CHAPTER I

INTRODUCTION

1.1 Background

Artificial Intelligence (AI) is a technology that enables machines to understand human language and make decisions (Sheikh et al., 2023). UNESCO (2021) defines AI as a set of technologies that allow machines to perceive, comprehend, act, and learn in ways that resemble human cognitive functions. In education, AI has been integrated into various learning activities to provide automated feedback, improve instructional delivery, and adapt teaching to students' needs (OECD, 2023). In the field of writing, AI-based applications such as grammar checkers, coherence evaluators, and productivity tools assist students in drafting, revising, and refining their writing (Bahari, 2021; Johnson and Lee, 2020). The increasing use of these tools reflects the growing role of AI in supporting academic writing practices in higher education.

The use of AI in education, particularly in academic writing, has increased because it can support students at several stages of the writing process. Common applications such as ChatGPT and Gemini help students generate ideas and draft initial sentences (Bahari, 2021). Tools that focus on language accuracy, such as Grammarly and GitHub Copilot, provide grammar corrections and suggestions that improve clarity and appropriateness in students' written work (Johnson and Lee, 2020). In addition, applications designed to enhance textual coherence, such as Storylab.ai, help students organise their ideas into more structured and cohesive paragraphs (Bahari et al., 2023). These developments demonstrate the expanding role of AI in supporting students' writing performance, although concerns remain

regarding the potential reduction in students' cognitive engagement when relying on such tools (Slimi, 2023).

Cognitive Load Theory (CLT), pioneered by Sweller, provides a framework for understanding how mental effort impacts skill acquisition and performance (Sweller et al., 2011). Sweller (2010) defined cognitive load as the total amount of mental energy required to process information at any given time. The theory categorises this load into three distinct types: intrinsic, extraneous, and germane (Paas et al., 2003). In the context of academic writing, intrinsic load is driven by the inherent complexity of the task, such as generating ideas, organising arguments, or mastering structural conventions. In contrast, extraneous load arises from external factors that do not contribute to learning, such as inefficient tool designs or cluttered interfaces (Sweller, 2010). Finally, germane load refers to the productive mental effort dedicated to deep cognitive engagement and the construction of new writing schemas. CLT suggests that by mitigating unnecessary burdens from intrinsic and extraneous loads, students can better allocate their limited cognitive resources to germane load, ultimately leading to more effective learning and improved writing outcomes (Sweller et al., 2011).

AI-powered writing applications are recognised for their ability to alleviate cognitive pressure, specifically by streamlining language production and offering instantaneous feedback (Johnson & Lee, 2020). Nevertheless, critical questions remain about how these technologies reshape the mental processes underlying academic writing (Slimi, 2023). While AI can effectively mitigate extraneous cognitive load by automating technical tasks such as grammar refinement and initial idea formulation (Bahari et al., 2023), the resulting ease may inadvertently lead to

a dependency on automation at the expense of active reasoning. This shift may stifle the allocation of mental resources toward deeper understanding, a process that relies heavily on sustained cognitive engagement (Sweller et al., 2011). Building upon these concerns, the current study examines the multifaceted impact of AI-assisted feedback. It aims to determine whether AI provides a seamless 'automated comfort' that truly facilitates the writing process or whether factors such as misleading responses and complex interfaces unintentionally increase students' cognitive burden (Wu & Chen, 2020; Gkintoni et al., 2025). Ultimately, this research seeks to clarify whether AI serves as a genuine cognitive scaffold or as a source of digital interference (Feng, 2024).

Perception is the process by which individuals interpret and assign significance to information, guided by their prior experiences, existing knowledge, and internal expectations. This interpretive framework ultimately dictates their behavioural responses and decision-making within learning settings (Burn, 2010; Goldstein, 2009). In this qualitative inquiry, students' perceptions serve as the primary lens for understanding their subjective cognitive experiences. Perception allows learners to interpret how they assign meaning to their mental effort and manage information processing during task execution (Burn, 2010). In the context of AI-assisted writing, these subjective insights are essential for identifying the nuances in how students mitigate task complexity and decide whether to reallocate their cognitive resources toward deeper, more germane processing (Mayer, 2022; Feng, 2024). Thus, exploring these perceived experiences provides a comprehensive view of the cognitive dynamics at play when students interact with AI tools.

Although recent studies acknowledge the growing integration of AI-assisted writing tools in higher education, there remains limited empirical attention to the cognitive dynamics underlying these tools (Slimi, 2023; Gasaymeh et al., 2025). Existing research primarily emphasises the functional benefits of AI, such as improving writing accuracy and fluency, or discusses general attitudes toward its adoption (Bahari, 2021; Lipalam et al., 2023). However, these studies rarely investigate the specific ways in which AI mitigates mental burdens, nor do they examine the extent to which students reallocate their cognitive resources toward deeper academic processing (Fan et al., 2025). This gap is significant because the convenience offered by AI may fundamentally alter students' depth of engagement and the development of skills that require active cognitive involvement (Kellogg, 2008; Sweller, 2020). Addressing this issue requires a shift from evaluating AI's technical advantages to understanding the mental processes and the redistribution of cognitive effort in AI-assisted writing (Feng, 2024; Seran et al., 2025). Consequently, there is a pressing need for a study that examines how reducing cognitive load through AI affects students' engagement with the complexities of academic writing.

