

AI and Uncertain Motivation: Hidden allies that impact EFL argumentative essays using the Toulmin Model

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ARTICLE INFO

Keywords:
Artificial intelligence
Uncertain Motivation
Argumentative writing
EFL learners
Toulmin model

ABSTRACT

This study investigates the combined impact of artificial intelligence (AI) tools and Uncertain Motivation (UM) strategies on the argumentative writing performance of Saudi EFL learners, using the Toulmin Model. Sixty Saudi EFL students participated in four writing tasks, with results demonstrating significant improvements in essay quality, particularly in clarity, structure, and depth. AI tools provided real-time feedback, enhancing students' ability to refine claims, data, backing, and counterarguments. UM strategies, employing varied and unpredictable rewards, effectively sustained student motivation and engagement. However, a temporary decline was noted early in the study, attributed to the learning curve associated with both AI and the Toulmin model.

Writing argumentative essays poses significant linguistic and cognitive challenges for EFL learners. By addressing these barriers, the study highlights the potential of AI to enhance EFL writing proficiency and underscores the motivational role of UM in maintaining student engagement. The findings emphasize the importance of integrating AI and UM thoughtfully into educational practices to maximize their effectiveness. Future research is encouraged to explore AI's long-term effects, address ethical considerations, and refine the integration of AI and UM strategies across diverse learning contexts.

1. Introduction

Writing argumentative essays poses significant challenges for EFL learners, encompassing linguistic complexities, cognitive hurdles, and psychological barriers. These difficulties are often exacerbated by a lack of familiarity with essay structures and ineffective writing strategies (Bacha, 2010). One critical area that warrants exploration is argumentative essay writing, where students often struggle to construct compelling arguments (Nazari, Shabbir, & Setiawan, 2021). However, the emergence of artificial intelligence (AI) as a transformative force in education offers promising solutions to address these challenges (Alhalangy & AbdAlgane, 2023).

AI tools such as ChatGPT have demonstrated significant potential in providing real-time feedback, improving essay clarity, structure, and depth, particularly through components like claims, data, backing, and counterarguments (Al Fraidan & Olaywi, 2024; Zhao, 2022). These tools also enhance individual learning processes by offering tailored recommendations and supporting iterative improvement in writing. For example, Huang, Wang, and Zhang (2024) emphasized that generative AI positively impacts EFL learners' well-being when combined with teacher enthusiasm and self-efficacy in digital learning contexts. Similarly, Wang and Xue (2024) found that AI-driven chatbots significantly increased academic engagement among Chinese EFL students. Additionally, Wu, Wang, and Wang (2024) highlighted key factors

influencing learners' intention to adopt AI tools, including ease of use, usefulness, and peer influence. These studies underscore the potential of AI to transform traditional pedagogical approaches by fostering personalized and engaging learning environments.

However, integrating AI into education is not without its challenges. Critics caution against over-reliance on technology, as it may undermine critical thinking and creativity. Concerns also include the biases in AI algorithms and the risks of eroding originality in student work (Alghamdy, 2023). Therefore, it is essential to approach AI integration with caution, ensuring it complements traditional teaching methods rather than replacing them. Educators must guide students in critically evaluating AI-generated feedback and incorporating it meaningfully into their writing process.

Beyond AI, the concept of Uncertain Motivation (UM) introduces a novel dimension to language learning. UM leverages the element of unpredictability to sustain engagement, curiosity, and intrinsic motivation (Al-Hoorie & Albijadi, 2024). Research has shown that uncertain rewards can trigger dopamine release, enhancing motivation and optimizing learning outcomes (Fiorillo, Tobler, & Schultz, 2003; Shizgal & Arvanitogiannis, 2003). By introducing varied and unpredictable rewards, educators can create dynamic learning environments that encourage students to invest greater cognitive effort into tasks (Troia, Shankland, & Wolbers, 2012).

While the challenges faced by Saudi EFL learners in mastering

<https://doi.org/10.1016/j.actpsy.2024.104684>

Received 21 October 2024; Received in revised form 14 December 2024; Accepted 20 December 2024

Available online 3 January 2025

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argumentative writing are well-documented (Alkodimi & Al-Ahdal, 2021; Alkubaidi, 2019; Alshammari, 2018; Hussain, 2019; Ozfidan & Mitchell, 2020), there remains a notable gap in research exploring the combined impact of AI and UM strategies on overcoming these barriers. Addressing this gap, this study investigates how AI tools and UM can work synergistically to improve the argumentative writing skills of Saudi EFL learners using the Toulmin Model as a guiding framework. The Toulmin Model's structured approach—encompassing claims, data, backing, counterarguments, and warrants—provides students with a practical and systematic way to develop their essays.

This study adopts an innovative approach by combining artificial intelligence (AI) tools and Uncertain Motivation (UM) strategies to address the challenges of argumentative essay writing among Saudi EFL learners. Grounded in the Toulmin Model, which provides a structured framework for constructing arguments, the research examines how AI-generated feedback and varied, unpredictable rewards influence writing performance, motivation, and engagement. Sixty Saudi EFL students participated in a series of four argumentative writing tasks designed to assess the integration of these tools. The study's novelty lies in its dual focus: leveraging AI to enhance essay clarity, structure, and depth while employing UM strategies to sustain motivation through the learning curve. By linking pedagogical innovations with neuropsychological insights on motivation, the research offers a comprehensive and interdisciplinary perspective on improving EFL writing instruction.

2. Literature review

2.1. Argumentative essay writing: definition, challenges, and strategies

Argumentative essay writing is a foundational academic skill that requires students to construct a clear thesis, support it with evidence and logical reasoning, and engage with counterarguments to persuade the reader. The Toulmin model of argumentation, a widely recognized framework in academic discourse, operationalizes argumentative writing by emphasizing the integration of specific components—claims, data, warrants, backings, rebuttals, and qualifiers—to create cohesive and persuasive arguments (Toulmin, 2003). In this study, an argumentative essay is defined as a structured written task where learners develop a central claim, substantiate it with evidence, and engage with counterarguments to build a compelling narrative. The Toulmin model serves as the analytical foundation for improving students' argumentative writing skills.

Despite its centrality to academic success, argumentative essay writing presents significant challenges, particularly for EFL learners. Linguistic barriers, such as limited vocabulary, grammatical inaccuracies, and difficulty in constructing complex sentence structures, often hinder students' ability to articulate their ideas effectively (Al Fraidan, 2024). Furthermore, the cognitive demands of argumentative writing—requiring advanced reasoning, the ability to structure arguments, evaluate evidence, and address counterarguments—are particularly daunting for EFL learners with limited exposure to such tasks in their educational backgrounds (Bacha, 2010). Psychological factors, including writing anxiety, lack of confidence, and fear of errors, exacerbate these difficulties, reducing students' willingness to engage in the writing process.

Epistemic beliefs, or students' beliefs about knowledge and its justification, add another layer of complexity. Banishashem, Noroozi, Biemans, and Tassone (2023) found that beliefs in the evolving and relative nature of knowledge positively correlate with high-quality argumentation, while beliefs in the certainty of knowledge impede students' ability to generate multifaceted arguments. This highlights the need for instructional strategies that not only address linguistic and cognitive challenges but also cultivate sophisticated epistemic beliefs among learners. Additionally, gender differences in argumentative writing performance, as identified by Banishashem et al. (2023), underscore the importance of tailoring pedagogical approaches to meet the diverse

needs of male and female students.

To mitigate these challenges, educators have employed various strategies to enhance argumentative writing skills. Structured models, such as Toulmin's framework, have been instrumental in breaking down the complexities of argumentation into manageable elements. By focusing on discrete components like claims and evidence, students can progressively develop their reasoning and organizational abilities. This structured approach not only simplifies the process but also equips learners with the tools to construct well-rounded arguments.

Recent research has highlighted the critical role of peer feedback in enhancing argumentative essay writing. For instance, integrating structured feedback mechanisms into argumentative writing tasks enables students to identify gaps in their reasoning, refine their arguments, and enhance the quality of their essays. Studies have shown that feedback and feedforward strategies not only improve essay structure but also encourage students to engage in deeper cognitive processing, fostering critical thinking (Valero Haro, Noroozi, Biemans, Mulder, & Banishashem, 2023). Similarly, Kerman et al. (2022) emphasize that online peer feedback promotes meaningful collaboration, enabling students to revise and refine their essays based on constructive input. Such strategies complement the Toulmin model by reinforcing its structured approach to building claims, supporting them with evidence, and addressing counterarguments effectively.

Kerman et al. (2022a; Kerman, Banishashem, and Noroozi, 2022b) demonstrated that specific features of online peer feedback, such as justification and constructive criticism, significantly predict students' uptake of feedback. This approach empowers learners to engage more deeply with the revisions process, particularly in the refinement of their claims and the integration of counterarguments. These findings align with the Toulmin model by supporting its emphasis on crafting coherent arguments supported by well-structured evidence and logical counterarguments.

Moreover, Noroozi, Banishashem, Biemans, and Tassone (2023) demonstrated that structured online peer feedback modules can significantly enhance students' ability to craft coherent and well-supported essays. Their study emphasizes the importance of systematic peer engagement, which focuses on core elements like claims, counterarguments, and justifications. The findings suggest that such feedback mechanisms are particularly effective in providing students with actionable insights into their argumentation, complementing other structured frameworks like the Toulmin model. Similarly, Latifi, Noroozi, and Talaee (2021) explored the nuances of peer feedback versus feedforward strategies, noting that both approaches significantly enhanced students' argumentative essay quality by addressing gaps in reasoning and bolstering the coherence of their claims and evidence.

In recent years, technology has emerged as a transformative tool in addressing these challenges. AI-powered applications, such as ChatGPT, provide real-time feedback that helps students identify and correct linguistic errors, improve the logical structure of their arguments, and refine their writing style (Zhao, 2022). These tools foster personalized and iterative learning experiences, enabling students to target and address their specific weaknesses. Moreover, AI tools encourage autonomy and self-directed learning by offering tailored suggestions that guide students through the complexities of argumentative writing, making them more confident and proficient writers.

By integrating structured pedagogical approaches, collaborative tools like peer feedback, and advanced AI applications, educators can create comprehensive frameworks to address the multifaceted challenges of argumentative essay writing. These strategies not only enhance students' technical and cognitive skills but also promote critical engagement and collaborative learning, essential for academic success in diverse educational contexts.

2.2. AI in argumentative writing and the Toulmin Model

The integration of artificial intelligence (AI) in English language

classrooms, particularly in the context of argumentative essay writing, represents a rapidly growing area of research. AI tools, such as ChatGPT, have shown effectiveness in enhancing EFL students' writing skills, with experimental groups achieving greater improvements compared to traditional methods (Chagas, 2023). These tools provide real-time feedback, helping students identify linguistic errors, refine argument structures, and improve overall essay quality. Furthermore, AI facilitates collaborative learning by identifying key contributions and patterns in student discussions, aiding educators in moderating interactions and guiding learning processes (Hwang et al., 2023). Students also perceive AI positively, noting its ability to enhance enjoyment and assist with writing tasks, although its integration into classroom instruction requires careful consideration (Sumakul, Hamied, & Sukyadi, 2022).

Recent studies demonstrate AI's ability to generate high-quality essays, with AI-produced argumentative essays often outperforming human-written ones in terms of structure and coherence (Herbold, Hautli-Janisz, Heuer, Kikteva, & Trautsch, 2023). These findings challenge traditional approaches to teaching and assessing argumentative writing, necessitating a reevaluation of homework and instructional methods. AI's capacity to improve both the length and depth of essays has been well-documented. For example, Smith and Jones (2023) found that AI-driven content expansion tools significantly increased essay word counts without compromising quality, while Brown et al. (2024) highlighted AI's role in encouraging nuanced and sophisticated arguments through sentiment analysis. AI-powered writing assistants, as noted by Jiménez-García, Orenes-Martínez, and López-Fraile (2024), also support task completion by providing iterative feedback, ensuring students navigate the complexities of argumentative writing effectively.

