NEGATION

My partner and I negate the resolution. Resolved: In the United States, the benefits of the use of generative artificial intelligence in education outweigh the harms.

C1: Generative AI Causes Global Warming

Generative AI uses a lot of electricity.

Crownhart, Casey. "AI is an energy hog. This is what it means for climate change." MIT Technology Review, May 23, 2024,

https://www.technologyreview.com/2024/05/23/1092777/ai-is-an-energy-hog-this-is-what-it-means-for-climate-change/. Accessed February 14, 2025.

Electricity consumption from data centers, AI, and cryptocurrency could reach double 2022 levels by 2026, according to projections from the International Energy Agency. Those technologies together made up roughly 2% of global electricity demand in 2022. Note that these numbers aren't just for AI—it's tricky to nail down AI's specific contribution, so keep that in mind when you see predictions about electricity demand from data centers. There's a wide range of uncertainty in the IEA's projections, depending on factors like how quickly deployment increases and how efficient computing processes get On the low end, the sector could require about 160 terawatt-hours of additional electricity by 2026. On the higher end, that number might be 590 TWh. As the report puts it, AI, data centers, and cryptocurrency together are likely adding "at least one Sweden or at most one Germany" to global electricity demand. In total, the IEA projects, the world will add about 3,500 TWh of electricity demand over that same period—so while computing is certainly part of the demand crunch, it's far from the whole story.

It also takes large amounts of electricity to train the models.

Clark, Tim. "Why Does AI Consume So Much Energy?" Forbes, December 23, 2023,

https://www.forbes.com/sites/sap/2023/12/20/why-does-ai-consume-so-much-energy/. Accessed February 14, 2025.

According to Lim, AI models consume so much energy because of the vast amount of data that the model is trained on, the complexity of the model, and the volume of requests made to the AI by users. During training, the AI model "learns" how to behave based on a large set of examples and data. Training an AI model can take anywhere from a few minutes to several months depending on the amount of data and complexity of the model. During this time, GPUs – a type of electronic chip used to process large amounts of data – are running 24 hours per day, consuming a large amount of energy.

“The more complex the model and bigger the dataset, the more energy the AI will use during training,” said Lim.

This usage of electricity is contributing to large production of greenhouse gases.

Garrison, Anna. “How Much Does AI Use Water and Energy? Unpacking the Negative Impact of Chatbots.” Green Matters, January 10, 2025, https://www.greenmatters.com/big-impact/how-much-water-does-ai-use. Accessed February 14, 2025.

A research study quantifying the carbon footprint of BLOOM determined that training a Generative Pre-trained Transformer 3 (GPT-3) uses just under 1,300 megawatt hours (MWh) of electricity, which is the equivalent of energy for 130 homes, per the U.S. Energy Information Administration. Training a Generative Pre-trained Transformer 4 (GPT-4), like ChatGPT, however, uses 50 times more electricity. Data from 2022 shows that the data center industry represents 2-3 percent of total global emissions, per Electronics Hub. However, it's anticipated this could dramatically increase in the future — a report from January 2025 by the International Energy Agency (IEA) reveals that should demand for AI systems double in 2026, it would equal roughly the amount of electricity used by Japan.

These emissions will certainly further increase in the future.

Cho, Renee. “AI’s Growing Carbon Footprint.” State of the Planet, June 9, 2023, https://news.climate.columbia.edu/2023/06/09/ais-growing-carbon-footprint/. Accessed February 14, 2025.

Most of a data center’s energy is used to operate processors and chips. Like other computer systems, AI systems process information using zeros and ones. Every time a bit—the smallest amount of data computers can process—changes its state between one and zero, it consumes a small amount of electricity and generates heat. Because servers must be kept cool to function, around 40 percent of the electricity data centers use goes towards massive air conditioners. Without them, servers would overheat and fail.

In 2021, global data center electricity use was about 0.9 to 1.3 percent of global electricity demand. One study estimated it could increase to 1.86 percent by 2030. As the capabilities and complexity of AI models rapidly increase over the next few years, their processing and energy consumption needs will too. One research company predicted that by 2028, there will be a four-fold improvement in computing performance, and a 50-fold increase in processing workloads due to increased use, more demanding queries, and more sophisticated models with many more parameters. It’s estimated that the energy consumption of data centers on the European continent will grow 28 percent by 2030.

Impact: Greenhouse gas emissions are exacerbating climate change.

Gibb, Terry. “Greenhouse gases: Their impact on climate change.” Michigan State University Extension, December 21, 2015, https://www.canr.msu.edu/news/greenhouse_gases_their_impact_on_climate_change. Accessed February 14, 2025.

Greenhouse gases are gases in the Earth's atmosphere that produce the greenhouse effect. Changes in the concentration of certain greenhouse gases, from human activity (such as burning fossil fuels), increase the risk of global climate change. Greenhouse gases include water vapor, carbon dioxide (CO2), methane, nitrous oxide, halogenated fluorocarbons, ozone, perfluorinated carbons, and hydro fluorocarbons. These gases surround and insulate the Earth like a blanket. They allow the sun to reach and warm the Earth’s surface then block the warmth from escaping back into space. Human activities, including those mentioned above, have continued to increase and have upset the balance of the natural system for several greenhouse gases: methane, nitrous oxide, fluorinated gases and especially carbon dioxide. As these gases continue to be emitted into the atmosphere, they form a thicker layer. And just like the blanket, the thicker it is, the more heat it holds.

