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Enhancing Student Engagement in online through Artificial Intel-ligence

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Enhancing Student Engagement in online through Artificial Intel-ligence

Abstract:

In the constantly evolving educational landscape, the integration of Artificial Intelligence (AI) has emerged as a transformative force, particularly in the realm of online courses. This article explores the use of AI-based solutions to enhance student engagement in virtual learning environments. By leveraging intelligent algorithms, machine learning, and data analytics, educators can personalize the learning experience, tailor content delivery, and provide timely feedback tailored to individual student needs. The study examines various AI-based strategies designed to foster student engagement, including predictive analytics to identify at-risk students, chatbots for instant support, and adaptive learning platforms for personalized program delivery. Additionally, the article delves into the ethical considerations surrounding the implementation of AI in education, addressing concerns related to privacy, bias, and human-machine interface. Through a comprehensive review of existing literature and case studies, this research aims to provide insights into the effectiveness of AI in promoting active student participation, collaboration, and motivation in online courses. Furthermore, it explores potential challenges and future directions for AI integration in education, emphasizing the importance of a balanced and ethical approach to fully harnessing the technology's potential in developing a more engaging and inclusive learning environment.

Keywords: Artificial Intelligence (IA), Student Engagement, Online Learning, Personalized Learning, Machine Learning, Data Analytics.
JEL code: O10
Paper type: Theoretical Research

Résumé :

Dans un paysage éducatif en constante évolution, l'intégration de l'intelligence artificielle (IA) s'impose comme une force transformatrice, en particulier dans le domaine des cours en ligne. Cet article explore l'utilisation de solutions basées sur l'IA pour améliorer l'engagement des étudiants dans les environnements d'apprentissage virtuels. En exploitant des algorithmes intelligents, l'apprentissage automatique et l'analyse des données, les éducateurs peuvent personnaliser l'expérience d'apprentissage, adapter la diffusion des contenus et fournir des retours d'information ciblés, répondant aux besoins individuels des étudiants. L'étude examine diverses stratégies basées sur l'IA visant à favoriser l'engagement des étudiants, notamment l'analyse prédictive pour identifier les étudiants à risque, les chatbots pour un soutien instantané et les plateformes d'apprentissage adaptatif pour une offre de programmes personnalisée. En outre, l'article aborde les considérations éthiques liées à l'utilisation de l'IA dans l'éducation, en traitant des préoccupations relatives à la vie privée, aux biais et à l'interface humain-machine. À travers une revue complète de la littérature existante et des études de cas, cette recherche vise à fournir des perspectives sur l'efficacité de l'IA dans la promotion de la participation active des étudiants, de la collaboration et de la motivation dans les cours en ligne. Enfin, elle explore les défis potentiels et les orientations futures de l'intégration de l'IA dans l'éducation, en soulignant l'importance d'une approche équilibrée et éthique pour exploiter pleinement le potentiel de cette technologie dans le développement d'un environnement d'apprentissage plus engageant et inclusif.

Mots-clés : Intelligence artificielle (IA), Engagement des étudiants, Apprentissage en ligne, Apprentissage personnalisé, Apprentissage automatique, Analyse des données.
Classification JEL : O10
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1. Introduction

Artificial Intelligence (AI) has evolved from a conceptual curiosity to a transformative force in modern technology, influencing industries, economies, and societies worldwide. The historical trajectory of AI is marked by distinct phases of development, from early theoretical foundations to contemporary advancements in machine learning, neural networks, and deep learning. Understanding the historical evolution of AI provides crucial insights into its current capabilities, challenges, and future directions.

The origins of AI can be traced back to philosophical inquiries into human reasoning and mechanical computation, with early influences from figures such as Aristotle and Leibniz. However, the formal establishment of AI as a field of study emerged in the mid-20th century with Alan Turing's seminal work on computation and intelligence, culminating in the Turing Test. The 1956 Dartmouth Conference, often regarded as the birth of AI, brought together pioneers such as John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon, who laid the groundwork for AI research.

