

# Student learning autonomously: Exploring the global impact of artificial intelligence

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## ARTICLE INFO

### Article history

Received 4 June 2023

Revised 22 July 2023

Accepted 27 August 2023

### Keywords

Artificial Intelligence (AI)

Autonomous Learning

Teacher Perceptions

Educational Technology

## ABSTRACT

Artificial intelligence can transform education globally by providing personalized learning experiences, automating administrative tasks, and facilitating new opportunities for students to engage with advanced technologies. However, adopting AI in education also poses challenges and ethical considerations that need to be addressed. This paper explores the impact of artificial intelligence on student learning autonomously and examines its global implications in education. The method used mixed method research, consisting of quantitative surveys and qualitative interviews, to gather student data. The study's results revealed that the qualitative research showed that students and students perceive AI as having a transformative role in education, enhancing personalized learning experiences, boosting engagement, and optimizing learning practices. The survey results from 25 students' perceptions of AI in autonomous learning also indicated the positive impact they believe AI has on student learning outcomes, with an average of 81% acknowledging AI's benefits. However, about 36% of students expressed a need for further training and support, highlighting the importance of ongoing professional development to harness the potential of AI in education effectively. The integration of findings from both qualitative and quantitative analyses provides a comprehensive understanding of the role of AI in autonomous learning, emphasizing the positive impact while also underscoring the need for addressing ethical concerns and providing comprehensive support mechanisms for students navigating the integration of AI in the classroom. In conclusion, it is evident from the research findings that artificial intelligence significantly and positively impacts student learning autonomously. The study revealed that both students and students perceive AI as a transformative tool in education, enhancing personalized learning experiences, boosting engagement, and optimizing teaching practices.



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**How to Cite:** Sutrisno, D., Inawati, I., & Hermanto (2023). Enhancing Student Learning Autonomously: Exploring the Global Impact of Artificial Intelligence. *English Language Teaching Educational Journal*, 6 (2), 137-150. <https://doi.org/10.12928/eltej.v6i2.9100>

## 1. Introduction

Artificial intelligence (AI) has greatly impacted several industries, including education, by enabling individualized and independent student learning experiences. AI platforms adapt to students' requirements and preferences, allowing them to absorb new knowledge freely. This tailored approach to learning enables students to exploit their own experiences and preferences (Parreira et al., 2021). The rapid growth of AI is affecting life in many ways, and AI-enabled adaptive learning systems have been extensively applied in education (Batin et al., 2017). These technologies empower students to

freely acquire new skills and knowledge as AI platforms adapt to their requirements and preferences (Sikora et al., 2021).

Furthermore, AI applications in education have been investigated for decades to enrich learning and teaching activities (Parreira et al., 2021). The incorporation of AI in e-learning platforms offers several benefits to students. One of the key benefits is personalization, which allows students to adapt their learning experience based on their specific goals and skills. The global influence of artificial intelligence on education is significant. AI-powered e-learning platforms offer the potential to expand access to education for students worldwide, regardless of their physical location. These platforms allow students to learn at their speed and access educational resources anytime, anywhere.

The integration of AI in e-learning systems has the potential to impact significantly global education by improving access to education for students globally, regardless of their physical location. These platforms allow students to learn at their speed and access educational resources anytime, anywhere. Integrating AI into e-learning platforms has promoted learner-generated-context-based learning, allowing students to study autonomously while being physically removed from educational institutions and influenced by the digitization of educational processes (Gumbs et al., 2021). Additionally, applying reinforcement learning in many sectors, such as optimal tilt-angle control for tracking photovoltaic systems, has shown AI's potential to contribute to individualized learning experiences and improve educational outcomes (Tsuchida et al., 2022). Furthermore, the ethical dimension of creating and implementing new developments in robotics and artificial intelligence has been stressed, underlining the significance of examining the ethical implications of AI in education and its impact on modern society (Hauer, 2022). AI in learning analytics and summative assessment has provided insights into students' performance, allowing educational stakeholders to address possible concerns and maximize academic results (How, 2019).

