



Intelligent Learning: A Comprehensive Study of Integrating Machine Learning Algorithms in the Era of AI to Predict the Success of E-Learning in Education

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Abstract. As the landscape of education undergoes a profound transformation, the intersection of Artificial Intelligence (AI) and e-learning emerges as a focal point of exploration. In this compelling article, we delve into the evolution of e-learning in the era of AI. Our study focuses on the application of powerful machine learning algorithms to predict the success of e-learning in the field of education. By closely examining data and emerging trends, we analyze how these machine learning algorithms can anticipate and enhance the effectiveness of online education. This research provides innovative insights into the impact of AI on education, paving the way for more personalized and efficient approaches to online learning. Through this exploration, we aim to contribute to the ongoing discourse surrounding the transformative potential of intelligent learning systems.

Keywords: E-Learning, Artificial Intelligence (AI), Machine Learning Algorithms, Personalized Learning, Emerging Trends, Data Analysis, Educational Innovation, Success Prediction, AI in Education

1 Introduction

In the ever changing field of education, one cannot overlook the profound impact of technology, particularly the advent of Artificial Intelligence (AI). As education transcends traditional boundaries and embraces digital platforms, the synergy between AI and e-learning emerges as a pivotal area of exploration. In this era of rapid technological advancement, understanding the intersection of AI and e-learning becomes imperative for educators, learners, and policymakers alike [1], [2].

Our article is based on a comprehensive examination of both questionnaire data and literature. It embarks on a journey to unravel the intricate dynamics between AI and e-learning. Through meticulous examination and analysis, we delve into the evolution of e-learning and its symbiotic relationship with AI, shedding light on how machine learning algorithms can revolutionize the effectiveness and efficiency of online education

As we navigate through this compelling discourse, we aim to elucidate the transformative potential of intelligent learning systems in shaping the future of education.

By closely scrutinizing emerging trends and data, we seek to provide innovative insights that pave the way for more personalized, adaptive, and impactful approaches to online learning. Our research endeavors to contribute meaningfully to the ongoing dialogue surrounding the fusion of AI and education, fostering a deeper understanding of how intelligent learning systems can augment the educational experience.

2 Evolution of E-Learning: A Historical Perspective

The evolution of e-learning spans several decades, marked by significant technological advancements and shifts in educational paradigms. Initially, e-learning emerged as a rudimentary form of distance education, leveraging basic electronic communication tools such as email and bulletin boards. In the 1990s, with the proliferation of the internet, e-learning gained momentum, offering learners access to a wealth of educational resources and interactive multimedia content. The early 2000s witnessed the rise of Learning Management Systems (LMS), which streamlined course delivery and administration, fostering the widespread adoption of online learning in academic institutions and corporate settings. As technological capabilities continued to evolve, so did the pedagogical approaches to e-learning, with the integration of multimedia, gamification, and social learning elements. Today, e-learning has become synonymous with flexibility, accessibility, and scalability, catering to diverse learners across the globe [3], [4], [5].



Fig. 1. Growth of E-Learning Users Over Time

This graph illustrates the exponential growth of e-learning users over the past few decades, depicting a clear upward trend in the adoption of online learning platforms. The increasing popularity of e-learning platforms reflects the growing demand for flexible, accessible educational opportunities in today's digital age.

3 Emergence of AI in Education

The emergence of Artificial Intelligence (AI) in education represents a paradigm shift in the way we perceive teaching and learning. AI technologies, including machine learning, natural language processing, and predictive analytics, have paved the way for personalized and adaptive learning experiences. One of the early manifestations of AI in education was intelligent tutoring systems, which provided individualized instruction based on the learner's performance and preferences. Over time, AI applications expanded to encompass automated grading, virtual mentors, and intelligent content recommendation systems. The rise of Massive Open Online Courses (MOOCs) further accelerated the integration of AI, enabling the analysis of vast amounts of learner data to optimize course delivery and engagement. AI-powered chatbots and virtual assistants have also become ubiquitous, offering learners instant support and guidance throughout their educational journey. AI has a significant impact on education and has the potential to revolutionize teaching strategies, student results, and the very nature of human-machine interaction in learning environments as it continues to advance. [6], [7], [8].