The subsequent decades saw alternating periods of optimism and stagnation, known as AI "winters," due to the challenges in computational power, algorithmic efficiency, and funding. The early symbolic AI approaches, reliant on rule-based systems, encountered significant limitations in handling complex real-world problems. However, the resurgence of AI in the 1980s and 1990s, fueled by expert systems and improved computing capabilities, reignited interest in the field.

The dawn of the 21st century ushered in a new era of AI, driven by breakthroughs in machine learning, big data, and high-performance computing. The advent of deep learning, spearheaded by innovations in artificial neural networks, led to remarkable achievements in image recognition, natural language processing, and autonomous systems. Today, AI continues to evolve, shaping industries such as healthcare, finance, and autonomous technologies while raising ethical considerations regarding bias, transparency, and societal impact.

This literature review aims to explore the historical development of AI, examining key milestones, theoretical advancements, and technological breakthroughs that have defined its evolution. By analyzing historical perspectives and contemporary trends, this review will provide a comprehensive understanding of AI's trajectory and its implications for future research and application.

2. Literature review

2.1. History of Artificial Intelligence

Artificial intelligence (AI) is a relatively youthful field, with a history of around sixty years, encompassing various disciplines such as mathematical logic, statistics, probability, computational neurobiology, and computer science. Its primary goal is to replicate human cognitive abilities. Emerging in the aftermath of World War II, AI advancements have closely paralleled those in computer science, enabling computers to tackle increasingly intricate tasks previously exclusive to humans.

Despite significant progress, AI's current state falls short of true human intelligence, prompting debates among experts about the appropriateness of the terminology. Achievements in AI, classified as "weak" or "moderate," excel within specific domains but lack the versatility and autonomous problem-solving capabilities of a hypothetical "strong" AI, still confined to the realm of science fiction. To reach this pinnacle, fundamental research advancements, rather than mere performance enhancements, are imperative to enable AI to comprehend the world as a whole.

1940-1960: Birth of AI in the Wake of Cybernetics

The era spanning from 1940 to 1960 was marked by significant technological advancements, spurred by the urgency of World War II, and a growing interest in bridging the gap between machine operations and biological processes. Norbert Wiener, a pioneer in cybernetics, envisioned a comprehensive theory of control and communication, aiming to unify mathematical principles, electronics, and automation in both biological organisms and machines. This period also saw the development of the first mathematical and computer model of the biological neuron, known as the formal neuron, pioneered by Warren McCulloch and Walter Pitts in 1943.

In the early 1950s, John Von Neumann and Alan Turing laid the groundwork for modern computing technology. They shifted from the decimal logic used in 19th-century calculators to binary logic based on Boolean algebra, which formed the basis of contemporary computers. Turing's seminal 1950 paper, "Computing Machinery and Intelligence," posed the fundamental question of whether machines could exhibit intelligence, introducing the concept of the "imitation game" to explore the boundary between human and machine intelligence.

The term "artificial intelligence" (AI) is often credited to John McCarthy of MIT, who defined it as the development of computer programs capable of performing tasks that typically require high-level cognitive processes. The Dartmouth Conference of 1956, attended by McCarthy and others, is considered a pivotal moment in the inception of AI as a field, despite being initially conceived as a workshop with only a handful of consistent participants.

Although early optimism about AI's potential, exemplified by Herbert Simon's prediction of computers beating humans at chess within a decade, waned in the early 1960s, foundational concepts like search trees for problem-solving began to emerge. The field experienced its first "winter" as enthusiasm dwindled, but Simon's prophecy eventually came to fruition three decades later.

1980-1990: Expert Systems

In 1968, Stanley Kubrick's film "2001: A Space Odyssey" brought the ethical dilemmas surrounding AI to the forefront through the character of HAL 9000, a sophisticated computer. The film raised questions about whether highly advanced AI systems like HAL would be a boon or a threat to humanity, a theme also explored by science fiction writer Philip K. Dick, who pondered the possibility of machines experiencing emotions.

The late 1970s saw a resurgence of interest in AI with the introduction of the first microprocessors, marking the beginning of the golden age of expert systems.