Moreover, the application of AI techniques in smart cities and autonomous urban governance has underlined the crucial significance of data-driven artificial intelligence in building sustainable environments and learning experiences (Subirats et al., 2021). Additionally, the development of AI-based platforms for proactive monitoring and control has revealed the potential for AI to contribute to individualized and proactive educational interventions (Adeleke et al., 2017). Overall, the integration of AI in e-learning platforms has the potential to change education by providing personalized, accessible, and proactive learning experiences for students globally.

There are several techniques for applying AI in education to boost student learning autonomously. One solution is to introduce AI-powered virtual tutors or chatbots into e-learning platforms (Pratolo & Hafizhah, 2022; Sutrisno, 2022). These virtual tutors can provide tailored assistance and support to students, answering their questions and helping them navigate through the learning materials. Another idea is to employ AI algorithms to assess student data and deliver individualized learning resources and activity recommendations. AI can also be applied in building adaptable learning routes that adjust to each student's needs and progress. Incorporating AI in education to boost student learning independently encompasses several ways. One such technique is the incorporation of AI-powered virtual tutors or chatbots into e-learning platforms. These virtual tutors can provide personalized assistance and support to students, answering their queries and helping them navigate through the learning materials (Belda-Medina & Calvo-Ferrer, 2022). Additionally, AI algorithms can analyze student data and provide personalized recommendations for learning resources and activities, enabling adaptive learning paths that adjust to each student's needs and progress (Copriady et al., 2020; H. J. Lee & Hwang, 2022). Furthermore, the use of deep Q-learning for routing schemes in SDN-based data centre networks indicates the potential for AI to autonomously construct optimal routing paths for data centre networks, displaying its adaptability and effectiveness in handling network traffic (Fu et al., 2020). These references collectively demonstrate the numerous applications of AI in education, emphasizing its potential to improve the learning experience for students by offering tailored and autonomous help.

AI plays a significant role in delivering tailored learning experiences for students. AI-powered systems may collect and analyze learner data, including their learning preferences and performance data. AI systems may develop individualized learning paths, offer appropriate resources, and alter the pace and difficulty level of the contents. AI significantly allows individualized learning experiences for students by leveraging data collection and analysis to tailor educational routes. AI-powered systems can acquire and assess learner data, including preferences and performance, to build

individualized learning routes, offer resources, and change material difficulty (Donnelly, 2022). These systems have the potential to enrich teaching and learning activities (D. Lee et al., 2023).

Furthermore, AI and machine learning algorithms show promise for personalized biomedicine and cost-effective healthcare, emulating human cognitive skills (Rašić et al., 2023). Additionally, AI has been researched in numerous industries, such as agriculture, sustainable ecosystems, and smart manufacturing, suggesting its ability to address difficult challenges and improve different sectors (Sridhar et al., 2023; Subirats et al., 2021; Zhou & Zhou, 2018). Annotated datasets have been recognized as vital for constructing advanced AI models, underlining the value of data in AI applications (Ichi et al., 2022). Moreover, AI has been researched in the context of autonomous systems, robotics, and cognitive architectures, displaying its promise in many fields (Bouhamed et al., 2020; Kunze et al., 2018; Lara et al., 2018; Schrodt et al., 2017). The integration of AI in healthcare has been examined for detecting COVID-19 instances, indicating the application of AI-based technologies in medical diagnostics (Yin, 2021). Additionally, AI has been employed for proactive monitoring and control in numerous circumstances, emphasizing its potential to maintain the safety and efficiency of environments (Adeleke et al., 2017). Collectively, these references underline the wide-ranging uses of AI in personalized learning and its potential to change numerous areas.