4 The Intersection of E-Learning and AI: Opportunities and Challenges

4.1 Opportunities of the Intersection of AI and E-Learning

There are numerous chances to improve educational experiences at the nexus of AI and e-learning. Algorithms driven by artificial intelligence (AI) have the ability to maximize educational outcomes, customize learning experiences, and modify information delivery to suit individual learning preferences. E-learning platforms can predict areas of difficulty, spot patterns in learner behavior, and customize interventions by utilizing data analytics and machine learning. [9], [10].

4.2 Challenges at the Intersection of E-Learning and AI

However, alongside these opportunities, the convergence of AI and e-learning also poses significant challenges. Issues such as data privacy concerns, algorithmic bias, and the displacement of traditional teaching roles need to be addressed. Ensuring the ethical use of AI in e-learning requires transparent algorithms, robust data protection measures, and ongoing dialogue between stakeholders. Moreover, integrating AI technologies into e-learning necessitates investments in infrastructure, teacher training, and digital literacy initiatives. Striking a balance between innovation and responsibility is crucial as we navigate the intersection of AI and e-learning, harnessing the potential of AI to enhance educational experiences while mitigating its risks [11], [12].

5 Application of Machine Learning Algorithms in Predicting E-Learning Success

5.1 Predictive Analytics: Unveiling E-Learning Success with Machine Learning Algorithms

The application of machine learning algorithms in predicting e-learning success offers a transformative approach to education. By harnessing the power of predictive analytics, educators can identify patterns and correlations within vast datasets, enabling them to anticipate learners' progress and tailor interventions accordingly. Machine learning algorithms, ranging from decision trees to neural networks, analyze various factors such as engagement metrics, assessment performance, and demographic information to forecast individual learner outcomes. This proactive approach not only enhances instructional design but also empowers educators to provide targeted support, ultimately improving learning outcomes and retention rates [13], [14].

5.2 Enhancing Learning Pathways: Personalized Education through Machine Learning

Machine learning algorithms play a pivotal role in creating personalized learning pathways, catering to the diverse needs and preferences of learners. By leveraging data-driven insights, e-learning platforms can dynamically adjust content delivery, pacing, and difficulty levels to match each learner's proficiency and learning style. Adaptive learning systems, powered by machine learning, continuously monitor learners' interactions and performance, offering customized recommendations and adaptive feedback in real time. This adaptive approach not only fosters engagement and motivation but also maximizes learning efficacy by ensuring that each learner receives tailored support and resources throughout their educational journey [15], [16], [17].

6 Analyzing Data and Emerging Trends in E-Learning

Analyzing data and identifying emerging trends in e-learning are essential steps in driving innovation and improving educational outcomes. With the proliferation of digital learning platforms and the widespread adoption of online education, vast amounts of data are generated daily, offering valuable insights into learner behaviors, preferences, and performance. Data analytics techniques, such as descriptive, diagnostic, predictive, and prescriptive analytics, enable educators and policymakers to gain a comprehensive understanding of e-learning dynamics. By examining trends in learner engagement, course completion rates, assessment scores, and other key metrics, stakeholders can identify areas of improvement and implement evidence-based interventions to enhance the effectiveness of e-learning initiatives. Moreover, the analysis of emerging trends,

such as the integration of immersive technologies, gamification elements, and micro-learning strategies, provides valuable foresight into the future direction of e-learning. By staying abreast of these trends and leveraging data-driven insights, educators can adapt their instructional practices and curriculum design to meet the evolving needs of learners in the digital age, ultimately fostering a more engaging, inclusive, and effective e-learning environment [18].