In response to this gap, the present study investigates the dynamics of cognitive load in AI-assisted writing, specifically examining how students mitigate mental burdens and reallocate their cognitive effort. Crucially, this research seeks to determine whether AI functions as a comprehensive cognitive scaffold that effectively alleviates the pressures of language production, or if it paradoxically introduces new forms of mental strain, such as the effort required to verify inaccurate outputs or navigate complex interfaces (Fan et al., 2025; Seran et al.,

2025). Furthermore, the study examines the extent to which reducing technical burdens enables students to redirect their focus toward deeper, germane cognitive engagement (Bahari et al., 2023). By identifying how cognitive resources are managed, these findings offer insights to help educators integrate AI tools more strategically into instruction. Ultimately, this research contributes to the broader discussion of AI in education by clarifying whether these technologies serve as genuine cognitive scaffolds or as sources of digital interference that reshape students' cognitive processes (Feng, 2024; Gkintoni et al., 2025).

1.2 Research Questions

The study examines the following research questions:

1. How do AI tools facilitate the mitigation of intrinsic and extraneous cognitive load during the students' academic writing process?

2. To what extent do students allocate the reduction in cognitive load to the germane cognitive load (deep cognitive engagement)?

1.3 Research Purpose

The purpose of this study is to investigate how AI tools shape students' cognitive experiences during the academic writing process. Specifically, the research examines how these tools mitigate intrinsic load by helping students manage the inherent complexity of writing tasks. It also evaluates the impact of AI on extraneous load, determining whether these tools reduce mental effort through streamlined feedback or inadvertently increase it due to technical constraints. Furthermore, this study explores the extent to which students allocate the reduction in cognitive load to germane load (deep cognitive engagement), particularly in

supporting knowledge construction and reflective writing. Central to this investigation is an analysis of the challenges students face, such as navigating inaccurate outputs, to determine whether AI serves as a genuine cognitive scaffold or merely adds to mental strain. By addressing these dynamics, the study seeks to provide a nuanced understanding of how AI tools influence the redistribution of mental resources and students' development as academic writers.

1.4   Scope of the Study

This study explores the dynamics of cognitive load among students when completing academic writing tasks with AI-powered tools. The investigation specifically examines the mechanisms through which students mitigate intrinsic and extraneous cognitive load, as well as the extent to which they reallocate their mental resources toward germane cognitive load (deep cognitive engagement). In line with the research objectives, particular emphasis is placed on identifying the cognitive challenges students encounter when integrating AI into their writing workflow, such as the mental strain of verifying outputs. This study does not aim to evaluate the technical accuracy of AI tools or measure objective writing performance outcomes; rather, its scope is confined to understanding the subjective management of cognitive demands. By focusing on these internal processes, the research provides a detailed account of how AI influences the distribution of mental effort in an academic setting.

The research was conducted within the English Language Education Department at Universitas Negeri Jakarta, involving twenty-five undergraduate students who actively utilise AI tools for academic writing. Consequently, the findings are localised to this specific institutional setting and are not intended to be

generalised to a broader population. Data collection took place over three months, from mid-April 2025 to mid-July 2025.

Adopting a qualitative case study approach, this research seeks to capture nuanced individual accounts of mental effort and cognitive distribution. This design is particularly suited to exploring the complex, real-world interactions between students and AI tools in the context of academic writing. Data were gathered through a combination of questionnaires and semi-structured interviews to obtain rich, detailed evidence of how students manage their cognitive resources. To ensure the credibility and depth of the findings, the study employed data triangulation by cross-referencing information across these multiple sources (Carter et al., 2014; Yin, 2018). Within this framework, the research provides a contextualised understanding of how students navigate the complexities of writing, specifically focusing on the internal mechanisms that mitigate load and redirect mental effort toward deeper cognitive engagement.

1.5 Significance of the Study

The significance of this study is outlined as follows: its theoretical, pedagogical, curricular, and institutional contributions.

1. Theoretical Significance

   This study contributes to the development of Cognitive Load Theory (CLT) by extending its application to AI-assisted academic writing contexts. By examining students' perceptions of intrinsic, extraneous, and germane cognitive load, the study provides empirical evidence that cognitive load in technology-mediated writing is shaped not only by task complexity and instructional design but also by learners' interaction with AI tools. The

findings, therefore, enrich CLT by highlighting the role of learners' perceptions and agency in managing cognitive load in digital learning environments.

2. Pedagogical Significance

Pedagogically, this study offers insights for lecturers and writing instructors regarding how AI tools influence students' cognitive engagement during academic writing. The findings demonstrate that AI can reduce unnecessary cognitive burden and support learning when used reflectively but may also hinder cognitive engagement if used uncritically. These insights can help educators design writing instruction that integrates AI as a mental support tool while maintaining students' responsibility for developing ideas, making arguments, and engaging in critical thinking.

3. Curricular Significance

From a curriculum development perspective, this study provides evidence-based guidance for integrating AI-assisted writing into higher education curricula. The findings suggest that AI literacy should be embedded within academic writing courses to help students manage cognitive load effectively. Curriculum designers may use these results to formulate learning outcomes that emphasise reflective use of AI, mental engagement, and development of writing skills, ensuring that AI integration aligns with pedagogical objectives rather than functioning solely as a productivity aid.

4. Institutional and Policy Significance

At the institutional level, this study informs policymakers and academic administrators about the cognitive implications of AI use in higher

education. The findings support the need for clear pedagogical and ethical guidelines governing AI-assisted writing to ensure academic integrity and meaningful learning. By considering cognitive load as a key factor, institutions can develop policies that balance technological innovation with students' cognitive development and academic responsibility.

5. Student Learning Significance

For students, this study enhances awareness of how AI tools affect their cognitive processes during writing. By understanding the different types of cognitive load involved in AI-assisted writing, students may become more reflective and strategic in their use of AI tools. This awareness can help students avoid overreliance on AI, maintain cognitive autonomy, and use AI as a learning partner rather than a substitute for critical thinking.