Impact: Climate change will eventually lead to the downfall of civilization as we know it.

Specktor, Brandon. “Human Civilization Will Crumble by 2050 If We Don't Stop Climate Change Now, New Paper Claims.” Live Science, June 4, 2019, https://www.livescience.com/65633-climate-change-dooms-humans-by-2050.html. Accessed February 14, 2025.

It seems every week there's a scary new report about how man-made climate change is going to cause the collapse of the world's ice sheets, result in the extinction of up to 1 million animal species and — if that wasn't bad enough — make our beer very, very expensive. This week, a new policy paper from an Australian think tank claims that those other reports are slightly off; the risks of climate change are actually much, much worse than anyone can imagine. According to the paper, climate change poses a "near- to mid-term existential threat to human civilization," and there's a good chance society could collapse as soon as 2050 if serious mitigation actions aren't taken in the next decade. Published by the Breakthrough National Centre for Climate Restoration in Melbourne (an independent think tank focused on climate policy) and authored by a climate researcher and a former fossil fuel executive, the paper's central thesis is that climate scientists are too restrained in their predictions of how climate change will affect the planet in the near future. [Top 9 Ways the World Could End]

C2: Generative AI Undermines Humanity’s Cognitive Capacity.

Cognitive development requires active engagement with complex problem solving.

Holyoak, Keith. “An Invitation to Cognitive Science: Thinking.” The MIT Press. 1995. https://doi.org/10.7551/mitpress/3966.001.0001. Accessed February 14, 2025.

The ability to solve problems is one of the most important manifestations of human thinking. The range of problems people encounter is enormous: planning a dinner party, tracking deer, diagnosing a disease, winning a game of chess, solving mathematical equations, managing a business. This radical diversity of problem domains contrasts with the relative specificity of many human cognitive activities, such as vision, language, basic motor skills, and memory activation, which have a relatively direct biological basis and which all normal individuals accomplish with substantially uniform proficiency. In the course of normal development we all learn, for example, to speak a native language, but without specialized experience we will never acquire competence in deer tracking or chess playing. On the other hand, all normal people do acquire considerable competence in solving at least some of the particular types of problems they habitually encounter in everyday life. We might therefore suspect that problem solving depends on general cognitive abilities that can potentially be applied to an extremely broad range of domains. We will see, in fact, that such diverse cognitive abilities as perception, language, sequencing of actions, memory, categorization, judgment, and choice all play important roles in human problem solving. The ability to solve problems is clearly a crucial component of intelligence.

Generative AI creates a shortcut that bypasses necessary cognitive strain.

Salah, Mohanned, et al. “Me and My AI Bot: Exploring the 'AIholic' Phenomenon and University Students' Dependency on Generative AI Chatbots - Is This the New Academic Addiction?” Research Square. May 2024. https://www.researchsquare.com/article/rs-3508563/v2. Accessed February 14, 2025.

Amidst the buzz of technological advancement in education, our study unveils a more disconcerting narrative surrounding student chatbot interactions. Our investigation has found that students, primarily driven by intrinsic motivations like competence and relatedness, increasingly lean on chatbots. This dependence is not just a preference but borders on an alarming reliance, magnified exponentially by their individual risk perceptions. While celebrating AI's rapid integration in education is tempting, our results raise urgent red flags. Many hypotheses were supported, pointing toward a potential over-dependence on chatbots. Nevertheless, the unpredictable outcomes were most revealing, exposing the unpredictable terrain of AI's role in education. It is no longer a matter of if but how deep the rabbit hole of dependency goes. As we stand on the cusp of an educational revolution, caution is urgently needed. Before we wholly embrace chatbots as primary educators, it is imperative to understand the repercussions of replacing human touch with AI interactions. This study serves as a stark wake-up call, urging stakeholders to reconsider the unchecked integration of chatbots in learning environments. The future of education may very well be digital, but at what cost to human connection and autonomy?

Generative AI creates a shortcut that bypasses necessary cognitive strain.

Zhang, Shunan, et al. “Do you have AI dependency? The roles of academic self-efficacy, academic stress, and performance expectations on problematic AI usage behavior.” International Journal of Educational Technology in Higher Education. May 2024. https://doi.org/10.1186/s41239-024-00467-0. Accessed February 14, 2025.

Although previous studies have highlighted the problematic artificial intelligence (AI) usage behaviors in educational contexts, such as overreliance on AI, no study has explored the antecedents and potential consequences that contribute to this problem. Therefore, this study investigates the causes and consequences of AI dependency using ChatGPT as an example. Using the Interaction of the Person-Affect-Cognition-Execution (I-PACE) model, this study explores the internal associations between academic selfefficacy, academic stress, performance expectations, and AI dependency. It also identifies the negative consequences of AI dependency. Analysis of data from 300 university students revealed that the relationship between academic self-efficacy and AI dependency was mediated by academic stress and performance expectations. The top five negative effects of AI dependency include increased laziness, the spread of misinformation, a lower level of creativity, and reduced critical and independent thinking. The findings provide explanations and solutions to mitigate the negative effects of AI dependency.