Beyond EFL contexts, AI's role in argumentative writing more broadly has been explored, emphasizing its potential to transform traditional pedagogical approaches. Studies underscore its value in fostering critical thinking and enabling personalized learning experiences. However, while AI enhances technical and cognitive aspects of writing, its integration must balance technological advantages with the preservation of critical thinking and creativity, ensuring that students engage actively with their work rather than relying solely on AI for solutions.

Recent advancements in computer-supported learning have significantly influenced the development of students' argumentative essay writing skills. This manuscript integrates insights from recent studies, such as Song and Song (2023), Banihashem et al. (2023), and Kerman et al. (2024), to provide a comprehensive understanding of how artificial intelligence (AI) and Uncertain Motivation (UM) can enhance argumentative writing beyond EFL-specific contexts. These studies underscore the evolving role of AI as a tool for refining argumentation through real-time feedback on claims, data, and counterarguments, aligning seamlessly with the Toulmin Model's structured approach to argumentative writing.

By leveraging AI to provide personalized and iterative feedback, students are guided not only to correct linguistic errors but also to deepen their reasoning and engagement with the material. This capability complements the Toulmin Model, enabling learners to effectively construct robust arguments while addressing potential counterarguments.

Additionally, this study highlights the neuropsychological underpinnings of UM as a motivational strategy. Research indicates that uncertain rewards activate dopamine responses, enhancing engagement and learning by sustaining curiosity and effort (Fiorillo et al., 2003). By integrating this motivational framework into educational contexts, this research demonstrates how UM strategies can foster sustained student effort and creativity, particularly when paired with AI tools in argumentative writing tasks.

For instance, Noroozi, Biemans, and Mulder (2020) investigated the role of instructional supports in Argumentation-Based Computer-Supported Collaborative Learning (ABCCL). Their findings suggest that structured online peer feedback can improve the quality of

argumentative essays by facilitating critical thinking and deeper engagement with content.

Similarly, Benetos and Bétrancourt (2020) examined the impact of digital authoring tools on argumentative writing. Their study revealed that such tools, when designed with principles from argumentation theory and self-regulation, can scaffold students' writing processes, leading to more coherent and persuasive arguments.

Moreover, Guo, Wang, and Liu (2023) explored the use of chatbots in assisting EFL students with argumentative writing. Their qualitative study demonstrated that chatbot-assisted learning environments could enhance students' engagement and provide immediate feedback, thereby improving the overall quality of argumentative essays.

Recent advancements in argumentative essay writing and computer-supported learning have highlighted crucial aspects of gender differences, peer review practices, and the integration of online platforms. Noroozi et al. (2023) explored gender-based disparities in argumentative writing, revealing that female students often excel in essay quality and peer review justification compared to their male counterparts. The study also demonstrated that gender influences peer review uptake and argumentation strategies in online environments, emphasizing the necessity of tailored support for different groups. Such findings align with Latifi et al. (2021), who showed that online peer feedback significantly enhances argumentative writing, particularly when supported by structured educational tools. Furthermore, Mokhtar, Jamil, Yaakub, and Amzah (2020) identified debates as an effective strategy for fostering higher-order thinking skills during essay writing, reinforcing the importance of interactive methods in argumentative instruction. Collectively, these studies underscore the critical role of gender-sensitive pedagogical strategies and technology integration in enhancing argumentative writing skills, particularly in diverse educational settings.

These studies underscore the importance of integrating technology into writing instruction to address challenges in argumentative essay writing. By leveraging digital tools and collaborative platforms, educators can provide targeted support, foster critical thinking, and enhance students' ability to construct well-reasoned arguments.

The Toulmin model of argumentation was chosen for this study as it aligns with the objectives of the "Essay Writing" course and addresses the specific needs of Saudi EFL learners. This model breaks down argumentative writing into clear, manageable components—claims, data, warrants, backings, rebuttals, and qualifiers—offering students a structured framework to construct logical and persuasive essays (Toulmin, 2003). For EFL learners who often struggle with linguistic and cognitive complexities, the Toulmin model provides a scaffolded approach that simplifies the process of constructing well-reasoned arguments.

The relevance of the Toulmin model to this study lies in its alignment with the course's focus on developing argumentative skills. By integrating this framework with AI tools, students were able to receive targeted feedback on specific elements of their essays, such as the clarity of their claims and the strength of their evidence. This combination not only reinforced their understanding of the model but also empowered them to apply it effectively in real-time writing tasks. Furthermore, the model's adaptability to diverse instructional contexts makes it a valuable tool for addressing the unique challenges faced by Saudi EFL learners, particularly in mastering argumentative essay writing.

2.3. Uncertain Motivation

The concept of Uncertain Motivation (UM) adds a complementary dimension to AI's role in education. Research demonstrates that incorporating unpredictability in rewards, such as varied and unexpected incentives, sustains student engagement and effort over time (Al-Hoorie & Albijadi, 2024). By combining AI's analytical capabilities with UM strategies, educators can create dynamic learning environments that address both cognitive and psychological challenges. This synergy

fosters not only academic growth but also sustained curiosity and perseverance among learners.

This study situates itself at the intersection of AI, UM, and the Toulmin model to explore their combined impact on argumentative writing. By engaging with contemporary research on AI's evolving role in education and emphasizing the practical relevance of the Toulmin framework, it contributes to the growing discourse on innovative strategies for improving writing skills in both EFL and broader educational contexts.

2.4. Dopamine, Uncertain Motivation and learning

Little attention has been given to the uncertainty of motivation in the psychology of language research (Ozcelik, Cagiltay, & Ozcelik, 2013). Costikyan (2013) claims that a process with a known outcome becomes less engaging to students. On the other hand, uncertain. Anticipating an uncertain reward elevates the release of dopamine, a neurotransmitter integral to feelings of pleasure and reward (Fiorillo et al., 2003). Dopamine plays a critical role in regulating various cognitive and behavioral functions, including learning, attention, mood, and motivation. Often referred to as the "learning and motivation hormone," it is essential for processes like memory consolidation (Wise, 2004). Studies have shown that increased dopamine levels positively impact language learning (De Vries, Ulte, Zwitserlood, et al., 2010), with the dopaminergic system potentially explaining individual differences in language acquisition abilities.

Dopamine is a neurotransmitter that plays a crucial role in the brain's reward system and is intimately involved in both learning and motivation. Its influence extends to various aspects of behavior, including the motivation to learn and engage in tasks such as language acquisition.

Dopamine enhances the performance of previously learned behaviors without necessitating new learning, indicating its role in scaling or expressing learned actions (Bromberg-Martin, Matsumoto, & Hikosaka, 2010). While dopamine is pivotal in reward learning and motivation, its functions are complex and interact with a variety of neural systems (Wise, 2004). Distinct types of dopamine neurons are proposed to encode different aspects of motivation, such as motivational value and salience, which are essential for adaptive behavior (Westbrook & Braver, 2016). Dopamine's role in motivation and reinforcement learning can be understood through its influence on the corticobasal ganglia system, affecting both the motivational drive and the learning of reward predictions (Westbrook & Braver, 2016).

Dopamine transmission is selectively required for stimulus-reward learning where cues acquire incentive salience, influencing individual susceptibility to impulse control disorders (Dayan & Balleine, 2002). Phasic dopamine signals are associated with learning through reward prediction errors, while tonic dopamine influences a range of behavioral processes, including motivation (Elzelingen et al., 2022). Dopamine dynamics can be dissociated into learning signals (prediction errors) and motivation signals (reward expectation), with the latter being regulated independently of dopamine cell firing (Phillips, Vacca, & Ahn, 2008). Dopamine levels correlate with reward rate and motivational vigor, and rapid fluctuations in dopamine release can serve both learning and motivational purposes (Udupa & Chen, 2016).

Al-Hoorie and Albijadi (2024) assert that gamifying vocabulary learning using uncertainty can sustain motivation in language learning over time. The study showed that the experimental group outperformed the control group in the posttest, highlighting the effectiveness of gamification among groups of EFL Saudi learners. However, the results were not sustained in the delayed posttest one month later. Implementing gamification strategies can be beneficial in maintaining learning motivation in language education (Dehghanzadeh, Fardanesh, Hatami, et al., 2021).

2.5. The Toulmin Model

The Toulmin model, developed by Stephen Toulmin, has been long used in the analysis and teaching of argumentation, particularly in educational settings. This review will synthesize the findings from recent research on the application and critique of the Toulmin model in various contexts, including its use in school science, argumentative writing instruction, and the solving of ill-structured problems.

The Toulmin model's utility in educational settings is evident in its adoption for evaluating argumentation in school science. Researchers have adapted the Toulmin Argument Pattern (TAP) for professional development programs for teachers, which has shown to be beneficial in conceptualizing argument and modeling it for students (Lunsford, 2002). The model's structure, which includes elements such as claims, data, warrants, backings, and rebuttals, provides a comprehensive framework for analyzing arguments (Verheij, 2005). This framework has also been integrated with argumentation software to assess student outcomes (Lunsford, 2002).

To explain more the structure of the model, here are some examples to clarify the notion of each element.

Claim: Social media has a negative impact on teenagers' mental health."

Data (Evidence to support the claim): A recent study by the American Psychological Association found that teenagers who spend more than 3 h per day on social media are more likely to report feelings of anxiety and depression.

Warrant (Explanation of how the data supports the claim): The correlation between excessive social media use and increased anxiety and depression suggests that the content and interactions on these platforms contribute to mental health issues.

Backing (Additional support for the warrant): Further research by Smith (XXXX) indicates that social media often exposes teenagers to unrealistic body images and cyberbullying, both of which are significant factors in the development of anxiety and depression.

Rebuttal (Counter-argument or acknowledgment of opposing viewpoints): While some argue that social media provides a valuable platform for social interaction, it is important to note that the negative effects on mental health outweigh the potential benefits."

These examples demonstrate how the elements of the Toulmin model can be applied to construct and analyze a well-rounded argument in a student's essay. These examples and other parallel ones were used to teach the present study participant how to use the Toulmin model.

In the context of argumentative writing, the Toulmin model has been employed to improve the structure and overall quality of essays. For instance, dynamic assessment of the Toulmin model through teacher-and collective-scaffolding has been shown to enhance the argument structure and writing achievement of Iranian EFL learners (Heidari, 2019). Similarly, the integration of Toulmin's model with the Think-Write-Pair-Share (TWPS) strategy has been investigated, with findings suggesting improvements in students' critical thinking in argumentative essays (Suhartoyo, Mukminati, & Laksmi, 2014). Another study by Qin and Karabacak (2010) analyzed argumentative papers written by Chinese university students found that while claims and data were commonly used, elements such as counterargument claims, counterargument data, rebuttal claims, and rebuttal data were less frequent. These elements, however, were significant predictors of the overall quality of the essays, indicating their importance in constructing high-quality arguments.

In conclusion, the Toulmin model remains a significant tool for the analysis and instruction of argumentation. Its adaptability to various educational and analytical contexts demonstrates its enduring relevance. It can be a useful tool for analyzing students' essays, but its effectiveness depends on the context and the interactions between students and teachers (Lunsford, 2002). Therefore, the current study will explore how the interactions between the participant, teacher, AI and UM may affect students argumentative essays. The complexity of using

this model in argumentative writing in relation to AI and UM is explored in this study through these research questions and hypotheses.

Research Question 1

To what extent does the integration of AI tools in argumentative essay writing improve the overall writing proficiency of Saudi EFL learners using the Toulmin Model?

Research Question 2

How does the introduction of Uncertain Motivation (UM) through varied incentives impact the engagement and writing performance of Saudi EFL learners in argumentative essay tasks?