7 Enhancing Effectiveness Through Intelligent Learning Systems

7.1 Adaptive Learning: Tailoring Education with Intelligent Systems

Intelligent learning systems have revolutionized education by enabling adaptive learning experiences tailored to individual learners' needs. These systems utilize sophisticated algorithms to analyze learners' interactions, preferences, and performance data, allowing for dynamic adjustments to content delivery, pacing, and difficulty levels. Through personalized learning pathways, adaptive systems empower learners to progress at their own pace, receive targeted support, and engage with content that matches their proficiency and learning style. By harnessing the power of intelligent learning systems, educators can enhance the effectiveness of online education by providing tailored, engaging learning experiences that maximize student success [19], [20].

7.2 Predictive Analytics: Anticipating Learning Needs with Precision

Another key aspect of enhancing effectiveness through intelligent learning systems lies in the application of predictive analytics. By leveraging machine learning algorithms, educators can anticipate learners' needs and proactively intervene to address potential challenges before they arise. Predictive analytics analyze various data points, such as engagement patterns, assessment performance, and demographic information, to forecast individual learner outcomes and identify at-risk students who may require additional support. This proactive approach not only improves retention rates but also allows educators to allocate resources more efficiently, ultimately enhancing the overall effectiveness of e-learning initiatives [13].

7.3 Interactive Feedback Mechanisms: Fostering Continuous Improvement

Intelligent learning systems also play a crucial role in providing timely and meaningful feedback to learners, fostering continuous improvement and mastery learning. Through interactive feedback mechanisms, such as automated grading, personalized recommendations, and adaptive quizzes, learners receive immediate insights into their progress and areas for growth. This real-time feedback loop encourages active engagement, self-reflection, and metacognitive skills development, empowering learners to take ownership of their learning journey. Moreover, by leveraging data analytics, educators can

gain valuable insights from learners' interactions with feedback mechanisms, enabling them to refine instructional strategies and optimize learning experiences over time.

8 Personalization and Adaptation in Online Education

In the context of online learning, personalization and adaptability are essential concepts that enable students to interact with the material in a way that best meets their own requirements and preferences. Online education systems may accommodate a diverse student body by customizing material, pacing, and instructional strategies to meet each student's learning preferences and skill level through individualized learning experiences. By analyzing student interactions and performance data, adaptive learning algorithms dynamically modify course contents to offer tailored help and scaffolding that promotes mastery learning. Additionally, progress trackers and individual dashboards give students the ability to keep an eye on their own development, which promotes independence and self-directed learning. Online educators may develop more inclusive, engaging, and productive learning environments that cater to the different requirements of learners by putting a priority on personalization and adaptation. [21], [22].

9 AI's Effect on Education: Consequences and Future Course

9.1 Artificial Intelligence in Education: Revolutionary Prospects

Artificial Intelligence (AI) has a much wider impact on education than just integrating technology into conventional classroom settings. It signals a fundamental change in instructional design, pedagogy, and the essence of teaching and learning itself. The ramifications of AI technologies for education are significant and varied as they develop. [12], [23], [24].

9.2 Enhancing Accessibility and Inclusivity

One of the foremost implications of AI in education is its potential to enhance accessibility and inclusivity. AI-powered tools, such as speech recognition software and text-to-speech converters, enable students with disabilities to access educational materials and participate in learning activities on equal footing with their peers. Additionally, AI-driven adaptive learning systems can accommodate diverse learning styles and preferences, ensuring that all students receive personalized support and resources tailored to their needs.

9.3 Redefining Teaching Roles and Practices

AI technologies are also reshaping the roles and practices of educators, blurring the lines between traditional teaching and machine-mediated instruction. Intelligent tutoring systems, chatbots, and virtual assistants are augmenting teachers' capabilities by providing real-time feedback, personalized recommendations, and administrative support. This shift towards a collaborative partnership between humans and machines necessitates educators to adapt their instructional strategies, embrace digital literacy, and cultivate a deeper understanding of AI's capabilities and limitations in educational contexts.