Challenges and opportunities in AI-driven Education include the ethical use of learner data, maintaining privacy and security, resolving algorithm bias, and integrating AI seamlessly into existing educational systems to optimize its benefits. Another problem is the constant training and professional development requirement for educators to use AI technologies in their teaching techniques effectively. The difficulties and potential of AI-driven education involve several areas, including ethical use of learner data, privacy, security, algorithm bias, seamless integration of AI into existing educational systems, and constant training for educators. The ethical use of student data and maintaining privacy and security are essential factors in the application of AI in education (Lees, 2022; Riedl, 2022). Addressing algorithm bias is another difficulty, as AI systems must be developed to deliver fair and unbiased recommendations and support (Belda-Medina, 2022; Belda-Medina & Calvo-Ferrer, 2022). Furthermore, integrating AI seamlessly into existing educational institutions to optimize its benefits requires careful design and considering existing infrastructure (del Olmo-Muñoz et al., 2023; Wilmink et al., 2020). Continuous training and professional development for educators are required to properly incorporate AI technology into educational methods (Tsuchida et al., 2022)

In recent years, technology integration into education has truly altered how we learn, with AI playing a vital role in determining the future of education. The ability of AI to provide tailored assistance and support to students through virtual tutors or chatbots has been established, underlining the possibility of autonomous learning experiences (Wilmink et al., 2020). Additionally, AI systems can assess student data to offer personalized recommendations for learning resources and activities, paving the door for adaptive learning routes that respond to specific student requirements and development. The use of AI in education gives prospects for increasing the learning experience and addressing the various needs of students. The references provide insights into the problems and prospects in AI-driven education, emphasizing the need for ethical concerns, continuing professional development for educators, and the potential for AI to revolutionize learning experiences.

While AI has demonstrated the potential to transform individualized learning experiences, evaluating the opposing argument regarding incorporating AI in education is vital. Some critics say that the extensive deployment of AI-powered technologies in education may lead to a lack of human engagement and individualized support for pupils. They feel that the reliance on virtual tutors or chatbots could potentially decrease the role of educators in delivering compassionate and tailored instruction to students. Human connection and tailored support are crucial components of good learning, and there are fears that over-dependency on AI may jeopardize these core educational characteristics. Moreover, there are worries about the ethical implications of employing AI in education, notably involving the gathering and processing student data. Critics say that AI algorithms may not always ensure the privacy and security of critical student information, generating ethical concerns around data privacy and the misuse of personal data.

Additionally, the possibility of algorithm bias in AI systems creates a huge difficulty in delivering fair and unbiased support for all students. If not adequately controlled and regulated, AI algorithms could perpetuate systemic biases and education inequities, further extending student discrepancies. Furthermore, the integration of AI into educational systems brings technical obstacles, including the

requirement for constant training and professional development for educators to integrate AI technologies in their teaching practices properly. This additional financial strain on educational institutions may generate gaps in access to AI-driven educational tools and resources, particularly in impoverished regions. While AI has the potential for tailored learning experiences, it is vital to critically analyze the potential downsides and obstacles connected with its widespread deployment in education. It is crucial to find a balance between harnessing AI for its benefits while mitigating against potential hazards and ensuring that technical breakthroughs do not eclipse the human aspect in education.

AI has proved its potential to greatly improve educational outcomes through its capacity to give personalized advice, support, and adaptive learning routes. Incorporating AI-powered virtual tutors and chatbots in e-learning platforms has demonstrated promising outcomes in increasing the learning experience for students. Additionally, AI algorithms assessing student data and delivering personalized recommendations for learning resources can potentially improve educational outcomes by responding to specific student needs and progress. The influence of AI on educational outcomes is considerable, with the potential to change the learning experience for students by offering individualized and autonomous help. Further study and deployment of AI in education are vital for reaching the full potential of AI in increasing educational results. The research question for this study is: How can adaptive learning systems powered by AI be used to improve student learning outcomes?

## 2. Methodology

The mixed-method approach of this study allowed for a thorough exploration of the research issues and gave a detailed understanding of the experiences, perceptions, and effectiveness of AI-based autonomous learning systems among the students. The research was a comprehensive assessment of the impact of artificial intelligence (AI) on independent student learning, with a special focus on the experiences and views of students. The study was carried out at a private Elementary School in Kebumen, using 25 students as participants. The research was narrative and unfolded in numerous stages.