3. Methodology

3.1. Context and study design

This study was conducted at King Faisal University in Saudi Arabia within the framework of a third-year “Essay Writing” course, which is part of the four-year Bachelor’s degree program for English as a Foreign Language (EFL) learners. This course serves as the final writing-focused module in the curriculum, emphasizing the development of argumentative writing skills. The curriculum includes exposure to various examples of argumentative essays, followed by exercises designed to guide students through constructing their own essays. These activities require students to practice critical thinking, organize ideas logically, and support their arguments with relevant evidence, all essential skills for their academic success.

To address the persistent challenges faced by students in mastering academic writing, this study integrated the Toulmin model of argumentation as a structured framework for teaching argumentative writing. The Toulmin model helps students break down arguments into key components, such as claims, data, warrants, backings, and rebuttals, making the writing process more accessible and systematic. Additionally, AI tools, specifically ChatGPT, were introduced to assist students with brainstorming, drafting, and refining their essays. To further sustain engagement, Uncertain Motivation (UM) strategies were implemented, involving varied and undisclosed incentives to reward task completion.

The study employed a quasi-experimental design, where students completed four argumentative writing tasks over eight weeks. Each task involved applying the Toulmin model and utilizing AI support. Upon completing each task, students received an incentive to reinforce motivation and encourage continued effort.

3.2. Participants

The study involved 60 Saudi EFL learners, aged between 20 and 23 years, all enrolled in the “Essay Writing” course, the final writing course in their Bachelor’s program. The course represents a critical juncture in their academic progression, focusing on the development of argumentative writing skills. By including all students enrolled in the course, the study ensured a real-life classroom context, eliminating selective criteria to simulate the natural diversity and challenges present in authentic educational settings. This inclusive design aimed to capture a representative sample of Saudi EFL learners with varied linguistic abilities, educational backgrounds, and motivational levels.

The participants’ baseline English proficiency was assessed using standardized test scores obtained during university admissions. Most participants achieved intermediate-level scores on widely recognized English proficiency tests, such as TOEFL or IELTS. The average TOEFL score among participants was 500 (Paper-Based Test), and those who had taken IELTS averaged a band score of 5.5. These scores indicated a functional understanding of English but highlighted the need for significant improvement in academic writing skills. Prior to this study, the participants had limited exposure to argumentative writing, primarily through brief classroom exercises that lacked a structured framework like the Toulmin model. None had received formal training in

constructing argumentative essays or using digital tools to aid their writing. Additionally, participants’ familiarity with AI tools was minimal, limited primarily to informal interactions with basic applications, making this study their first experience integrating AI into academic writing tasks.

The participants came from diverse educational backgrounds, having completed their secondary education in various regions across Saudi Arabia. While all students had several years of exposure to English, their proficiency levels varied, reflecting the broader challenges faced by EFL learners in non-native English-speaking countries (Al Fraidan & Fakhli, 2024). This diversity in educational experiences and linguistic abilities provided a rich context for evaluating the impact of the Toulmin model, AI tools, and motivational strategies on their writing performance.

Historically, students in this course have struggled with crafting well-structured and compelling argumentative essays. Over the past several years, average scores ranged between 65 and 75 out of 100, with only a few students achieving scores as high as 85 or 90. These consistent challenges prompted the researcher to explore innovative strategies to enhance students’ writing skills, incorporating both the Toulmin model and AI tools. The combination of these interventions aimed to bridge gaps in their understanding and application of argumentative writing principles.

The participants’ limited prior exposure to argumentative writing and intermediate proficiency levels contextualize the observed improvements during the study. These factors underscore the necessity of providing structured pedagogical interventions to support their linguistic and cognitive development. Moreover, the participants’ generational familiarity with digital tools and online learning platforms made them particularly suited for a study exploring the integration of AI in education. However, their varied levels of comfort with technology and their differing approaches to academic writing provided valuable insights into how students adapt to technology-based learning interventions.

While this study offers valuable insights, it is essential to acknowledge that its context is limited to Saudi EFL learners at a single institution. Factors such as students’ prior exposure to argumentative writing and their familiarity with technology may have influenced the outcomes. Future research should expand to include a broader participant pool with diverse educational and cultural backgrounds. Longitudinal studies are also recommended to assess the lasting effects of integrating AI and UM strategies into argumentative writing instruction.

3.3. Instruments

3.3.1. Toulmin Model training

The participants received systematic instruction on the Toulmin model of argumentation over four consecutive weeks to ensure a thorough understanding and practical application of its components. Recognizing the complexity of the model, the initial outcomes were not expected to be exceptionally high; instead, the primary objective was to familiarize students with the framework as a foundation for integrating AI tools into their writing process.

The training sessions included detailed explanations and examples of each Toulmin component—claims, data, warrants, backing, and rebuttals. Each week focused on one or more components:

Week 1: Introduction to claims and crafting clear, concise thesis statements.

Week 2: Providing quality supporting evidence (data) and backing for claims.

Week 3: Logical coherence (warrants) and addressing counterarguments with rebuttals.

Week 4: Integration of all components into complete arguments.

The instructional activities involved analyzing model essays, identifying Toulmin components, and completing targeted exercises to practice constructing individual elements before integrating them into full essays.

At the conclusion of the Toulmin training, students completed an in-class essay assignment to evaluate their understanding and ability to apply the model. This diagnostic task ensured students had achieved an acceptable level of proficiency before moving on to AI integration.

3.3.2. AI training

Following the Toulmin model training, students were introduced to ChatGPT as a tool to assist in drafting argumentative essays. The emphasis was on using AI for brainstorming, generating ideas, and improving argument structure without relying on it to write or organize essays on their behalf.

The first AI training session was conducted as a pilot, during which students raised numerous questions about ethical boundaries and proper usage. Given the confusion, the session was used as an opportunity to address concerns and clarify expectations. Students were informed that subsequent sessions would involve formal tasks, and misuse of AI (e.g., using it to generate entire essays) would result in penalties, including an automatic zero.

3.4. Ethical considerations and mitigating over-reliance on AI

The integration of AI tools into the study was accompanied by a strong emphasis on ethical usage. Students were explicitly informed about the potential biases inherent in AI tools like ChatGPT and the importance of maintaining originality and critical thinking in their writing. During the initial AI training sessions, students were introduced to the concept of AI biases and their implications. Specific examples were provided to illustrate how AI-generated content might reflect limitations or inaccuracies in its underlying data. For instance, students were shown how AI might prioritize widely accepted viewpoints over less common but equally valid perspectives, potentially limiting the depth of their arguments. These examples encouraged students to critically evaluate AI outputs and refine them to align with their argumentative goals.

To safeguard originality and academic integrity, several measures were implemented, as detailed in the appendix, along with the following guidelines:

Guidelines for AI Usage

- AI was to be used as a brainstorming tool, not as a substitute for original writing.
- Misuse, such as submitting AI-generated content without personal input, would lead to disqualification.
- Completion of tasks, regardless of performance, would be rewarded with unknown incentives (e.g., money, pens, football tickets, gaming cards).

3.5. Focused Training Sessions

Students practiced using ChatGPT to enhance specific Toulmin components:

Students used AI-generated suggestions to refine their central arguments by crafting stronger claims. AI was leveraged to explore diverse and relevant supporting details (data and backing).

Students used AI-generated prompts to identify and address opposing viewpoints (rebuttals).

An additional training session was conducted to reinforce effective and ethical AI use. Detailed instructions, including prompt templates and examples, were provided to help students navigate the tool confidently and responsibly. Reflective exercises were also incorporated, requiring students to document their writing process and describe how they interacted with AI. This encouraged accountability and deeper engagement with their work.

Furthermore, students were explicitly informed about the potential biases in AI-generated content. For instance, they analyzed outputs where AI inadvertently reflected culturally specific norms or provided insufficient counterarguments. These exercises underscored the

importance of cross-checking AI outputs with credible sources and emphasized students' agency in refining AI-generated ideas.

By combining structured Toulmin model instruction with practical AI training, the study aimed to equip students with the skills and tools necessary to construct well-organized, critical, and coherent argumentative essays. The focus on ethical considerations ensured that students developed not only technical proficiency but also critical digital literacy, preparing them to use AI responsibly in academic and professional contexts.

3.6. The four writing tasks

Throughout the study, participants were regularly assigned an argumentative writing task each week. These tasks were designed to simulate real-world writing conditions and were conducted during a dedicated two-hour session. The structured environment allowed students to focus solely on developing their argumentative essays, applying the Toulmin model, and integrating AI tools as they had been instructed. Each task was not merely an exercise but contributed directly to the students' overall grade for the course, adding a layer of seriousness and motivation for the participants to perform well.

The following week after each writing task was a regular class session where the instructor provided general feedback on the completed assignments. During these sessions, common problems and recurring issues in the students' writing were addressed. The feedback sessions were interactive, allowing students to ask questions and engage in discussions about their challenges and mistakes. This approach aimed to reinforce learning by not only highlighting areas that needed improvement but also by encouraging students to reflect on their own writing practices and strategies.

The topics carefully selected to engage and challenge their critical thinking and writing skills. The topics were introduced consecutively as follows: 'Social Media and Learning,' 'Women Empowerment in Saudi Arabia,' 'The Use of AI in Education,' and 'The New Saudi Educational System of Three Semesters.' These topics were chosen for their relevance to contemporary issues, encouraging students to apply their learning to real-world contexts.

Upon completion of each writing task, students received rewards designed to be both encouraging and varied. The incentives were as follows: 10 SAR for every student after the first task, blue pens after the second, PlayStation gaming cards after the third, and chocolates after the final task. These rewards were deliberately varied to maintain an element of UM and to assess its impact on the students' writing performance.

3.7. Scoring the four writing tasks

The Toulmin Model components—claims, data, warrants, backings, and counterarguments—were equally weighted during scoring as detailed below. AI tools were integrated to provide real-time feedback, with specific attention to how students used AI to improve claims and generate counterarguments.

The participants produced a total of 240 essays during the study, each reflecting their progress and adaptation to the writing tasks. These essays served as a rich source of data, enabling a comprehensive evaluation of the development of students' argumentative writing skills, the effectiveness of the Toulmin model, and the impact of AI tools and varied incentives. The analysis of this corpus provided valuable insights into patterns, strengths, and areas for improvement in the students' writing abilities.

The scoring of the 240 essays was conducted using a detailed analytical scoring scale designed to evaluate multiple dimensions of argumentative writing. The evaluated components included:

Claim. Clarity, relevance, and strength in establishing the central argument.

Data and Backing. Quality, relevance, and depth of evidence used to

support claims.

Warrants. Strength of logical connections between claims and evidence.

Counterarguments and Rebuttals. Inclusion and effectiveness of addressing opposing viewpoints.

Language Proficiency. Grammar, vocabulary, and overall cohesion of the essay.

Each criterion was assigned a maximum score of 25 points, resulting in a total score of 100 for each essay. This scoring structure allowed for a comprehensive and balanced evaluation of the key elements of argumentative writing.

To assess improvements beyond general writing proficiency, the Toulmin Model's core components—claims, data, warrants, backings, and counterarguments—were analyzed individually and in relation to one another. The evaluation focused on the depth and logical integration of these components, highlighting how students advanced in their ability to construct complex arguments. For example, growth in the use of counterarguments was identified as a significant indicator of critical engagement, reflecting students' ability to anticipate opposing viewpoints and respond effectively.

Additionally, the integration of AI allowed for targeted improvements, particularly in the precision of claims and the robustness of evidence. By leveraging AI-generated suggestions, students were able to refine their argument structure and address weaknesses identified in earlier tasks. This iterative process demonstrated a clear trajectory of progress in their argumentative writing skills, providing evidence of development beyond general linguistic accuracy and cohesion.

3.8. Coding scheme for argumentative components

The coding scheme captured the depth of integration of the Toulmin components into the students' essays. This systematic approach allowed the researchers to quantitatively analyze the effectiveness of students' argument construction and how well the Toulmin model was utilized.