9.4 Ethical Considerations and Algorithmic Bias

As AI becomes increasingly integrated into education, ethical considerations and algorithmic bias emerge as significant concerns. The design and deployment of AI-powered educational tools must adhere to principles of fairness, transparency, and accountability to mitigate the risk of perpetuating existing inequalities and biases. Educators, policymakers, and technologists must collaborate to develop robust frameworks for ethical AI use in education, ensuring that AI technologies serve the best interests of all learners and promote equity and social justice.

9.5 Future Directions and Opportunities for Innovation

The application of AI in education has enormous potential for growth and innovation in the future. The possibilities are endless, ranging from intelligent content production tools and individualized learning routes to immersive virtual reality experiences and adaptive evaluation systems. To fully realize this promise, though, coordinated efforts are needed to address pedagogical, technical, and ethical issues. Additionally, players from all sectors must continue to collaborate. We can build an educational environment that is more inclusive, equitable, and learner-centered and that equips students for success in the digital age and beyond by wisely and ethically utilizing AI's transformational power in education [1].

10 Insights from a Field Study: Perspectives on AI Integration in Online Education

10.1 Importance of Field Study in Understanding Perspectives on AI and E-Learning

Understanding the perspectives and insights of individuals regarding Artificial Intelligence (AI) and e-learning is paramount in shaping the future of education. Through this field study conducted among a sample of 100 individuals from our entourage, we aim to gain valuable insights into the perceptions, concerns, and expectations surrounding

the integration of machine learning algorithms in online education. By soliciting responses from individuals representing diverse professions, educational backgrounds, and levels of expertise in AI, we can capture a comprehensive range of perspectives that inform our understanding of the opportunities and challenges associated with leveraging AI in e-learning environments [6], [7].

10.2 Overview of Questions and Rationale

The questionnaire utilized in this field study comprises a series of carefully crafted questions designed to elicit nuanced responses regarding various aspects of AI integration in online education. Each question serves a specific purpose, addressing key areas of inquiry such as participants' comprehension of AI concepts, expertise in machine learning integration, concerns regarding ethical implications, and recommendations for optimizing AI integration. Additionally, questions pertaining to the perceived impact of machine learning algorithms on the quality and effectiveness of online education aim to gauge participants' attitudes towards AI-driven educational technologies. By posing targeted questions tailored to the complexities of AI in education, we can gather rich qualitative and quantitative data that shed light on the multifaceted dynamics of this evolving field.

List of questions used in the field study:

1. What is your profession or field of study?
2. To what extent do you feel you understand concepts related to artificial intelligence and online learning?
3. Do you have expertise in integrating machine learning algorithms?
4. What are your main concerns regarding the integration of machine learning algorithms in online education?
5. What challenges do you anticipate encountering in the implementation of these technologies?
6. Have you ever used AI-based online learning platforms?
7. Do you believe that the use of machine learning algorithms impacts the quality of online learning?
8. How do you perceive the idea that machine learning algorithms can predict the success of online learning?
9. Do you believe these predictions can actually improve the efficiency of online education?
10. What are your ethical concerns regarding the use of AI in education?
11. How should we address data privacy issues in the context of AI-based online learning?
12. Do you have any suggestions or recommendations to optimize the integration of machine learning algorithms in online education?
13. Are there any specific areas you believe should be prioritized for future research in this field?
14. Any additional comments or questions?

