

TRANSFORMING GENERATIVE AI INTO A COGNITIVE SCAFFOLD: A SOCRATIC-STRUCTURED MODEL FOR DEVELOPING ACADEMIC WRITING SKILLS

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ABSTRACT

This study investigates how generative artificial intelligence can be transformed from a text-producing tool into a cognitive scaffold in academic writing instruction. A quasi-experimental study was conducted with 64 first-year university students (aged 17–19) enrolled in an English-medium program in Uzbekistan. Participants were divided into the AI- Assisted Writing Group using conventional AI-assisted writing and the Socratic-AI Guided Writing Group applying a structured Socratic-AI scaffolding model. Over eight weeks, students completed argumentative writing tasks. Results show that the experimental group demonstrated greater improvement in argument structure, logical coherence, and metacognitive awareness. The findings suggest that structured Socratic prompting can reposition AI from a passive writing assistant to an active cognitive mediator in academic writing development.

KEYWORDS: *generative AI, academic writing, scaffolding, Socratic questioning, metacognition*

АННОТАЦИЯ

В данном исследовании рассматривается возможность трансформации генеративного искусственного интеллекта из инструмента автоматического создания текста в когнитивный механизм поддержки (scaffold) в обучении академическому письму. Квазиэкспериментальное исследование было проведено с участием 64 студентов первого курса (17–19 лет), обучающихся по англоязычной программе в Узбекистане. Участники были распределены на две группы: группа AI-Assisted Writing, использующая традиционную модель применения ИИ при письме, и группа Socratic-AI Guided Writing, в которой применялась структурированная модель сократического ИИ-скэффолдинга. В течение восьми недель студенты выполняли задания по написанию

аргументативных эссе. Результаты показали, что вторая группа продемонстрировала более значительный рост по показателям структуры аргументации, логической связности и метакогнитивной осознанности. Полученные данные свидетельствуют о том, что структурированное сократическое взаимодействие позволяет переосмыслить роль ИИ — от пассивного ассистента по созданию текста к активному когнитивному медиатору в развитии академического письма.

КЛЮЧЕВЫЕ СЛОВА: *генеративный искусственный интеллект, академическое письмо, скэффолдинг, сократическое обучение, метакогниция.*

INTRODUCTION

The rapid development of generative artificial intelligence tools such as systems developed by OpenAI has significantly influenced academic writing practices. Students increasingly use AI to generate essays, summaries, and research drafts. While these tools improve linguistic accuracy and productivity, educators express concerns about reduced critical thinking and cognitive dependency.

In English as a Foreign Language (EFL) contexts, academic writing requires not only language proficiency but also argumentation skills, logical reasoning, and metacognitive awareness. If AI is used primarily as a text generator, students may bypass essential cognitive processes involved in academic writing development.

This study proposes a Socratic-structured AI scaffolding model in which AI does not directly produce full texts but instead guides students through structured questioning and reflective prompts. The research question guiding this study is:

- ***Does a Socratic-AI scaffolding model improve academic writing quality and cognitive engagement more effectively than conventional AI-assisted writing?***

LITERATURE REVIEW

Scaffolding and Cognitive Development

The concept of scaffolding originates from the sociocultural theory of Lev Vygotsky, who introduced the Zone of Proximal Development (ZPD). Scaffolding supports learners in performing tasks slightly beyond their independent ability through guided assistance.

In academic writing, scaffolding traditionally involves teacher feedback, structured outlines, and guided questioning. Digital environments, however, often replace scaffolding with automation.

Cognitive Load and Writing

According to John Sweller, learning occurs when cognitive load is optimally managed. Excessive automation may reduce productive cognitive effort necessary for deep learning. When AI generates entire essays, students may experience reduced engagement in planning, organizing, and evaluating arguments.

Socratic Questioning in Education

The pedagogical approach attributed to Socrates emphasizes guided inquiry through structured questioning. Socratic dialogue encourages learners to clarify assumptions, examine evidence, and refine reasoning. Integrating this method into AI interaction can shift AI from content producer to cognitive facilitator.

Uzbek Academic Context

In Uzbek higher education, scholars such as Sh. Safarov and N. Mahmudov emphasize discourse competence and functional text construction in academic writing pedagogy. However, structured AI integration in academic writing instruction remains underexplored in the national context.

METHODOLOGY

1. *Research Design*

A quasi-experimental design was implemented over eight weeks (January-February 2026) at a private English-language learning center affiliated with a university in Termez.

2. *Participants*

The study involved 64 *first-year university students* enrolled in an English-medium foundation program.

AGE	PROFICIENCY LEVEL	GENDER DISTRIBUTION
17-19	B2(CEFR)	36 FEMALE, 28 MALE

- All participants had prior experience using AI writing tools

Students were randomly assigned to:

- **AI- Assisted Writing Group** (n=32): Conventional AI-assisted writing
- **Socratic-AI Guided Writing Group** (n = 32): Socratic-AI scaffolding model

Participation was voluntary, and informed consent was obtained.

3. *Instructional Procedure*

Both groups completed four argumentative essays (500–600 words).

- *AI- Assisted Writing Group* Students were allowed to use AI freely for drafting, editing, and idea generation.
- *Socratic-AI Guided Writing Group* Students used AI under structured rules:
 1. AI could not generate full paragraphs.
 2. AI provided only guided questions for:
 - Clarifying thesis statements
 - Identifying supporting evidence
 - Considering counterarguments
 3. Students produced all final text independently.
 4. AI provided limited feedback on coherence and clarity after drafting.

4. *Data Collection*

Data sources included:

- ❖ Pre-test argumentative essay
- ❖ Post-test argumentative essay
- ❖ Academic Writing Rubric (argument structure, coherence, evidence use)
- ❖ Metacognitive Awareness Questionnaire

Two independent raters evaluated essays. Inter-rater reliability reached 0.87 (Cohen’s kappa).

5. *Data Analysis*

Independent samples t-tests were conducted to compare pre- and post-test scores between groups.

RESULTS

Writing Performance

Both groups improved; however, the Socratic-AI Guided Writing Group showed significantly greater gains.

CRITERION	AI- Assisted Writing Group (Mean Gain)	Socratic-AI Guided Writing Group (Mean Gain)
Argument Structure	+1.2	+2.4
Logical Coherence	+1.0	+2.1
Evidence Integration	+0.9	+2.0

Statistical analysis indicated significant differences ($p < .01$).

Metacognitive Awareness

The Socratic-AI Guided Writing Group reported higher awareness of:

- ✓ Planning strategies
- ✓ Self-monitoring
- ✓ Evaluating argument quality

Students noted that structured questioning helped them “think before writing.”

DISCUSSION

The findings suggest that AI becomes pedagogically effective when structured as a cognitive scaffold rather than a content generator. The Socratic-AI model encouraged deeper engagement with argument construction and reduced passive reliance on automated text generation.

The study demonstrates that in EFL academic contexts, AI integration should emphasize cognitive activation rather than productivity alone.

CONCLUSION

This study confirms that generative AI can support academic writing development when used as a structured scaffold. The Socratic-AI model improved argument quality and metacognitive awareness among B2-level university students.

Future research may explore longitudinal effects and adaptation for advanced academic writing contexts.

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