advanced content. Bloom's (1968) foundational work on mastery learning provides the basis for using performance thresholds to regulate learner progression, while Guskey (2010) further explains that mastery-based instruction requires corrective feedback and opportunities for reassessment to ensure conceptual consolidation. Applied to academic writing, mastery principles support the design of structured checkpoints that require learners to revise and improve before progressing.

In this study, the adaptive pathway operationalizes Process Writing Theory through iterative practice and revision cycles. At the same time, Mastery Learning is reflected in the use of the 80% mastery threshold, corrective feedback, and reattempts. Students are not expected to move forward simply because they complete an activity; rather, they progress when they demonstrate sufficient understanding of the target writing skill. This design is particularly important for EFL academic writing because skills such as paraphrasing, sentence restructuring, coherence, citation, and source integration require repeated practice and refinement before learners can apply them independently.

2.6.2 Self-Regulated Learning Theory and Feedback-Driven Monitoring

Self-Regulated Learning Theory explains how learners manage learning through goal setting, monitoring performance, and adjusting strategies. Writing development relies heavily on metacognitive regulation because learners must evaluate coherence, check alignment between claims and evidence, and refine paraphrasing accuracy.

Without active monitoring and strategy adjustment, revision often remains surface-level.

Technology-supported adaptive environments can strengthen self-regulatory behaviors by providing timely performance information and immediate feedback. El-Sabagh (2021) argues that adaptive systems can enhance engagement through individualized feedback that supports reflection and corrective action. Jing et al. (2023) also note that adaptive technologies can promote learner autonomy by adjusting content sequencing based on performance data, encouraging learners to respond to feedback and refine understanding. In more advanced systems, AI-driven mechanisms can detect response patterns and provide targeted remedial support aligned with learner needs (Afolabi et al., 2025).

In this study, Self-Regulated Learning principles are reflected in continuous performance tracking, visible progress indicators, feedback use, and optional practice opportunities within the LMS. Mastery-based progression encourages learners to monitor outcomes, interpret feedback, and revise strategically before advancing. Optional task completion also reflects learner agency because students decide whether to engage in additional practice beyond minimum requirements. Thus, self-regulation explains how learners interact with the adaptive pathway and how their voluntary engagement may contribute to writing improvement.

2.6.3 Differentiated Instruction Theory and Adaptive Sequencing

Differentiated Instruction Theory recognizes that learners vary in readiness, prior knowledge, and learning profiles. Tomlinson (2001) argues that effective instruction should respond to these differences through adjustments in content, process, and assessment. In EFL academic writing classrooms, heterogeneity is commonly observed across linguistic accuracy, organization, and rhetorical control. Uniform instruction may therefore overwhelm some learners while failing to extend others.

Adaptive learning provides a systematic mechanism for implementing differentiation through data-informed sequencing. Brusilovsky's (1996) foundational work on adaptive hypermedia explains how adaptive systems modify content and

navigation based on learner characteristics. VanLehn (2011) further demonstrates that intelligent tutoring systems can approximate the benefits of individualized tutoring by adjusting instructional support in response to learner performance. Kinshuk (2016) extends these principles by emphasizing cognitive profiling and content-based adaptivity as key design mechanisms for personalization.

In this study, differentiation is embedded through diagnostic profiling and tiered progression. Learners receive instructional support aligned with their demonstrated performance, enabling foundational support for students who require scaffolding and greater challenge for learners who progress more quickly. Diagnostic placement, tiered tasks, and adaptive sequencing therefore operationalize differentiated instruction within the LMS environment. This is especially relevant to EFL academic writing because students may differ considerably in their readiness to perform sentence-level restructuring, paragraph-level coherence, citation accuracy, and source integration.

2.6.4 Synthesis of Theoretical Perspectives

The four theoretical perspectives converge in justifying a structured adaptive design for EFL academic writing instruction. Process Writing Theory provides a rationale for iterative drafting, revision cycles, and writing-as-process. Mastery Learning supports the use of performance thresholds, corrective feedback, remediation, and reattempts before progression. Self-Regulated Learning Theory explains the importance of progress monitoring, feedback use, optional practice, and learner agency. Differentiated Instruction Theory provides the pedagogical basis for diagnostic placement, tiered tasks, and adaptive sequencing for heterogeneous learners.

In practical design terms, the adaptive pathway integrates these theoretical foundations into a coherent instructional cycle. Diagnostic assessment functions as an initial profiling mechanism to identify learner readiness. Mastery thresholds regulate progression and ensure consolidation before advancement. Automated feedback and targeted remediation support revision behavior and reflective learning processes. Data-informed sequencing and differentiated tasks ensure appropriate levels of challenge and support across learners. Through this synthesis, the adaptive pathway is

positioned not as a technological feature alone but as a pedagogically grounded design for revision-based academic writing development.

To clarify how these theoretical perspectives are connected, Figure 1 presents the theoretical framework underpinning the LMS-based adaptive learning pathway. The figure illustrates how Process Writing Theory, Mastery Learning, Self-Regulated Learning Theory, and Differentiated Instruction Theory jointly inform the pedagogical logic of the adaptive writing system.

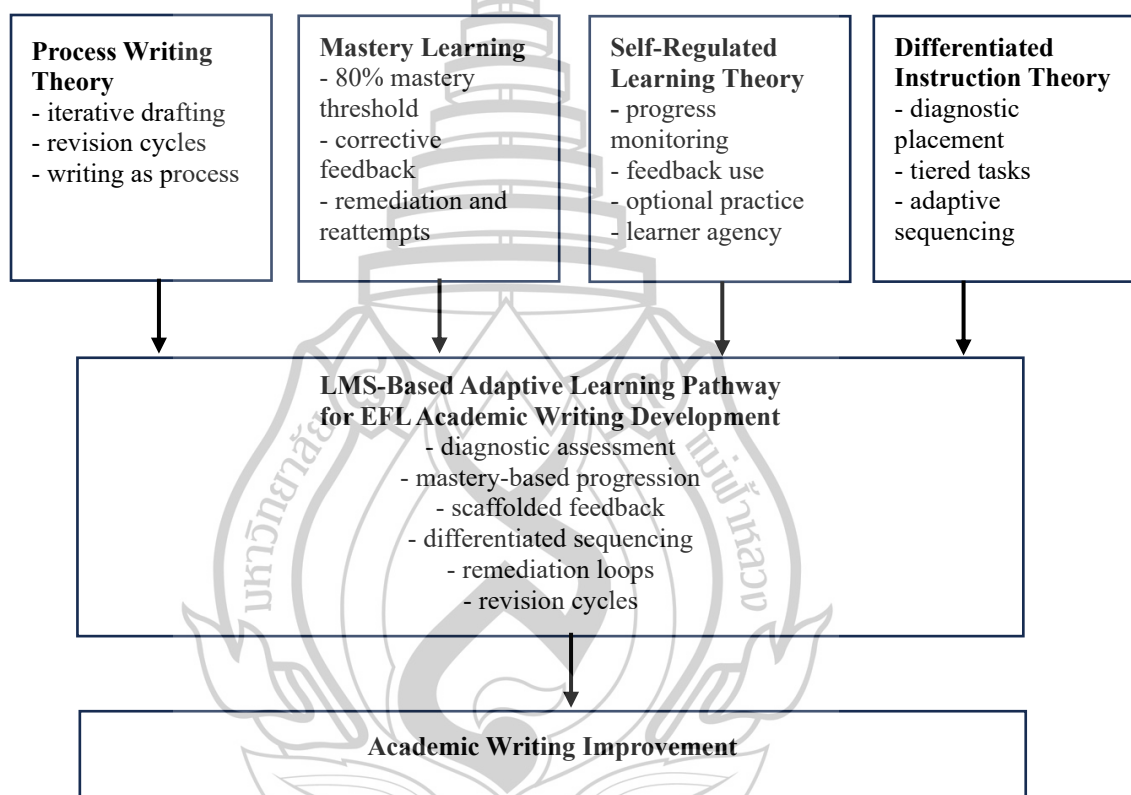


Figure 1 Theoretical Framework for LMS-Based Adaptive Academic Writing Instruction

The figure illustrates how the four theoretical perspectives jointly inform the design of the adaptive learning pathway used in this study. Process Writing Theory supports revision cycles and iterative writing development. Mastery Learning underpins the use of the 80% mastery threshold, corrective feedback, remediation, and reattempts before progression. Self-Regulated Learning Theory explains how learners monitor progress, use feedback, and engage in optional practice. Differentiated

Instruction Theory provides the rationale for diagnostic placement, tiered task design, and adaptive sequencing. Together, these theories form the pedagogical foundation of the LMS-based adaptive learning pathway designed to support the development of paraphrasing, coherence, citation, and source integration in EFL academic writing.

2.7 Findings from Previous Research

This section reviews empirical studies that relate directly to the theoretical mechanisms outlined earlier in this chapter. The focus is on how adaptive learning systems influence academic performance, behavioral engagement, and writing development. Rather than assuming that technology itself produces improvement, prior research emphasizes that learning gains emerge from how adaptive environments structure progression, regulate practice, and guide learners through feedback and revision processes.

2.7.1 Adaptive Learning and Academic Performance

Research across educational contexts indicates that adaptive learning environments can improve academic achievement when instructional decisions are systematically informed by learner data and formative assessment (du Plooy et al., 2024; ShafieeRad et al., 2024). Performance gains are more consistently observed when systems adjust task difficulty, pacing, and instructional support in response to diagnostic evidence. These improvements are associated less with the technological platform itself and more with how adaptive mechanisms organize learning sequences and validate mastery (Bernacki et al., 2021).

Mastery-based progression has been identified as a key contributor to sustained achievement. When learners must reach a defined performance threshold before moving forward, they tend to engage in additional practice that consolidates understanding. Studies suggest that repeated attempts combined with targeted corrective input strengthen retention and reduce persistent misconceptions (du Plooy et al., 2024). Structured remediation also appears to prevent cumulative knowledge gaps by requiring learners to address weaknesses prior to advancement (ShafieeRad et al., 2024).

Within writing research, similar patterns are evident. Investigations into second language writing processes demonstrate that improvement is often linked to iterative drafting and revision rather than single-stage production (Révész & Michel, 2019). Research on continuation writing further shows that guided revision sequences contribute to improved coherence and linguistic precision when learners receive feedback that supports concrete revision decisions (Liu, 2025). These findings indicate that adaptive learning environments are most effective when they integrate mastery checkpoints with systematic revision opportunities.

At the same time, evidence suggests that outcomes depend on the quality of instructional design. Feedback must be clear and interpretable in order to support meaningful revision. When feedback lacks specificity or focuses primarily on surface-level corrections, its impact on higher-order writing development may be limited (Liu, 2025). In addition, complex adaptive branching structures can increase cognitive demands if progression pathways are not transparent or logically organized (Bernacki et al., 2021; ShafieeRad et al., 2024). Therefore, academic improvement in adaptive environments is conditional upon pedagogical coherence and usability of feedback mechanisms.

2.7.2 Behavioral Engagement Mechanisms in Adaptive Systems

In addition to achievement outcomes, empirical studies increasingly examine behavioral indicators as mediating factors in adaptive learning contexts. Learning analytics generated within LMS environments often include measures such as time spent on tasks, frequency of attempts, completion patterns, and persistence during remediation cycles. These behavioral variables are frequently associated with learning improvement when instructional design channels effort toward mastery goals (Bernacki et al., 2021; du Plooy et al., 2024).

Time-on-task has been linked to skill acquisition when engagement reflects focused and purposeful practice. Similarly, multiple mastery attempts can signal productive persistence when learners revise their responses in light of corrective feedback (ShafieeRad et al., 2024). Research also suggests that structured remediation supports continued effort when learners perceive corrective tasks as opportunities for improvement rather than repetitive penalties (du Plooy et al., 2024).

Engagement is further influenced by perceived challenge level. When adaptive systems calibrate task difficulty appropriately, learners are more likely to maintain motivation and avoid disengagement (Bernacki et al., 2021). Visible progress indicators and clearly defined mastery thresholds can strengthen learners' sense of direction and autonomy (du Plooy et al., 2024). However, engagement may decline if automated feedback is excessive, mechanical, or disconnected from performance expectations (ShafieeRad et al., 2024).

Overall, existing research indicates that adaptive systems affect outcomes through learner behaviors. The effectiveness of adaptivity depends not only on system architecture but also on how learners interact with structured tasks, feedback cycles, and mastery requirements.

2.7.3 Pedagogical Design Features and Writing Development in EFL Contexts

In tertiary EFL settings, academic writing presents substantial cognitive demands. Learners must simultaneously manage linguistic accuracy, discourse organization, and rhetorical intent (Révész & Michel, 2019). Research consistently shows that writing development is enhanced when instruction incorporates scaffolded guidance, iterative drafting, and structured formative assessment rather than isolated writing assignments (Liu, 2025).

Adaptive systems that combine scaffolded feedback with staged revision opportunities appear particularly promising. While automated feedback tools may efficiently address grammatical issues, improvement in coherence, argument structure, and source integration typically requires guided modeling and iterative practice (Liu, 2025). Integrating automated feedback within structured revision sequences may therefore strengthen both lower-level and higher-level writing skills.

Differentiated task sequencing also plays an important role. When instructional tasks are aligned with learners' proficiency levels, cognitive overload is reduced and learners can focus more effectively on specific writing challenges. Research suggests that matching task complexity to learner readiness supports deeper engagement and more stable performance development (du Plooy et al., 2024). Formative checkpoints

embedded within adaptive pathways further reinforce staged learning by signaling readiness for progression (Bernacki et al., 2021).