10.3 Interpreting the Results: Insights and Implications

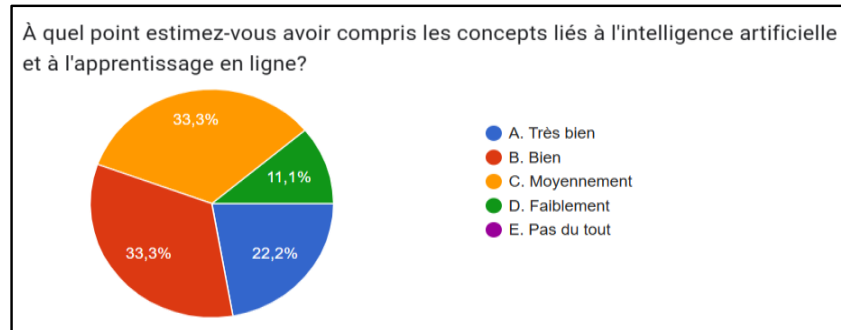


Fig. 2. Response of question 1

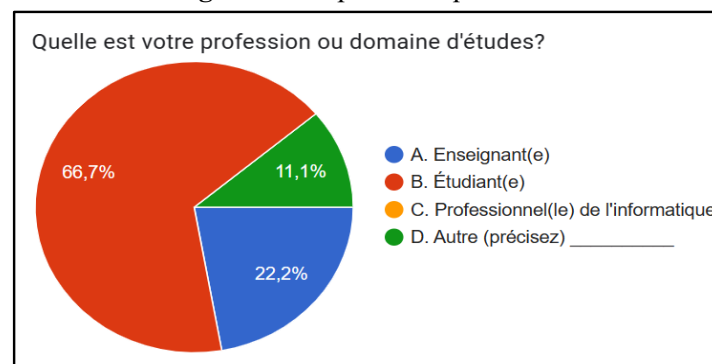


Fig. 3. Response of question 2

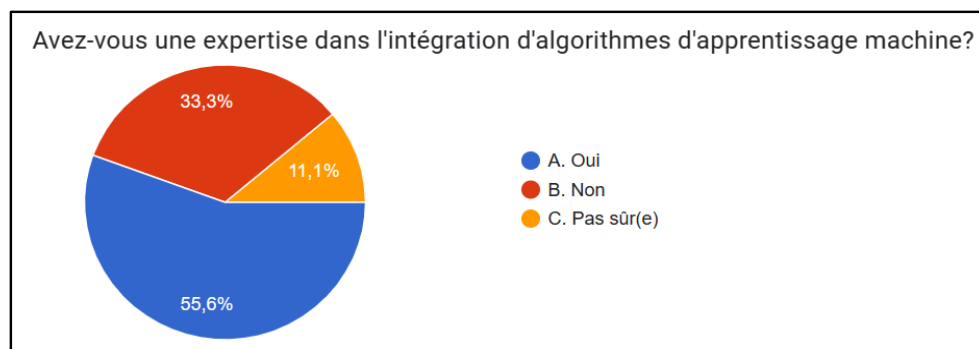


Fig. 4. Response of question 3

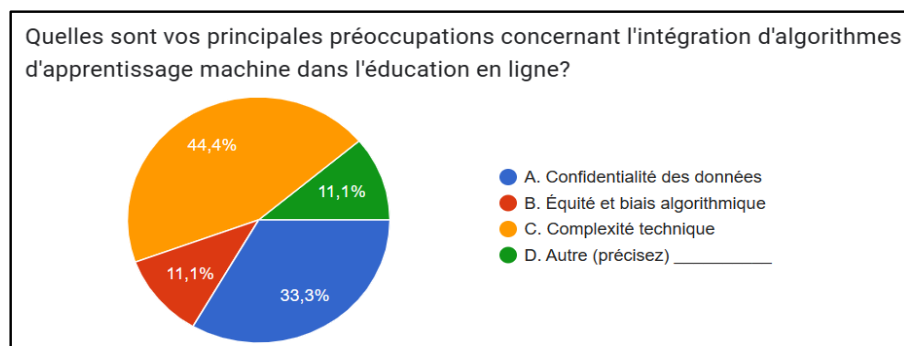