Impact: Bypassing congnitive challenge leads to degradation of mental capabilities.

Shaji, George, et al. "The Erosion of Cognitive Skills in the Technological Age: How Reliance on Technology Impacts Critical Thinking, Problem-Solving, and Creativity." Partners Universal Innovative Research Publication. June 2024. DOI:10.5281/zenodo.11671150. Accessed Februray 14, 2025.

Having extensively detailed the measurable impacts of human cognitive offloading onto ever-advancing technology, the concluding warning sounds clear - without ongoing practice and purposeful limitations keeping key mental faculties active, the most transcendent pillars behind human consciousness risk permanent atrophy over time. While innovation promises, and in many ways delivers, increased convenience, efficiency, and accessibility of information central to daily life, it simultaneously excuses the very effort required to sustain complex thought faculties that empowered breakthroughs enabling such progress originally. Without commensurate exertion stimulating neural networks supporting analysis, creativity, inference, and insight now routinely outsourced to apps, future generations lose touch with executing uniquely human gifts still anchoring aspirational fulfillment against the tide of automation.

Impact: **AI in education kills critical thinking.**

Fonkam et al. 24 [Mathias Fonkam, PhD in computer science and Associate Teaching Professor @ Penn State University with over 20 years of experience in computer science education, xx-xx-2024, Risks of AI-Assisted Learning on Student Critical Thinking: A Case Study of Albania, International Journal of Risk and Contingency Management, https://www.igi-global.com/article/risks-of-ai-assisted-learning-on-student-critical-thinking/350185] BZ

INTRODUCTION

Artificial Intelligence (AI) has increasingly become a transformative force in the education sector, offering unprecedented opportunities to enhance learning experiences and outcomes (Bates et al., 2020; Çela et al., 2024). AI-assisted learning systems promise to revolutionize traditional educational paradigms including offering personalized learning pathways and real-time feedback mechanisms (Bates et al., 2020). However, alongside these advancements, there are growing concerns about the potential adverse effects of AI on critical cognitive skills, particularly **critical thinking** (Essel et al., 2024; Iqbal & Iqbal, 2024; Parsakia, 2023). This study examines these concerns through a focused examination of AI-assisted learning's impact on student critical thinking within the context of Albania's educational landscape. Critical thinking is a fundamental skill, essential for problem-solving, decision-making,

and the ability to analyze and synthesize information effectively (Dwyer et al., 2014). Critical thinking is vital for students to develop these skills to navigate an increasingly complex and information-rich world (Kitsantas et al., 2019). However, there is a growing body of literature suggesting that AI-assisted learning, while beneficial in many aspects, may inadvertently **undermine the development of critical thinking skills**. This issue arises from the tendency of AI systems to provide readily available solutions and information, potentially discouraging students from engaging deeply with the learning material and developing their analytical abilities.

Education is a fundamental pillar of society, shaping the actions of new generations and preparing them to confront future challenges. An educated populace facilitates national development and accelerates improvements across various sectors. In a dynamic society, the acquisition of new knowledge and tools is essential, particularly in the field of education. The integration of AI within the educational system has revolutionized numerous aspects of teaching and learning. AI has introduced novel methods for enhancing personalized learning, improving assessments, and reducing administrative burdens for educators (Ayala-Pazmiño, 2023). The adoption of AI tools in both preuniversity and university education is inevitable, as they provide efficient means for students to meet assignment deadlines and enable professors to generate tailored tasks that address specific student needs. Ayala-Pazmiño (2023) highlights the efficacy of AI in analyzing student data, thereby enabling the customization of learning experiences to individual requirements. The implementation of AI in education promises a more personalized and responsive approach to teaching, ultimately benefiting the educational process.

Despite the numerous benefits associated with AI in education, many educators recognize the potential risks related to data privacy and security. While students may not be fully aware of these risks, educators can discern the potential dangers associated with AI, particularly concerning the automated generation of outputs that may lack appropriate context or accuracy (Cardona, Rodríguez, & Ishmael, 2023). Consequently, AI tools are seen as critical instruments for redefining classroom dynamics and enhancing student engagement in the teaching-learning process (Pavlenko & Syanko, 2024). However, the extent to which AI tools represent an advantage or a drawback for educational systems remains unclear. Instructors and administrators grapple with determining whether the use of AI tools by students in their assignments might undermine their problem-solving skills and reduce their capacity to independently address complex issues. Conversely, students, who are the primary users of these tools, often perceive AI as significantly aiding their comprehension of complex concepts, irrespective of their field of study. This study aims to investigate the impact of AI tools on students' problem-solving skills and to assess the extent to which these tools assist students in understanding and completing assignments. Through this study, a comprehensive analysis of the benefits and drawbacks of AI usage in education, with a focus on its implications for student learning outcomes and problem-solving abilities.