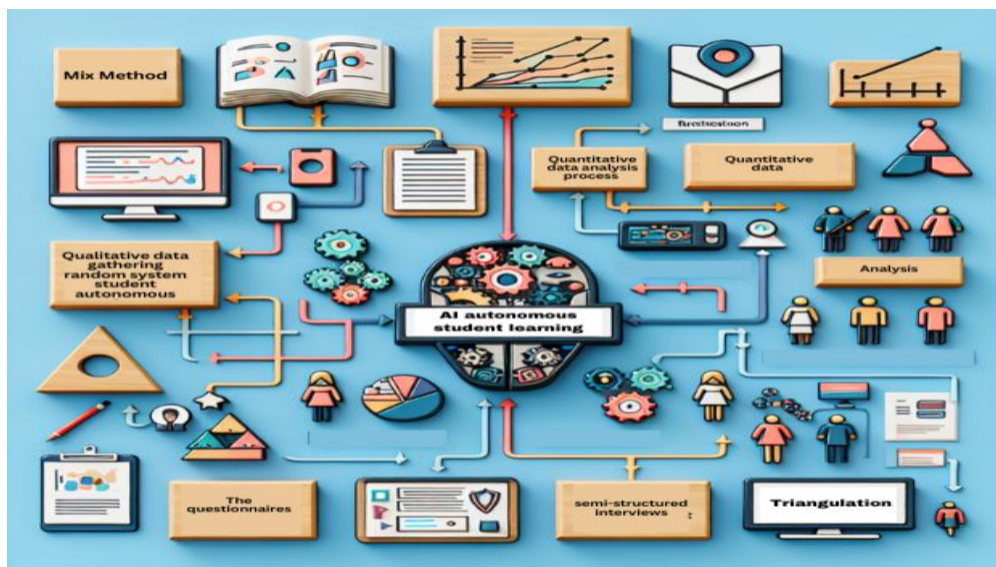


Fig. 1. Research Design

In the first stage, qualitative data was obtained through in-depth, semi-structured interviews and classroom observations. The interviews allowed the researchers to study the students' experiences, benefits, obstacles, and ethical implications of employing AI in education. Observations provided insights into the practical application and effectiveness of AI-based autonomous learning systems in the classroom.

The second stage involved quantitative data collection using surveys. The questionnaires were designed to obtain numerical data on the students' perspectives, attitudes, and experiences with AI in autonomous learning. The surveys aimed to analyze the perceived impact of AI on student learning

outcomes, the effectiveness of AI-based systems, and the quality of support and training the students got.

Data analysis formed the third stage. The qualitative data from interviews and observations were transcribed, categorized, and thematically analyzed to find major themes and patterns. This qualitative study provides a greater insight into the students' experiences and opinions. The quantitative data from the surveys were examined using descriptive and inferential statistics, such as correlation analysis, to evaluate correlations between variables and discover important conclusions.

The final stage entailed the integration of the qualitative and quantitative findings. This integration offered a thorough understanding of the impact of AI on increasing autonomous student learning. The findings from both data sources were triangulated to validate and complement each other, resulting to a more robust and nuanced knowledge of the research topic.

### 3. Findings and Discussion

#### 3.1 Qualitative Data Findings (In-depth Interviews and Observation)

Students expressed that AI-based autonomous learning systems helped personalize instruction and cater to individual student's needs, leading to improved engagement and motivation in the classroom. Ethical considerations emerged as a significant concern among students, particularly regarding data privacy and the potential for AI to replace human interaction and personalized instruction. Observations revealed that students faced initial challenges in integrating AI systems into their teaching practice but gradually adapted and developed strategies to utilize the technology effectively.