Fig. 5. Response of question 4



Fig. 6. Response of question 5

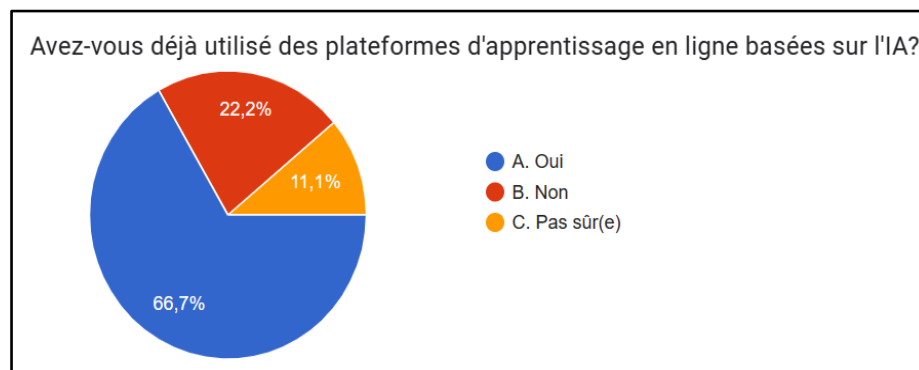


Fig. 7. Response of question 6

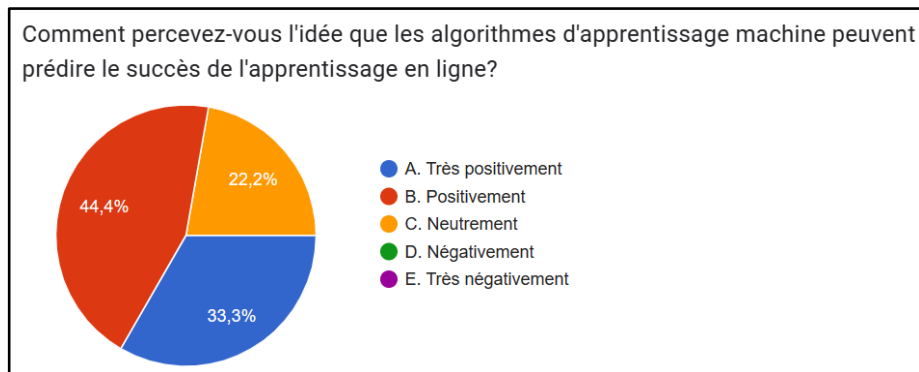


Fig. 8. Response of question 7

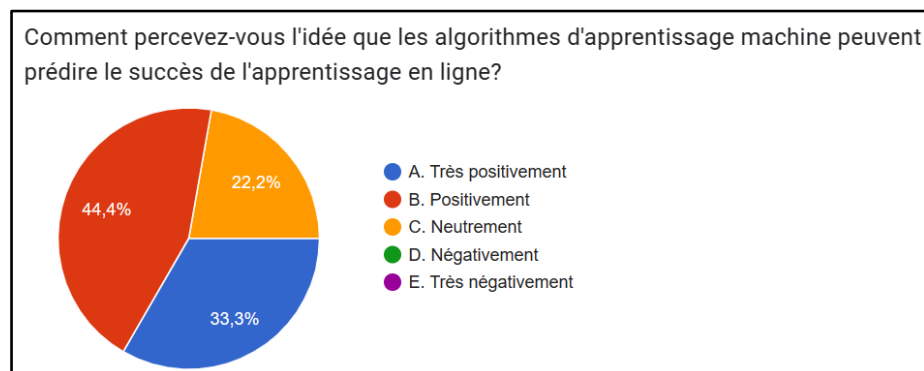
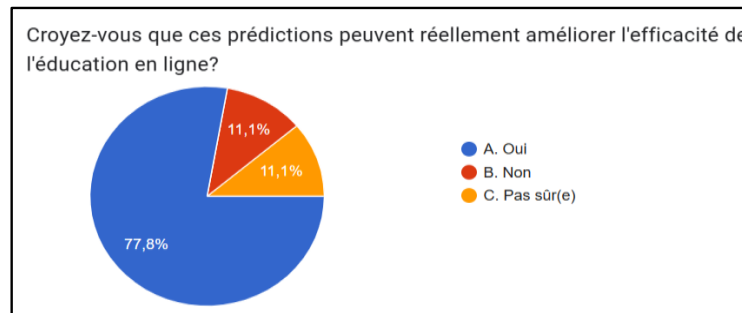