The groundwork for expert systems had been laid earlier, with projects like DENDRAL at MIT in 1965 and MYCIN at Stanford University in 1972. These systems utilized an "inference engine" to mimic human reasoning logically, providing expert-level responses based on input data.

Despite the initial promises of expert systems, enthusiasm dwindled by the late 1980s and early 1990s. Programming such systems required substantial effort, and beyond a certain complexity threshold, their reasoning process became opaque. Additionally, alternative, simpler methods began to yield comparable results more efficiently. The term "artificial intelligence" even became somewhat taboo during this period, with more discreet terms like "advanced computing" entering academic discourse.

The victory of IBM's Deep Blue over Garry Kasparov in a chess match in May 1997 fulfilled Herbert Simon's prophecy from 1957, but it didn't lead to sustained funding and development for this form of AI. Deep Blue's success relied on a brute force algorithm, evaluating all possible moves, and its victory, while symbolic, was limited to the realm of chess rules, far from the complexity of modeling the real world.

Since 2010: A New Surge from Massive Data and Enhanced Computing Power

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IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

Two factors explain the renewed momentum of the field around 2010.
The recent advancements in artificial intelligence have been propelled by several key factors. Firstly, the availability of vast amounts of data has revolutionized the field. Previously, collecting data samples for tasks like image classification required significant effort. However, with the advent of search engines like Google, access to massive datasets has become effortless, providing the necessary material for training algorithms.
Secondly, the discovery of the computational power of graphics processing units (GPUs) has greatly accelerated the training process for learning algorithms. Before 2010, it could take weeks to process a single dataset. However, GPUs, capable of performing over a trillion operations per second, have drastically reduced processing times at a relatively low cost.
These technological breakthroughs have led to notable successes in the public domain and reinvigorated funding for AI research. For instance, in 2011, IBM's AI Watson defeated champions on the quiz show "Jeopardy!" In 2012, Google X achieved the milestone of recognizing cats in videos using AI. AlphaGo, Google's AI for the game of Go, also made headlines by defeating top human players.
These achievements stem from a paradigm shift in AI approaches, moving from rule-based expert systems to inductive methods like deep learning. Deep learning, championed by researchers like Geoffrey Hinton, Yoshua Bengio, and Yann LeCun, involves allowing computers to discover patterns and rules independently from vast datasets, rather than coding them explicitly.
Deep learning, particularly in areas like speech and image recognition, has shown immense promise. Experiments conducted by Hinton's team and others have demonstrated significant error rate reductions in tasks like speech and image recognition. However, challenges remain, especially in areas like text comprehension, where systems struggle to fully understand context and intentions.
While conversational agents, such as smartphone assistants, have made strides in transcribing instructions, they still face hurdles in fully grasping and analyzing human intentions within context. Despite the progress, there is still much ground to cover in developing AI systems capable of nuanced understanding and comprehension.

2.2. Current State of AI in Education

At present, artificial intelligence (AI) is applied in education through a range of methods, including round-the-clock assistance from chatbots for students and personalized learning algorithms that tailor to the individual needs of each student.
AI-driven tools are further utilized to streamline administrative duties, such as grading assignments and delivering feedback. Moreover, AI is harnessed to sift through extensive data sets, pinpointing patterns and insights crucial for shaping novel educational strategies and policies.
Various instances of successful implementation of AI-powered educational tools and platforms abound. Some of the most prevalent include:

- Duolingo: An app for language learning that employs AI to tailor lessons according to each user's preferences and proficiency level.
- ALEKS: A math learning platform driven by AI, offering adaptive assessments and personalized learning paths.
- Coursera: Utilizes AI to suggest courses to students based on their learning preferences and past engagement.
- QuestionPro: Recently introduced QxBot, a feature facilitating the rapid creation of surveys and assessments.

2.3. Advantages and Disadvantages of Using AI

Although AI integration in education brings significant benefits, it's crucial to acknowledge and tackle its limitations and hurdles. One major challenge is ensuring equitable access to AI-driven tools and platforms for all students, irrespective of their socioeconomic background or geographical location. Moreover, there's apprehension regarding the potential reinforcement of existing biases and discrimination within education by AI.
Additionally, educators express concerns about the possibility of AI tools supplanting human interaction and impacting teaching quality in classrooms. Moving forward, it's imperative to ensure that AI is employed in a manner that supplements rather than substitutes human educators, emphasizing the importance of maintaining a balance between the two.