Despite increased attention to adaptive learning across disciplines, relatively few studies have examined semester-long adaptive LMS interventions targeting tertiary EFL academic writing skills such as paraphrasing accuracy, paragraph coherence, and source integration. In addition, limited research connects behavioral log indicators directly to writing-specific performance outcomes in university contexts (Nguyen & Ha, 2023; Révész & Michel, 2019).

2.7.4 Research Gap and Positioning of the Present Study

Prior research suggests three key conclusions. First, adaptive learning can improve academic performance when grounded in diagnostic assessment, mastery-based progression, and actionable feedback (Bernacki et al., 2021; du Plooy et al., 2024). Second, behavioral engagement indicators, including time-on-task, repeated attempts, and persistence during remediation, contribute to learning gains when supported by coherent instructional design (ShafieeRad et al., 2024). Third, in EFL writing contexts, scaffolded revision and differentiated sequencing are critical for sustained improvement (Liu, 2025; Révész & Michel, 2019).

However, there remains limited empirical evidence examining semester-long adaptive LMS pathways that integrate diagnostic placement, mastery thresholds, behavioral analytics, and writing-specific outcome measures in tertiary EFL academic writing courses. Few investigations simultaneously analyze structured remediation loops, learner persistence patterns, and performance development in areas such as paraphrasing, coherence, and source integration.

The present study addresses this gap by operationalizing adaptive learning as an interaction among cognitive profiling, content-based adjustment, mastery validation, and feedback-supported revision cycles within an LMS environment. It examines how these mechanisms relate to both academic writing performance and behavioral engagement across a full semester in a university EFL context. By linking adaptive design features to measurable writing outcomes and LMS analytics data, this study extends current research and provides a more integrated understanding of adaptive learning in academic writing instruction.

2.8 Conceptual Framework of the Study

Drawing on the preceding theoretical and empirical discussions, this study conceptualizes academic writing improvement as the outcome of a systematic interaction between adaptive instructional design and learner behavioral engagement within the LMS environment. The framework assumes that instructional design does not directly produce learning gains. Instead, it establishes structured conditions that shape how learners engage with tasks, feedback, and progression over time.

Adaptive pathway design features form the pedagogical architecture of the system. These features organize instructional sequencing, regulate progression through clearly defined mastery criteria, and provide targeted feedback with opportunities for remediation. Through diagnostic profiling and differentiated sequencing, learners are guided into pathways aligned with their proficiency levels and specific writing challenges. In this way, the adaptive system structures the learning environment so that progression depends on demonstrated understanding rather than mere task completion.

Within this structured environment, behavioral engagement mechanisms function as the processes through which learning development occurs. Indicators such as time-on-task, repeated mastery attempts, revision frequency, persistence, progression patterns, and voluntary engagement through optional task completion reflect how learners respond to adaptive conditions. While mastery-based progression ensures minimum competency across required units, voluntary engagement represents learners' discretionary effort beyond mandatory requirements. Conceptually, optional task completion captures a dimension of self-initiated practice that aligns with Self-Regulated Learning theory, particularly the behavioral regulation component involving strategic effort allocation and extended practice.

These observable engagement behaviors constitute the operational link between instructional design and learning outcomes. Time investment and repeated attempts indicate sustained effort under structured conditions. Revision frequency reflects responsiveness to feedback. Progression patterns reveal how learners navigate tiered difficulty levels. Optional task completion, in contrast, reflects learner agency in choosing to extend practice beyond compulsory thresholds, thereby providing an

additional behavioral pathway through which adaptive design may influence writing development.

Academic writing improvement is therefore conceptualized as the measurable result of sustained and qualitatively varied engagement within a pedagogically organized adaptive pathway. Writing performance gain emerges when learners repeatedly interact with structured tasks, respond to feedback, progress through mastery-based sequencing, and, where applicable, voluntarily engage in supplementary practice opportunities.

Conceptually, the framework can be summarized as follows:

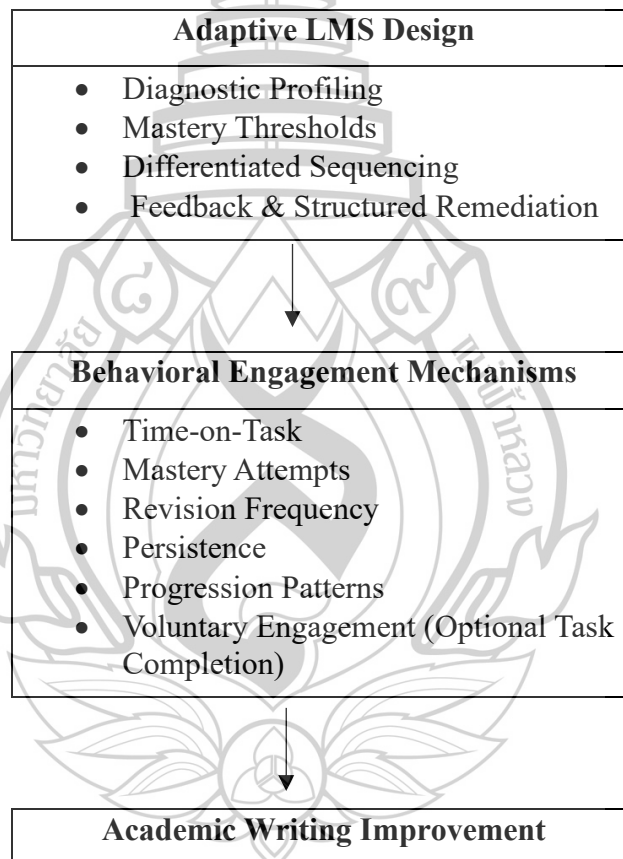


Figure 2 Conceptual Framework of the Adaptive Learning Pathway for Academic Writing Development

The figure illustrates the proposed relationship among adaptive LMS design features, behavioral engagement mechanisms, and academic writing improvement. Adaptive design elements establish the instructional conditions of the system, while

behavioral engagement indicators represent observable learner responses to those conditions. Writing performance gain is conceptualized as the measurable outcome of sustained engagement within the structured adaptive pathway. In particular, voluntary engagement through optional task completion is positioned as a distinct behavioral mechanism reflecting learner agency and extended practice beyond minimum mastery requirements.



Chapter 3

Methodology

This chapter presents the research methodology employed to investigate the development of academic writing skills through LMS-based adaptive learning pathways. It describes the research design, population and sample, research instruments, data collection procedures, and data analysis methods. Ethical considerations are also addressed to ensure compliance with established standards for research involving human participants.

3.1 Research Design

This study employed a mixed-methods research design to examine the development of undergraduate students' academic writing skills through LMS-based adaptive learning pathways. The design enabled systematic investigation of writing development across one academic semester while also capturing students' engagement and experiences related to the adaptive learning component.

Quantitatively, the study adopted a one-group pretest–posttest quasi-experimental design. Students' academic writing performance was assessed at the beginning and at the end of the semester using parallel writing tasks. This structure enabled measurement of changes in writing performance following sustained participation in the adaptive learning pathway provided as supplementary structured practice throughout the semester.

Because the study did not include a control group, this design cannot establish strong causal claims regarding the effect of the LMS-based adaptive learning pathway. Therefore, changes in students' writing performance should be interpreted as improvement associated with participation in the adaptive learning pathway rather than as definitive evidence that the intervention alone caused the improvement. This design was considered appropriate because the study was conducted in an authentic course context where all enrolled students were provided access to the same supplementary learning support for ethical and instructional reasons.

The adaptive learning pathway functioned as an additional learning component outside regular classroom instruction. It did not replace face-to-face teaching, nor did it directly influence course grading. Instead, it provided structured, mastery-based practice opportunities aligned with course learning outcomes. Participation in the adaptive activities was voluntary and independent from formal course assessment.

Academic writing performance served as the primary outcome variable and was operationalized through analytic scores in paraphrasing, summarizing, coherence, and source integration.

Qualitatively, the study incorporated student questionnaires and semi-structured interviews to explore students' perceptions of their writing development, engagement, and experiences with the adaptive learning pathway. The qualitative component provided explanatory depth to complement the quantitative findings and offered insight into how students utilized and responded to the supplementary adaptive learning structure.

The study was conducted within an authentic university course context over one academic semester. While regular classroom instruction proceeded according to the official syllabus, the adaptive pathway operated as a parallel, structured support mechanism. Quantitative analysis identified measurable changes in writing performance, whereas qualitative analysis provided interpretive insight into student engagement and experiences. The integration of quantitative and qualitative data strengthened the rigor of the study through methodological triangulation..

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engagement and experiences. The integration of quantitative and qualitative data strengthened the rigor of the study through methodological triangulation.

3.2 Population and Sample

The population of this study consisted of undergraduate students enrolled in the Advanced English Reading and Writing course offered by the School of Liberal Arts, Mae Fah Luang University, during Semester 1 of the academic year 2026. This compulsory course enrolled approximately 250 students, including both Thai and international learners from diverse linguistic and educational backgrounds.

The study utilized an intact classroom sample. All students enrolled in the course were invited to participate in the research component related to the LMS-based adaptive learning pathway. Participation in the research was voluntary and independent of course grading. This approach enabled investigation of adaptive learning engagement within an authentic and naturally heterogeneous academic writing context.

Inclusion criteria were as follows:

1. Students had to be officially registered in the course; and
2. Students had to provide informed consent to participate in the study.

Exclusion criteria included:

1. Students who declined participation;
2. Students who withdrew consent at any stage; and
3. Students who did not complete both the pre-test and post-test assessments.

Out of the total population of approximately 250 enrolled students, 180 students provided informed consent and completed all required research components. These participants constituted the quantitative analytic sample for pre-test and post-test comparison.

Given the repeated-measures design and the sample size of 180 participants, the study had adequate statistical power to detect moderate effects at the .05 level of significance, consistent with established conventions in educational research (Cohen, 1988). The sample retained the natural variability in writing proficiency within the course cohort, thereby strengthening ecological validity and supporting examination of adaptive learning effects across diverse learner profiles.

For the qualitative component, a purposive sample of 20 students was invited to participate in semi-structured interviews to reflect a range of writing development trajectories and engagement patterns observed in the LMS data. Participation in interviews was entirely voluntary and had no impact on course evaluation.

3.3 Design of the Adaptive Learning Pathway

The LMS-based adaptive learning pathway was designed as a structured differentiation system to support the development of academic writing skills. The pathway functioned as a supplementary mastery-based practice system operating alongside regular classroom instruction. It did not replace formal teaching sessions and did not directly influence course grading. Instead, it provided structured, performance-driven practice opportunities aligned with course learning outcomes.

The design operationalized the conceptual framework presented in Chapter 2 by translating adaptive instructional principles into systematic decision rules embedded within the LMS environment. The pathway was implemented across six academic writing units and followed an adaptive cycle to ensure consistency and internal coherence.

3.3.1 Instructional Architecture

The adaptive pathway was intentionally designed as a structured instructional architecture rather than a collection of independent activities. The system operationalized adaptive learning through three interconnected mechanisms:

1. Diagnostic-based cognitive profiling
2. Tiered mastery progression
3. Adaptive remediation loop

Each instructional unit followed a consistent adaptive sequence:

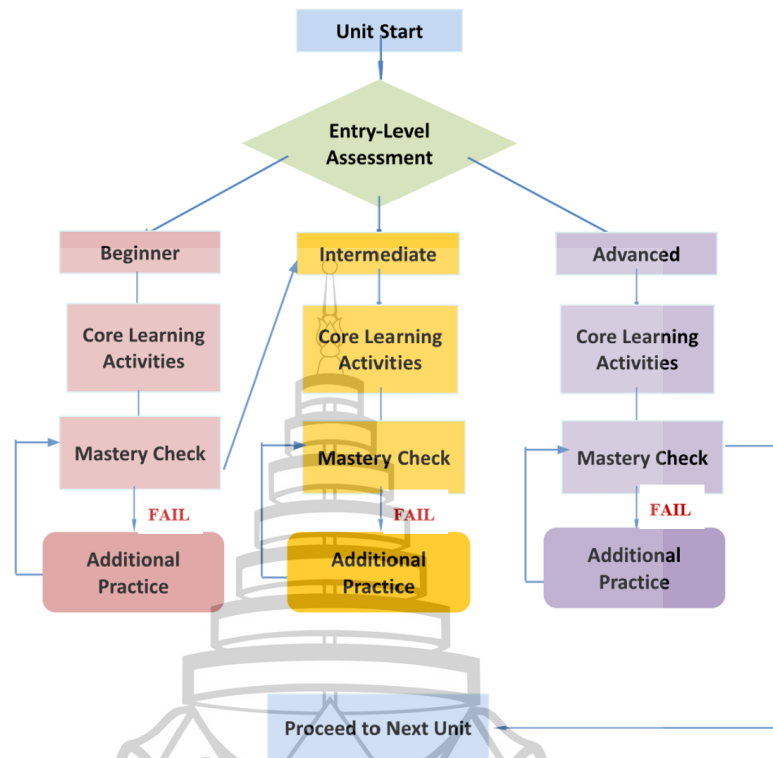


Figure 3 LMS-Based Adaptive Learning Pathway

Figure 2 illustrates the operational flow of the LMS-based adaptive learning pathway implemented in each instructional unit. Students begin with an entry-level diagnostic assessment, which determines their initial task pathway. Progression is structured through tiered learning activities and a mastery check. Students who do not meet the predefined mastery threshold are redirected to additional practice before advancing to the next unit. This design ensures performance-based progression within a structured adaptive system.