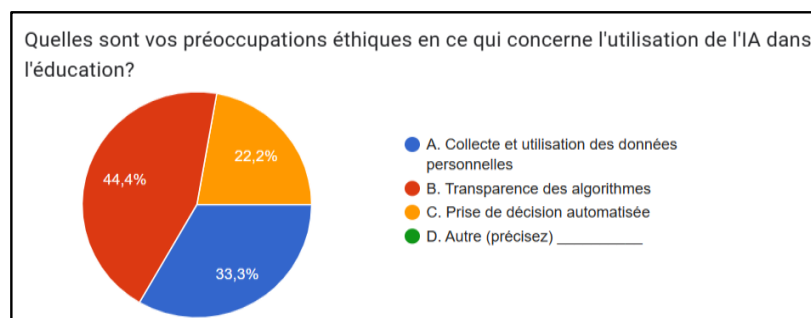
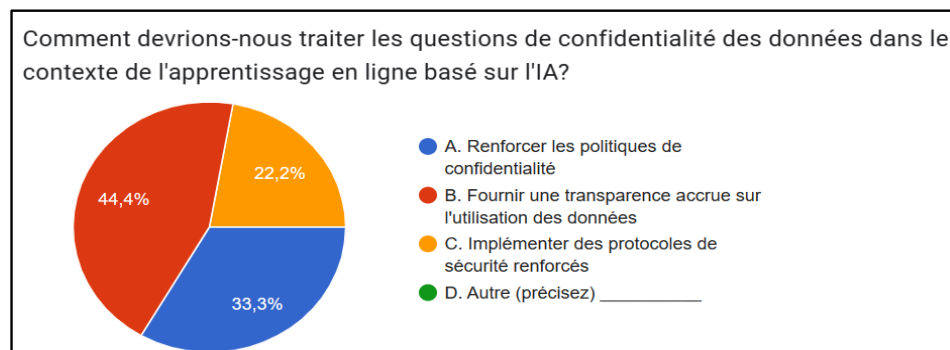
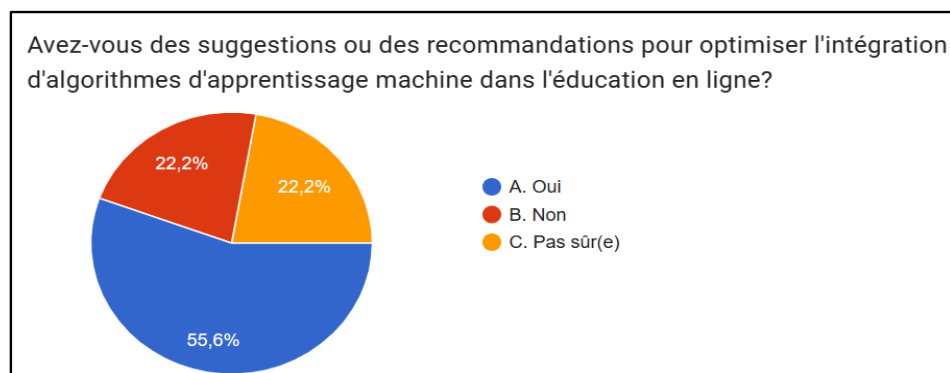


Fig. 9. Response of question 8

**Fig. 10.** Response of question 9**Fig. 11.** Response of question 10**Fig. 12.** Response of question 11**Fig. 13.** Response of question 12