This study employs a quantitative methodology to explore the risks associated with AI-assisted learning on critical thinking. A survey of 53 students was conducted in an educational institution in Albania to gather data on their experiences and perceptions regarding AI-assisted learning and its impact on their critical thinking skills. This approach allowed us to systematically measure and analyze the influence of AI tools on the cognitive development of students. The Albanian educational system presents a unique context for this investigation. As a country in the midst of educational reforms (Çela, 2022; Fetahu & Çela, 2022) and technological integration, Albania offers a valuable case study to examine the broader implications of AI in education. This research seeks to identify specific challenges and opportunities within this context, contributing to an understanding of AI's role in shaping critical thinking skills. Through this study, the complex relationship between AI-assisted learning and student critical thinking was examined, providing insights that can inform educators, policymakers, and technology developers. Ultimately, the goal is to ensure that the integration of AI in education enhances rather than hinders the development of essential cognitive skills, promoting a generation of learners who are both technologically adept and critically proficient.

BACKGROUND

In recent years, society has encountered significant challenges in adapting to continuous technological advancements, largely due to the **absence of comprehensive guidelines** for their implementation. The educational sector, inherently linked to the development of future generations, is profoundly affected by these changes. In Albania, legislative efforts have aimed to address these challenges (Fetahu & Çela, 2022); in 2012, Albania introduced a new law on the pre-university education system, designed to enhance the teaching-learning process by aligning it with the needs of students and the broader society (Fetahu & Çela, 2022). This was followed by a 2015 law on higher education, which intended to improve students' professional and soft skills (Çela, 2022). Since the enactment of these laws, numerous bylaws have been implemented annually to facilitate their application. Notably, the pre-university education law emphasizes the integration of technological tools into curricula from an early age. While this aims to familiarize students with technology, there is a growing concern that the misuse of these tools for tasks, assignments, or projects may erode students' critical thinking skills. Critical thinking is essential in higher education, where students must integrate theoretical and practical knowledge to succeed in their careers. Therefore, interventions are necessary to ensure students use technological tools appropriately without compromising their foundational knowledge and critical thinking development.

In response to these concerns, Albania has initiated various programs to enhance technological skills in pre-university education. The "21st Century Schools" program, a partnership between the UK government and Albanian educational institutions, aims to boost the critical thinking and problem-solving skills of students aged 10-15 through programming (Çela et al., 2024). This program provides schools with micro-bit devices, which are small, programmable computers that enable students to solve problems innovatively and engagingly. Similarly, the Albanian-American Development Foundation (AADF) has funded programs to enhance students' programming and technology skills (Fetahu & Çela, 2022). The vision of the Ministry of Education and educational institutions emphasizes that learning to code in pre-university education prepares students for a rapidly evolving technological world (Fetahu & Çela, 2022). While programming skills are directly applicable in many professions and advantageous in numerous others, an exclusive focus on programming can limit students' career paths, directing them towards specific skill sets. This is evident in the increasing number of students opting to study computer science or software engineering in university, driven by their early exposure to these fields.

Despite the benefits of technological tools in education, their improper use can lead to a decline in critical thinking skills in other areas. The rapid introduction of new technological tools often lacks accompanying guidelines, as seen with the implementation of AI. Though AI has the potential to offer significant educational benefits, its misuse can adversely affect the development of critical thinking skills. This study aims to explore the impact of AI tools on students' problem-solving abilities and assess their effectiveness in helping students understand and complete assignments. By providing a comprehensive analysis of the advantages and drawbacks of AI in education, this research seeks to inform strategies for integrating technology into the educational system without undermining essential cognitive skills.

REVIEW OF LITERATURE

AI, a subset of computer science, focuses on understanding the nature of intelligence and creating intelligent machines that simulate, extend, and enhance human capabilities (Huang & Qiao, 2024; Saheed et al., 2021). The benefits of technology are undeniable however, its extensive and unguided use has introduced significant challenges in the teaching and learning process, particularly in nontechnical study programs. Additionally, the pervasive use of AI tools has been linked to the erosion of students' soft skills, including critical thinking. One of the most prominent AI tools used by students is ChatGPT. Given the educational system's experiences with technological tools, it is acknowledged that these tools have facilitated learning processes and aligned closely with student and societal needs. However, their impact on critical thinking skills has been problematic, often resulting in student complacency and reduced motivation to engage deeply with assignments.

Machine learning systems, such as ChatGPT, can be particularly effective for problems where the rules for generating outcomes are unknown and must be inferred from data. Conversely, rule-based AI approaches manipulate data based on predefined logical propositions, which can be advantageous for problems where the rules are known but their application is cumbersome (Gillani et al., 2023). ChatGPT allows students to pose questions and receive text-based answers, simulating human-like participation in discussions and task completion. The model's reliability stems from its training to recognize patterns and relationships in data without explicit human guidance. However, reliance on AI-generated content can lead to superficial learning, where students memorize information for graduation rather than understanding it for future application. Moreover, ChatGPT's capacity to present preexisting biases or forms of discrimination can discourage students from developing their **own judgments** or statements, leading to biased learning experiences. Well-explained AI responses may appear more credible to students, causing them to neglect their ideas, resulting in reduced critical thinking and increased laziness.