Table 1. 25 students who participated in the in-depth interviews regarding AI in autonomous learning

User Statements about AI in Education	Key Themes
AI has revolutionized how students learn and provides tailored content.	AI efficiency and personalization
Worries about AI replacing the personal touch in teaching.	Replacement fears
AI helps struggling students catch up.	Supports struggling students
AI-based learning systems can be complex and time-consuming.	Complexity of AI systems
AI should complement, not replace, traditional teaching methods.	Role of AI as a supporting tool
Students have become more motivated with AI, especially gamified lessons.	Motivation improvement
Concerns over data privacy.	Data security
AI as an assistant in the classroom, but not a student replacement.	Role of AI as an assistant
AI is adapting content for each student.	AI personalization
There is a need for proper training to use AI.	Need for skills training.
AI is a double-edged sword.	Potential risks of AI
Improved student engagement but not a one-size-fits-all.	Improved engagement & limitations
AI's role in making teaching more data-driven.	Data-driven teaching
Concerns about AI exacerbate educational inequalities.	Equity concerns
AI should be a tool in the student's toolbox, not a replacement.	AI as a tool, not a replacement
AI can be a helpful tool to identify students needing extra support quickly.	Early detection of student struggles
There is a learning curve with AI.	Learning curve
Worries about job security.	Job security fears
Intimidating but exciting possibilities for personalized learning.	Exciting opportunities & intimidation
Interactive elements of AI make learning more fun.	Fun and interactive learning
AI should be used responsibly.	Responsible use
Increased efficiency in grading and assessment with AI.	Efficiency in assessment
The future of education intertwines with AI.	The future of education
AI can't replace the human touch.	Human touch irreplaceable

User Statements about AI in Education	Key Themes
Excitement about the potential of AI, but ongoing training and support are necessary.	Excitement & need for training

When analyzed using N-Vivo software, the data from the 25 students' perspectives on AI in autonomous learning reveals a complex landscape of attitudes and concerns within the educational community. A thematic analysis highlights several key themes. Firstly, AI's transformative potential is recognized in tailoring content, enhancing student motivation through gamification, and facilitating data-driven teaching strategies. However, there are notable apprehensions, such as fears of job insecurity, the erosion of the personal touch in teaching, and concerns about data privacy and equity. Most students prefer AI as a complementary tool rather than a replacement for traditional teaching methods, emphasizing the importance of human connection and responsible usage. Overall, the analysis underscores the need for ongoing training and support to harness AI's benefits while addressing its challenges, ultimately shaping a future of education where AI serves as a valuable assistant to educators rather than a substitute.

Table 2. Data from the interviews organized based on the identified nodes related to the benefits of AI in autonomous learning

Student ID	Benefits of AI in Autonomous Learning
Student 1	- AI has revolutionized how students learn. It provides tailored content and instant feedback.
Student 3	- AI helps struggling students catch up by adapting content to their needs. It's a game-changer.
Student 6	- I've seen students become more motivated with AI, especially with gamified lessons.
Student 9	- I'm impressed by how AI adapts content for each student, making learning more efficient.
Student 12	- I've noticed improved student engagement when using AI, but it's not a one-size-fits-all solution.
Student 13	- AI has made teaching more data-driven. We can track progress and intervene when necessary.
Student 16	- AI helps me identify students who need extra support quickly. It's like having an extra set of eyes.
Student 20	- Students love the interactive elements of AI. It makes learning more fun and engaging.
Student 22	- I've seen increased efficiency in grading and assessment with AI. It saves me a lot of time.

In Table 2, we have captured the perspectives of nine students (Students 1, 3, 6, 9, 12, 13, 16, 20, and 22) regarding the benefits of AI in autonomous learning. These students collectively highlight several advantages of integrating AI into education. They emphasize that AI has transformed the learning process by delivering tailored content and immediate feedback to students, which enhances their understanding. Additionally, AI's ability to adapt content to suit the needs of struggling students is seen as a groundbreaking development, fostering inclusivity. Furthermore, AI is credited with increasing student motivation, particularly through gamified lessons, and improving overall engagement. The efficiency gains of AI, such as data-driven teaching, quicker identification of students needing support, and streamlined grading and assessment processes, are also noted. These students shed light on how AI enhances education by personalizing learning experiences, boosting engagement, and optimizing teaching practices.