3.9. Inter-rater agreement and scoring reliability

Each essay was independently scored by the primary researcher to ensure adherence to the analytical scale. A secondary scorer, who was blinded to the initial scores, also evaluated the essays using the same criteria. The inter-rater agreement was calculated using Cohen's Kappa, which yielded a value of 0.87 for overall scores, indicating excellent consistency. For individual Toulmin components, Kappa values ranged from 0.80 to 0.91, reflecting strong reliability across all dimensions.

In cases of discrepancies, the scorers discussed their evaluations to reach a consensus. If a consensus could not be reached, a third evaluation was conducted to finalize the score. This rigorous process ensured that scoring was as objective and fair as possible.

3.10. Analysis and evaluation

For statistical analysis purposes, Each component of the Toulmin model was assessed as follows:

0: No integration of the component.

1: Poor integration of the component into the essay.

2: Good integration, demonstrating clear and effective use of the component

The compiled scores for each task were analyzed to identify trends and measure improvements in students' argumentative writing skills. This analysis allowed for an in-depth assessment of the interventions, such as the use of AI and UM strategies, and their influence on essay length, depth, and overall quality. The structured approach ensured that the findings accurately reflected the impact of these methodologies on students' learning outcomes.

AI tools, particularly ChatGPT, were employed to assist students in generating ideas, structuring arguments, and refining their essays. The

integration of AI was aligned with the Toulmin model in the following ways:

Claims: AI provided suggestions to clarify thesis statements, ensuring a strong foundation for the essays.

Data and Backing. AI facilitated brainstorming and offered examples or prompts to strengthen supporting evidence.

Counterarguments. AI suggested potential opposing viewpoints and rebuttals, helping students address these elements more comprehensively.

Cohesion. AI tools provided feedback on logical coherence, ensuring that warrants effectively linked claims to evidence.

This alignment between AI support and the Toulmin model allowed the study to assess not only improvements in general writing proficiency but also targeted advancements in argument structure. By isolating the effects of AI on each Toulmin component, the study provides a nuanced understanding of how technology and pedagogy interact to enhance argumentative writing.

3.11. Incentives and their impact on student motivation

To maintain high levels of engagement and motivation among the participants, the researcher implemented a system of varied incentives that were distributed after the completion of each writing task. The incentives included small monetary rewards (10 SAR for each student), blue pens, football match tickets, and PlayStation gaming cards. These rewards were deliberately kept varied and undisclosed until the end of each task to introduce an element of Uncertain Motivation (UM), a strategy aimed at sustaining students' interest and encouraging them to complete subsequent tasks with enthusiasm and ultimately improve their writing performance.

3.12. Distribution of incentives

After each of the four argumentative writing tasks, the researcher distributed the incentives to the students as follows:

Each student received 10 SAR immediately after submitting their first completed essay. This small monetary reward was intended to provide immediate gratification and establish a positive association with task completion. Upon completion of the second task, students were given blue pens. The pens symbolized the tools of the trade, subtly reinforcing the connection between effort and academic progress. After the third task, the students received tickets to a local football match. This reward was chosen to appeal to the students' interests outside of academics, adding a layer of excitement and personal relevance to the incentive program. For the final task, students were rewarded with PlayStation gaming cards, a highly sought-after item among the participants, which served as a strong motivator for task completion.

3.13. Analyzing the impact of incentives

To assess the impact of these incentives on students' motivation and their intention to continue participating in the writing tasks, the researcher conducted a series of observations and informal interviews. After each writing task, students were asked about their feelings toward the incentive they received and whether it influenced their desire to engage in the next task.

The study aimed to evaluate the combined effects of AI tools and Uncertain Motivation (UM) strategies on improving the argumentative writing skills of Saudi EFL learners. However, it did not include a control group that used the Toulmin model without AI or UM strategies. This was due to the focus on exploring the combined potential of these interventions rather than isolating their individual contributions. While this design provided valuable insights into the integrated use of AI and UM, it also introduced certain limitations in interpreting their separate effects.

The simultaneous implementation of AI tools and UM strategies

created a dynamic and interactive learning environment. AI tools provided real-time feedback and enhanced students' ability to construct well-organized arguments, while UM strategies sustained their motivation through varied and unpredictable rewards. The observed improvements in essay length, depth, and quality suggest that the interplay between these two factors had a synergistic effect.

However, without a control group, it is challenging to determine the extent to which each factor independently contributed to the outcomes. For example: the structured feedback and support from AI tools likely played a critical role in helping students apply the Toulmin model components effectively. While, the element of unpredictability in rewards may have driven students to exert greater effort and engage more deeply in the writing process.

3.14. Data collection

The data collection process for this study spanned eight weeks, involving a combination of training, task completion, feedback, and evaluation to comprehensively assess the impact of AI tools and Uncertain Motivation (UM) strategies on students' argumentative writing. The Toulmin training spanned four weeks, during which students practiced each model component individually—claims, data, warrants, backings, and counterarguments—before integrating them into full essays. AI training followed, emphasizing brainstorming, iterative feedback, and critical evaluation of AI outputs.

This was followed by two sessions introducing the use of ChatGPT as an AI tool, emphasizing its role in brainstorming and refining ideas rather than generating content autonomously. Over the subsequent four weeks, students participated in weekly in-class writing tasks, each lasting 2 h and focusing on a relevant and engaging topic. After each task, incentives based on the UM strategy, such as monetary rewards, pens, or gaming cards, were distributed to maintain engagement. Essays were evaluated using a detailed rubric, with scores assigned by two independent raters to ensure reliability, and discrepancies resolved through consensus. Post-task surveys and semi-structured interviews were conducted to capture students' perceptions of AI and UM, providing qualitative insights to complement the quantitative data. This comprehensive and structured approach ensured a robust evaluation of the interventions, offering a clear picture of their impact on students' writing skills and motivation.

3.15. Data analysis

The data analysis process was structured to evaluate both quantitative and qualitative data, providing a comprehensive understanding of the impact of AI tools and Uncertain Motivation (UM) strategies on students' argumentative writing performance. Quantitative data, including scores from the analytical rubric, were analyzed using statistical methods to assess trends and significant changes across the four writing tasks. Initially, normality tests, including the Shapiro-Wilk and Kolmogorov-Smirnov tests, were conducted to determine whether the data met the assumptions for parametric testing. A one-way ANOVA test was then employed to identify significant differences in students' total scores across the tasks, followed by post-hoc analyses to pinpoint specific improvements. Correlation analyses were performed to explore the relationships between AI use, the Toulmin model components (claims, data, backing, and counterarguments), and essay quality in terms of length and depth.

For qualitative data, thematic analysis was applied to the survey responses and interview transcripts. This involved coding the data to identify recurring patterns and themes related to students' perceptions of AI and UM. Key themes included the motivational effects of varied rewards, challenges in adapting to AI tools, and the perceived usefulness of the Toulmin model for structuring arguments. Verbatim quotes from interviews were selected to substantiate findings and provide deeper insights into student experiences. By integrating quantitative statistical

methods with qualitative thematic analysis, this dual approach ensured a holistic understanding of how the interventions influenced students' performance, engagement, and motivation.

4. Results

4.1. The impact of AI on student writing performance

The influence of AI on the overall performance of the students' writing became increasingly clear as the study progressed. This impact is vividly illustrated in the figure below, which shows a steady upward trend in writing quality over the course of the four writing tasks. As the line graph demonstrates, students' writing performance improved consistently with each successive task, indicating that the integration of AI tools played a significant role in enhancing their argumentative writing skills.

To determine if there were significant differences in the students' total scores across the four tasks, normality tests (Shapiro-Wilk Test and Kolmogorov-Smirnov Test) were conducted. The results indicated that the data were normally distributed, as shown in [Table 1](#).

Thus, an ANOVA test was conducted, revealing a significant difference between the students' total scores across the four tasks ($F = 1298.837, p < 0.001$).

To assess whether AI contributed to the improvement in students' writing performance, correlations were calculated between AI usage and the four components of the Toulmin model (claim, data, backing, and counterargument), as well as the total scores. The analysis showed no significant relationships between AI and the four elements of the Toulmin model across the four tasks. However, AI usage was significantly and positively correlated with students' total scores in the first three tasks, but not in the final task, as detailed in [Table 2](#).

The ANOVA results provided significant insights into the progression of students' argumentative writing performance, revealing nuanced patterns across various Toulmin Model components. For instance:

4.2. Claims and counterarguments

The results demonstrated modest improvements in clarity and logical coherence of claims during early tasks (Tasks 1 and 2), with a marked increase in later tasks (Tasks 3 and 4). This trend suggests that students initially struggled with formulating persuasive claims and addressing counterarguments, likely due to limited familiarity with the Toulmin Model and AI tools.

The later improvements can be attributed to the cumulative effect of iterative practice and feedback, emphasizing the importance of sustained instructional support for mastering complex argumentative

Table 1
Tests of normality for the students' total scores in the four tasks.

Task	Kolmogorov-Smirnov Statistic	df	Sig. (p-value)	Shapiro-Wilk Statistic	df	Sig. (p-value)
Students' Total Score in Task 1	0.271	60	<0.001	0.758	60	<0.001
Students' Total Score in Task 2	0.243	60	<0.001	0.766	60	<0.001
Students' Total Score in Task 3	0.283	60	<0.001	0.797	60	<0.001
Students' Total Score in Task 4	0.263	60	<0.001	0.678	60	<0.001

Table 2

Correlations of AI with students' total scores in the four tasks.

Use of AI	Total scores Task 1	Total scores Task 2	Total scores Task 3	Total scores Task 4
Pearson	0.922**	0.846**	0.267*	0.017
Sig	<0.0001	<0.0001	<0.039	0.896

** indicates a statistically significant correlation at the $p < 0.01$ level.

structures.

4.3. Warrants and backing

The ANOVA for warrants and backing revealed consistent growth across tasks, with significant gains observed by Task 3. This steady progression indicates that students became more adept at drawing logical connections and substantiating their arguments with relevant evidence.

The steady improvement underscores the value of breaking down argumentative writing into manageable components and providing targeted support through tools like AI (Fig. 2).

4.4. Length and depth of essays

We also examined how AI contributed to the length and depth of students' essays. To assess essay length, we counted the total number of words in each essay. Essays exceeding 800 words were categorized as "lengthy" and assigned a score of 2, while those with fewer than 800 words were categorized as "not lengthy" and assigned a score of 1. Similarly, to evaluate essay depth, we measured the accurate use of the four components of the Toulmin model (claim, data, backing, and counterargument). Essays that employed these components accurately were scored as 2, whereas those that did so inaccurately were scored as 1 as shown in Figs. 3 and 4.

Figs. 3 and 4 provide a visual representation of the positive trends in essay length and depth as students became more proficient with AI tools and the Toulmin model across four successive writing tasks. These trends are quantitatively supported by Pearson correlation coefficients and significance levels, which offer insight into the relationships between AI use and the measured outcomes. The plateau observed in essay length reflects cognitive fatigue after Task 2, while subsequent improvements indicate successful adaptation to AI tools and instructional methods (Table 3).

4.4.1. Essay length

Task 1: The Pearson correlation for Task 1 ($r = -0.054, p = 0.680$) shows a slight negative association between AI use and essay length, which does not reach statistical significance. This suggests that initially, AI use did not positively impact the length of essays.

Task 2: By Task 2, there is a slight positive correlation ($r = 0.192, p = 0.141$), indicating a minor improvement in essay length with AI use, though this is still not statistically significant.

Task 3 and Task 4: A significant positive correlation emerges in Tasks 3 ($r = 0.608, p < 0.001$) and 4 ($r = 0.537, p < 0.001$), showing that

Table 3

Correlations of AI with essays length and depth in the four tasks.