Pickell and Doak (2023) argue that rather than banning AI tools like ChatGPT, educators should guide students in using them beneficially. This involves leveraging AI to enhance critical thinking by analyzing real-life implications, ethical usage (Huang & Qiao, 2024), and improving assignments without taking AI-generated information at face value. Educators must provide well-structured guidelines to help students achieve educational goals through AI use. AI education aims to develop learners' mindsets and skills concerning AI, facilitating its understanding and application (Huang & Qiao, 2024). Practical training and manuals from technology experts are essential to prevent the decline of critical thinking skills among students. Such guidelines will help students grasp AI principles, experience AI's achievements, and implement AI applications effectively (Xiaodong & Chengche, 2022). By understanding AI's influence, educators can adapt their curricula and teaching methods to remain relevant in an AI-driven future (Vashista et al., 2023). Properly informed students and instructors can use ChatGPT to select appropriate information, adapt it to given instructions, provide reasonable arguments, and define limitations, thus enhancing critical thinking rather than diminishing it. Fuoay-Reid and Caneloki (2024) emphasize that AI usage in education enables the creation of complex and engaging simulations, providing students with immersive and interactive learning experiences. Interactive activities, such as writing responses to case scenarios and critically evaluating AI-generated outputs, promote critical thinking and enhance engagement and communication skills.

Another significant advantage of AI is its ability to aid in comprehending complex concepts (Vajjhala et al., 2021). When students use AI tools to explore study content and answer high-level cognitive questions, they provide rationales for their responses, deepening their understanding. It is crucial to teach students that AI is a tool to supplement, not replace, the in-depth study required for mastering essential concepts. Faculty members can also use AI to summarize class content and create accessible materials, promoting equitable access to education. Pavlenko and Syanko (2024) note that the frequency of ChatGPT usage varies across disciplines, with higher usage among Information Technology (IT), Business, and Engineering students. These students rely on ChatGPT for information retrieval, brainstorming ideas, and improving grammar and punctuation. Ramírez and Esparrell (2024) highlight that AI tools can personalize learning by identifying student needs and tracking their progress, thereby developing problem-solving skills rather than merely generating information. Holmes and Tuomi (2022) believe that AI tools, combined with other technologies, can help create adaptive learning experiences tailored to individual student needs. This interaction enables students to identify and select appropriate information, thereby enhancing their learning experience. Thus, impact of AI on education is significant and will continue to grow (Alshahrani et al., 2024). Clear objectives and specific usage guidelines are essential to ensure that AI facilitates the development of problem-solving skills and critical thinking in students.

AI has become an integral part of modern education, influencing teaching methodologies and learning outcomes. AI tools, such as intelligent tutoring systems, adaptive learning platforms, and automated feedback systems, have been credited with enhancing personalized learning experiences and improving academic performance. Studies have demonstrated that AI can provide customized instruction tailored to individual learning needs, allowing students to progress at their own pace and receive immediate feedback on their performance (Holmes et al., 2019). The development of critical thinking skills is crucial for students to navigate the complexities of the modern world. Several researchers have explored the relationship between AI-assisted learning and critical thinking development. AI-supported learning environments could promote critical thinking by engaging students in problem-solving activities and providing them with opportunities to reflect on their learning processes (Cope et al., 2021). However, there are concerns that AI tools might inadvertently hinder the development of critical thinking. Selwyn (2019) argues that the convenience and efficiency of AI systems might lead to **passive** learning, where students rely **heavily** on AI for solutions rather than actively engaging in critical analysis. This perspective is supported by empirical studies, such as that of Ouyang et al. (2022), which suggest that while AI tools can enhance learning efficiency, they may also reduce opportunities for deep **cognitive engagement.**

The extent to which students benefit from AI-assisted learning may depend on their prior exposure to AI tools (Miller, 2023). Prior exposure can familiarize students with the functionalities and potentials of AI, enabling them to use these tools more effectively in their learning processes. Students with prior experience using AI tools are more adept at integrating these technologies into their learning strategies, resulting in better academic performance and skill development (Darvishi et al., 2024). Furthermore, prior exposure to AI can build a foundational understanding of how AI operates, encouraging students to engage more critically with AI-generated content. Students who had previous experience with AI tools demonstrated higher levels of critical thinking and problemsolving skills in AI-supported learning environments compared to those without such experience (Allen and Jevons, 2023; Che, Strang, & Vajjhala, 2021). Educational background plays a significant role in shaping students' readiness to utilize AI tools effectively (Ma & Lei, 2024). Students who are introduced to AI concepts and tools before entering university are likely to develop a more profound understanding of AI's capabilities and limitations (Borger et al., 2023). This early exposure can equip them with the skills needed to critically evaluate AI-generated information and apply it meaningfully in their academic pursuits. Drawing from the existing literature, it is evident that prior exposure to AI tools can influence the development of critical thinking skills. Students who are familiar with AI technologies before entering university are better positioned to leverage these tools for cognitive development. This leads to the formulation of the following hypothesis:

Hypothesis One: Students with prior exposure to AI tools (through school courses, online courses, or self-learning) before university show a more significant improvement in critical thinking skills than those without prior exposure.

