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Modified Flipped Learning as an Approach to Mitigate the Adverse Effects of Generative Artificial Intelligence on Education

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Abstract: Generative Artificial Intelligence (GAI) systems such as ChatGPT, which create new educational content based on their training data, have led to debates on the systems' impact on educational practice and the question of whether academia should embrace or reject these tools. Flipped learning is a pedagogical approach that reverses the traditional order of teaching and learning. Instead of receiving direct instruction in the classroom, students are introduced to the learning material before class. This study explores the potential of modified flipped learning as an approach to mitigate the effects of GAI on education. The study highlights the relevance and importance of flipped learning and GAI in the 21st-century educational landscape and proposes a modified flipped learning model that combines the individualized and active learning aspects of flipped learning with the adaptive capabilities of GAI. The study also addressed concerns related to the responsible use of GAI, ethical considerations, and the role of educators in guiding students' interactions with intelligent systems. In conclusion, the proposed modified flipped learning model would empower students to actively engage in the learning process and take ownership of their education by replacing the traditional role of the teacher with the use of GAI systems for pre-class activities and content creation. However, further research is needed to explore the effectiveness of flipped learning in this context and identify the best ways to implement this approach in the classroom.

Keywords: ChatGPT, Natural Language Processing, Education, Flipped Classroom, Flipped Learning, Blended Learning, Generative Artificial Intelligence

1. Introduction

Generative artificial intelligence (GAI) systems are capable of generating novel content based on their training data. This has led to debates on their impact on educational practice and raise the question of whether academia should embrace or reject these tools. While some studies viewed GAI as a powerful technology that offers adaptive learning and access to diverse information and resources [1, 2], others highlighted skepticism regarding potential threats to educational practice [3–7]. Consequently, the effective integration of GAI systems into educational practices depends on the ability of educators, researchers, and relevant stakeholders to proactively redefine educational approaches in response to the potential threats of emerging AI tools.

Recent studies have highlighted several themes related to the educational integration of GAI systems. Particularly, studies on the educational use of the ChatGPT developed by OpenAI, discussed themes related to the reliability of the generated educational content [8, 9], its social implications [3, 6], the need for educational transformation [8, 10], and responsible implementations [11, 12]. In essence, GAI systems can enhance educational activities; however, there are challenges and concerns related to accuracy, policy, and teachers' competencies that need to be addressed. However, there are no long-term studies on educational use of GAI, and there is insufficient empirical evidence to investigate the effects of the systems on educational practice, especially, with considerations to students' learning outcomes and pedagogical approaches. Additionally, there is a need for studies on the perspectives of stakeholders such as students, teachers, and policymakers, which are essential for developing and implementing effective educational approaches that address their needs.

This study explores how the implementation of a modified flipped learning approach with GAI can effectively address and mitigate the possible adverse effects of GAI on educational practice, enhance student learning outcomes, and prepare them for the future by fostering critical thinking, creativity, and adaptability.

2. Related Studies

The rapid advancements in GAI systems have signaled significant transformations in various fields, including education. While GAI presents numerous opportunities to enhance teaching and learning experiences, it also brings certain challenges and concerns. One particular concern revolves around the potential adverse effects on education, such as cheating and overreliance on the automated systems. In response to these concerns, educators and researchers have started exploring alternative pedagogical approaches to explore positive impacts and mitigate the negative effects of emerging technologies including GAI [13, 14]. This article identified the common issues highlighted in the existing literature and proposed a mitigation approach with a Modified Flipped Learning, which combines elements of traditional flipped learning with tailored modifications to leverage GAI technology effectively. Through an in-depth literature review, this study aims to examine the potential benefits and limitations of the Modified Flipped Learning as a strategy to address the adverse effects of GAI on education. Several studies have highlighted the results of experimenting with GAI, especially ChatGPT, under various conditions [1, 3–7, 9, 11, 12, 15–25]. Accordingly, the relevant literature on the educational integration of GAI can be classified into four major dimensions, which can be explained as follows:

2.1. Reliability of ChatGPT

Several studies have discussed the importance of understanding the reliability and limitations of GAI systems when integrating technology into educational practice. By understanding the limitations of GAI systems, educators can avoid misinformation, address ethical considerations, moderate human-machine interaction, and manage student expectations. For instance, Sevgi et al. [9] evaluated the reliability of ChatGPT in neurosurgery education in preparing case reports, answering questions, and academic writing. The findings revealed the interesting performance of ChatGPT despite the lack of citations that could support the reliability of the responses generated. Thus, the authors suggest the need for further evaluation and improvement before it can be widely adopted in neurosurgical education. Tlili et al. [6] investigated user experiences and concerns about cheating, honesty, privacy, and manipulation among early adopters of ChatGPT on social media and identified several research dimensions that should be considered to ensure safe and responsible integration of the technology in education. Gregorcic [19] identified ChatGPT's unreliable responses to physics questions and its limitations as an educational tool for physics students and teachers. Su [2] proposed a theoretical framework called "IDEE" for ensuring ethical considerations and responsible use of GAI systems in establishing the potential benefits and challenges of the technology in education within the proposed theoretical framework. Farrokhnia et al. [4] utilized the SWOT analysis framework to explore the strengths and weaknesses of ChatGPT in education and identified multifaceted issues that could lead to a decline in high-order cognitive skills among students, threaten academic integrity, and perpetuate other long-term adverse effects.

2.2. Ethical Implications

Another research dimension focuses on the ethical and

social implications of using GAI in educational contexts to empower educationists with vital considerations that could ensure student safety and privacy, promote the responsible use of AI, and foster a positive learning environment. This is particularly important for understanding the potential biases, misinformation, manipulation, or deception that can arise from GAI systems [3]. Thus, educators can guide students in critically evaluating the information generated by AI tools, teaching them to discern reliable sources, and encouraging them to question and analyze the content. In addition, educational administrators could utilize related findings to establish ethical guidelines and promote discussions around responsible AI use and the ethical responsibilities of technology creators and users. By incorporating these considerations into educational practices, GAI systems can be integrated in a way that prioritizes student well-being, fosters ethical behavior, and supports the development of responsible and informed learners. For instance, Dwivedi [3] discussed the limitations, disruptions, and ethical issues associated with ChatGPT across 43 fields, including education, based on experts' opinions, and identified three thematic areas for handling GAI systems in ethical contexts. Kooli [22] examined the ethical challenges of using GAI systems in research and education and highlighted several issues, including the need for more creative and innovative assessment methods to protect educational systems. Crawford [23] commented on the potential negative implications of ChatGPT on academic integrity and identified the need for authentic assessment and effective teacher leadership for responsible use of the GAI system to support deeper learning and better learning outcomes for students. Cotton [24] discussed the challenges of ensuring academic integrity and preventing plagiarism in the era of ChatGPT and considered proactive and ethical approaches, including policy development and staff training to ensure the responsible use of AI tools.

2.3. Educational Applications

Definitive explanations of the targeted educational applications and the resulting impacts of GAI are crucial to the effective utilization of these technologies in educational practice. Specifically, identifying areas where GAI can enhance teaching and learning would aid educators in anticipating challenges, evaluating content suitability, and assessing the effects of integration on student motivation and critical thinking. Thus, enabling informed decision-making, responsible AI use, and maximizing the benefits of GAI, while mitigating its negative effects on education. In this dimension, Lim [25] analyzed the potential of GAI in education and its paradoxes to reconcile the debate on GAI as a transformative resource in the future of education and its implications. Cooper [8] conducted a self-study to explore the use of ChatGPT in answering science education questions, its utilization in science pedagogy, and as a research tool. The study findings suggest modeling responsible use by prioritizing critical thinking, setting clear expectations, and anticipating potential copyright infringement due to a lack of proper citations in the generated content. Humphry & Fuller [10] discussed the potential use of ChatGPT in undergraduate chemistry laboratories for written lab reports and highlighted hints on identifying AI-generated content. Halaweh [11] examined the concerns and strategies for incorporating ChatGPT into educational settings. Geerling [18] assessed the performance of the ChatGPT in standardized economics tests and its implications for assessment methods in higher education. The study identified how GAI systems present a challenge to traditional assessment methods in higher education, leading to the need for educators to mitigate adverse effects by redesigning curricula to embrace in-person assessments and experiential learning projects. Ivanov [20] highlighted the disruption of tourism education and research by ChatGPT, the need for curriculum redesign, the need to reevaluate teaching and assessment strategies, and the incorporation of generative language models in teaching. Yan [26] adopted a qualitative approach to investigate the applicability and concerns of using ChatGPT in L2 (second language) writing pedagogy. The study revealed the applicability of ChatGPT in L2 writing pedagogy, but participants expressed concern about its threat to academic honesty and educational equity. Lastly, asking ChatGPT and other GAI systems may not give students the same answer, because these tools use the questions from users to generate content and sometimes can generate content outside the context. Thus, training students on how to interact with these tools will help a lot in learning.