Use of AI	Length Task 1	Length Task 2	Length Task 3	Length Task 4
Pearson	-0.054	0.192	0.608**	0.537**
Sig	0.680	0.141	<0.001	<0.001

Use of AI	Depth Task 1	Depth Task 2	Depth Task 3	Depth Task 4
Pearson	-0.051	0.208	0.525**	0.577**
Sig	696	0.112	<0.001	<0.001

as students became more accustomed to using AI, the length of their essays increased notably.

4.4.2. Essay depth

Task 1: Similar to essay length, the depth of essays in Task 1 shows a negligible negative correlation with AI use ($r = -0.051, p = 0.696$), indicating no significant impact.

Task 2: A slight positive correlation ($r = 0.208, p = 0.112$) is observed by Task 2, suggesting that students began to apply the Toulmin model more effectively, though the change is not significant.

Task 3 and Task 4: Significant improvements are seen in Task 3 ($r = 0.525, p < 0.001$) and Task 4 ($r = 0.577, p < 0.001$), with stronger and more statistically significant correlations indicating that students are using AI to enhance the depth of their arguments effectively.

The initial lack of impact on essay length and depth may be attributed to a learning curve, as students were still adapting to how AI can be leveraged to support their writing. The significant improvements in later tasks suggest that students not only became more proficient with AI tools but also learned how to integrate the elements of the Toulmin model more effectively into their essays. This is reflected in the statistically significant results seen in the latter half of the study, particularly in how students' essays both lengthened and gained in-depth analysis of topics.

The figures, complemented by the statistical analysis, show a rising trend in both the length and depth of essays but with a noted little decline in the second task. This temporary decline aligns with qualitative observations that students were initially struggling with understanding both the use of AI and the intricacies of the Toulmin model. As they overcame these challenges, their proficiency in utilizing AI for writing improved markedly, leading to enhanced performance in subsequent tasks.

Figs. 3 and 4 illustrate the trends in essay length and depth across the four writing tasks, revealing key insights into the effects of AI tools, the Toulmin model, and Uncertain Motivation (UM) strategies. These trends highlight not only improvements but also plateaus and declines, which reflect the interplay of pedagogical and psychological factors influencing student performance.

The increasing trajectory in essay length and depth observed from Task 1 to Task 3 suggests a steady improvement as students adapted to using AI tools and the Toulmin model. However, a plateau in the fourth task indicates that students may have reached a saturation point in their ability to extend essay length and refine depth within the scope of this study.

By Task 4, students may have achieved a baseline proficiency in applying the Toulmin model and utilizing AI effectively. As their focus shifted from learning new strategies to consolidating existing skills, further substantial gains in length and depth became less likely. Repeated engagement with similar writing tasks might have reduced the novelty and cognitive challenge, limiting opportunities for significant performance gains.

AI's significant impact on essay length and depth emerged in later tasks, likely reflecting a learning curve. Initial sessions were dedicated to familiarizing students with AI tools and Toulmin concepts, which delayed measurable improvements. This underscores the importance of adequate training phases in future implementations.

While UM successfully sustained engagement early on, the diminishing returns of predictable task formats and potential reward fatigue might have tempered student enthusiasm by Task 4. The cumulative demands of mastering both AI tools and the Toulmin model could have led to cognitive fatigue, reducing the likelihood of further performance improvement.

4.5. The impact of uncertain motivation on student writing performance

The analysis revealed that the varied nature of the rewards kept the students curious and motivated. All students reported that the element of surprise associated with not knowing what the next reward would be

created a sense of anticipation, which played a crucial role in maintaining their engagement throughout the study. Additionally, most students (80 % of the students) reported that the non-monetary rewards, such as the football tickets and gaming cards, were particularly effective. This could be explained that this was motivating to students who were passionate about sports or gaming, thereby tapping into their personal interests.

The researcher noted that the introduction of Uncertain Motivation through varied incentives had an impact on students' willingness to participate in each subsequent writing task. The first incentive, a monetary reward of 10 SAR, had a notable positive impact on students' motivation. This reward encouraged students to continue to the next task, likely triggering a dopamine response that positively influenced their mental engagement, as discussed earlier. As a result, their writing performance showed significant improvement after the first task, as evidenced by the results of the paired *t*-test comparing scores between Task 1 and Task 2. The analysis revealed a statistically significant difference, with a ($t = 3.267, p > 0.001$). This suggests that UM may have influenced the students' performance, leading to higher scores on the second task. This explanation is further supported by students' verbal feedback, where many reported that the initial incentive motivated them to put in more effort, hoping for an even better reward after the second task.

However, the second incentive—a blue pen—had a less motivating effect. Some students expressed dissatisfaction with the reward, and a few expressed less willing to engage in the third task. But they changed their minds in the last minute. This dip in motivation is reflected in the performance data, where a slight stagnation or decline in progress was observed as shown in Fig. 1 and the analysis of the *t*-test between task 2 and task 3 ($t = 4.631, p \geq 0.001$).

The third incentive appeared to provide a notable boost to the students' overall performance, particularly in terms of the length and depth of their essays. This observation is supported by both quantitative and qualitative data, indicating a positive correlation between the

introduction of the incentive and the students' improved performance. The paired *t*-test comparing students' total scores in Task 3 and Task 4 revealed a statistically significant difference ($t = 2.355, p = 0.022$), suggesting that the third incentive had a meaningful impact on students' academic engagement and output. This statistical result is not only a reflection of quantitative improvement but also of motivational factors at play during this stage of the study.

The nature of the third incentive, which provided a reward that was perceived as valuable and relevant to the students' interests, likely acted as a catalyst for heightened motivation. Students expressed verbally during interviews that this reward significantly increased their enthusiasm for completing the writing tasks at a higher level. Here are some quotes from the interviews:

- "I was excited to know what the next reward would be. It made me want to do better each time."
- "The football tickets were my favorite reward. It felt like my effort was being recognized in a fun way."
- "The pen didn't feel like much of a reward, so I wasn't as motivated for the next task."

The psychological boost provided by this incentive could be linked to the theory of extrinsic motivation, where external rewards stimulate greater effort and performance. In this context, the reward may have generated a dopamine response, reinforcing positive behavior and prompting students to extend their effort in both the length and depth of their essays. This aligns with motivational theories that suggest rewards perceived as personally valuable can lead to an increase in sustained effort, goal-setting, and performance.

Moreover, the third incentive seemed to act as a trigger for behavioral and cognitive shifts. The increase in essay length and the more accurate application of Toulmin model components (claims, data, backing, and counterarguments) could be a result of students being more engaged and willing to put forth extra effort, knowing that a meaningful

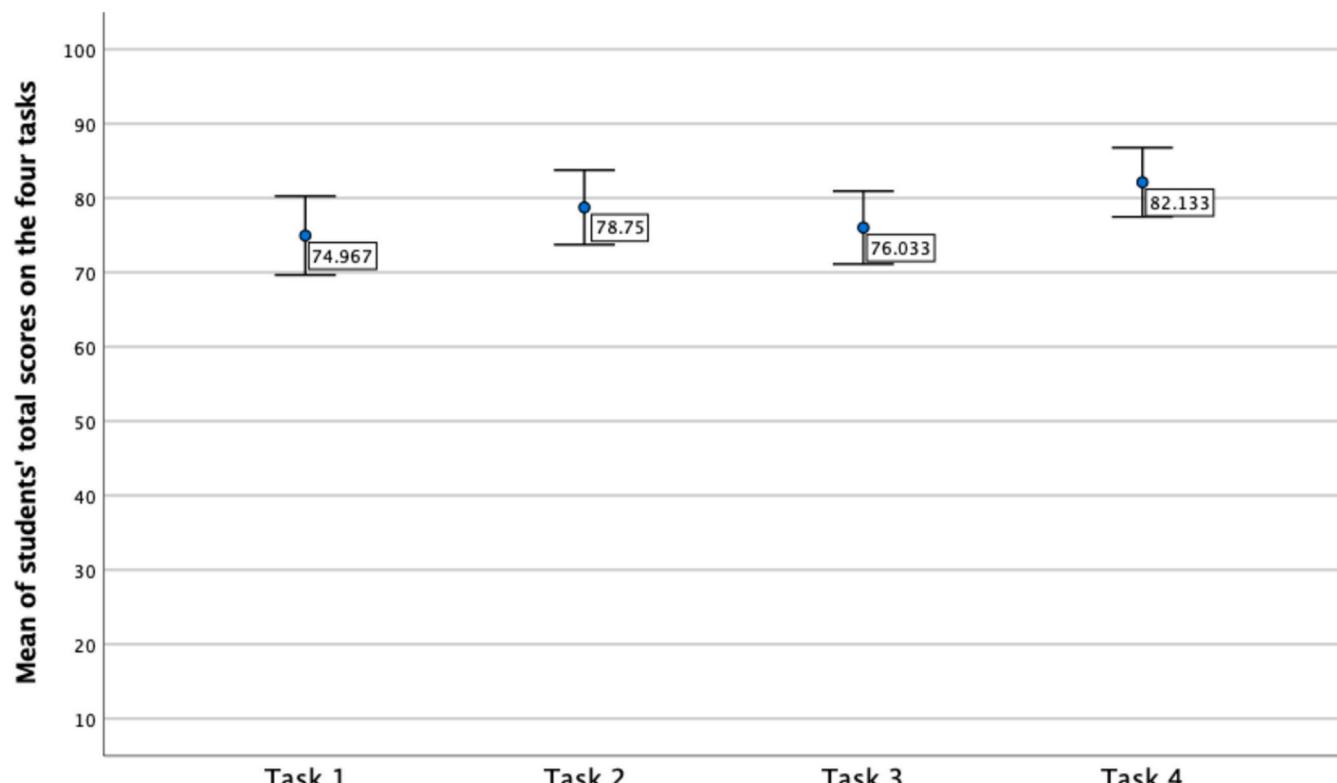


Fig. 1. Students' total scores in the four writing tasks.

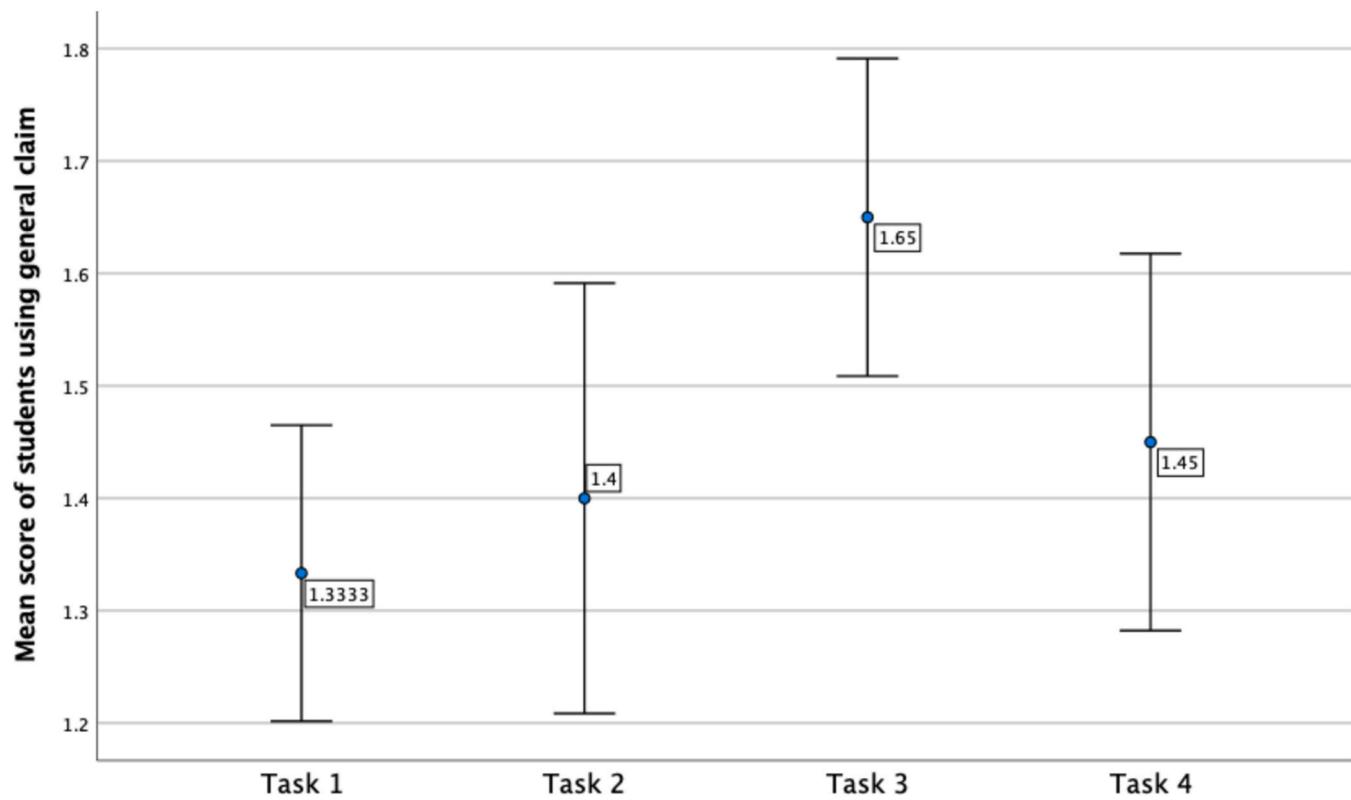


Fig. 2. Students' mean score of using general claim.