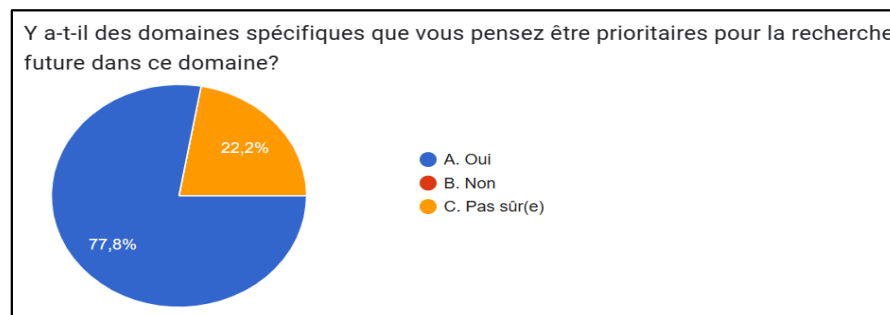


Fig. 14. Response of question 13

Interpreting the results of the field study provides valuable insights into the perspectives and concerns surrounding the integration of machine learning algorithms in online education. The participants primarily comprised students (66.7%), followed by teachers (22.2%), and others (11.1%). Regarding their understanding of AI and online learning concepts, responses varied, with 22.2% feeling very confident, 33.3% confident, 33.3% moderately confident, and 11.1% having low confidence. A significant portion (55.6%) reported expertise in integrating machine learning algorithms, highlighting a potential resource for implementation. However, concerns regarding integration were notable, with 33.3% expressing concerns about data privacy, 44.4% about technical complexity, and 11.1% each about equity and algorithmic bias. Challenges anticipated in implementation included the need for additional training (77.8%), financial resource constraints (11.1%), and resistance from teachers/students (11.1%). Despite concerns, all participants acknowledged the impact of machine learning algorithms on online learning quality, with 77.8% believing these algorithms could positively affect efficiency. Ethical concerns centered around transparency of algorithms (44.4%), data collection/use (33.3%), and automated decision-making (22.2%). Suggestions for addressing data privacy issues included providing increased transparency (44.4%), reinforcing privacy policies (33.3%), and implementing enhanced security protocols (22.2%). While a majority (55.6%) suggested recommendations for optimizing integration, 77.8% believed specific areas should be prioritized for future research. These findings underscore the importance of addressing ethical, technical, and pedagogical considerations in the integration of machine learning algorithms in online education, while also highlighting opportunities for further exploration and refinement in this evolving field.

11 Conclusion: Towards a Transformative Future of Education

The convergence of Artificial Intelligence (AI) and education heralds a transformative future characterized by innovation, inclusivity, and personalized learning experiences. Throughout this article, we have explored the evolution of e-learning, the emergence of AI in education, and the intersection of these domains, highlighting both opportunities and challenges. From predictive analytics and adaptive learning systems to personalized feedback mechanisms and ethical considerations, AI holds immense potential to revolutionize teaching and learning in profound ways.

As we navigate this transformative landscape, it is essential to recognize the importance of responsible AI adoption, ethical considerations, and ongoing collaboration among stakeholders. Educators, policymakers, technologists, and learners must work together to harness the potential of AI in education while mitigating risks and ensuring equity and accessibility for all.

Looking ahead, the future of education promises unprecedented opportunities for innovation and advancement. By embracing the principles of personalization, adaptation, and inclusivity, we can create more engaging, effective, and learner-centric educational experiences that empower individuals to thrive in a rapidly evolving digital world.

As we embark on this journey towards a transformative future of education, let us remain committed to leveraging AI as a tool for positive change, fostering creativity, critical thinking, and lifelong learning for generations to come. Through collaborative efforts and a shared vision of excellence, we can shape an educational landscape that prepares learners to succeed in the complex challenges of the 21st century and beyond.

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