- ***The potential of artificial intelligence (AI) in education is immense:***

AI-driven tools and technologies, ranging from personalized learning algorithms to virtual and augmented reality, are poised to transform the educational landscape in unprecedented ways.
The integration of AI in education holds immense potential benefits. Notably, it enables personalized learning experiences tailored to individual students. Through AI analysis of performance and preference data, educators can craft customized lesson plans and assessments, catering to each student's unique strengths and weaknesses. Moreover, AI streamlines administrative tasks like grading, allowing educators to devote more attention to other vital aspects of teaching.
In addition to personalization, AI-powered tools and technologies enrich the learning journey in various ways. For instance, virtual and augmented reality foster interactive and immersive learning environments. Chatbots and similar AI tools offer students continuous assistance, enhancing accessibility to support resources round-the-clock. Furthermore, AI facilitates the creation of personalized quizzes and games, promoting engagement with course material in enjoyable and interactive formats.
The prospect of personalized learning stands out as one of AI's most promising contributions to education. By harnessing the capability to analyze performance data and preferences, AI empowers educators to design tailored lesson plans and assessments, ultimately enhancing student experience and motivation, leading to improved academic outcomes.
AI, alongside ChatGPT, has the potential to revolutionize academic research by expediting data processing, uncovering novel discoveries, generating hypotheses, and facilitating literature reviews more efficiently than traditional methods. ChatGPT can aid researchers in writing papers by providing feedback, suggestions, and even generating portions of the text. Moreover, it facilitates natural language processing tasks like text summarization, sentiment analysis, and language translation, enabling the analysis of unstructured data.
Nevertheless, it's essential to emphasize that AI and ChatGPT should complement human intelligence. While these technologies offer valuable assistance, the final decision-making and accountability for outcomes remain with the researchers.

- ***Challenges and Concerns of AI in Education***

While the integration of AI in education presents numerous benefits, it is essential to address ethical considerations that arise. One primary concern is the potential for AI to reinforce existing biases and discrimination within the education system. Additionally, there are apprehensions regarding the impact of AI on students' privacy and data security.
Educators have also raised concerns regarding the chatbot's capacity to generate pertinent responses to assessment and exam questions. Furthermore, the difficulty in attributing these responses to a specific source complicates plagiarism detection efforts.

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Volume 6, Issue 3 (2025), pp. 505-516.

IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

Another significant concern is the possibility of job displacement within the education sector as technology progresses. With the automation of various administrative tasks, there may be a decrease in available positions for educators and support staff.
Ensuring equitable access to AI-powered education for all students poses a notable challenge. As online education and educational resources become increasingly prevalent on the internet, it is crucial to guarantee that students from all socioeconomic backgrounds and geographical locations have equal access to these resources.

2.4. Ethical Considerations in AI-driven Education

As AI becomes increasingly integrated into educational settings, it brings forth ethical concerns that cannot be overlooked. Two major areas of concern are data privacy and algorithmic biases.

Data Privacy:

The use of AI in education involves the collection, storage, and analysis of vast amounts of student data. While this data can be invaluable for tailoring personalized learning experiences, it also raises serious privacy concerns.
Educational institutions and tech companies must ensure that student data is handled with utmost care, adhering to strict data protection regulations such as GDPR or CCPA. Transparency regarding data collection practices, purpose, and usage is essential to build trust among students, parents, and educators. Moreover, robust security measures should be implemented to safeguard against potential data breaches.

Algorithmic Biases:

AI algorithms, including those used in education, are trained on data sets that may contain biases inherent in the data collection process. These biases can result in unfair or discriminatory outcomes, affecting students' learning experiences and opportunities.
It's crucial for developers and educators to be aware of these biases and work towards mitigating them through rigorous testing, validation, and continuous monitoring of AI systems. Implementing fairness-aware algorithms and conducting regular audits can help identify and rectify biased decision-making processes.