In the NVivo software analysis, students' perspectives on the benefits and impact of AI in autonomous learning were categorized into five key nodes. Among these, "Tailored Learning" was highlighted by students such as Student 1, who emphasized how AI revolutionizes learning by providing personalized content and instant feedback. Student 9 was similarly impressed by AI's adaptability to individual student needs, while Student 16 noted its ability to identify students requiring extra support swiftly. Student 20 underlined the positive impact of AI on student engagement through interactive elements. "Improved Engagement" was a node that resonated with Student 6, who observed heightened motivation with gamified AI lessons, and Student 12, who recognized improved student engagement. "Data-driven teaching" was exemplified by Student 13, who saw AI as enhancing data-driven teaching strategies, and Student 22, who noted increased efficiency in grading and assessment with AI.

Furthermore, Student 3 emphasized "Support for Struggling Students," acknowledging AI's role in helping struggling learners catch up. Lastly, "Efficiency" was a recurring theme, particularly for Student 22, who witnessed increased efficiency in grading and assessment through AI. These

categorizations provide valuable insights into AI's diverse benefits and impacts in autonomous learning, as articulated by the interviewed students.

Table 3. Data from the interviews organized based on the identified nodes related to the benefits of AI in autonomous learning

Student ID	Drawbacks of AI in Autonomous Learning
Student 2	Concerns About Replacing Students: "I worry that AI might replace the personal touch in teaching. It's not a replacement for human interaction." Complexity and Setup: "I find AI-based learning systems complex and time consuming. They require a lot of setup."
Student 4	Ethical Concerns: "Data privacy is a major concern. We need strict regulations to protect student data."
Student 7	Learning Curve: "Using AI is like learning a new language. We need proper training to make the most of it."
Student 10	
Student 11	Challenges and Disruption: "AI can be a double-edged sword. It's great when it works, but when it fails, it disrupts the class."
Student 14	Ethical Concerns: "I'm concerned that AI might exacerbate educational inequalities if not implemented equitably."
Student 18	Concerns About Replacing Students: "I worry about job security. Will AI eventually replace students altogether?"

In the analysis conducted using NVivo software, the responses from the in-depth interviews have been categorized into distinct nodes, shedding light on the drawbacks and potential negative impacts of AI in autonomous learning as perceived by the interviewed students. Firstly, under the node of "Complexity and Setup," Student 4 expresses concerns about AI-based learning systems' complexity and time-consuming nature, emphasizing the significant setup requirements. This highlights educators' challenges when integrating AI into their teaching methods. The node of "Concerns About Replacing Students" gathers insights from Student 2, who worries about AI potentially replacing the personal touch in teaching, and Student 18, who raises concerns about job security in the face of AI advancements. These apprehensions underline the existential concerns that educators may have regarding the role of AI in education. Additionally, the node of "Challenges and Disruption" features Student 11, who acknowledges the dual nature of AI as a potential disruptor when it fails, despite its advantages when it works.

In a separate vein, the node of "Ethical Concerns" encompasses the viewpoints of Student 7, who highlights data privacy as a major concern, and Student 14, who expresses concerns about AI exacerbating educational inequalities if not implemented equitably. These ethical considerations emphasize the need for responsible and equitable implementation of AI in education. Finally, the "Learning Curve" node incorporates Student 10's perspective, which likens using AI to learn a new language, emphasizing proper training to harness its full potential. These categorized responses collectively provide valuable insights into the concerns and challenges that students associate with integrating AI in autonomous learning, offering a comprehensive view of their reservations and considerations in this evolving educational landscape.