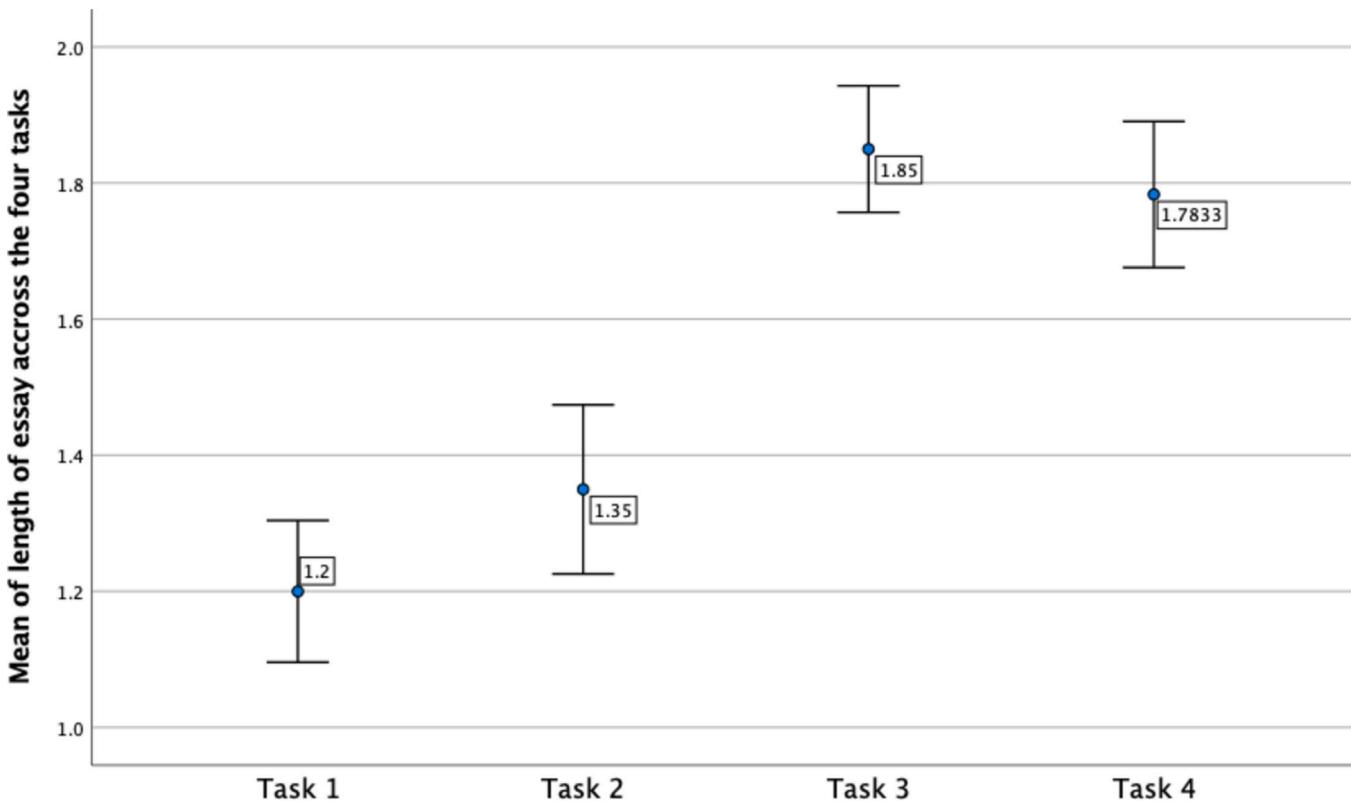


Fig. 3. Length of essays over the four tasks.

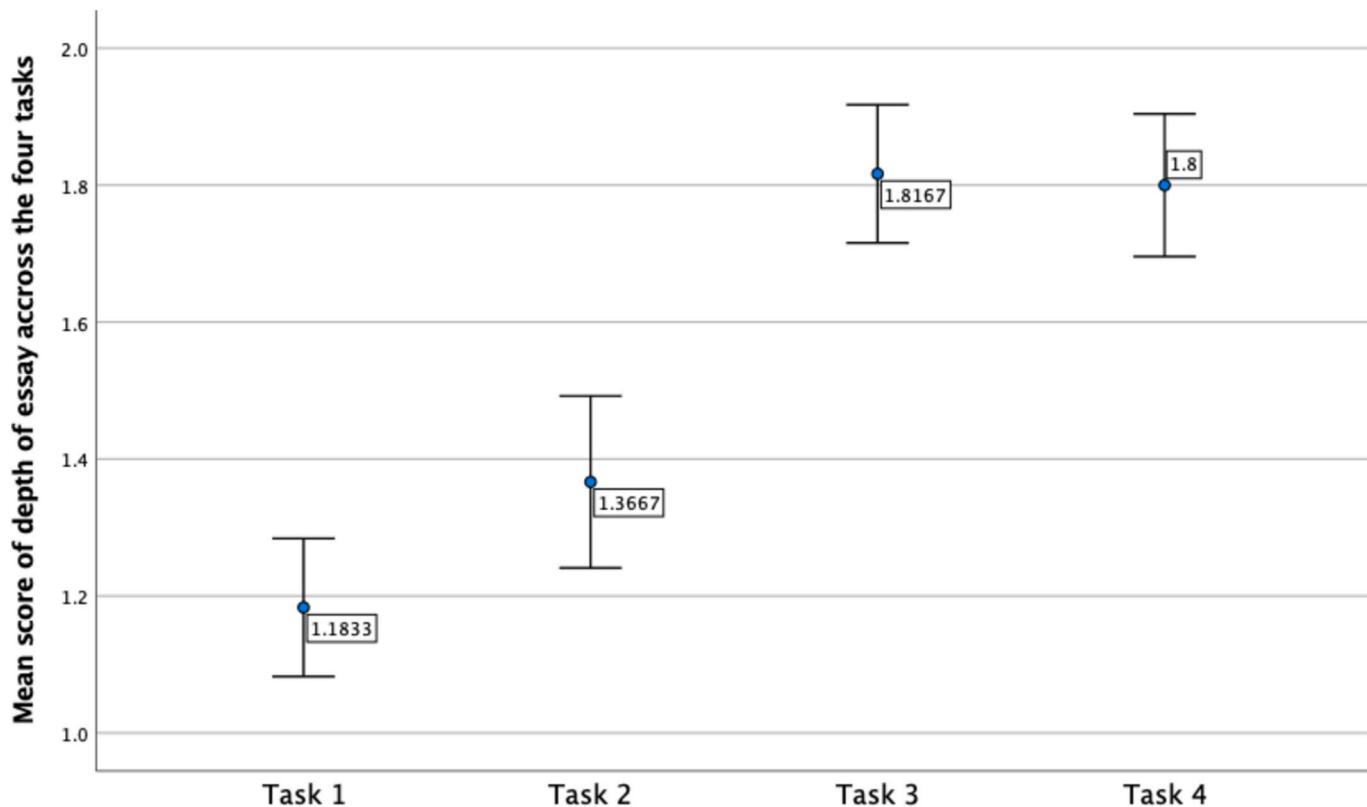


Fig. 4. Depth of essays over the four tasks.

reward awaited them. This shift from a purely academic focus to one that intertwines academic and extrinsic motivation is crucial in understanding how rewards can affect students' cognitive processes and behavior.

Regarding the fourth incentive, it provided a unique perspective into the complexities of motivational influences on academic performance. Unfortunately, there was no opportunity to measure the direct impact of this incentive through test scores, as Task 4 was the final task in the study, preventing a follow-up performance-based evaluation. However, the qualitative data gathered through student interviews provided rich insight into its potential motivational power. There was a strong consensus among students that the fourth incentive was considered the most desirable, with many stating that it would have provided them with even more motivation had there been another task.

The decline in student motivation observed after the second task, primarily attributed to dissatisfaction with the reward (blue pens), highlights the nuanced role of incentives in sustaining engagement. This finding underscores the importance of aligning rewards with students' preferences and the potential limitations of generic or less appealing incentives. The element of surprise and the unpredictability of rewards, which are central to the Uncertain Motivation (UM) strategy, played a significant role in maintaining enthusiasm for the writing tasks. However, when the reward failed to meet expectations or personal interests, motivation temporarily stagnated.

This observation suggests that while UM can be an effective motivational strategy, its success depends on the careful selection and variation of rewards. The blue pens, though symbolically tied to academic progress, lacked the personal appeal of other incentives like gaming cards or football tickets, which resonated more with students' extra-curricular interests. As a result, some students expressed dissatisfaction, which was reflected in a slight decline in performance and enthusiasm for subsequent tasks.

To address this challenge and optimize the motivational impact of UM, several actionable recommendations emerge:

- Frequent Variation of Reward Types

Introducing a broader range of reward types and varying them more frequently could sustain curiosity and engagement. Alternating between academic, non-academic, and experiential rewards (e.g., vouchers, books, or event tickets) ensures that students remain intrigued by the possibilities.

- Tailoring Rewards to Student Preferences

Gathering input from students on their preferred types of rewards before implementing UM strategies could enhance the relevance and appeal of incentives. Rewards that align with students' interests or hobbies are more likely to evoke positive responses and sustained motivation.

- Balancing Tangible and Intangible Rewards

Combining tangible incentives with intangible benefits, such as recognition through certificates or praise, might add an emotional dimension to the motivation strategy. Students often value acknowledgment of their efforts, which can complement material rewards.

4.6. Student perceptions of AI and UM

The analysis of student interviews revealed distinct patterns in their perceptions of AI and UM. Students widely acknowledged AI tools as instrumental in clarifying essay structure, particularly in identifying weaknesses in their claims and counterarguments. For example, one student commented, *"The AI tool helped me see gaps in my reasoning that I wouldn't have noticed on my own. It made me think more critically about how to back up my arguments."*

However, some participants expressed concerns about over-reliance on AI. As one remarked, *"While AI was helpful, I felt I needed to double-check everything to make sure it made sense in my own words. Otherwise, it felt like the essay wasn't fully mine."* This underscores the need for balancing AI's support with fostering independent critical thinking.