3.3.2 Diagnostic-Based Cognitive Profiling

At the beginning of each unit, students completed a diagnostic quiz designed to assess baseline proficiency in the target writing subskill. Diagnostic items measured both conceptual understanding and applied writing performance.

Diagnostic results were used to determine the initial complexity level of practice tasks. Importantly, students were not informed of any proficiency categorization. This design decision was implemented to prevent stigmatization and

maintain learner confidence. Placement operated implicitly through system logic rather than explicit labeling.

The placement mechanism functioned as follows:

- Lower diagnostic performance triggered scaffolded sentence-level tasks
- Moderate performance directed students to contextualized application tasks
- Higher performance enabled immediate engagement with paragraph-level integration tasks

This profiling mechanism operationalized differentiated instruction principles while avoiding fixed ability grouping.

3.3.3 Tiered Mastery Progression

Each instructional unit consisted of three levels of progressively increasing cognitive demand:

- Level 1 Controlled recognition and guided transformation tasks
- Level 2 Contextualized sentence-level application
- Level 3 Paragraph-level academic integration tasks

Progression across levels was conditional upon achieving a predefined mastery threshold of 80 percent. The mastery threshold functioned as a progression regulator, ensuring that students demonstrated competency before advancing to more complex tasks.

This mastery-based structure was designed to prevent superficial completion and reinforce skill consolidation. Rather than progressing based on time spent in the system, students advanced only after demonstrating measurable understanding.

3.3.4 Adaptive Remediation Loop

Students who did not meet the 80 percent mastery threshold were automatically redirected to structured remediation activities. The remediation mechanism was designed to address specific weaknesses identified through diagnostic and practice performance.

Remediation tasks included:

- Targeted error-focused exercises
- Scaffolded explanatory feedback
- Guided revision opportunities

After completing remediation activities, students were required to retake the mastery check. This remediation loop continued until the required threshold was achieved.

The loop ensured that progression was based on demonstrated understanding rather than task completion alone. It also operationalized formative feedback principles by requiring learners to act on feedback before advancing.

3.3.5 Structure of the Six Adaptive Units

The adaptive pathway was organized around six core academic writing competencies aligned with course learning outcomes:

1. Synonym precision in paraphrasing
2. Sentence restructuring
3. Main idea identification and restatement
4. Reporting verb variation
5. Citation format accuracy
6. Source integration

Each unit followed the same adaptive architecture but targeted a distinct writing construct. Structural consistency across units enhanced internal validity and allowed systematic examination of engagement patterns and skill progression.

By integrating diagnostic profiling, tiered progression, and mastery-based remediation within a consistent instructional architecture, the adaptive learning pathway translated theoretical differentiation principles into an operationalized LMS-based system designed to support academic writing development.

3.4 Research Instruments

This study employed multiple research instruments to examine the development of academic writing skills through LMS-based adaptive learning pathways. All instruments were developed based on course learning outcomes and were reviewed by

two experts in applied linguistics and educational measurement to ensure content validity.

3.4.1 Academic Writing Pre-test and Post-test

The academic writing pre-test and post-test were developed to measure students' performance in the core writing competencies targeted by the adaptive learning pathway. The assessments were designed to capture changes in writing quality over the course of one academic semester.

3.4.1.1 Instrument Development

The writing assessment was constructed based on the six academic writing competencies addressed in the adaptive instructional units:

1. Synonym precision in paraphrasing
2. Sentence restructuring
3. Identification and restatement of main ideas
4. Use of varied reporting verbs
5. Citation format accuracy
6. Source integration

A test blueprint was developed to ensure alignment between assessment tasks and course learning outcomes. The writing task required students to paraphrase and integrate information from a short academic source into a coherent paragraph. The task was designed to assess both linguistic accuracy (e.g., lexical substitution and syntactic transformation) and discourse-level competence (e.g., coherence, organization, and source integration).

An analytic scoring rubric was developed to evaluate performance across five criteria:

1. Lexical appropriateness
2. Sentence transformation accuracy
3. Coherence and organization

4. Citation format accuracy
5. Quality of source integration

Each criterion was rated on a five-point scale, resulting in a maximum total score of 25. The use of an analytic rubric allowed detailed assessment of distinct writing dimensions aligned with the study's conceptual framework.

Parallel task forms were constructed for the pre-test and post-test to ensure structural equivalence while minimizing practice effects.

3.4.1.2 Content Validity

Content validity was established through expert evaluation. Two specialists in applied linguistics and language assessment reviewed the test blueprint, task prompts, and scoring rubric to ensure alignment with the intended writing constructs.

The Index of Item-Objective Congruence (IOC) was used to evaluate alignment between assessment components and instructional objectives. Items receiving IOC values below .50 were revised for clarity and alignment. Following revision, all components achieved acceptable IOC values ranging from .50 to 1.00, indicating satisfactory content validity.

3.4.1.3 Reliability

Inter-rater reliability was established to ensure scoring consistency. Two trained raters, who were also the course instructors and researchers, independently evaluated 30 randomly selected scripts using the analytic rubric. Prior to scoring, a calibration session was conducted to align interpretation of rubric criteria.

All scripts were anonymized and assigned coded identifiers before scoring. The raters were blind to whether each script belonged to the pre-test or post-test administration. Scoring was conducted after completion of the course to ensure that research evaluation did not influence academic grading.

Inter-rater reliability was examined using the intraclass correlation coefficient (ICC), based on a two-way random-effects model for absolute agreement. The ICC value was .93, indicating excellent inter-rater reliability. After reliability was confirmed, the remaining scripts were scored using the same rubric. Any scoring

discrepancies were discussed and resolved through consensus before finalizing the scores.

3.4.2 LMS Log Data Indicators

LMS log data were utilized as an objective measure of students' behavioral engagement within the adaptive learning pathway. Unlike self-reported instruments, system-generated records captured observable interaction patterns throughout the semester and provided traceable evidence of learner activity.

Log data were operationalized into specific behavioral indicators aligned with the conceptual framework described in Chapter 2. Engagement was conceptualized as multidimensional behavioral participation, reflected through access patterns, time investment, interaction frequency, and progression consistency. The following indicators were extracted for analysis:

1. Access and Page Views: Frequency of system login and number of content views, including documents, instructional posters, infographics, and other learning materials.
2. Time-on-Task: Duration of active engagement within the LMS, including time spent on individual pages, completion of animated instructional videos, and participation in learning activities.
3. Interaction Activities: Observable user actions within the system, including opening multimedia resources, downloading files, posting or responding in discussion forums, and interacting with adaptive tasks.
4. Progress and Completion Indicators: Consistency in assignment submission, percentage of completed course components, and quiz completion rates across instructional units.

In addition to individual behavioral indicators, the following structured variables were analyzed:

5. Optional Tasks Completed: The total number of voluntary, non-mandatory practice exercises completed by the student beyond the required mastery threshold. This indicator reflects self-directed learning behavior and willingness to engage in supplementary revision.

6. Overall Mastery Rate (%): The percentage of adaptive instructional units in which the student successfully achieved the 80 percent progression threshold. This variable serves as an indicator of overall task success and sustained performance across the adaptive pathway.
7. Overall Average Attempts: The mean number of attempts required to achieve mastery across adaptive units.
8. Engagement Score (0–100): A composite behavioral metric calculated by the researcher to represent overall engagement intensity within the adaptive learning environment. The score was derived by aggregating standardized indicators of (1) access frequency and page views, (2) time-on-task, (3) interaction activities, and (4) course progression and completion percentage. Each component was normalized to ensure comparability across participants and combined into a unified 100-point scale. Higher scores indicate greater consistency, persistence, and active participation throughout the semester. The Engagement Score was treated as a continuous variable for statistical analysis.

These variables were selected to operationalize core behavioral mechanisms, including persistence, sustained attention, iterative practice, and performance-based progression. All log data were automatically recorded by the LMS platform and stored within the system database, ensuring procedural reliability and eliminating manual data entry errors. At the conclusion of the semester, de-identified log records were exported for statistical analysis. Student identifiers were replaced with coded IDs to maintain confidentiality.

Because engagement indicators were system-recorded rather than subjectively rated, measurement consistency was maintained across participants. Data extraction procedures followed standardized criteria to ensure uniform operationalization of engagement variables prior to analysis.

3.4.3 LMS-Based Adaptive Learning Pathway

The LMS-based adaptive learning pathway served as the core intervention instrument in this study. While Section 3.3 described the instructional design

architecture of the pathway, this section outlines its development process and quality assurance procedures to establish validity and reliability as a research instrument.

3.4.3.1 Development Process

The adaptive learning pathway was developed by the researchers to operationalize the conceptual framework presented in Chapter 2. The system was structured around six academic writing competencies: synonym precision, sentence restructuring, main idea identification, reporting verb variation, citation accuracy, and source integration.

Each unit followed a standardized adaptive cycle consisting of Diagnostic assessment, Tiered practice, Mastery check (80% threshold), Remediation (if required), and Progression.

The pathway was constructed within the university LMS platform and integrated as supplementary learning material to support out-of-class practice. It did not replace classroom instruction nor influence course grading. This design ensured that participation reflected genuine engagement rather than grade-driven compliance.

The mastery threshold of 80 percent was predetermined to regulate progression and ensure skill consolidation before advancement to higher cognitive levels. All branching rules and progression logic were embedded within the LMS to enable automated adaptation.

3.4.3.2 Content Validity

Because the adaptive learning pathway was researcher-developed, content validity was established through expert evaluation. Two specialists in applied linguistics and language assessment reviewed:

- Alignment between unit objectives and adaptive tasks
- Logical progression across tiered levels
- Appropriateness of the 80 percent mastery threshold
- Clarity and pedagogical accuracy of automated feedback

The Index of Item-Objective Congruence (IOC) was used to assess alignment between adaptive tasks and targeted writing competencies. Tasks receiving IOC values below .50 were revised to improve clarity and construct alignment.

Following revision, all components met acceptable IOC criteria, indicating satisfactory content validity.

To further strengthen construct alignment, each diagnostic item and practice task was explicitly mapped to the corresponding writing subskill identified in the conceptual framework. This mapping ensured that the pathway reinforced the intended dimensions of academic writing development.

3.4.3.3 Reliability and System Consistency

Reliability of the adaptive learning pathway was addressed through procedural standardization and system stability verification.

First, automated scoring mechanisms were embedded within the LMS for objective items, ensuring consistent evaluation across participants. Since task progression and remediation triggers were system-generated, uniform branching logic was applied to all students.

Second, system logs and progression data were reviewed periodically to confirm that mastery thresholds and redirection rules functioned consistently throughout the semester.

Prior to full implementation, the pathway underwent pilot testing with a small group of students comparable to the target population. Feedback from the pilot phase led to minor revisions, including clarification of task instructions, refinement of mastery logic, and adjustment of remediation sequencing.

These procedures ensured that the adaptive pathway functioned consistently at both pedagogical and technical levels, supporting its use as a validated intervention instrument within the study.

3.4.4 Questionnaire

The questionnaire was developed to examine students' perceptions of their academic writing development and their learning experiences with the LMS-based adaptive learning pathway. The instrument was designed in direct alignment with the research objectives and the conceptual framework presented in Chapter 2.

3.4.4.1 Instrument Development

The questionnaire targeted five primary constructs:

1. Perceived academic writing development

2. Perceptions of adaptive level placement and content appropriateness
3. Feedback and mastery-based progression
4. Engagement and motivation
5. Learning challenges and difficulties

The development process involved four stages.

First, the researchers identified key constructs derived from adaptive learning theory, mastery-based progression principles, and academic writing development models.

Second, questionnaire items were constructed to reflect the structure of the six adaptive instructional units and the mastery-based progression system implemented within the LMS.

Third, an initial pool of 30 Likert-scale items was generated using a five-point agreement scale ranging from 1 (strongly disagree) to 5 (strongly agree). Items were written to ensure clarity, simplicity, and alignment with measurable constructs. Background questions and open-ended items were included to capture contextual information and qualitative reflections.

Fourth, following expert review, redundant or ambiguous items were revised or removed. The final instrument consisted of:

- 23 closed-ended Likert-scale items
- 3 open-ended questions
- 2 background questions

The final structure enabled subscale analysis corresponding to the five identified constructs.

3.4.4.2 Content Validity

Content validity was established through evaluation by two experts in applied linguistics and language assessment. Each item was reviewed for clarity, construct alignment, and relevance to the research objectives.

The Index of Item-Objective Congruence (IOC) was used to determine alignment between questionnaire items and intended constructs. Items receiving IOC values below .50 were revised to improve precision and clarity. After revision, all

items achieved acceptable IOC values ranging from .50 to 1.00, indicating satisfactory content validity.

3.4.4.3 Reliability

To examine internal consistency reliability, the questionnaire was pilot-tested with a group of undergraduate students comparable to the target population.

Cronbach's alpha coefficients were calculated for the overall instrument and for each subscale. The overall alpha coefficient exceeded .70, and subscale coefficients also met or exceeded the acceptable threshold of .70, indicating satisfactory internal consistency.

These procedures confirmed that the questionnaire demonstrated acceptable levels of validity and reliability for use in this study.

3.4.5 Semi-Structured Interviews

Semi-structured interviews were conducted to obtain in-depth insights into students' learning experiences with the LMS-based adaptive learning pathway and to complement quantitative findings derived from writing assessments, log data, and questionnaire responses.