2.4. Technical Aspects

Gaining insights into the technical aspects and frameworks of GAI would aid educationists, teachers, researchers, and relevant stakeholders in successfully integrating the technology into educational practices, assessing their appropriateness with specific educational activities, and ensuring responsible utilization. Understanding the underlying algorithms, training data, and model architectures helps educators make informed decisions about incorporating GAI into teaching and learning processes. Some studies have focused on the technical aspects and frameworks of GAI in relation to educational practices [1, 5, 7, 21, 27]. For instance, Lo [27] proposed the CLEAR Framework for Prompt Engineering to optimize interactions with GAI systems and demonstrated effective creation and evaluation of AI-generated content based on ChatGPT technical settings of tokens, temperature, and top-p prompts. Yeadon et al. [7] presented evidence of AI-generated essays achieving high grades in university physics assessments and discussed the technical aspects of how plagiarism detection viewed the generated responses. The researchers suggested that the study findings revealed how GAI systems could pose a serious threat to the validity of short essays as a form of assessment in physics. Similarly, Perkins [5] examined the academic integrity considerations of students' use of GAI in formal assessments. The study findings, based on several academic integrity-related issues, suggest that students' use of GAI does not constitute plagiarism or a violation of academic

integrity; rather, university policies should be updated to reflect how these tools will be used in future learning settings. Gilson [1] evaluated the performance of ChatGPT on medical examination questions and found its superior performance over comparable GAI models on the study datasets, suggesting potential applications as an interactive medical education tool. In essence, ChatGPT and other GAI models are developed through a combination of deep learning techniques, natural language processing, and large-scale pretraining on vast amounts of text data. These models learn patterns and relationships in language, enabling them to generate coherent and contextually appropriate responses [1, 5, 7, 27]. During inference, the models utilize their learned knowledge to generate responses based on the input and decoding algorithms that balance coherence and creativity [1, 5, 7, 27]. However, challenges such as biases, factual accuracy, and safety concerns remain [21], highlighting the ongoing need for research and development to ensure the responsible and reliable deployment of GAI systems.

Previous literature reviews have highlighted significant discussions and concerns in various domains regarding the integration of GAI into educational practice. In particular, the synthesis of existing literature reviews highlighted the key ideas related to the impacts, benefits, risks, and challenges associated with GAI in the context of education. For instance, Emenike & Emenike, Kasneci et al., Lo, and Rahimi [12, 15–17] highlighted the potential impacts, capabilities, and challenges posed by GAI in various domains of education, with emphasis on the need for productive discussions and careful consideration of the benefits, risks, and limitations associated with AI text-based systems, such as generating incorrect information, bypassing plagiarism detectors, potential biases, and ethical concerns while serving as a virtual tutor, generating course materials, and enhancing student engagement. Eysenbach, Lee, Subramani et al. [28–30] focused on the ethical considerations and limitations associated with the integration of GAI in medical education, research, and practice as a virtual teaching assistant, its performance in medical examinations, and its role in clinical decision-making. Notably, Gentile [31] discussed the need for changes in the teacher's role triggered by the integration of AI into educational systems and proposed a manifesto to guide the evolution of the teacher's role in line with the need for a paradigm shift. In addition, other studies explored the underlying technologies behind GAI and various issues, including its affordances in language teaching and learning [32], its influence on tourism education [33], and academic libraries [34, 35], as well as its broader influence, including ethics, data ownership, effective learning practices, and policy development [36].

Based on the foregoing literature, we explored how GAI systems could potentially enhance various educational domains, including flipped learning while considering the highlighted challenges as well as the need for improved teacher competencies. In addition, there is a need for more research to understand the implications of AI in education and to develop robust guidelines for responsible AI integration. Thus, the present study proposes a modified flipped learning approach to address some of the issues highlighted.