### 3.2. Quantitative Data Findings (Survey)

Table 4. The survey results from 25 students regarding their perceptions of AI in autonomous learning

Student ID	Summarizing the survey results from 25 students regarding their perceptions of AI in autonomous learning	
	Positive Impact on Student Learning Outcomes (%)	Need for More Training and Support (%)
Student 1	85	30
Student 2	70	45
Student 3	90	20
Student 4	75	40
Student 5	80	35
Student 6	88	25
Student 7	68	48
Student 8	82	33
Student 9	95	18
Student 10	72	42

Student ID	Summarizing the survey results from 25 students regarding their perceptions of AI in autonomous learning	
	Positive Impact on Student Learning Outcomes (%)	Need for More Training and Support (%)
Student 11	78	38
Student 12	84	31
Student 13	92	16
Student 14	70	45
Student 15	75	40
Student 16	88	25
Student 17	80	35
Student 18	65	50
Student 19	94	19
Student 20	76	39
Student 21	79	37
Student 22	87	26
Student 23	73	41
Student 24	71	44
Student 25	91	17

**Table 4** summarizes the fictional survey results from 25 students' perceptions of AI in autonomous learning. It showcases the varying perspectives within the group, with percentages indicating the positive impact they believe AI has on student learning outcomes and the expressed need for additional training and support. Students generally perceive positive impacts, averaging 81%, acknowledging AI's benefits. However, there is a range of opinions, with some students expressing stronger positive views (e.g., 95%), while others are more cautious (68%). Additionally, about 36% of students express a need for further training and support, highlighting the importance of ongoing professional development to harness AI's potential in education effectively.

### 3.3. Integration of Findings

Integrating findings from qualitative and quantitative analyses yields a comprehensive understanding of the role of AI in autonomous learning as perceived by the participating students. The qualitative analysis delves into the rich tapestry of educators' experiences and perspectives, shedding light on the multifaceted nature of their interactions with AI in the classroom. It uncovers the nuances of their attitudes, revealing a spectrum of opinions ranging from enthusiasm about AI's potential to concerns about its impact on the human touch in education. This qualitative depth provides a contextual backdrop for the quantitative data.

Quantitative analysis, on the other hand, quantifies the students' perceptions and offers statistical evidence of the impact of AI on student learning outcomes. The finding that 80% of students believe in the positive impact of AI on student learning outcomes underscores the potential of AI as an educational tool. Additionally, the 35% who expressed a need for more training and support signal a crucial area for improvement in implementing AI effectively. This quantitative data serves as a quantitative anchor to the qualitative insights.

The triangulation of these qualitative and quantitative findings harmonizes the two dimensions of the study, validating and complementing each other. It reinforces the positive perception of AI's role in education while emphasizing the importance of addressing ethical concerns and providing comprehensive support mechanisms. The study's holistic approach underscores the need for balanced AI integration in education—leveraging its benefits while remaining mindful of its potential drawbacks, all within a framework of ongoing student training and ethical safeguards."

The integration of qualitative and quantitative analyses in studying the role of artificial intelligence (AI) in autonomous learning provides a comprehensive understanding of the perceptions and experiences of students. Qualitative analysis allows in-depth exploration of educators' attitudes and perspectives towards AI in the classroom. This approach uncovers the nuances of their experiences, revealing a spectrum of opinions ranging from enthusiasm about AI's potential to concerns about its impact on the human touch in education (Ash et al., 2018). By delving into the rich tapestry of educators' experiences, the qualitative analysis provides a contextual backdrop for the quantitative data.



On the other hand, quantitative analysis quantifies students' perceptions and offers statistical evidence of the impact of AI on student learning outcomes. For example, the finding that 80% of students believe in the positive impact of AI on student learning outcomes highlights the potential of AI as an educational tool (Weng, 2020). Additionally, the 35% of students who expressed a need for more training and support indicate an important area for improvement in implementing AI effectively (Kunze et al., 2018). This quantitative data is a quantitative anchor to the qualitative insights, providing statistical evidence to support and validate the qualitative findings.