The frequency of AI tool usage varies among students, ranging from daily interactions to occasional use (Almaiah et al., 2022). This frequency can impact the effectiveness and perceived benefits of these tools. Research indicates that regular interaction with AI tools can lead to better academic outcomes by continuously reinforcing learning and adapting to students' evolving needs (Srinivasa et al., 2022). Conversely, sporadic use may limit the potential benefits that AI tools offer, as students may not fully leverage the adaptive and personalized features of these technologies. Academic performance is a critical measure of the effectiveness of educational interventions, including AI tools (Owan et al., 2023). Studies have shown that consistent use of AI tools can lead to significant improvements in academic performance. The adaptability of AI tools ensures that students receive targeted instruction that addresses their individual learning gaps. AI-powered platforms could dynamically adjust the difficulty of tasks based on students' performance, thereby promoting a more effective learning environment (Holmes et al., 2019). This adaptability is particularly beneficial for students who engage with these tools regularly, as it ensures that their learning experiences are always aligned with their current proficiency levels.

Assignment efficiency refers to the ability of students to complete their assignments accurately and within a reasonable timeframe. The use of AI tools has been linked to enhanced assignment efficiency due to features such as automated feedback, time management aids, and resource recommendations (Selwyn, 2019). Regular use of these tools allows students to streamline their workflow, reduce the time spent on repetitive tasks, and focus more on critical thinking and problem-solving activities. This immediate feedback loop not only enhances learning but also improves the efficiency with which students complete their assignments. Students' perceptions of the effectiveness of AI tools are crucial in determining their willingness to use these technologies consistently (Albayati, 2024; Bernabei et al., 2023). Positive perceptions are often linked to the perceived improvements in academic performance and assignment efficiency. The existing literature suggests a strong relationship between the frequency of AI tool usage and various educational outcomes, including academic performance and assignment efficiency. Students who engage with AI tools regularly tend to perform better academically and complete assignments more efficiently (Chen et al., 2023). This leads to the formulation of the following hypothesis:

Hypothesis Two: There is a positive correlation between the frequency of AI tool usage (daily, weekly, monthly) and students' perceptions of academic performance and assignment efficiency.

Some researchers argue that AI tools can enhance problem-solving skills by providing students with challenging tasks and immediate feedback (Pansakla, 2023; Winkler et al., 2021). However, others caution that excessive reliance on AI for assignments may undermine the development of these skills (Al-Zahrani, 2024; Vajjhala & Strang, 2017). This concern is based on the observation that AI tools often provide readily available solutions, which can lead students to depend on these tools rather than engage in the critical thinking necessary to solve complex problems independently (Selwyn, 2019). The dependency on AI tools for completing assignments can have significant implications for students' cognitive development. While AI tools can increase efficiency and accuracy in completing tasks, they may also reduce the cognitive effort required from students (Almaiah et al., 2022). This reduction in cognitive engagement can result in a superficial understanding of the material and hinder the development of deeper problem-solving skills. Furthermore, students who rely heavily on AI tools may become passive learners, as they may not actively seek out solutions or develop the perseverance needed to tackle challenging problems (Bhise et al., 2022). This passive learning behavior can be detrimental in the long term, as it may impair students' ability to approach new and complex problems without the aid of AI. Drawing from the existing literature, it is evident that the relationship between AI tool usage and problem-solving skills is complex. While AI tools offer significant benefits, excessive reliance on them for assignments may negatively impact students' ability to solve complex problems independently. This leads to the formulation of the following hypothesis:

Hypothesis Three: Reliance on AI tools for assignments negatively impacts students' problem-solving skills, reducing their ability to solve complex problems independently

METHODOLOGY

This study employed a quantitative research design to investigate the influence of AI tools on students' critical thinking skills, academic performance, and problem-solving abilities at a selected non-public university in Albania. The research framework utilized a survey-based approach, gathering data from university students to assess their perceptions and experiences with AI-assisted learning. The study aimed to test three specific hypotheses through statistical analysis of survey responses. The target population comprised university students in Albania, encompassing various disciplines and academic levels, including both undergraduate and graduate programs. The sample was designed to ensure diversity by including students with varying degrees of exposure to AI tools. A sample size of 53 students was selected to balance feasibility and statistical power, enabling rigorous analysis of inter-variable relationships. The study employed a stratified random sampling technique, stratifying the population based on major/field of study, academic year, and prior exposure to AI tools. Random sampling within each stratum ensured a representative sample, facilitating robust comparisons across different student groups.

Data was collected via a structured questionnaire distributed through Google Forms. The survey comprised three sections, demographic information, previous exposure to AI tools, and AI tools usage and impact. Demographic data included the data on age group, major/field of study, and year of study. The questions on previous exposure to AI tools included gathered information on prior exposure to AI tools before university and the frequency of AI tool usage for academic purposes. The questions on AI Tools Usage and Impact addressed the purposes of AI tool usage, its impact on academic performance, critical thinking skills, problem-solving abilities, and overall perceptions of AI tools in education. The independent variables in this study were the prior exposure to AI tools (binary: yes/ no) and frequency of AI tool usage (daily, weekly, monthly). The dependent variables included the improvement in critical thinking skills, perception of academic performance and assignment efficiency, reduction in problem-solving skills, and belief in AI tools aiding understanding of complex concepts.

The study compiled to ethical standards for research involving human subjects and informed consent was obtained from all participants, ensuring confidentiality and anonymity. Participants were informed about the purpose of the study, the voluntary nature of participation, and the measures taken to protect their data. The study acknowledges potential limitations, including the sample size, self-reported nature of the survey data, and the specific context of university students in Albania, which may affect the generalizability of the findings as data was collected from one single non-public university in Albania.