Balancing Innovation with Ethics:

While AI offers promising solutions to enhance educational experiences, it's imperative to strike a balance between innovation and ethics. As educators and stakeholders navigate the complexities of AI integration, an ethical framework should guide decision-making processes, ensuring that the use of AI prioritizes student welfare, equity, and inclusivity.
By addressing these ethical considerations head-on, educational institutions can harness the full potential of AI while safeguarding students' rights and promoting a more equitable learning environment.

2.5. Theoretical Framework of Artificial Intelligence

The development of Artificial Intelligence (AI) has been shaped by various theoretical paradigms, each contributing to its conceptual foundation and technological advancements. AI theory draws from multiple disciplines, including cognitive science, mathematics, computer science, and philosophy. Key theoretical frameworks in AI include symbolic reasoning, connectionism, and probabilistic models, each offering a different perspective on how intelligence can be replicated in machines.
Symbolic AI, rooted in formal logic and rule-based systems, dominated early AI research. This approach, pioneered by scholars like Allen Newell and Herbert Simon, relied on explicitly pro-

grammed rules and symbolic representations of knowledge. However, its limitations in handling uncertainty and learning from data led to the rise of connectionist models. Inspired by neuroscience, connectionism, particularly through artificial neural networks, enables AI systems to learn patterns and make predictions without relying on predefined rules. The resurgence of deep learning, a subset of connectionist AI, has further propelled advancements in natural language processing, computer vision, and autonomous systems.

In parallel, probabilistic models and statistical learning have played a crucial role in AI's evolution. Bayesian networks, Markov decision processes, and reinforcement learning integrate uncertainty and decision-making processes into AI, allowing systems to adapt to dynamic environments. These approaches have been instrumental in developing AI applications ranging from predictive analytics to robotics and autonomous agents.

3. Data analysis

The sample is composed of individuals from the faculties of the city of Fes who are perfectly relevant and representative of the subject of the study. Each message contained a link to the appropriate questionnaire (students or teachers). The data collection took place between February 12th and February 20th, 2024. The large number of respondents (60 teachers and 150 students) ensures statistically significant results.

The analysis was conducted jointly by Sphinx. Given our approach, we made a point of not expressing a "biased" judgment on the results of this study. The analysis of the results remains deliberately factual. It is up to each individual to interpret this data according to their own sensitivity and to draw their own conclusions.

- The objectives of this survey are to:
  - Factually measure the usage of generative AI in education,
  - Understand the motivations behind the use of these tools,
  - Grasp the ethical dimensions related to artificial intelligences such as ChatGPT.

Research Hypotheses:

H1: The use of generative AI tools by students is significantly underestimated by teachers.
H2: The use of generative AI in higher education is increasing and will continue to grow in the future.
H3: Students primarily use generative AI to enhance their understanding of academic subjects rather than to generate content directly.
H4: Generative AI is reshaping learning and assessment practices, requiring adaptations in pedagogical approaches.
H5: The more frequently a student uses generative AI, the more they perceive this practice as acceptable in an academic context.
H6: Teachers who are unfamiliar with generative AI tools are more likely to consider their use as plagiarism or cheating.
H7: Both teachers and students perceive the need for increased regulation regarding the use of AI in education.

4. Discussion:

- ***Do teachers overestimate AI usage?***

According to their statements, half of the students (55%) already use a generative AI tool at least occasionally. However, nine out of ten teachers (88%) believe that students resort to these artificial intelligences for their work.

These findings confirm H1, indicating that teachers tend to overestimate the extent to which students rely on AI-generated texts. 80% of teachers believe that their students copy and paste

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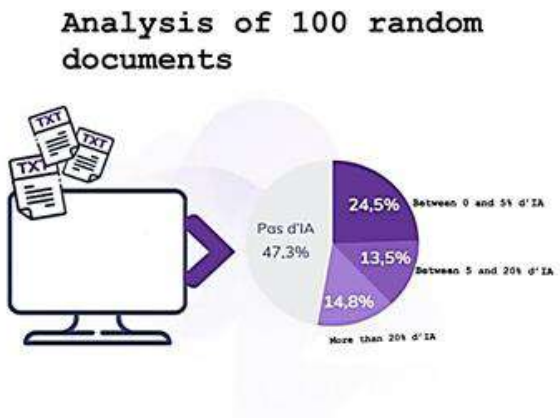
IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

all or part of the AI-generated content directly into their submissions. In reality, only 9% of students admit to doing so.