Regarding UM, the interview analysis highlighted how varied and unpredictable rewards maintained motivation. Students reported that

the gaming cards and football tickets were particularly motivating, with one noting, “*I worked harder on the third task because I knew the reward was something I really wanted.*” Conversely, dissatisfaction with Task 2’s reward (blue pens) led to reduced enthusiasm, as one student explained, “*I didn’t feel as excited about the second task because the reward wasn’t something I cared about.*”

These insights suggest that while AI tools effectively enhance the technical aspects of writing—such as structure, argumentation, and clarity—UM strategies play a critical role in maintaining student engagement throughout the learning process. However, for UM strategies to be successful, they must be thoughtfully designed to align with students’ interests and motivational triggers. Tailoring rewards to be both relevant and varied can sustain curiosity and effort, preventing potential disengagement due to monotony or dissatisfaction. This highlights the need for a balanced approach where AI provides consistent support for skill development while UM strategies dynamically address the emotional and motivational dimensions of learning.

5. Discussion

This discussion section is structured to provide a comprehensive analysis of the study’s findings in relation to the research questions and existing literature. It begins by addressing the key quantitative results, highlighting the role of AI and Uncertain Motivation (UM) in improving students’ argumentative writing performance. This is followed by a qualitative exploration of students’ perceptions and experiences, supported by direct quotes from interviews and surveys. The discussion then integrates these findings with theoretical frameworks, such as the Toulmin model and motivational theories, to contextualize their significance. Finally, the section identifies limitations of the study and proposes actionable recommendations for future research and pedagogical practices.

The challenges EFL learners face in mastering argumentative essay writing are well-documented and multifaceted, encompassing linguistic, cognitive, and psychological barriers. These obstacles often leave students struggling to structure their arguments effectively and articulate their ideas with clarity (Bacha, 2010). In this context, integrating artificial intelligence (AI) into the classroom emerges as a transformative solution, offering innovative approaches to enhance writing proficiency. Research by Song and Song (2023) underscores AI’s potential to provide real-time feedback and personalized support, particularly in guiding students through complex argumentative frameworks such as the Toulmin model. This study builds on these insights, examining the combined effects of AI and Uncertain Motivation (UM) strategies in fostering both the length and depth of students’ essays.

A notable limitation of this study is the absence of a control group to isolate the effects of UM from AI. While this study highlights the combined impact of these strategies, future research could design controlled experiments to distinguish their independent contributions.

5.1. The transformative role of AI in EFL writing

AI tools, such as ChatGPT, have shown significant promise in addressing the challenges of argumentative writing by providing immediate, personalized feedback on grammar, style, and argument structure. These tools enable students to iteratively refine their essays, clarifying claims, strengthening arguments, and addressing counterarguments more effectively (Zhao, 2022). In this study, the Toulmin model served as the structural foundation, and AI tools acted as facilitators, helping students organize their ideas and improve their arguments.

Student feedback revealed transformative experiences with AI tools. One participant noted,

‘AI helped me understand how to organize my arguments better, especially when working on counterarguments.’ Similarly, UM strategies were described as motivating, with another student stating,

‘The rewards made each task exciting and worth the effort.

However, as Alghamdy (2023) cautions, over-reliance on AI could undermine critical thinking and creativity, making it essential for AI to complement rather than replace traditional pedagogical approaches. Teachers remain pivotal in guiding students to critically evaluate AI feedback, ensuring it is meaningfully incorporated into their writing process. The evidence from this study supports this balanced approach, as students exhibited significant improvement in argumentative skills when AI was used as a tool for support, not substitution.

5.2. The motivational benefits of Uncertain Motivation (UM)

The introduction of UM strategies, incorporating unpredictability in reward-based learning, proved to be a critical driver of student engagement and performance. UM aligns with findings by Al-Hoorie and Albijadi (2024), which suggest that uncertain rewards stimulate dopamine release, enhancing motivation and focus. This neuropsychological basis is further supported by Fiorillo et al. (2003), who note that a 50 % uncertainty rate optimizes learning by increasing attention and drive.

In this study, varied and unpredictable rewards, including monetary incentives and gaming cards, were used to sustain students’ motivation across four argumentative writing tasks. Paired with AI tools, these rewards created an engaging learning environment that encouraged sustained effort and deeper cognitive engagement. The study’s findings align with research by Dehghanzadeh et al. (2021), which demonstrates that gamification strategies, such as unpredictable rewards, effectively maintain students’ engagement over time.

The decline in motivation after Task 2 highlighted the need for varied and engaging rewards. Incorporating peer-based incentives, such as team challenges, and diversifying reward types could sustain engagement in future applications. This observation indicates that while UM can be a powerful motivational strategy, its effectiveness hinges on the thoughtful selection and variation of rewards. The blue pens, despite their symbolic connection to academic progress, lacked the personal appeal of incentives like gaming cards or football tickets, which aligned better with students’ extracurricular interests. Consequently, some students reported dissatisfaction, leading to a noticeable dip in both performance and enthusiasm for subsequent tasks.

To address this challenge and optimize the motivational impact of UM, several actionable recommendations emerge:

- Frequent Variation of Reward Types

Introducing a broader range of reward types and varying them more frequently could sustain curiosity and engagement. Alternating between academic, non-academic, and experiential rewards (e.g., vouchers, books, or event tickets) ensures that students remain intrigued by the possibilities.

- Tailoring Rewards to Student Preferences

Gathering input from students on their preferred types of rewards before implementing UM strategies could enhance the relevance and appeal of incentives. Rewards that align with students’ interests or hobbies are more likely to evoke positive responses and sustained motivation.

- Balancing Tangible and Intangible Rewards

Combining tangible incentives with intangible benefits, such as recognition through certificates or praise, might add an emotional dimension to the motivation strategy. Students often value acknowledgment of their efforts, which can complement material rewards.

These actionable steps could mitigate the risk of motivational decline, ensuring that the UM strategy remains effective across all tasks. Furthermore, this finding emphasizes the importance of continuous monitoring and adaptability in implementing motivational interventions, as student preferences and responses may evolve over time. Future studies could explore how different reward structures impact motivation and performance, providing deeper insights into optimizing UM strategies in diverse educational contexts.

5.3. AI and UM as complementary strategies

The combination of AI and UM represents a comprehensive approach to improving argumentative writing among EFL learners. AI tools offered students the technical support needed to structure and refine their essays, while UM strategies addressed emotional and motivational dimensions, driving greater effort and focus. Statistical analysis from this study revealed significant improvements in essay length and depth, particularly in Tasks 3 and 4, when AI was effectively utilized.

Moreover, uncertain rewards were found to enhance engagement, as reflected in students' feedback during interviews. Many students reported feeling more motivated to complete tasks, knowing that the next reward could be highly desirable. This dynamic interplay between AI's technical assistance and UM's motivational boost highlights the potential of these complementary strategies to enhance not only writing outcomes but also students' overall learning experience.

The observed plateau or decline in student performance during certain phases of the study can be attributed to both pedagogical and psychological factors. From a pedagogical perspective, the plateau may indicate a saturation point in the learning curve, where students have internalized the basic elements of the Toulmin Model but require additional scaffolding or varied instructional techniques to advance further. This stagnation could also reflect the need for differentiated instructional strategies to address the varying proficiency levels and engagement patterns of students.

Psychologically, the decline may be linked to motivational fatigue, a phenomenon where initial excitement and effort wane as tasks become routine or rewards fail to sustain interest. In this study, dissatisfaction with the less appealing Task 2 reward (blue pens) illustrates the role of intrinsic and extrinsic motivation in maintaining sustained effort. When rewards do not resonate with students' personal interests or seem less valuable compared to prior incentives, engagement and performance are likely to drop.

Additionally, the plateau might signify cognitive overload, where students grapple with the dual demands of mastering the Toulmin Model and integrating AI tools into their writing. The need to simultaneously process multiple new skills can temporarily hinder performance, as students allocate more cognitive resources to managing the learning process rather than producing high-quality outputs.

These trends underscore the importance of balancing novelty and routine in educational interventions. Introducing more varied and personally meaningful rewards, combined with strategically phased instructional support, can help mitigate motivational and cognitive fatigue. This approach ensures sustained engagement and continuous performance improvement throughout the learning process.

5.4. Practical implications

The findings of this study have several practical implications for educators, curriculum designers, and educational institutions, particularly in the context of EFL learning and argumentative writing instruction.

1- AI as a Writing Support Tool

AI-powered tools can be integrated into the writing curriculum to provide real-time feedback on students' argumentative essays. These tools help students identify and correct linguistic errors, improve the structure of their arguments, and refine their writing style. Teachers can use AI to supplement traditional instruction by offering personalized feedback that is difficult to provide in large classroom settings. Educators can employ AI tools to create individualized learning experiences, allowing students to work on their specific weaknesses. For instance, students struggling with argumentation can receive targeted suggestions to strengthen claims, backing, and counterarguments. Teachers can leverage AI as a collaborative tool, using it to complement their feedback

and involve students in discussions about AI-generated suggestions. This encourages critical thinking and ensures students do not become overly dependent on technology but instead use it to enhance their understanding of argumentative writing.

The findings of this study highlight the importance of combining structured pedagogical tools like the Toulmin model with innovative technologies such as AI to enhance students' argumentative writing. Complementing these strategies, the role of peer feedback has been extensively documented in the literature. For instance, [Noroozi, Banihashem, Taghizadeh Kerman, et al. \(2023\)](#) demonstrated that structured online peer feedback modules significantly enhance students' ability to craft coherent and well-supported essays. This aligns with the findings in this study, where participants who received detailed feedback via AI tools demonstrated marked improvements in crafting claims, integrating counterarguments, and strengthening the coherence of their essays.

Similarly, [Latifi et al. \(2021\)](#) emphasize the importance of both peer feedback and feedforward strategies in enhancing students' argumentative learning outcomes. These strategies resonate with this study's emphasis on iterative feedback, as the integration of AI fostered a continuous process of drafting and revision. Participants expressed that AI's real-time feedback complemented their understanding of Toulmin model components, allowing for a deeper engagement with the argumentative structure of their essays. Studies by [Kerman et al. \(2022\)](#) and [Valero Haro et al. \(2023\)](#) further emphasize that structured peer feedback enhances the quality of argumentative essays by promoting collaborative learning and deeper cognitive engagement. In this study, although AI served as the primary feedback mechanism, the insights align with the argument that iterative and systematic feedback—whether peer-based or AI-driven—is critical for improving argumentative writing. The findings suggest that integrating peer feedback features, such as justification and constructive criticism as outlined by [Kerman et al. \(2022a\)](#), within AI systems could further enhance the quality and uptake of feedback, thereby refining students' writing processes.

2- Uncertain Motivation (UM) in the Classroom

The study highlights the importance of incorporating uncertainty into motivational strategies. Practical applications could include offering varied incentives, such as academic rewards (e.g., bonus points), non-academic rewards (e.g., small gifts, event tickets), or privileges (e.g., extra credit or flexible deadlines). This keeps students engaged and invested in the learning process.

3- Gamification of Writing Tasks

By applying principles of gamification—such as introducing unpredictability in reward distribution—teachers can enhance students' motivation to complete writing tasks. This method can be particularly effective in long-term assignments where maintaining consistent effort is challenging for students.

The use of uncertain rewards may sustain students' engagement throughout a course. Teachers can experiment with alternating between known and unknown rewards, allowing students to remain curious and eager to perform well across tasks.

This study revealed a plateau in motivation and performance during the second task, attributed to dissatisfaction with rewards and cognitive fatigue. [Kerman et al. \(2022b\)](#) highlight that students' attitudes toward feedback significantly influence their ability to incorporate suggestions into their writing. Similarly, feedback uptake is closely tied to the perceived quality and clarity of feedback mechanisms ([Noroozi, Banihashem, Taghizadeh Kerman, et al., 2023](#)). These observations underscore the need to design feedback systems that are adaptive and engaging, ensuring that students remain motivated to actively engage with the feedback process. For instance, combining AI feedback with elements of peer interaction could address motivational plateaus and

encourage sustained cognitive engagement.