3.4.5.1 Instrument Development

An interview guide was developed by the researchers based on the study's conceptual framework and research objectives. The guide was structured around five core domains:

1. Perceived academic writing development
2. Experiences with adaptive level placement
3. Use of feedback and mastery-based progression
4. Engagement and motivation
5. Challenges and suggestions for improvement

Questions were designed to be open-ended to encourage detailed reflection. Probing prompts were prepared to clarify responses and to elicit specific examples related to the six adaptive instructional units.

The semi-structured format ensured consistency across participants while allowing flexibility to explore individual learning experiences in greater depth.

3.4.5.2 Content Validity

Content validity of the interview guide was established through expert review. Two specialists in applied linguistics and language assessment examined the clarity, neutrality, and alignment of each question with the study's conceptual framework and research objectives.

Minor revisions were made to refine wording and reduce potential ambiguity. This review process ensured that interview questions adequately represented the constructs under investigation.

3.4.5.3 Interview Procedure

Approximately 20 participants were selected using purposive sampling to represent varying levels of writing proficiency and engagement patterns within the adaptive learning pathway. Selection criteria were based on quantitative performance data and LMS log indicators to ensure representation across:

- High mastery progression
- Moderate improvement
- Persistent difficulty in reaching mastery thresholds

The purpose of this sampling strategy was to capture diverse learner experiences rather than to select only students who demonstrated strong improvement or positive engagement. Because the study aimed to explore both experiences and challenges, participants were selected to represent different learning trajectories, including students with high improvement, moderate improvement, limited improvement, high optional task engagement, low optional task engagement, and persistent difficulty in reaching mastery thresholds. This variation enabled the qualitative data to reflect a broader range of perspectives on the adaptive learning pathway, including successful experiences, partial engagement, and learning difficulties.

The sample size of approximately 20 participants was considered appropriate for obtaining in-depth qualitative insights while remaining manageable for semi-structured interviews and thematic analysis. This sampling rationale also helped reduce selection bias and strengthened the credibility of the qualitative findings by ensuring that interview data were not drawn only from students with positive or highly successful learning experiences.

Students were invited to participate voluntarily after completion of the course. Participation in the interview was entirely optional and independent of course grading or academic standing.

Prior to the interview, participants received a clear explanation of the study's purpose and signed informed consent forms.

Each interview lasted approximately 15–20 minutes and was conducted individually in a quiet setting. With participants' permission, interviews were audio-recorded to ensure accurate data capture. Participants were informed of their right to decline any question or withdraw at any time without penalty.

All recordings were transcribed verbatim and anonymized. Identifiable information was replaced with coded labels. Digital files were stored on password-protected devices accessible only to the research team. Audio recordings were deleted after transcription verification.

These procedures ensured adherence to ethical standards and safeguarded participant confidentiality.

3.5 Data Collection Procedures

Data were collected over one academic semester during Semester 1 of the academic year 2026. The data collection process followed a clearly defined sequence to ensure procedural consistency, comparability of measurements, and ethical compliance.

Stage 1: Pre-Test Administration

The first stage involved administration of the academic writing pre-test at the beginning of the semester. Only students who provided informed consent participated in the research component. The test was conducted during regular class hours under

standardized conditions. All students received identical instructions, task prompts, and time allocation.

To ensure measurement integrity, students completed the task individually without access to external materials or digital assistance. Upon completion, all scripts were collected immediately to prevent post-task revision. The pre-test served as baseline data representing students' initial academic writing proficiency prior to engagement with the adaptive learning pathway. These scores were later used for comparison with post-test results to determine writing development over time.

Stage 2: Implementation of the LMS-Based Adaptive Learning Pathway and Collection of Log Data

Following the pre-test, students engaged with the LMS-based adaptive learning pathway throughout the semester. The adaptive system functioned as supplementary practice material outside regular classroom instruction and did not contribute to course grades. This design was intended to encourage authentic engagement rather than grade-driven participation.

The pathway consisted of six instructional units implemented sequentially according to the course schedule. Within each unit, students completed a diagnostic assessment to determine initial readiness, followed by tiered practice tasks of increasing cognitive complexity. Advancement required achievement of an 80 percent mastery threshold. Students who did not meet this criterion were automatically redirected to structured remediation tasks before reattempting mastery checks.

All activities were completed individually through the university LMS platform. Throughout this stage, the LMS automatically recorded system-generated engagement data, including duration of time spent on tasks, number of mastery attempts, remediation frequency, progression across levels, and completion status. Because the system captured these data directly, manual recording was not required, thereby reducing potential errors.

At the conclusion of the semester, log data were exported from the LMS database for analysis. Prior to processing, all identifiable information was removed and replaced with coded identifiers to maintain participant confidentiality.

Stage 3: Post-Test Administration

At the end of the semester, students completed the academic writing post-test under conditions equivalent to those of the pre-test. The parallel structure of the assessment ensured comparability of task demands while minimizing familiarity effects.

As with the pre-test, students completed the writing task individually under standardized time constraints. Scripts were collected immediately upon completion and anonymized before scoring. All scoring procedures were conducted after the semester concluded to ensure that research evaluation remained independent from course grading decisions. This separation reduced the possibility of bias associated with instructional roles.

Stage 4: Questionnaire Administration

Following completion of the post-test, the questionnaire was administered electronically using Google Forms. The questionnaire link was distributed to students through the course communication channel on the Learning Management System (LMS). Students accessed and completed the questionnaire individually outside of class time within a specified response period.

The questionnaire was designed to ensure anonymity. The Google Form did not collect names, student identification numbers, email addresses, or any other personally identifiable information. Participants were explicitly informed that their responses would remain confidential and would not affect their course grades, academic standing, or relationship with the instructors. This assurance was provided to reduce response bias and encourage honest self-reporting.

Responses were automatically recorded and securely stored within the Google Forms database. After the response period ended, data were exported to a spreadsheet format for analysis. Prior to analysis, responses were screened to ensure completeness and consistency. Only students who completed both the pre-test and post-test were retained in the final dataset to maintain alignment across quantitative measures.

Stage 5: Semi-Structured Interviews

The final stage involved qualitative data collection through semi-structured interviews. After completion of all quantitative measures, approximately 20 participants were selected using purposive sampling. Selection was informed by variation in writing performance and engagement indicators derived from test scores and LMS log data. This approach ensured representation of students demonstrating high mastery progression, moderate improvement, and persistent difficulty in achieving mastery.

Selected students were contacted individually and invited to participate voluntarily. The invitation clarified that participation was independent of course evaluation and entirely optional. Prior to the interview, participants reviewed the study information sheet and signed informed consent forms.

Interviews were scheduled at mutually convenient times and conducted individually in a quiet setting. Each session lasted approximately 15 to 20 minutes. With permission, interviews were audio-recorded to ensure accurate capture of responses. Participants were reminded of their right to decline any question or withdraw at any time without consequence.

Following each interview, recordings were transcribed verbatim. Identifying information was removed and replaced with coded labels to ensure anonymity. Digital files were stored on password-protected devices accessible only to the research team. Audio recordings were permanently deleted after transcription verification.

3.6 Data Analysis

Data analysis was conducted using both quantitative and qualitative methods in accordance with the research objectives of this study. Quantitative data were analyzed to determine changes in academic writing performance and students' reported engagement levels, while qualitative data were analyzed to explore learning experiences and challenges.

3.6.1 Academic Writing Pre-test and Post-test

Data from the academic writing pre-test and post-test were analyzed to examine changes in students' writing performance over the semester. These assessments served

as the primary outcome measure for evaluating the effectiveness of the LMS-based adaptive learning pathway.

The writing test was assessed using an analytic rubric consisting of five criteria, each rated on a 5-point scale, resulting in a maximum raw score of 25 points. To facilitate data interpretation and comparability, raw scores were converted to a percentage scale (0–100) prior to statistical analysis using the following formula:

$$\text{Percentage Score} = (\text{Raw Score} \div 25) \times 100$$

All pre-test and post-test results reported in Chapter 4 are presented in percentage format. Descriptive statistics, including means and standard deviations, were calculated to summarize performance at both time points. Writing gain was operationalized as the difference between post-test and pre-test percentage scores.

A paired-sample t-test was conducted to determine whether the observed change in writing performance was statistically significant. The significance level was set at .05. A p-value below .05 was interpreted as indicating a statistically significant difference between pre-test and post-test scores. In addition, effect size was calculated using Cohen's d to determine the magnitude of improvement and to assess practical significance beyond statistical significance.

3.6.2 LMS Log Data

LMS log data were analyzed to examine students' behavioral engagement within the adaptive learning pathway. These data provided objective indicators of how students interacted with the system across the semester.

Descriptive statistics were calculated for time-on-task, number of mastery attempts, remediation frequency, progression across levels, and unit completion status. These indicators were used to characterize engagement behavior.

To examine associations between engagement and writing improvement, Pearson correlation analysis was conducted between log data indicators and writing gain scores. Statistical significance was evaluated at the .05 level. Significant correlations indicated that specific behavioral engagement patterns were associated with greater writing development.

3.6.3 Questionnaire

Questionnaire responses were analyzed to examine students' perceptions of writing development, adaptive placement, feedback use, engagement, and learning challenges.

Mean scores and standard deviations were calculated for each construct. Mean score interpretation followed predefined criteria ranging from very low to very high levels. Internal consistency reliability of the scales was verified using Cronbach's alpha prior to interpretation.

Where appropriate, correlation analyses were conducted to examine relationships between perceived engagement and writing gain scores. This analysis allowed comparison between subjective perceptions and objective performance outcomes.

The questionnaire analysis supported Research Objective 2 by identifying pedagogical factors associated with writing improvement and provided contextual information relevant to Research Objective 3.

3.6.4 Semi-Structured Interviews

Qualitative data from semi-structured interviews were analyzed using thematic analysis to explore students' experiences and challenges in engaging with the adaptive learning pathway.

Transcripts were read repeatedly to ensure familiarity with the data. Meaningful segments were coded and grouped into categories. Themes were then developed to represent recurring patterns related to adaptive progression, feedback mechanisms, motivation, and learning challenges.

Representative excerpts were selected to illustrate key themes while preserving participant anonymity.

This analysis provided in-depth insight into how students experienced the adaptive learning system and what factors influenced their engagement.

3.7 Ethical Considerations

This study was conducted in accordance with established ethical standards for research involving human participants. Ethical approval was granted by the Human Research Ethics Committee of Mae Fah Luang University (Approval Code: EC

25106-10). All procedures adhered to institutional guidelines for voluntary participation, informed consent, confidentiality, and data protection.

3.7.1 Voluntary Participation

Participation in the study was entirely voluntary. Although the research was conducted within a regular academic course, students were clearly informed that their decision to participate or decline would not affect their grades, academic standing, or relationship with the instructors. The adaptive learning pathway functioned as supplementary practice material, and research participation was separated from formal course assessment procedures.

Students were provided with adequate time to consider participation and were given the option to decline without penalty.

3.7.2 Informed Consent

Prior to data collection, participants received a written information sheet explaining the purpose of the study, research procedures, types of data to be collected, potential benefits and minimal risks, and their rights as participants.

Participants were informed that they could withdraw at any stage without consequence. Written informed consent was obtained from all participants before inclusion in the research.

3.7.3 Right to Withdraw

Participants were explicitly informed of their right to withdraw from the study at any point without providing a reason. Withdrawal would not affect academic evaluation, grading, or access to course materials. If a participant chose to withdraw, their data would be excluded from analysis upon request.

3.7.4 Confidentiality and Anonymity

All data were treated as confidential. Identifiable information was removed and replaced with coded identifiers prior to analysis.

Writing scripts were anonymized before scoring. Questionnaire responses were collected anonymously through the LMS platform. Interview transcripts were coded using pseudonyms, and identifying details were removed during transcription.

Only members of the research team had access to raw data. Data were reported in aggregate form to prevent identification of individual participants.

3.7.5 Data Protection and Storage

All digital data were stored on password-protected devices accessible only to the research team. Interview audio recordings were deleted after transcription and verification. De-identified datasets were retained securely for the period required by institutional policy and will not be used for purposes beyond the scope of this study without additional ethical approval.

3.7.6 Minimization of Risk

The study posed minimal risk to participants. The adaptive learning activities were aligned with regular instructional objectives and did not introduce additional academic burden beyond typical coursework.

To reduce potential psychological pressure resulting from the dual role of instructor and researcher, data analysis was conducted after course grading was finalized. Students were reminded that participation in questionnaires and interviews was optional and independent of academic evaluation.

These measures ensured that participants' rights, autonomy, and well-being were protected throughout the research process.

Chapter 4

Results

Chapter 4 presents the findings of the study in alignment with the research objectives. The results are organized into three main sections. First, quantitative findings from the academic writing pre-test and post-test are reported to examine changes in writing performance following participation in the LMS-based adaptive learning pathway. Second, behavioral and pedagogical factors associated with writing improvement are analyzed using LMS log data and questionnaire responses. Third, qualitative findings from semi-structured interviews are presented to provide in-depth insights into students' learning experiences and challenges within the adaptive learning environment.

4.1 Improvement in Academic Writing Performance

This section reports the results of the pre-test and post-test comparison to examine whether students' academic writing performance improved over the semester. A total of 180 students completed both assessments and were included in the analysis.

Table 4.1 Descriptive Statistics of Pre-test and Post-test Writing Scores (N = 180)

Test	Mean	Standard Deviation
Pre-test	59.71	11.46
Post-test	63.98	14.57
Mean Gain	4.27	—

As shown in Table 4.1, the mean writing score increased from 59.71 in the pre-test to 63.98 in the post-test. This indicates that, on average, students obtained higher writing scores at the end of the semester than at the beginning.