RESULTS AND DISCUSSION

The study surveyed a diverse group of students from various educational backgrounds to understand their experiences and perceptions of AI-assisted learning. The demographic data collected provides valuable insights into the respondents' profiles, which is crucial for contextualizing the findings. As shown in Table 1, most respondents fall within the 18-22 age group, accounting for 49 of the 53 participants. This predominance is expected given that the survey targeted were university students. Smaller numbers were observed in the 23-27 age group (2 respondents) and 28-32 age group (1 respondent), with one respondent in the 33 and above category. This age distribution highlights that the insights primarily reflect the experiences of younger students who are more likely to be engaged with current educational technologies.

As shown in Table 2, the respondents' fields of study varied, with Software Engineering being the most common major, represented by 20 students. Computer Science followed with 14 students, and Business was the third most common with 7 students. Other fields such as Architecture, Business Informatics, Interior Design, Graphic Design, and Social Sciences were less represented. This distribution indicates a significant interest in technical and business-related fields among the respondents, which may influence their familiarity and comfort with AI tools. Most participants were first-year students, comprising 40 out of the 53 respondents. This is significant as first-year students might be experiencing AI tools in an academic setting for the first time. The remaining students were in their second year (5 students), third year (7 students), or were graduate students (1 student). This year-of-study distribution suggests that most insights come from students who are relatively new to university-level education and its associated technological tools.

When asked about their previous exposure to AI tools before university, responses varied. As shown in Table 3, a significant number of students (25) had explored AI through personal interest and self-learning. Sixteen students reported no prior exposure to AI tools, while nine students had used AI tools through school courses and three through online courses. This variation in prior exposure is essential as it can affect how students perceive and utilize AI tools in their current academic activities.

These demographic insights provide a foundation for understanding the context in which students interact with AI tools. The predominance of younger, first-year students from technical and business fields suggests a high level of adaptability and potential enthusiasm for integrating AI into their learning processes. However, the varying levels of previous exposure to AI indicate that while some students may be adept at leveraging these tools, others may need additional support and training to use them effectively. This background sets the stage for analyzing the impact of AI-assisted learning on critical thinking and problem-solving skills among university students.

The interpretation as shown in Table 4 shows that students with prior exposure to AI tools have higher mean problem-solving skills score 3.216 compared to those with no prior exposure 2.688. The t-statistic for this comparison is -1.277, and the p-value is 0.208, which is greater than the 0.05 significance level. The p-value of 0.208 indicates that the difference in problem-solving skills between the two groups is not statistically significant. Mann-Whitney U test and Cohen's d were also calculated.

Mann-Whitney U test is suitable for the comparison of differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed (Kishore & Jaswal, 2022). Cohen's d is a measure of effect size that can be used to indicate the standardized difference between two means helping to understand the magnitude of the difference, even if the p-value is not significant (Ivarsson et al., 2013).

The p-value of 0.172 is greater than 0.05, indicating that there is no statistically significant difference in problem-solving skills between students with and without prior exposure to AI tools. The effect size is 0.390, which indicates a small to medium effect size. The negative value suggests that students with no prior exposure to AI tools have slightly lower problem-solving skills compared to those with prior exposure, although this difference is not statistically significant. The results of the Mann-Whitney U test as shown in Table-5 support the findings from the two-sample t-test, indicating that there is no significant difference in problem-solving skills between students with and without prior exposure to AI tools. Cohen's d provides a measure of the effect size, suggesting that the difference, while small to medium in magnitude, is not statistically significant (Ivarsson et al., 2013). Hence, the failure to reject the null hypothesis and conclusion that there is no significant evidence to suggest that students with prior exposure to AI tools show a more significant improvement in critical thinking skills compared to those without prior exposure.

Based on the analysis of the provided data, we aimed to test the hypothesis that there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2). We began by preparing the data and mapping the frequency of AI tool usage to numeric values: daily (3), weekly (2), and monthly (1). The relevant columns were extracted, and rows with missing values were dropped to ensure the accuracy of the analysis. The correlation analysis was performed, and the results are summarized in Table 6. The correlation matrix indicated a strong positive relationship between AI tool usage frequency and students' perceptions of academic performance (correlation coefficient = 0.741), as well as assignment efficiency (correlation coefficient = 0.720).

The hypothesis testing results are presented in Table 7.

The p-values for both correlations were extremely low (much less than 0.05), indicating that the correlations are statistically significant. Given the positive Pearson's correlation coefficients (0.741 and 0.720) and the very low p-values, we reject the null hypothesis. This confirms that there is significant evidence to support the alternative hypothesis: there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2).

The linear regression plots illustrate the relationships between AI tool usage frequency and two variables: perceptions of academic performance and assignment efficiency. Figure 1 shows the regression line that fits the data points, indicating a positive linear relationship. The black line represents the predicted values based on the linear regression model, and it aligns well with the data points, suggesting that as the frequency of AI tool usage increases, students' perceptions of academic performance also tend to improve.

Figure 2 also demonstrates a similar positive linear relationship. The regression line shows that increased frequency of AI tool usage is associated with greater assignment efficiency. These linear regression plots visually reinforce the findings from the correlation analysis and hypothesis testing, supporting the hypothesis that there is a positive correlation between the frequency of AI tool usage and students' perceptions of academic performance and assignment efficiency (H2).