5.5. Theoretical implications

While previous studies have explored the role of AI in supporting EFL learners' writing (Chagas, 2023; Sumakul et al., 2022), there has been limited focus on how motivational strategies, specifically UM, can be integrated into AI-supported writing tasks. This study fills that gap by investigating how the interplay between AI and UM can enhance students' engagement and performance. The results suggest that the combined use of these tools not only improves the technical aspects of writing, such as grammar and structure, but also fosters greater engagement and enjoyment in the learning process.

Moreover, this study contributes to the ongoing debate about the role of AI in education. While some researchers, such as Herbold et al. (2023), argue that AI-generated essays may surpass human-written ones in quality, this research emphasizes the importance of using AI as a tool for skill development rather than as a substitute for human effort. The findings align with the work of Wang (2023) and others, who advocate for AI's integration into the classroom as a way to enhance, not replace, traditional pedagogical practices.

The findings of this study align with broader advancements in computer-supported collaborative learning (CSCL). Noroozi, Banihashem, Taghizadeh Kerman, et al. (2023) emphasized the role of structured technological interventions in improving argumentative writing, while Kerman et al. (2024) highlighted the importance of scaffolding techniques for EFL learners. This research demonstrates how the Toulmin model, paired with AI tools, provides such scaffolding, enabling students to better organize and present their arguments.

While the study's outcomes are promising, future research could explore the sustainability of these improvements over longer periods and in diverse educational contexts. Longitudinal studies could investigate whether students internalize AI feedback and apply it independently, fostering lasting critical thinking and argumentative skills. Furthermore, the integration of multimodal AI tools, such as voice-based feedback or argument visualizations, could expand the applicability of these findings and cater to diverse learner needs.

Finally, the study's findings reflect broader discussions in the literature about the integration of technology in writing instruction. While the Toulmin model provided a structured framework for argumentation, AI tools supported iterative improvement by offering tailored feedback. Valero Haro et al. (2023) and Latifi et al. (2021) underscore the importance of balancing structured pedagogical interventions with dynamic, technology-enabled feedback mechanisms to maximize learning outcomes. This balance ensures that students not only master the technical aspects of argumentation but also engage critically and collaboratively in the writing process.

5.6. Conclusion and framework for future integration

This study underscores the transformative potential of integrating artificial intelligence (AI) and Uncertain Motivation (UM) strategies to enhance argumentative writing among Saudi EFL learners. AI significantly improved students' ability to craft coherent, structured, and in-depth essays by providing real-time feedback, particularly on the Toulmin model's core components (claims, data, backing, and counterarguments). Simultaneously, UM maintained student motivation through varied and unpredictable rewards, encouraging deeper cognitive engagement in essay development. Together, AI and UM fostered a dynamic and supportive learning environment that stimulated both extrinsic and intrinsic motivation.

The initial lack of significant improvement (Tasks 1 and 2) across certain components reflects a learning curve associated with both the Toulmin Model and AI tools. Students needed time to internalize the model's framework and navigate AI functionalities effectively. This underscores the necessity of providing preparatory sessions and ongoing

guidance.

The plateau observed in Task 4 may indicate cognitive fatigue or a decline in motivation after repeated use of similar tools and strategies. This aligns with psychological theories on diminished returns in learning, particularly when novelty and challenge decrease.

To address this, educators could introduce diversified tasks or gamified elements to sustain engagement and prevent stagnation. The findings reveal how culturally and linguistically diverse learners respond to structured frameworks like the Toulmin Model. The progressive improvements highlight the adaptability of such models when paired with AI tools, especially in contexts where EFL learners face unique linguistic barriers.

5.7. Framework for integrating AI and UM in education

1. Effective Use of AI in Writing Instruction:

Educators should position AI as a support tool to enhance brainstorming, refine ideas, and improve structure, rather than as a replacement for independent writing. AI can be employed to target specific weaknesses, such as developing claims or addressing counterarguments, while promoting iterative learning. Students must be trained to use AI responsibly, understanding issues of bias and originality while fostering their critical evaluation skills. Educators can create structured guidelines to mitigate over-reliance and ensure AI complements, rather than replaces, traditional instruction.

2. Uncertain Motivation as a Dynamic Strategy:

Incentives should align with students' interests to maintain engagement, such as combining academic rewards (e.g., bonus points) with personal rewards (e.g., gaming cards). Alternating between known and unknown rewards sustains curiosity and enthusiasm across tasks. Educators should complement extrinsic rewards with strategies that highlight the intrinsic value of learning, such as self-reflection, mastery goals, and peer recognition. This ensures students find motivation not just in rewards but in personal growth and academic accomplishment.

3. Scalability and Adaptability:

The proposed framework can be adapted for various educational contexts, including other EFL learner groups or academic disciplines like STEM and the humanities. Flexibility in the implementation of AI tools and UM strategies allows for customization based on institutional resources and learner needs. Ensuring equitable access to AI tools and training for educators is essential to mitigate disparities in implementation and outcomes.

4. Creating Balanced and Collaborative Learning Environments:

Teachers remain essential for guiding critical thinking, providing nuanced feedback, and ensuring ethical academic practices. AI should complement rather than replace traditional methods. Incorporating peer reviews, group discussions, and team-based tasks enhances both motivation and deeper learning outcomes. Rotating high-demand tasks with reflective or creative activities helps prevent burnout and reinforces long-term learning.

5.8. Potential pitfalls and mitigation strategies

While AI and UM offer significant benefits, they must be implemented carefully to avoid potential downsides. Excessive use of AI could hinder students' development of independent critical thinking and creativity. Teachers should actively encourage students to engage critically with AI-generated suggestions and promote self-reflection. Repetitive or poorly aligned rewards may diminish their motivational impact; regular adaptation based on student feedback is essential. Additionally, addressing challenges like unequal access to AI tools and teacher resistance through targeted training and institutional support is critical.

5.9. Future research directions

Future research should investigate the long-term effects of AI on writing proficiency, particularly whether students can sustain improvements once AI support is reduced. Exploring the optimal balance between AI-generated and teacher feedback can reveal how these approaches complement each other, determining which stages benefit most from AI and where human intervention is indispensable. The role of UM strategies across diverse learner types, levels of motivation, and cultural contexts warrants further exploration. Tailored strategies could maximize engagement in various educational settings. Additionally, the adaptability of AI and UM in disciplines beyond EFL, such as the sciences and humanities, should be examined to broaden their applicability.

Further studies should focus on the cognitive and creative dimensions of AI tools. Investigating how AI fosters critical engagement, challenges assumptions, and stimulates innovative thinking is crucial. The potential for multimodal AI tools integrating text, visuals, and interactivity to cater to diverse learning styles also presents an exciting area for future exploration.

This study's findings also reveal the potential of AI and UM to foster critical thinking and argumentative coherence. However, [Banihashem et al. \(2023\)](#) highlight the role of epistemic beliefs and gender differences in shaping argumentative performance, opening new directions for further studies. Students who believe in the evolving and relative nature of knowledge tend to produce higher-quality arguments, whereas those with rigid epistemic beliefs face difficulties in constructing nuanced arguments. This observation underscores the need for pedagogical strategies that not only address linguistic and cognitive barriers but also cultivate advanced epistemic beliefs. For example, the AI tools employed in this study could be tailored to challenge students' assumptions and encourage a more exploratory approach to argumentation, addressing both cognitive and psychological barriers.

In conclusion, AI and UM have the potential to revolutionize argumentative writing instruction in EFL contexts, creating engaging, supportive, and effective learning environments. However, thoughtful implementation is necessary to ensure these tools enhance traditional teaching methods without undermining essential pedagogical practices. Ongoing research is vital to refine these strategies, maximizing their benefits for diverse educational contexts while addressing their inherent challenges.

CRediT authorship contribution statement

Abdullah Al Fraidan: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Ethical approval

This research project was approved by the ethical committee at the Deanship of Scientific Research in King Faisal University, Saudi Arabia under the request number Ethics867. Researchers obtained written informed consents from all participants.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This work was funded and supported by the Deanship of Scientific Research, Vice Presidency for Graduate Studies and Scientific Research, King Faisal University, Saudi Arabia, [Grant, 242873].

Acknowledgment

I would like to acknowledge all the people who facilitated this project including administrators, faculty members and the research participants for their cooperation. Special acknowledgments to the love of my life, my wife, AlAnoud Alwasmi who facilitated a lot of this research analysis and entry.

Appendix

A. Guide in how to use AI ethically

Rule 1: AI should be used to assist with brainstorming, generating ideas, and refining arguments, but not to write the entire essay on your behalf.

Rule2: All work submitted must be your own. AI-generated content should be properly edited and incorporated with your original thoughts.

Rule3: If AI tools were used to help generate ideas or content, this should be acknowledged in a brief note at the end of the essay.

Rule3: Ensure that any content generated by AI is unique and does not copy from other sources. Plagiarized content, whether from AI or elsewhere, will result in penalties.

Rule5: Use AI to explore different perspectives, generate supporting evidence, and develop counterarguments, but ensure that you critically evaluate and refine these ideas.

Rule6: AI should be used responsibly, in line with academic ethics. Misuse of AI, such as generating entire essays without meaningful input, will result in consequences.

Rule7: If you're unsure about how to use AI appropriately, consult your teacher for guidance.

Rule8: While AI can assist you, the bulk of the essay should be your own effort. AI is a tool to help refine your work, not do it for you.

Rule9: Understand that AI has limitations and may provide inaccurate or biased information. Always fact-check and critically evaluate AI-generated content.

Rule10: Regularly practice writing without AI to strengthen your skills. Use AI as a supplement, not a replacement for skill-building.

B. Examples of prompts to start with while using AI

1. Brainstorming Ideas:

Prompt: "What are some strong arguments for and against [topic]?"

Prompt: "What are some common counterarguments to the claim that [claim]?"

2. Essay Development:

Prompt: "Can you help me formulate a clear and concise thesis statement for an essay on [topic]?"

Prompt: "What would be a strong position to take on the issue of [topic]?"

3. Evidence and Support:

Prompt: "What are some credible sources or examples that support the argument that [claim]?"

Prompt: "Can you provide data or statistics that strengthen the argument for [topic]?"

4. Exploring Counterarguments:

Prompt: "What are some possible counterarguments to the idea that [claim]?"

Prompt: "How can I effectively refute the counterargument that [opposing view]?"

5. Outlining the Essay:

Prompt: "Can you help me outline the main points I should cover in an argumentative essay on [topic]?"

Prompt: "What is a logical structure for an essay arguing that [claim]?"

6. Introduction Writing:

Prompt: "What is a strong way to start an essay on [topic]?"

Prompt: “Can you suggest a hook for an argumentative essay about [topic]?”

7. Developing Body Paragraphs:

Prompt: “How should I structure a paragraph that argues [point] in my essay?”

Prompt: “What are some key points I should include in a paragraph about [subtopic]?”

8. Conclusion Writing:

Prompt: “How can I write a strong conclusion for an argumentative essay on [topic]?”

Prompt: “What are some ways to restate my thesis and summarize my main points effectively in the conclusion?”

9. Transition Sentences:

Prompt: “Can you suggest transition sentences that smoothly connect [paragraph 1 topic] to [paragraph 2 topic]?”

Prompt: “What are some good phrases to transition from discussing [point] to [counterpoint]?”

10. Strengthening Arguments:

Prompt: “How can I make my argument that [claim] more convincing?”

Prompt: “What are some logical fallacies to avoid in my argument about [topic]?”

11. Language and Tone:

Prompt: “Can you suggest a more formal way to express [informal phrase] in my essay?”

Prompt: “What are some persuasive words and phrases I can use in an argumentative essay?”

Data availability

Data will be made available on request.

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