3. Comparison of Traditional and Flipped Learning Models

A brief recap of flipped learning in comparison with the traditional learning model is essential for the foundation of the proposed modified flipped learning approach in the present study. The flipped classroom model is a pedagogical approach in which students are introduced to new content before class and use class time for discussion, problem-solving, and other activities [37–39]. Although both traditional and flipped learning models are distinct educational approaches and have their strengths and weaknesses, the effectiveness of each model depends on various factors, including subject matter, student population, and teaching methodologies employed [38]. In essence, in the traditional learning model, the teacher delivers direct instruction during class time, while in flipped learning, students access instructional materials outside of class, and in-class time is dedicated to interactive activities and discussions. Unlike traditional learning, in the flipped learning model, the teacher's role changes from the primary source of knowledge to a facilitator and mentor, providing guidance, feedback, and support. It is noteworthy that the educational context, learning needs, and goals are the criteria for choosing between models. In addition, traditional learning involves passively absorbing information, while flipped learning promotes active engagement through interactive in-class activities, collaboration, and knowledge application. One of the strengths of flipped learning is that it can help teachers to take large number of students without need of large building structures, high number of staffs and other teaching resources. However, the content generated by the teacher may not be rich enough for students and certain questions might not be accommodated to help student to understand before in-class discussion. Figures 1 and 2 show a pictorial comparison of the two learning models.

It is important to note that in both flipped and traditional learning, teachers' overhead of providing learning materials is not eliminated, in addition to elements that limit students' creativity, access to information, and critical thinking, among others. Therefore, there is a need for a robust approach that can address these challenges and the emerging adverse effects of generative AI systems identified in the literature review. Accordingly, the notable flipped learning models examined in the present study include Micro-Flipped, Faux-Flipped, and Role-Reversal 2.0 [38, 40]. Specifically, Micro-Flipped involved distributing study materials in the form of short video lectures and assignments, while the rest of the lectures and assignments were conducted during classroom time. In Faux-Flipped, teachers use interactive whiteboards to present content in class, while students use tablets or laptops to work on assignments. in Role-Reversal 2.0

students take on the role of teachers and create content to teach their peers.

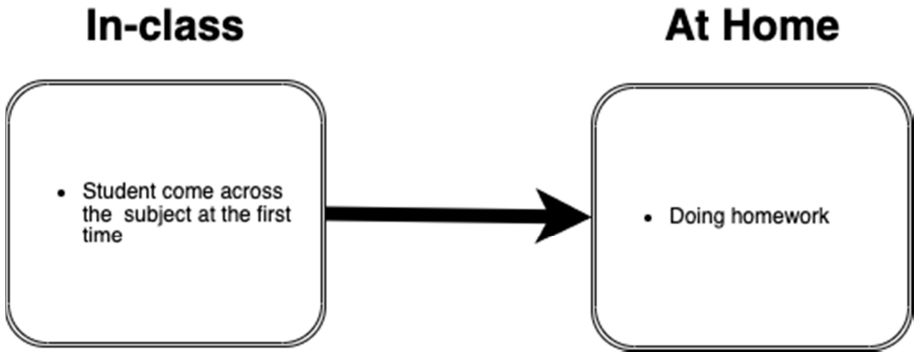

Figure 1. *Traditional learning model.*

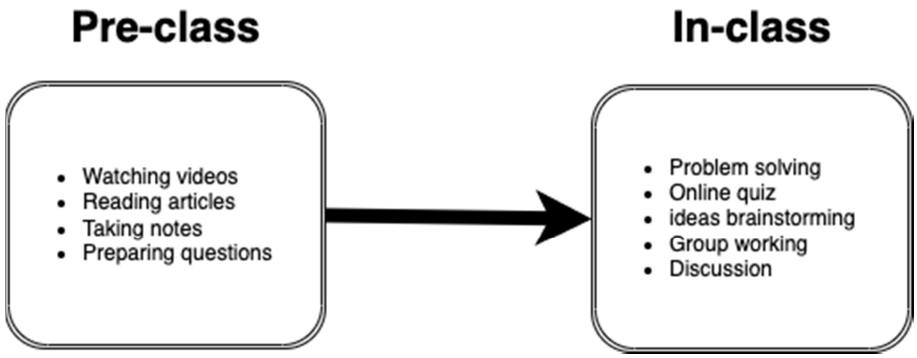

Figure 2. *Flipped learning model.*

4. The Proposed Modified Flipped Learning Model

The proposed modified flipped learning model extends Role-Reversal 2.0, with students using contents generated from generative AI, such as ChatGPT, as the primary source of class lectures, while the teacher will use the class as an interactive session for discussion to supervise students and reshuffle ideas. The proposed model is illustrated in Figure 3.