Table 4.2 Paired-Sample t-Test Comparing Pre-test and Post-test Scores (N = 180)

Comparison	t	df	p-value	Cohen's d
Post-test – Pre-test	6.01	179	< .001	0.45

To determine whether this improvement was statistically significant, a paired-sample t-test was conducted. The results revealed a statistically significant difference between pre-test and post-test scores, $t(179) = 6.01, p < .001$. Since the p-value is below the .05 threshold, the improvement is considered statistically significant, suggesting that the observed increase in writing scores is unlikely to be due to chance.

The magnitude of improvement was examined using Cohen's d , which yielded a value of 0.45. According to conventional benchmarks, this represents a moderate effect size. This indicates that the improvement was not only statistically significant but also meaningful in practical terms.

In addition, the standard deviation increased from 11.46 to 14.57, indicating greater variability in post-test scores. While overall writing performance improved, the extent of improvement differed across individual students.

Overall, the findings demonstrate measurable and statistically significant improvement in students' academic writing performance over the semester.

4.2 Behavioral and Pedagogical Factors Associated with Writing Improvement

4.2.1 LMS Behavioral Engagement Indicators

This section presents descriptive statistics of students' behavioral engagement within the LMS-based adaptive learning pathway, based on system-generated log data collected throughout the semester.

Table 4.3 Descriptive Statistics of LMS Behavioral Engagement Indicators (N = 180)

Variable	Mean	Standard Deviation
Engagement Score (1–100)	58.91	18.66
Optional Tasks Completed	8.89	3.25
Overall Mastery Rate (%)	87.85	2.81
Overall Average Attempts	2.99	0.87

As shown in Table 4.3, the mean engagement score was 58.91 (SD = 18.66) on a 100-point scale, indicating variation in the level of interaction with adaptive learning

activities across participants. On average, students completed 8.89 optional tasks ($SD = 3.25$), suggesting differences in voluntary engagement beyond required tasks.

The overall mastery rate across units was 87.85% ($SD = 2.81$), indicating that students, on average, achieved the required mastery threshold in most instructional units. The mean number of attempts required to reach mastery was 2.99 ($SD = 0.87$), showing that students generally required approximately three attempts per unit to achieve the 80 percent mastery criterion.

4.2.2 Relationship Between Behavioral Indicators and Writing Gain

To examine whether students' behavioral engagement within the LMS was associated with improvement in academic writing performance, Pearson product-moment correlation analysis was conducted. Writing gain scores were calculated by subtracting pre-test scores from post-test scores for each participant. Positive gain values indicate improvement in writing performance.

Correlation coefficients were computed between gain scores and four behavioral indicators: engagement score, overall average attempts, overall mastery rate, and optional tasks completed.

Table 4.4 Pearson Correlation Between Behavioral Indicators and Writing Gain ($N = 180$)

Behavioral Variable	r	p-value
Engagement Score	-0.045	.548
Overall Average Attempts	0.030	.685
Overall Mastery Rate	0.001	.990
Optional Tasks Completed	0.527	< .001

As shown in Table 4.4, optional tasks completed was positively and significantly correlated with writing gain ($r = .527$, $p < .001$). This indicates that students who completed more optional tasks tended to demonstrate higher writing improvement.

In contrast, engagement score ($r = -0.045$, $p = .548$), overall average attempts ($r = 0.030$, $p = .685$), and overall mastery rate ($r = 0.001$, $p = .990$) were not significantly correlated with writing gain.

These results indicate that among the behavioral indicators examined, only the completion of optional tasks showed a statistically significant association with improvement in academic writing performance.

4.2.3 Pedagogical Perceptions

This section reports students' perceptions of the LMS-based adaptive learning system as measured by the questionnaire. Mean (M) and standard deviation (SD) were calculated for each construct. Higher scores (5-point scale) indicate stronger agreement, except for the Challenges construct, where higher scores indicate greater perceived difficulty.

Table 4.5 Descriptive Statistics of Questionnaire Constructs (N = 180)

Construct	Mean	Standard Deviation
Diagnostic Appropriateness	4.14	0.48
Engagement Perception	4.14	0.52
Perceived Writing Development	4.11	0.55
Feedback & Mastery	4.11	0.55
Challenges	2.63	0.50

As shown in Table 4.5, students reported high levels of agreement across most positive constructs, with mean scores above 4.00. Diagnostic appropriateness (M = 4.14) and engagement perception (M = 4.14) were the highest-rated constructs. Perceived writing development (M = 4.11) and feedback and mastery (M = 4.11) were also rated highly.

The Challenges construct had a mean score of 2.63, indicating a moderate level of perceived difficulty relative to the other constructs.

Overall, the questionnaire results indicate that students generally reported positive perceptions of the adaptive learning system.

4.2.4 Relationship Between Pedagogical Perceptions and Writing Gain

To determine whether students' perceptions of the adaptive learning system were associated with writing improvement, Pearson correlation analysis was conducted between gain scores and each questionnaire construct.

Table 4.6 Pearson Correlation Between Questionnaire Constructs and Writing Gain (N = 180)

Construct	r	p-value
Perceived Writing Development	0.011	.879
Diagnostic Appropriateness	-0.028	.704
Feedback & Mastery	-0.001	.985
Engagement Perception	0.056	.454
Challenges	-0.027	.720

As shown in Table 4.6, none of the questionnaire constructs were significantly correlated with writing gain ($p > .05$). Correlation coefficients were close to zero, indicating no meaningful linear relationship between students' reported perceptions and their measured improvement in writing performance.

The results indicate that some behavioral indicators demonstrated statistical associations with writing gain, while others did not show significant relationships. Pedagogical perceptions were generally positive; however, their direct correlation with writing gain was limited. [This finding highlights a noticeable disconnect between students' favorable perceptions of the adaptive learning pathway and their measured writing improvement. Although students generally perceived the system as useful, supportive, and engaging, these perceptions did not statistically correspond to higher writing gain scores. This disconnect suggests that perceived usefulness and measurable academic improvement may represent different dimensions of learning.](#)

4.3 Students' Experiences and Challenges

4.3.1 Questionnaire Findings

This section presents the findings related to students' experiences and challenges in engaging with the LMS-based adaptive learning pathway.

Table 4.7 Students' Experiences and Challenges in Engaging with the Adaptive Learning Pathway (N = 180)

Perceived Academic Writing Development		Mean	Standard Deviation
1	Improved overall academic writing	4.23	0.62
2	Can apply skills to other writing tasks	4.18	0.65
3	Increased confidence in academic writing	4.22	0.60
4	Improved paraphrasing ability	4.25	0.59
5	Improved summarizing ability	4.17	0.66
6	Improved source integration	4.20	0.63
7	Better understanding of citation & plagiarism	4.29	0.55
Perceptions of the Adaptive Learning System			
8	Diagnostic reflected writing ability	4.06	0.68
9	Assigned difficulty level was appropriate	4.03	0.71
10	System adjusted difficulty appropriately	4.08	0.67
11	Exercises matched learning needs	4.11	0.64
12	Step-by-step progression helped improvement	4.19	0.60
Feedback and Mastery-Based Progression			
13	Feedback helped understand mistakes	4.24	0.58
14	Feedback encouraged revision	4.22	0.61
15	Mastery check ensured understanding	4.16	0.66
16	Extra practice helped improvement	4.10	0.70
Engagement and Motivation			
17	Self-paced increased motivation	3.95	0.75
18	Adaptive structure increased engagement	3.90	0.78
19	Willing to spend extra time improving writing	3.92	0.73
Challenges and Difficulties			
20	Experienced technical problems	2.58	0.88
21	Instructions/tasks unclear	2.61	0.83
22	Felt overwhelmed by workload	2.70	0.79
23	Feedback difficult to understand	2.66	0.81

As shown in Table 4.7, students reported generally positive experiences in engaging with the adaptive learning pathway.

All items related to perceived academic writing development received high mean scores, ranging from 4.17 to 4.29. The highest mean score was observed for Item 7 (Better understanding of citation and avoidance of plagiarism) ($M = 4.29$, $SD = 0.55$), followed by Item 4 (Improved paraphrasing ability) ($M = 4.25$, $SD = 0.59$). Mean scores above 4.00 across all seven items indicate a high level of agreement that the adaptive learning pathway contributed to improvements in overall writing performance as well as specific academic writing skills, including paraphrasing, summarizing, source integration, and citation practices.

Students' perceptions of the adaptive learning system were also rated at a high level. For diagnostic and level appropriateness (Items 8–9), mean scores ranged from 4.03 to 4.06, indicating that most students agreed that the diagnostic assessment accurately reflected their writing ability and that the assigned difficulty level was appropriate. Items related to adaptivity and content design (Items 10–12) yielded mean scores between 4.08 and 4.19, suggesting that the progression structure and task adjustment were generally perceived as supportive of gradual improvement.

Similarly, feedback and mastery-based progression (Items 13–16) received consistently high ratings, with mean scores ranging from 4.10 to 4.24. The item “Feedback helped understand mistakes” ($M = 4.24$, $SD = 0.58$) and “Feedback encouraged revision” ($M = 4.22$, $SD = 0.61$) were among the highest-rated items in this section, indicating that students perceived the feedback mechanism as clear and beneficial. The mastery check and additional practice activities were also rated positively.

In contrast, engagement and motivation items (Items 17–19) showed slightly lower mean scores, ranging from 3.90 to 3.95. Although still reflecting agreement, these values suggest greater variation in students' motivational experiences compared to writing development and feedback-related perceptions.

For challenges and difficulties (Items 20–23), mean scores ranged from 2.58 to 2.70. As higher scores indicate greater perceived difficulty, these results suggest that technical problems, unclear instructions, workload concerns, and difficulty understanding feedback were reported at a moderate level rather than a high level.

Overall, the findings indicate that students generally perceived the adaptive learning pathway as supportive of writing development and system usability, while challenges were present but not strongly emphasized across the majority of participants.

4.3.2 Interview Findings

Semi-structured interview data were analyzed using thematic analysis. Five major themes emerged, corresponding to writing development, adaptive placement, feedback and mastery-based progression, engagement, and reported challenges. Representative excerpts are presented to illustrate recurring patterns across participants.

Table 4.8 Summary of Themes Identified from Interview Data (n = 20)

Domain	Recurrent Themes	Students Mentioning (n)	Illustrative Focus
Writing development	Improvement in specific sub-skills	20	Paraphrasing (5), Citation (3), Source integration (4), Summarizing (2), Main idea (3), Sentence restructuring (2)
Placement	Appropriate level placement	19	Reduced anxiety (7), Reduced peer comparison (4), Appropriate challenge (5)
Feedback & mastery	Timely feedback helpful	18	Immediate correction, targeted revision
	80% mastery motivating but demanding	14	Pressure, persistence, pride after passing
Engagement	Increased motivation & time-on-task	17	Progression unlocking, personalization
	Development of self-regulation	9	Discipline, revision habits
Challenges	Heavy workload (Level 3)	9	Cognitive demand, long tasks
	Time management issues	5	Deadline clustering

Domain	Recurrent Themes	Students Mentioning (n)	Illustrative Focus
	Technical issues	3	Lag, loading delay
	Instruction clarity / feedback complexity	4	Long feedback, unclear wording

4.3.2.1 Perceived Improvement in Academic Writing Skills

All participants reported improvement in at least one academic writing skill. However, the specific areas of development varied across individuals. Frequently mentioned skills included paraphrasing, citation accuracy, source integration, summarizing, main idea identification, and sentence restructuring.

A recurring pattern involved a shift from surface-level vocabulary substitution to structural rewriting. Several students described this change explicitly:

“Before, I used to copy a sentence and only change vocabulary. Now I know how to restructure the sentence properly.”

(STU001)

“Now I know the trick of changing active to passive instead of just replacing words.” (STU006)

“My sentences are more complex and better structured now.” (STU009)

Improvements in citation accuracy and source integration were also frequently mentioned:

“Now my citation is accurate. I’m no longer confused about punctuation and publication year.” (STU005)

“I can integrate other people’s ideas more smoothly into my writing.” (STU003)

“My source integration is better. It doesn’t look like I just pasted information.” (STU008)

Beyond discrete technical skills, several participants described broader cognitive shifts in how they approached writing:

“It changed the way I write. Now I always plan before writing.”

(STU003)

“My way of thinking about writing has changed. It’s more logical now.” (STU019)

These responses indicate that perceived improvement extended beyond isolated techniques to changes in writing strategy and organization.

4.3.2.2 Adaptive Placement and Reduced Anxiety

Nineteen participants described the diagnostic placement as accurate and appropriate to their proficiency level. Students across proficiency bands reported increased confidence and reduced pressure when starting at a suitable level.

Lower-proficiency students emphasized emotional safety:

“Starting at my level reduced my anxiety. I could begin from what I was able to do.” (STU001)

“When the system placed me at a basic level, I felt safe to practice and make mistakes.” (STU012)

“When it made the tasks easier at first, I wasn’t afraid to continue.” (STU002)

Higher-level students described appropriate challenge rather than boredom:

“I was placed at Level 3 from the beginning. It was challenging, but it matched my background.” (STU003)

“The test was accurate. I didn’t waste time on things I already knew.” (STU007)

Some students also highlighted reduced peer comparison:

“I liked that everyone started at their own level. I didn’t have to compare myself with others.” (STU015)

Overall, adaptive placement was consistently described as both academically appropriate and emotionally supportive.

4.3.2.3 Timely Feedback and Mastery-Based Progression

Timely feedback emerged as one of the most dominant themes. Students consistently emphasized the benefit of immediate error identification:

“When I submitted, I immediately knew where I was wrong.”