To authenticate the assertions made by students in this survey, we conducted a random analysis of 100 student documents. The aim was to ascertain the presence of text generated by artificial intelligence within these documents. The findings validate the students' assertions, with 53% of the documents containing AI-generated text, closely aligning with the declaration of 55% of students claiming occasional use of generative AI tools.

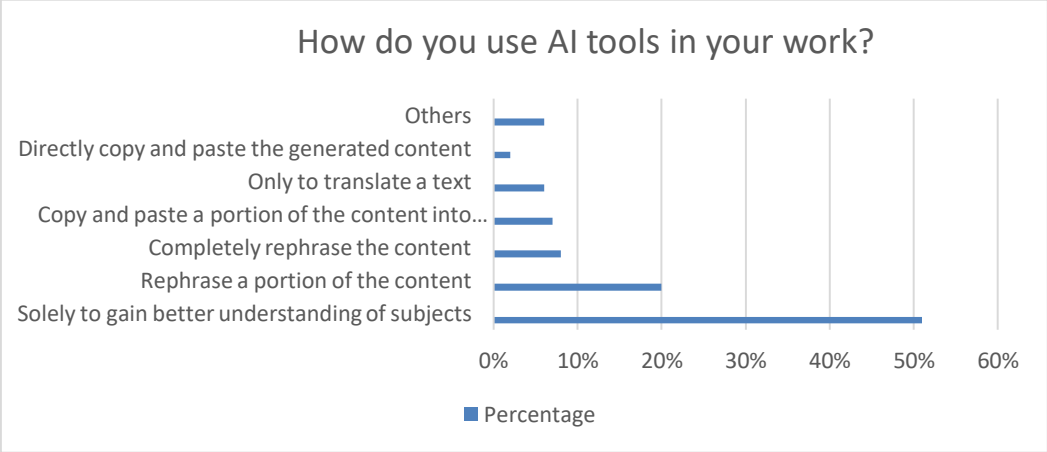
Figure 1: ranking based on AI usage



Source: Own Work

- ***Students rely on AI to... better understand a subject? Yes.***

The primary objective of ChatGPT in serving students is to provide assistance in comprehension. According to research, 51% of students utilize content-generating tools to enhance their understanding of specific subjects.



Source: Own Work

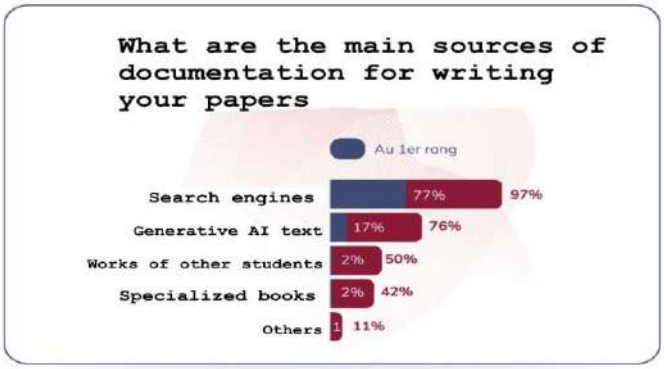
- ***To write for them? Not really...***

Thus, the primary role of AI wouldn't be to be a "pure writer." To date, "only" 2 out of 5 students (43%) declare using AI as such, among whom 28% "take the trouble" to reformulate before integrating the content into their work. AI would rather have the role of a "writing assistant" to improve syntax and rephrase written text. In fact, 75% of students consider this usage acceptable (67% of teachers share the same opinion).

The question now arises: why do students rephrase the content generated by AI? To deceive correctors and detectors or to appropriate knowledge? In any case, they should cite their sources while verifying their accuracy and credibility!