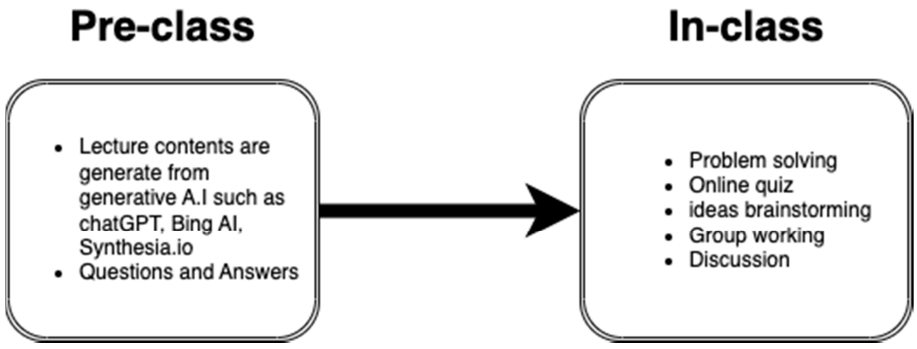

Figure 3. *Proposed modified flipped learning model.*

In the proposed modified flipped learning model, the traditional and flipped learning role of the teacher as a content creator is replaced by students' utilization of generative AI for pre-class activities and content creation. Thus, instead of relying solely on the teacher to curate and deliver instructional materials, students actively engage with AI technology to generate their content. This shift empowers students to become co-creators of knowledge, fostering a sense of ownership and creativity during the learning process. Additionally, by leveraging generative AI, students can access vast amounts of information, synthesize ideas, and develop their unique content such as video presentations, interactive quizzes, or multimedia projects. This approach not only enhances students' critical thinking and problem-solving skills but also encourages collaboration and peer-to-peer learning as students share and discuss their AI-generated content during class sessions. The modified flipped learning model with generative AI places students at the center of

their learning journey, promoting active participation and a deeper understanding of the subject matter.

5. Discussion

Studies have shown that the ChatGPT and other GAI systems may have limitations and potential inaccuracies [2, 4, 6, 9, 19]. Therefore, while implementing the proposed modified flipped learning model with GAI, educators should provide students with critical evaluations of the generated contents, address any potential errors or biases that may arise, and emphasize the importance of cross-referencing information, fact-checking, and developing critical thinking skills to ensure accuracy and reliability. Promoting responsible and ethical use of GAI is among the key dimensions that motivated the proposed modified flipped learning approach based on the numerous studies that raised ethical and social implications in the use of the technologies in educational settings [3, 22–24]. Accordingly, educators could direct classroom discussions toward ethical decision-making and foster awareness of the potential consequences and societal impact of these technologies with respect to the curriculum before the class. Studies explored how GAI systems could potentially enhance various educational domains, by offering personalized learning, adaptive feedback, and access to vast knowledge resources [8, 10, 18, 20, 25, 26]. Identifying various educational applications, particularly with the flipped learning model, and the subsequent impact will guide the consideration of the unique needs and goals of students and research other appropriate integration strategies. From related studies, we can deduce that knowledge of the technical aspects and frameworks associated with GAI, including algorithms, training data, and model architecture, will enable educators to make informed decisions and guide students by evaluating the reliability, limitations, and potential biases of these systems in educational settings [1, 5, 7, 27]. This is particularly vital because GAI presents several technical challenges that researchers and developers must address. These include bias and fairness, controllability, robustness, and safety. These challenges require a multidisciplinary approach, combining advancements in natural language processing, machine learning, fairness, and ethics. Collaboration between academia, industry, and policymakers is essential to overcome these obstacles and develop more robust, fair, and controllable AI systems.

6. Conclusion

Generative AI is a technology that raises concerns about its effects on education and student learning, with cheating being the primary concern. Flipped learning has been shown to improve student outcomes. Combining flipped learning with adaptive instruction can further improve upon the shortcomings of flipped learning, which does not consider individual differences. While technology can help improve student learning, it is important to have measured expectations and to recognize that the teacher's role will shift from instructor to facilitator and coach. Therefore, flipped learning can mitigate the effects of generative AI on education by improving student outcomes and providing a more personalized learning experience. We propose a modified flipped learning model that empowers students to actively engage in the learning process and take ownership of their education by replacing the traditional role of the teacher with the use of generative AI by students for pre-class activities and content creation. Flipped learning can help ensure that students receive a high-quality education in the age of generative AI by mitigating the potential adverse effects of the technology on education, particularly in counteracting the passive learning experience that could result from the increased use of generative AI. Additionally, flipped learning provides teachers with an opportunity to balance the use of automation with human input, ensuring that students are introduced to limitless learning opportunities. However, further research is needed to explore the effectiveness of flipped learning in this context and identify the best ways to implement this approach in the classroom.

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