(STU001)

“Feedback is the most useful part of this system.” (STU005)

“Without detailed feedback, I wouldn’t have passed 80%.”

(STU011)

The 80% mastery threshold was described as both demanding and motivating. Some participants reported frustration:

“Sometimes I missed the 80% by just a little and had to repeat it.”

(STU006)

“Even small mistakes can prevent you from reaching 80%.”

(STU016)

Some participants also expressed ambivalent views toward the mastery requirement and feedback process. While they recognized the value of repeated practice, they also noted that the process could become tiring when they were close to passing or when feedback was difficult to act on immediately:

“I understand that repeating helps me improve, but sometimes it feels tiring when I almost pass and have to do the task again.” (STU014)

“The feedback was useful, but sometimes I needed more time to understand what exactly I should revise.” (STU017)

At the same time, several students described a sense of achievement:

“It created pressure, but it was good pressure.” (STU010)

“Passing the mastery level made me feel proud.” (STU001)

Remediation tasks were framed as supportive rather than punitive:

“After doing the extra practice, I passed easily the next time.”

(STU015)

“Remediation helped rebuild my foundation before trying again.”

(STU012)

“The system doesn’t abandon us. It gives us another chance.”

(STU008)

These responses indicate that mastery-based progression fostered persistence and revision-oriented learning behavior.

4.3.2.4 Engagement, Motivation, and Self-Regulation

Seventeen participants reported increased engagement associated with the self-paced and adaptive structure of the system. Students frequently described spending more time on tasks without feeling bored:

“I spent more time on the system without feeling bored.” (STU001)

“It feels like I have a personal tutor.” (STU007)

Visible progression and level advancement were repeatedly described as motivating:

“When I see my progression bar reaching 100%, it makes me want to continue.” (STU008)

“Unlocking the next level motivates me to keep going.” (STU018)

“The rewards and level structure make me want to finish.”
(STU019)

Several participants explicitly referred to improved self-regulation and discipline:

“It changed my habit of checking my work. Now I review it carefully.” (STU005)

“It trained my discipline. I couldn’t just guess.” (STU013)

“Now I manage my time better because I have to complete each level properly.” (STU009)

Although engagement was predominantly positive, a few participants noted that heavy workload occasionally affected motivation, particularly at higher levels. These comments suggest that the adaptive structure did not motivate all students equally throughout the semester:

“At first, I felt motivated because the system was new, but later some tasks took a lot of time, so I felt less motivated.” (STU010)

“I liked the system, but when I had many assignments from other courses, I only tried to finish the required parts.” (STU020)

Overall, engagement was described as sustained, personalized, and internally driven, with the adaptive structure contributing to both motivation and self-directed learning.

4.3.2.5 Reported Challenges

Despite predominantly positive experiences, participants identified several recurring challenges related to workload intensity, time management, technical issues, and clarity of instructional design.

A commonly reported concern involved the cognitive demand and length of Level 3 tasks. Several students described these tasks as requiring sustained concentration and greater effort compared to earlier levels:

“Sometimes in Level 3 the workload feels heavy and quite long.” (STU001)

“Level 3 tasks require a lot of concentration.” (STU007)

“The amount of content in Level 3 is very challenging.” (STU019)

Time management also emerged as a difficulty for some participants, particularly during peak academic periods. Students described feeling overwhelmed when multiple deadlines coincided:

“Near the final exam, everything comes together and feels overwhelming.” (STU010)

“Some lessons take longer than I expected.” (STU015)

“At first, managing my time was difficult.” (STU020)

In addition, a small number of participants reported technical and interface-related issues. These included occasional system lag and loading delays:

“Sometimes the feedback page loads slowly.” (STU002)

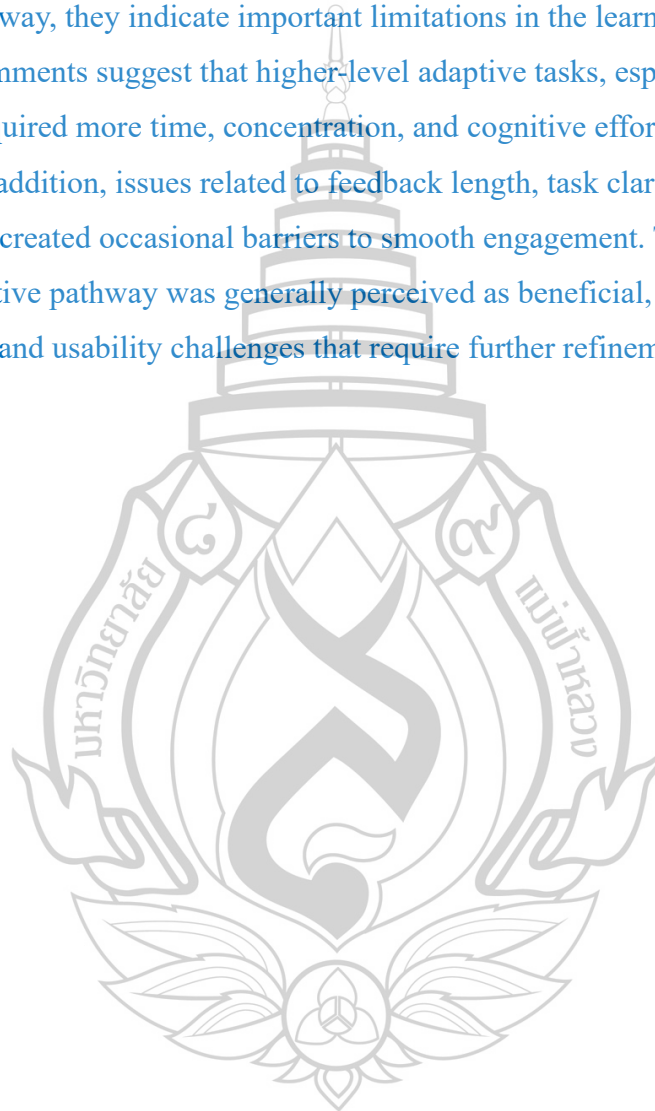
“The system lags when submitting answers.” (STU008)

Some students also noted challenges related to clarity, including complex vocabulary or lengthy feedback explanations:

“Some feedback is quite long and difficult to process.” (STU006)

“Sometimes the instructions are not very clear.” (STU017)

Although these challenges did not lead participants to reject the adaptive learning pathway, they indicate important limitations in the learning experience. Students’ comments suggest that higher-level adaptive tasks, especially Level 3 activities, required more time, concentration, and cognitive effort than some learners expected. In addition, issues related to feedback length, task clarity, and system loading time created occasional barriers to smooth engagement. These findings show that the adaptive pathway was generally perceived as beneficial, but not without instructional and usability challenges that require further refinement.



Chapter 5

Conclusion and Discussion

This chapter presents the conclusion, discussion, and recommendations of the study. It synthesizes the key findings in relation to the research objectives and provides an interpretive analysis grounded in the theoretical framework. The chapter is organized into three main sections. Section 5.1 summarizes the major findings of the study in a concise and objective manner. Section 5.2 discusses the findings in depth by explaining why the results occurred and by comparing them with relevant theories and prior research. Section 5.3 presents practical recommendations for instructional implementation as well as suggestions for future research. Together, these sections aim to clarify the overall contribution of the study to the field of EFL academic writing instruction and adaptive learning design.

5.1 Summary of the Major Findings

The purposes of this study were: (1) to examine the effects of LMS-based adaptive learning pathways on the development of academic writing skills; (2) to identify behavioral and instructional factors associated with writing improvement; and (3) to explore learners' experiences and challenges in engaging with the adaptive system.

This study employed a mixed-methods design. The quantitative component adopted a one-group pretest–posttest quasi-experimental design. The participants consisted of 180 undergraduate students enrolled in the course *Advanced English Reading and Writing*. The research instruments included an academic writing pre-test and post-test, LMS behavioral log data, a structured questionnaire, and semi-structured interviews conducted with 20 students. Quantitative data were analyzed using descriptive statistics, paired-sample t-tests, and Pearson correlation analysis, while qualitative data were analyzed using thematic analysis.

The major findings of the study are summarized according to the research objectives as follows.

First, the comparison of academic writing scores revealed that the mean post-test score (63.98 percent) was significantly higher than the mean pre-test score

(59.71 percent) at the .001 level of statistical significance. The magnitude of improvement was moderate (Cohen's $d = 0.45$). In addition, the standard deviation of post-test scores increased relative to the pre-test, indicating greater variability in individual improvement following engagement with the adaptive learning system.

Second, correlation analysis between behavioral indicators, pedagogical perceptions, and writing gain indicated that *Optional Tasks Completed* was the only variable significantly and positively correlated with writing improvement ($r = 0.527$, $p < .001$). In contrast, required behavioral indicators, including *Overall Mastery Rate*, *Overall Average Attempts*, and *Engagement Score*, were not significantly correlated with score gains.

Furthermore, although students reported high levels of positive perception toward the adaptive instructional design, none of the perception-based constructs demonstrated a statistically significant relationship with actual writing improvement. This finding suggests that behavioral engagement and perceived engagement operated differently in relation to measurable writing development.

Finally, findings from the questionnaire and interviews indicated that students generally reported positive experiences with the adaptive learning system. Participants stated that the system contributed to observable improvement in specific writing sub-skills, particularly paraphrasing and source integration. Diagnostic placement was perceived as accurate and appropriate, contributing to reduced anxiety and minimized peer comparison within the classroom context.

Timely feedback and the 80 percent mastery threshold were identified as important mechanisms that encouraged revision, sustained effort, and the development of self-regulation skills. However, students also reported several challenges, including the cognitive demand and workload intensity of Level 3 tasks, time management difficulties during the latter part of the semester, and occasional technical issues within the LMS platform.

5.2 Discussion of Findings

5.2.1 Effects of the Adaptive Learning System on Academic Writing Development

The findings of this study indicate that participation in the LMS-based adaptive learning pathway was associated with statistically significant improvement in academic writing performance, with a moderate effect size. This improvement can be interpreted through the theoretical perspectives of Process Writing and Mastery Learning.

From a process-oriented standpoint, the adaptive system transformed the instructional model from single-draft submission to structured iterative revision. Rather than submitting a written product once for grading, students were required to revise their responses until they met the established mastery threshold. The 80 percent criterion functioned as a regulatory mechanism that compelled learners to engage with scaffolded feedback and refine their writing through repeated attempts. This structured revision cycle aligns with Process Writing Theory, which emphasizes drafting, feedback, and recursive improvement as essential components of writing development. It also reflects Bloom's Mastery Learning framework, which proposes that systematic corrective feedback and sufficient practice enable learners to close performance gaps and achieve higher levels of competence.

The present findings are consistent with previous research. Révész and Michel (2019) and Liu (2025) reported that EFL writing development is strengthened when learners receive scaffolded guidance and opportunities for multiple revisions. Similarly, Bernacki et al. (2021) and du Plooy et al. (2024) found that adaptive learning systems enhance academic performance when progression is regulated by mastery criteria. The results of this study therefore support prior evidence that structured feedback and controlled progression contribute to measurable writing gains.

Beyond statistical improvement, qualitative evidence revealed a deeper transformation in students' writing processes. Interview data indicated a shift from surface-level lexical substitution toward structural rewriting, logical organization, and pre-writing planning. Students described moving from replacing individual words to reorganizing sentence structure and integrating sources more coherently. This shift

suggests development in higher-order cognitive processes, including metacognitive monitoring and strategic planning, as conceptualized in cognitive models of writing (Flower and Hayes, 1981).

Such transformation addresses a persistent challenge in EFL academic writing, particularly the tendency toward patchwriting identified by Alzahrani (2025) and Doolan (2021). The adaptive design appears to have supported deeper cognitive restructuring rather than merely correcting surface-level linguistic errors. These findings extend the conventional understanding of LMS environments as static content delivery platforms. When integrated with adaptive logic and pedagogical design, digital systems can facilitate higher-order thinking and strategic writing development.

An additional pattern emerged in the increased variability of post-test scores. Although the overall mean improved, the standard deviation widened from 11.46 to 14.57, indicating greater dispersion in individual outcomes. This pattern can be interpreted through the lens of Differentiated Instruction Theory (Tomlinson, 2001). The adaptive pathway removed the constraints of uniform instruction by allowing learners to progress at individualized rates and engage with tiered levels of complexity. While the mastery mechanism supported lower-performing students in reaching a baseline proficiency level, higher-performing students were not restricted by a fixed ceiling and were able to advance through more cognitively demanding tasks, particularly at the paragraph integration level.

The widening dispersion may also reflect differences in learner agency and engagement intensity. Although the mastery structure ensured minimum performance standards, not all students engaged with the system to the same extent. As indicated in Objective 2, voluntary participation in optional tasks was associated with greater writing gains. This suggests that adaptive systems may function simultaneously as equalizing mechanisms at the foundational level and as amplifiers of self-regulated learning behaviors among more proactive learners. In this sense, the adaptive pathway did not produce uniform improvement; rather, it created conditions under which learners' strategic engagement influenced the magnitude of their development.

Taken together, the findings indicate that the adaptive LMS contributed to both baseline improvement and differentiated growth. The system supported structured revision, cognitive restructuring, and tiered progression, thereby accommodating

learner diversity while fostering higher-order academic writing skills in a university-level EFL context.