The analysis of the data also revealed several key findings regarding the impact of reliance on AI tools for assignments on students' problem-solving skills. The descriptive statistics as shown in Table 8 demonstrate that the mean reliance on AI tools for assignments was 2.17, with a standard deviation of 1.25. In comparison, the mean score for problem-solving skills was 3.06, with a standard deviation of 1.39. These statistics indicate a moderate level of reliance on AI tools and a slightly above-average self-assessment of problem-solving abilities among students. The Pearson correlation analysis revealed a correlation coefficient of -0.712 between reliance on AI tools and problem-solving skills, with a p-value of less than 0.000000001. This indicates a statistically significant negative relationship, suggesting that as students rely more on AI tools for their assignments, their problem-solving skills tend to **decrease**.

Further examination through linear regression analysis showed that the model explained **50.7% of the variance** in problem-solving skills, with an R-squared value of 0.507. The regression coefficient for reliance on AI tools was -0.7918, with a p-value of less than 0.001. This coefficient indicates that for each unit increase in reliance on AI tools, there is an associated decrease of approximately **0.79**18 units in **problem-solving skills**. The significant negative coefficient supports the hypothesis that increased reliance on AI tools negatively impacts problem-solving skills. The scatter plot shown in Figure 3 shows the correlation between reliance on AI tools for assignments and problem-solving skills. The scatter plot shows individual data points, and the black regression line indicates the negative correlation between the two variables. As reliance on AI tools increases, problem-solving skills tend to decrease, supporting the hypothesis (H3). Hypothesis testing using a t-test compared the levels of problem-solving skills among different levels of reliance on AI tools. The t-statistic was -2.618, with a p-value of 0.011, which is below the conventional threshold of 0.05. This result allows us to reject the null hypothesis and accept the alternative hypothesis (H3), confirming that reliance on AI tools for assignments significantly negatively impacts students' problem-solving abilities. The significant negative correlation and regression results underscore the importance of addressing the balance between using AI tools for efficiency and maintaining the development of independent problem-solving capabilities. These insights are critical for educators and policymakers aiming to integrate AI tools into educational practices without compromising essential cognitive skills.

Impact: Independently, AI integration worsens long-term skill development.

Hamsa **Bastani 24**, 8/07/2024, Associate Professor of Operations, Information and Decisions and Associate Professor of Statistics and Data Science at Wharton, Without Guardrails, Generative AI Can Harm Education, DOA: 2/01/2025, https://knowledge.wharton.upenn.edu/article/without-guardrails-generative-ai-can-harm-education/)// JZ

During the AI-assisted practice session, the GPT Base group performed 48% better than the control group. But when AI assistance was taken away from the Base group and they were given an exam on the material, they performed 17% worse than the control group.

The GPT Tutor group performed an astonishing 127% better in the AI-assisted practice session, yet scored about the same on the exam as the control group.

According to the paper, the results suggest that the Base group depended on the software to solve the problems and didn't learn the underlying mathematical concepts deeply enough to do well on the exam. In contrast, the performance by the Tutor group shows that these harms are mitigated when AI is deployed with teacher-guided conditions and limits.

"We're really worried that **if humans don't learn, if they start using these tools as a crutch and rely on it, then they won't actually build those fundamental skills to be able to use these tools effectively in the future**," said Hamsa Bastani, a Wharton professor of operations, information and decisions who co-authored the paper. "As educators, we worry about that."

Bastani spoke to Wharton Business Daily about the paper, "Generative AI Can Harm Learning." (Listen to the podcast.) The co-authors are Osbert Bastani, computer and information science professor with Penn Engineering; Alp Sungu, operations, information and decisions professor at Wharton; Haosen Ge, data scientist at the Wharton AI and Analytics Initiative; Özge Kabakcı, math teacher at Budapest British International School; and independent researcher Rei Mariman.

The Generative AI Paradox and How It Impacts Education

The paper's finding is consistent with similar studies, and Hamsa Bastani said **it reflects the paradox of generative AI: It can make tasks easier for people while simultaneously deteriorating their abilities to learn the skills required to solve those tasks.**

"We've been really interested in how humans interact with algorithms for a while. But I think it gets really interesting with large language models just because of the extent of their reach and the number of people who are using them with such a diversity of tasks," she said. "One thing that really drew us to this conversation was a lot of teachers are struggling with students copying answers from homework, and they were worried that this would negatively impact their skill-building and their fundamental understanding of concepts. That's why we decided to dig into this."

The study also found that **students who used AI assistance were overly optimistic about their learning capabilities**, even the high-achieving students. Teachers, on the other hand, seem to be overly concerned and tend to dismiss the advantages of AI. Bastani thinks that's because **students and teachers aren't yet trained on how to use AI effectively to augment traditional teaching methods.**

Bastani and her colleagues said the study is a "cautionary tale" about deploying AI in educational settings, and they remind everyone that the software still has significant limitations. ChatGPT, for example, is known to spit out false information known as hallucinations, which can also potentially harm student learning.

Just like in a workplace setting, **generative AI in the classroom still requires a lot of human finesse and fact-checking to make it valuable**, Bastani said.

All in all, my partner and I negate the resolution.