- ***...for their documentary research? No.***

Generative AI tools are not poised to replace search engines. Despite the remarkable advancement of AI technology, 77% of students still rely on search engines as their primary means of accessing information. However, 17% of students view AI as their most significant resource.



Source: ourselves

Surprisingly, teachers and students share similar viewpoints. The use of generative AI doesn't always divide teachers and students. The survey highlights several points of convergence:

- Teachers (76%) and students (65%) agree that using AI constitutes cheating in the context of completing assignments or exams.
- Nearly all (90%) AI-using students affirm that it saves them considerable time, and 80% of teachers understand why this is the case.
- Nearly 66% of teachers and students hold a common stance opposing the prohibition of AI.
- Both cohort's express apprehensions regarding the implications of AI on the future of education, with 72% of students and 81% of teachers stating their concerns.

Reevaluation necessary for positive evolution of learning

The numbers indicate that the use of generative text AI is going to increase. Among students who are not yet using them, 6% believe they will use them in the future, and among those already using them, 19% assert that they will do so increasingly.

Questioning necessary for positive evolution of learning

The figures show that the use of generative text AI is on the rise. Among students who are not yet using them, 6% believe they will use them in the future, and among those already using them, 19% say they will do so increasingly.

However,

➢ **on the students' side:**

- 28% of respondents find it acceptable to utilize AI for composing paragraphs in their assignments.
- They perceive cheating through AI as less severe compared to using content authored by humans.
- Additionally, a portion of respondents, 3%, still do not consider using texts generated by either AI or humans as morally objectionable.

➢ **On the teachers' side:**

- "Nevertheless," a quarter of teachers (25%) find it acceptable for their students to write paragraphs with the help of AI.
- More than half (53%) of the teachers believe it is entirely acceptable for a student to generate a first draft of work with the assistance of AI.
- 2% of teachers still believe that none of the following practices are reprehensible:

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IJAFAME
International Journal of Accounting, Finance, Auditing, Management & Economics

- ✓ Having someone else write an assignment
- ✓ Copying and pasting a text generated by AI
- ✓ Copying and pasting a text written by a human
- ✓ Recopying an assignment from a previous year
- ✓ Having an AI rewrite a text copied from the internet
- ✓ Paraphrasing a text generated by AI
- ✓ Having an AI rewrite a text written by oneself
- ✓ Having a text corrected by a spell checker.

- 2 out of 3teachers (65%) do not use generative AI, including one out of ten teachers (9%) who are not familiar with these tools at all.

Wouldn't it be a crucial step for educators to familiarize themselves with these new tools in order to be able to raise awareness and educate on best practices?

The need for supervision and control

93% of teachers and 79% of students believe that measures should be implemented to regulate the use of generative text AI in education.
The same applies to providing control tools. Indeed, 63% of teachers believe that AI enables students to achieve better grades, and nearly half (47%) of AI-using students claim that they have better grades thanks to its use.

5. Conclusion

As artificial intelligence (AI) continues to reshape the educational landscape, it is crucial to approach its integration with a critical lens, considering both its potential benefits and ethical implications. The findings from this study conducted among students and teachers from the faculties of the city of Fes reveal an increasing use of generative AI tools by students, with significant implications for learning and academic practices.
It is evident that teachers' perceptions of students' AI usage may be overestimated, highlighting the need for deeper understanding and open communication between the two parties. This disparity underscores the importance for educators to familiarize themselves with these new tools to guide students towards responsible and ethical practices.
Shared concerns regarding ethics and fairness in AI usage in education, as well as the need for regulation and supervision, are also highlighted by the findings. By promoting transparency, prioritizing data privacy, and actively addressing algorithmic biases, we can create a more responsible and inclusive AI-driven educational system that truly meets the needs of all students.
In conclusion, this study validates several hypotheses regarding the growing use of generative AI, its role in academic work, and the need for regulation (H1, H2, H3, and H7). It underscores the importance of reassessing pedagogical approaches to constructively integrate these emerging technologies while maintaining academic integrity.

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