5.2.2 Factors Associated with Writing Improvement

The findings related to the second research objective provide important insight into which dimensions of engagement were meaningfully associated with measurable writing development. The results revealed that Optional Tasks Completed was the only variable that demonstrated a statistically significant and positive correlation with writing gain. In contrast, required behavioral indicators, including Overall Mastery Rate, Overall Average Attempts, and Engagement Score, were not significantly related to score improvement. Similarly, perception-based measures did not show any statistically significant relationship with writing gain.

These findings can be interpreted through several theoretical lenses presented in Chapter 2. First of all, the absence of a significant relationship between Overall Mastery Rate and writing gain can be explained by the concept of the ceiling effect. As reported in Chapter 4, the mean mastery rate was high (87.85%) with very low variability ($SD = 2.81$). This suggests that the adaptive system effectively ensured that nearly all students reached the required 80 percent mastery threshold.

From the perspective of Mastery Learning theory (Bloom, 1968), this outcome indicates that the system successfully fulfilled its core function: ensuring minimum competency before progression. However, when most participants cluster at similarly high mastery levels, the variable no longer has sufficient variance to explain differences in improvement. In other words, mastery ensured baseline competence, but it did not differentiate higher levels of performance growth. This interpretation aligns with prior research in adaptive learning environments, which has shown that mastery thresholds promote minimum standards but do not necessarily predict advanced performance unless accompanied by deeper engagement behaviors (Bernacki et al., 2021; du Plooy et al., 2024). The present findings therefore support, rather than contradict, previous scholarship on mastery-based progression.

In contrast, Optional Tasks Completed, which reflected voluntary engagement beyond mandatory requirements, demonstrated a substantial positive correlation with writing improvement. This finding can be interpreted through Self-Regulated Learning

theory (Zimmerman, 2002), which emphasizes that effective learners actively plan, monitor, and regulate their learning behaviors.

Optional tasks were not required for progression. Therefore, completion of these tasks reflects learners' initiative, persistence, and willingness to engage in additional revision. This suggests that the adaptive system provided opportunities for practice, but learners' self-regulatory capacity determined whether those opportunities were utilized. This interpretation is further supported by qualitative findings in Chapter 4, where students reported increased discipline, more careful revision habits, and improved time management. These behavioral changes reflect metacognitive regulation rather than mere task completion. The results are also consistent with studies by El-Sabagh (2021) and Jing et al. (2023), which indicate that adaptive technologies are most effective when they promote autonomy and self-directed engagement. The present study extends this line of research by demonstrating that voluntary behavioral indicators, rather than required system compliance, were associated with measurable writing gains. Importantly, this does not imply that optional practice alone causes improvement. Rather, it suggests that self-initiated engagement within a structured adaptive environment may serve as a key mechanism supporting writing development.

Another noteworthy finding is that the composite Engagement Score was not significantly correlated with writing improvement. As defined in Chapter 3, this metric aggregated platform access frequency, page views, time-on-task, interaction behaviors, and course completion percentage. The lack of correlation suggests that interaction intensity does not necessarily equate to strategic learning. From the perspective of engagement theory, behavioral engagement can be differentiated from cognitive engagement. A student may log in frequently, access multiple resources, or spend extended time on tasks without necessarily engaging in deep processing or strategic revision. This distinction aligns with the deep versus surface learning framework (Marton & Säljö, 1976), which suggests that time spent and activity frequency do not automatically indicate meaningful conceptual change. Therefore, the findings refine existing assumptions in learning analytics research by suggesting that composite activity metrics may require careful interpretation when used to predict academic performance outcomes. Rather than undermining the value of engagement metrics,

this result highlights the importance of distinguishing between quantity of interaction and quality of self-regulated engagement.

Similarly, the absence of a significant relationship between Overall Average Attempts and writing gain suggests that repeated attempts alone were insufficient to predict improvement. While Mastery Learning emphasizes iterative practice, repetition without reflective revision may not produce substantive cognitive change. This interpretation is consistent with Process Writing theory, which stresses meaningful revision rather than mechanical rewriting. It is possible that some learners repeated mastery checks without fully engaging with scaffolded feedback. Thus, the quality of revision, rather than the frequency of attempts, may be more critical for writing development. Future research may benefit from examining qualitative characteristics of revision behavior rather than relying solely on attempt frequency as a proxy for persistence.

An additional important finding is that positive pedagogical perceptions were not statistically associated with writing gain. Although students reported favorable attitudes toward the adaptive system, these perceptions did not translate into measurable performance improvement. This result contributes to ongoing methodological discussions in educational technology research. As highlighted in Chapter 2, self-report instruments capture subjective experience, whereas log data capture observable behavior. The present findings suggest that perceived engagement and actual behavioral engagement may function differently in relation to learning outcomes.

This observation aligns with recent work in learning analytics (Li & Lu, 2025), which emphasizes the importance of multimodal behavioral modeling over reliance on satisfaction surveys alone. However, the findings should not be interpreted as dismissing the value of perception measures. Instead, they indicate that behavioral evidence provides complementary and, in this case, more predictive insight into writing development.

Taken together, the findings suggest that adaptive systems may operate in two distinct layers. First, mastery mechanisms establish baseline competency across learners. Second, voluntary self-regulated engagement differentiates levels of improvement beyond that baseline. This nuanced interpretation advances existing

research by clarifying that adaptive progression alone does not guarantee uniform performance gains. Rather, learner agency within structured adaptive environments appears to play a central role.

Importantly, the study does not claim that adaptive systems inherently widen achievement gaps. However, the results indicate that learners with stronger self-regulatory tendencies may benefit more substantially from optional learning opportunities. This insight underscores the importance of integrating explicit self-regulation scaffolds within adaptive instructional design.

5.2.3 Learner Experience, Emotional Safety, and Instructional Challenges

The qualitative findings related to the third research objective provide insight into how learners experienced the LMS-based adaptive learning pathway beyond measurable performance outcomes. While students generally reported positive perceptions of the system, their reflections reveal a nuanced interaction between emotional safety, cognitive challenge, and workload management.

First, students consistently described the diagnostic placement mechanism as accurate and supportive. Many reported that beginning at a level aligned with their actual ability reduced anxiety and increased their willingness to engage with writing tasks. Interview responses such as “Starting at a level I could manage reduced my anxiety” and “I liked that everyone could begin at their own level without comparison” suggest that the adaptive system successfully minimized visible stratification within the classroom.

This finding can be interpreted through Differentiated Instruction Theory (Tomlinson, 2001). Traditional ability grouping often makes proficiency differences explicit, which may unintentionally stigmatize lower-performing learners. In contrast, the adaptive system employed an implicit placement mechanism, assigning learners to appropriate tiers without public labeling. This approach appears to have created what may be described as emotional safety, particularly important in EFL writing contexts where writing anxiety and fear of negative evaluation are well-documented barriers to performance.

From the perspective of Self-Regulated Learning theory (Zimmerman, 2002), reduced anxiety may also support cognitive regulation. Emotional safety lowers

evaluative pressure, thereby decreasing cognitive interference and allowing learners to allocate attentional resources toward revision, monitoring, and strategic decision-making. In this sense, the adaptive placement mechanism did not merely distribute tasks by ability level; it may have created psychological conditions conducive to sustained engagement and reflective practice.

These findings align with Marlina (2024) and Esperanzate (2024), who emphasize the role of affective factors in shaping learners' willingness to revise written work. The present study extends this literature by demonstrating how adaptive technology can operationalize differentiated instruction in a manner that simultaneously supports affective stability and academic progression. However, it does not claim that adaptive placement eliminates anxiety entirely. Rather, the qualitative evidence suggests that implicit tiered progression can mitigate some of the evaluative pressures commonly associated with EFL writing instruction.

At the same time, students reported that tasks at Level 3 were cognitively demanding and required sustained concentration. Several participants noted difficulty managing workload during the latter part of the semester when multiple academic deadlines overlapped. These experiences can be interpreted through Cognitive Load Theory. Level 3 tasks were intentionally designed to foster paragraph-level academic integration, requiring learners to coordinate multiple processes simultaneously, including structural organization, coherence maintenance, and source integration. Unlike earlier levels that focused primarily on lexical or sentence-level modification, Level 3 required higher-order synthesis and structural rewriting.

Such tasks inherently impose higher intrinsic cognitive load. Therefore, students' perception of increased workload reflects the elevated cognitive complexity of advanced academic writing rather than a breakdown in instructional design. This interpretation is consistent with Révész and Michel (2019) and Liu (2025), who argue that meaningful writing development in EFL contexts requires substantial cognitive effort, particularly when moving from surface-level editing to discourse-level integration.

Nevertheless, the reported time management difficulties highlight an important nuance. While the adaptive system effectively adjusted task difficulty through tiered progression, it did not fully adapt pacing. In other words, personalization occurred

primarily at the level of content complexity rather than temporal distribution. This suggests that adaptive instructional design may benefit from incorporating temporal scaffolding, such as phased deadlines or micro-task segmentation, particularly at higher tiers. Such refinements would align with scaffolding principles outlined in Chapter 2 and may help balance cognitive rigor with sustainable workload management.

An additional dimension emerging from these findings concerns educational equity. By minimizing visible ability grouping and allowing learners to progress privately through differentiated tiers, the system reduced explicit comparison and potential stigma. This suggests that adaptive technologies, when carefully designed, can contribute to more inclusive pedagogical environments. However, the results also indicate that personalization alone does not eliminate workload pressure, particularly at advanced stages of skill development. Therefore, adaptive systems must be designed not only to differentiate difficulty but also to support sustainable engagement across diverse learner profiles.

The equity implication of this finding is particularly important in heterogeneous EFL writing classrooms. In traditional classroom settings, students with lower writing proficiency may become visible to peers when they require additional explanation, simplified tasks, or repeated correction. Such visibility can create embarrassment, reduce confidence, and discourage participation. In contrast, the adaptive pathway allowed students to receive differentiated levels of support privately through diagnostic placement and tiered progression. This design helped protect learner dignity while still providing targeted support. Therefore, educational equity in this study does not mean giving all students identical tasks, but providing different levels of support so that learners with different starting points can work toward the same academic writing outcomes. The adaptive LMS pathway thus functioned as an inclusive instructional structure that combined differentiation with emotional safety.

Taken together, the findings suggest that adaptive learning environments function as socio-cognitive systems rather than merely instructional delivery platforms. Emotional safety appears to create the psychological conditions necessary for sustained engagement, while structured cognitive challenge supports higher-order writing development. However, maintaining academic rigor within adaptive

environments requires careful calibration of pacing to prevent overload. These insights refine current understandings of adaptive learning by demonstrating that personalization must address affective, cognitive, and temporal dimensions simultaneously in order to optimize both learner well-being and academic development.

5.3 Conclusion

Taken together, the findings across the three research objectives provide a coherent explanation of how and why the LMS-based adaptive learning pathway influenced academic writing development.

First, with regard to writing improvement, the significant increase in post-test scores with a moderate effect size indicates that the adaptive system contributed meaningfully to measurable gains in academic writing performance. Importantly, qualitative evidence revealed that this improvement extended beyond surface-level correction. Learners described a shift from simple lexical substitution to structural rewriting and more logical source integration, suggesting a change in writing processes rather than mere error reduction. These findings align with Process Writing Theory and Mastery Learning principles, as iterative revision cycles and an 80 percent mastery threshold required learners to actively engage with feedback until competence was demonstrated.

Second, in relation to factors associated with writing development, the results showed that voluntary engagement in optional tasks was the only behavioral indicator significantly correlated with writing gains. This finding underscores the role of self-regulated learning. While the mastery mechanism ensured that most students reached a minimum performance standard, it was the willingness to engage beyond mandatory requirements that differentiated higher levels of improvement. The adaptive system therefore functioned not simply as a progression tool, but as a structured environment in which learner agency became consequential for academic outcomes.

Third, regarding learner experiences and challenges, qualitative findings demonstrated that implicit diagnostic placement contributed to reduced anxiety and minimized peer comparison. This emotional safety likely facilitated sustained engagement with revision tasks. At the same time, the cognitive demand of advanced

tasks, particularly at the paragraph-integration level, created workload and time management challenges. These findings reflect the inherent complexity of higher-order academic writing and confirm that increased rigor may generate pressure even within supportive learning environments.

When integrated, these three strands of evidence suggest that the adaptive learning pathway operated through a layered mechanism. Emotional safety enabled participation, mastery-based revision structured effort, and voluntary engagement amplified development. Writing improvement therefore emerged from the interaction between pedagogical design, adaptive system logic, and learner self-regulation.

Nevertheless, the findings also indicate important limitations. Log data captured observable behavioral engagement but could not directly measure depth of cognitive processing. Moreover, while task difficulty was personalized, motivational support was not fully individualized. Learners who completed only mandatory tasks improved to a baseline level, but did not demonstrate the same degree of advancement as those who engaged voluntarily. This suggests that adaptive logic alone does not guarantee equitable outcomes without complementary motivational and instructional support.

The instructor's role remains central. Although automated feedback and progression rules structured the pathway, pedagogical mediation and human oversight likely reinforced engagement and clarified expectations. Adaptive systems should therefore be understood as complementary instructional tools rather than autonomous replacements for teaching expertise.

Finally, the findings are situated within a specific context of undergraduate EFL learners in a university setting. Cultural norms surrounding revision, assessment structures, and institutional workload patterns may influence engagement behaviors. Replication across different educational contexts is necessary before broader generalizations can be made.

Overall, this study demonstrates that adaptive LMS design, when grounded in established pedagogical theories and supported by learner self-regulation, can facilitate measurable performance gains, process-level cognitive shifts, and emotionally supportive learning environments. At the same time, it cautions against technological determinism and emphasizes the continuing importance of learner motivation and instructional guidance in academic writing development.

The specific contribution of this study lies in demonstrating how LMS-based adaptive learning can be pedagogically designed to support EFL academic writing development through diagnostic placement, mastery-based progression, scaffolded feedback, optional self-regulated practice, and emotionally safe differentiation. Rather than treating adaptive learning as a technological solution alone, the study positions it as a theory-informed instructional design model for supporting diverse writers in higher education. The findings contribute to the field by linking adaptive LMS design, behavioral engagement, and writing-specific outcomes, particularly in relation to paraphrasing, coherence, citation, and source integration. In doing so, the study offers both empirical evidence and a practical design framework for integrating adaptive learning into EFL academic writing instruction.

5.4 Recommendations

5.4.1 Recommendations for Practical Application

The quantitative findings clearly indicate that Optional Tasks Completed was the only behavioral variable positively associated with writing improvement. This suggests that voluntary engagement beyond mandatory requirements plays a critical role in skill development. Therefore, future LMS design and instructional planning should not be limited to mandatory mastery-based tasks alone. Instead, instructors and system designers should intentionally incorporate structured spaces for voluntary extension activities.

Such optional tasks serve not merely as supplementary practice but as mechanisms for cultivating learner autonomy and self-regulation. By providing opportunities for learners to challenge themselves beyond minimum requirements, adaptive systems can support the development of disciplined practice habits and metacognitive awareness. These optional spaces should be carefully designed to encourage meaningful engagement rather than superficial completion.

In addition, interview findings revealed that diagnostic placement without explicit labeling significantly reduced learner anxiety and minimized peer comparison. The absence of visible ability grouping contributed to increased confidence and willingness to engage in revision. Educational institutions and instructors are encouraged to adopt this implicit placement approach when implementing

differentiated instruction. Rather than publicly categorizing learners into high- or low-proficiency groups, adaptive systems can discreetly assign learners to appropriate tiers based on diagnostic data. This design protects learner dignity, reduces stigma, and creates an emotionally supportive environment in which students feel safe to experiment, revise, and learn from errors. Given the well-documented impact of writing anxiety in EFL contexts, such psychologically sensitive instructional design can meaningfully enhance learner engagement without compromising academic rigor.

Moreover, students reported that Level 3 tasks, which required paragraph-level integration and higher-order writing processes, imposed substantial cognitive demand. Time management difficulties were particularly evident toward the end of the semester when multiple academic deadlines converged. When implementing adaptive systems in practice, instructors should consider incorporating micro-task segmentation at advanced levels. Breaking complex writing tasks into smaller, manageable components may reduce cognitive overload while maintaining instructional rigor. Additionally, flexible deadlines or temporal scaffolding strategies can help prevent learner burnout during periods of intensive academic demand. Balancing cognitive challenge with sustainable pacing is essential to ensure that advanced writing tasks promote growth without overwhelming learners.

Finally, although most students perceived the feedback provided by the system as beneficial, some indicated that certain feedback messages were overly lengthy or difficult to interpret. This suggests the need for feedback optimization. Developers and instructors utilizing automated feedback systems should ensure that feedback is concise, concrete, and actionable. Clear guidance that directly indicates how revisions should be made can reduce unnecessary cognitive load during the revision process. Streamlining feedback language not only enhances usability but also supports efficient self-regulated revision.

5.4.2 Recommendations for Future Research

5.4.2.1 Employing Controlled Experimental Designs

One limitation of this study lies in its use of a one-group pretest–posttest design. Although significant improvements were observed, the absence of a control group limits the ability to establish causal inference.

Future research should adopt experimental or quasi-experimental designs incorporating control groups. For example, comparing traditional instruction with adaptive LMS-supported instruction would help isolate the specific impact of adaptive learning mechanisms and strengthen claims regarding causal relationships.

5.4.2.2 Conducting Longitudinal Studies

This study was conducted over a single academic semester. While cognitive shifts in writing processes were observed, academic writing development is inherently gradual and cumulative.

Future research should employ longitudinal designs spanning multiple semesters to examine the durability of learning gains. Such studies could investigate knowledge retention and the transfer of writing skills to other university-level courses. Long-term analysis would provide a more comprehensive understanding of the sustained impact of adaptive learning pathways.

5.4.2.3 Investigating Self-Regulation and Motivation in Greater Depth

Given that optional task completion emerged as a key predictor of writing improvement, further investigation into underlying motivational factors is warranted. Future studies should explore why some learners voluntarily engage in extension tasks while others limit participation to mandatory requirements.

Qualitative or mixed-methods studies focusing on motivational profiles, goal orientation, and self-regulatory capacity may provide deeper insight into engagement patterns. Additionally, action research could explore targeted interventions designed to cultivate proactive learning behaviors among less autonomous learners.

5.4.2.4 Advancing Learning Analytics Approaches

The present study utilized foundational LMS log data indicators such as time-on-task, attempt frequency, and remediation patterns. However, the findings showed that not all behavioral indicators were meaningfully associated with writing improvement. In particular, the composite Engagement Score, Overall Mastery Rate, and Overall Average Attempts were not significantly correlated with writing gain, whereas Optional Tasks Completed showed a significant positive relationship with improvement. This pattern suggests that general activity indicators may not fully capture the quality of students' cognitive engagement or revision processes.

Future research may extend this work through the application of advanced learning analytics techniques. Future research should therefore move beyond basic system log indicators and incorporate more fine-grained learning analytics approaches. For example, keystroke logging could be used to examine drafting pauses, deletion patterns, revision sequences, and the amount of text transformation during paraphrasing. Feedback uptake analysis could investigate whether students actually apply automated feedback to subsequent revisions. Sequence analysis could also be used to examine how learners move between diagnostic tasks, remediation, mastery checks, optional activities, and revision attempts. Such methods would provide richer evidence of how students engage with academic writing processes, not merely how frequently they access or complete LMS activities.

Predictive modeling using artificial intelligence, as well as multimodal behavioral data collection, may yield more nuanced insights into writing processes. Predictive modeling may also be useful for identifying learners who are at risk of superficial engagement, low persistence, or delayed progression. However, these approaches should be used ethically and transparently, with attention to data privacy, informed consent, and the risk of over-reliance on algorithmic prediction. Advanced learning analytics should therefore be understood as a means of strengthening pedagogical insight rather than replacing teacher judgment.

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Appendices



Appendix A: Questionnaire

Topic: Evaluating Learning Experiences through LMS-Based Adaptive Learning Paths for Academic Writing Development

Instructions

This questionnaire is part of the research project titled “*Developing Academic Writing Skills through LMS Adaptive Learning Paths.*”

Please respond based on your actual learning experience in this course. All responses will remain confidential and will be analyzed in aggregate form for research purposes only.

Part 1: Background Information

1. Before taking this course, how confident were you in your academic writing skills?
 1 = Very Low
 2 = Low
 3 = Moderate
 4 = High
 5 = Very High
2. Have you previously experienced an adaptive learning system that adjusts content based on learner performance?
☐ Yes
☐ No

Part 2: Perceived Academic Writing Development

Instructions:

Please indicate your level of agreement with the following statements.

- 5 = Strongly Agree
 4 = Agree
 3 = Neutral
 2 = Disagree
 1 = Strongly Disagree

A. Overall Writing Development

1. The adaptive learning pathway helped improve my academic writing skills.
2. I can apply the skills learned in this course to other academic writing tasks.
3. I feel more confident in completing academic writing assignments after using this system.

B. Specific Writing Skills

4. The system improved my ability to paraphrase accurately without changing the original meaning.

5. The system improved my ability to summarize key ideas effectively.
6. The system improved my ability to integrate source information into my writing.
7. The system helped me understand proper citation and avoid plagiarism.

Part 3: Perceptions of the Adaptive Learning System

A. Diagnostic and Level Appropriateness

8. The diagnostic assessment accurately reflected my writing ability.
9. The level of difficulty assigned to me was appropriate for my skill level.

B. Adaptivity and Content Design

10. The system adjusted task difficulty appropriately based on my performance.
11. The exercises matched my learning needs.
12. The progression from easier to more advanced tasks helped me improve step by step.

C. Feedback and Mastery-Based Progression

13. The feedback provided by the system helped me understand my mistakes.
14. The feedback encouraged me to revise and improve my work.
15. The mastery check ensured I understood the content before moving to the next level.
16. Additional practice activities helped me improve when I did not reach mastery.

Part 4: Engagement and Motivation

17. The self-paced structure increased my motivation to learn.
18. The adaptive structure made learning more engaging.
19. I was willing to spend additional time improving my writing through this system.

Part 5: Challenges and Difficulties

20. I experienced technical problems while using the system.
21. Some instructions or tasks were unclear.
22. I sometimes felt overwhelmed by the workload.
23. Some feedback was difficult to understand or apply.

Part 6: Open-Ended Questions

24. Which feature of the adaptive learning system was most helpful for your writing development? Please explain.
25. What challenges did you experience while using this system?
26. What suggestions do you have for improving this adaptive learning pathway in the future?



Appendix B: Semi-Structured Interview Questions

Title: Interview Questions for Exploring Students' Experiences with LMS Adaptive Learning Paths

Thank you for agreeing to participate in this interview. The purpose of this interview is to better understand your learning experience with the LMS-based adaptive learning pathway in the Advanced English Reading and Writing course.

There are no right or wrong answers. Please feel free to share your honest thoughts. Your responses will remain confidential and will be used for research purposes only.

Section 1: Academic Writing Development

1. In what ways, if any, do you think your academic writing skills have improved after using the adaptive learning system?
 - Can you give a specific example?
 - Which writing skill improved the most?
2. How did the system influence your ability to paraphrase, summarize, or integrate sources?
 - Did you notice changes in how you revise your writing?
3. Did you feel more confident in completing academic writing tasks after using this system? Why or why not?

Section 2: Adaptive Structure and Level Placement

4. How did you feel about the diagnostic assessment at the beginning of each unit?
 - Did it reflect your actual ability?
5. What was your experience with being placed at a certain difficulty level?
 - Was the level too easy, too difficult, or appropriate?
 - How did it affect your learning?
6. How did the step-by-step progression (Level 1 to Level 3) influence your learning process?

Section 3: Feedback and Mastery-Based Progression

7. How did you use the feedback provided by the system?
 - Did you revise your work based on feedback?
 - Was the feedback clear and understandable?
8. What was your experience with the mastery check requirement before moving to the next level?

- Did it motivate you?
 - Did it create pressure?
9. When you did not reach mastery, how helpful were the additional practice activities?

Section 4: Engagement and Motivation

10. How did the self-paced structure affect your motivation?
11. Did the adaptive structure make learning more engaging compared to traditional instruction? Why or why not?
12. Were there moments when you felt particularly motivated or discouraged while using the system?
- What caused those feelings?

Section 5: Challenges and Improvement

13. What challenges did you encounter while using the adaptive learning system?
14. Were there any parts of the system that were confusing or difficult to use?
15. What suggestions do you have for improving the adaptive learning pathway in the future?

Section 6: Reflection on Learning Process

16. Do you think this adaptive system changed the way you approach academic writing? If yes, how?
17. Would you recommend this type of adaptive learning system for other writing courses? Why or why not?

Researcher Biography

1. Atima Kaewsa-ard, Ph. D., SFHEA

Position and Affiliation:

Lecturer, School of Liberal Arts, Mae Fah Luang University, Chiang Rai, Thailand

Educational Background:

- Ph.D. in English for Professional Development, Mae Fah Luang University, Thailand
- M.A. in Applied Linguistics (International Program), King Mongkut's University of Technology Thonburi, Thailand
- B.Ed. in English, Chiang Rai Rajabhat University, Thailand

Professional Experience and Academic Contributions:

Dr. Atima Kaewsa-ard has been a lecturer at Mae Fah Luang University since 2009. Her teaching focuses on academic reading and writing, second language learning, and technology-enhanced language learning. Her research interests include learning analytics, artificial intelligence in education, adaptive learning technologies, and digital pedagogy. She has published research in international journals and conference proceedings related to language education and educational technology.

She has held several academic leadership roles, including Assistant to the President for Academic Affairs, Director of the Learning Innovation Institute, Assistant Dean, and Head of the Self-Access Language Learning Center. She currently serves as Chair of the Collaboration Network Committee of the School of Liberal Arts and as a member of the Academic Council at Mae Fah Luang University.

Dr. Kaewsa-ard is also a Senior Fellow of the Higher Education Academy (SFHEA) under the UK Professional Standards Framework. Her work has received recognition through several awards, including prizes in national competitions on AI and educational innovation.

2. Pitak Tragoolsawang, FHEA

Position and Affiliation:

Lecturer, School of Liberal Arts, Mae Fah Luang University, Chiang Rai, Thailand

Educational Background:

- M.A. in Applied Linguistics, Mahidol University, Thailand
- B.A. in English, Mae Fah Luang University, Thailand

Professional Experience and Academic Contributions:

Mr. Pitak Tragoolsawang is a lecturer in the English program at the School of Liberal Arts, Mae Fah Luang University. He has extensive experience teaching English as a Foreign Language (EFL) at the university level, particularly in courses related to academic reading and writing. His teaching emphasizes learner-centered pedagogy, critical thinking, and effective writing strategies.

His research interests include technology-enhanced language learning, AI-assisted writing feedback, second language acquisition, and digital learning environments for EFL instruction. He has presented his work at international conferences and has been actively involved in academic and community service activities that promote English language learning and teacher development.

Mr. Tragoolsawang also integrates digital tools and Learning Management Systems (LMS) into his teaching to support student engagement and improve writing development in EFL contexts.