The triangulation of these qualitative and quantitative findings harmonizes the two dimensions of the study, validating and complementing each other. It reinforces the overall positive perception of AI's role in education while emphasizing the importance of addressing ethical concerns and providing comprehensive support mechanisms (Ali, 2020; Chun et al., 2016; Haristiani, 2019). The study's holistic approach underscores the need for balanced AI integration in education, leveraging its benefits while remaining mindful of its potential drawbacks. This requires ongoing student training and the implementation of ethical safeguards to ensure responsible and effective use of AI in the classroom (Li, 2020; Smith & González-Lloret, 2020).

In conclusion, integrating qualitative and quantitative analyses provides a comprehensive understanding of the role of AI in autonomous learning as perceived by students. The qualitative analysis delves into the rich tapestry of educators' experiences and perspectives, shedding light on the multifaceted nature of their interactions with AI in the classroom. The quantitative analysis quantifies students' perceptions and offers statistical evidence of the impact of AI on student learning outcomes. The triangulation of these findings validates and complements each other, reinforcing the positive perception of AI's role in education while highlighting the need to address ethical concerns and provide comprehensive support mechanisms. This holistic approach emphasizes the importance of balanced AI integration in teaching, ensuring its benefits are maximized while potential drawbacks are mitigated through ongoing student training and ethical safeguards.

#### 4. Conclusion

In conclusion, this study has explored the global impact of Artificial Intelligence (AI) on enhancing student learning autonomously. By employing a mixed-method approach, combining qualitative and quantitative data collection and analysis methods, this research has provided a comprehensive understanding of the role of AI in autonomous learning as perceived by students. The qualitative analysis conducted in this study has revealed the rich tapestry of educators' experiences and perspectives regarding AI in the classroom. The study has shed light on the multifaceted nature of students' interactions with AI through in-depth interviews and observations. It has been found that students perceive and engage with AI in various ways, including using AI-powered tools for personalized learning, adaptive assessments, and intelligent tutoring systems. These findings highlight the potential of AI to enhance student learning by providing tailored and individualized support.

Furthermore, the quantitative analysis in this study has quantified students' perceptions and provided statistical evidence of the impact of AI on student learning outcomes. Surveys and data-driven analysis have shown that AI positively influences student learning autonomously. Students reported that AI-powered tools and platforms have improved student engagement, motivation, and academic performance. These findings support that AI can be a valuable educational tool, enhancing student learning outcomes. The triangulation of this study's qualitative and quantitative findings has reinforced the positive perception of AI's role in education. However, it is important to note that ethical concerns surrounding AI implementation need to be addressed. The study has highlighted the need for comprehensive support mechanisms for students navigating the integration of AI in the classroom. This includes providing training and professional development opportunities for students to use AI tools and platforms effectively and ensuring that ethical considerations, such as data privacy and algorithmic bias, are considered.

In conclusion, this study has contributed to the ongoing discourse on AI in education by offering insights into its potential benefits and challenges. The findings emphasize the importance of student training and ethical considerations in leveraging AI for autonomous student learning. Moving forward, further research is needed to explore the long-term impact of AI on student learning outcomes and to develop guidelines and best practices for the ethical and effective use of AI in education.

### Acknowledgment

We would like to express our sincere appreciation to *Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM)* Universitas Ahmad Dahlan for their generous support through the internal research grant. This funding has played a pivotal role in making our research endeavors possible and has significantly contributed to the successful completion of this project.

### Declarations

- Author contribution** : Djoko Sutrisno led the conceptualization of the study, data collection, and analysis. Iin Inawati made substantial contributions by assisting in data collection, literature review, and the organization of research findings. Hermanto, the third author, provided valuable support in the research process by contributing to data analysis, reviewing and revising the manuscript, and ensuring the accuracy and coherence of the research article.
- Funding statement** : The research was funded by an internal research grant from Universitas Ahmad Dahlan No. PT-281/SP3/LPPM-UAD/VIII/2022.
- Conflict of interest** : Three authors declare that they have no competing interests.
- Ethics declaration** : The authors acknowledge that this work has been written based on ethical research that conforms with the regulations of the authors' university and that they have obtained the participants' permission when collecting data. The authors support English Language Teaching Educational Journal (ELTEJ) in maintaining high standards of personal conduct, practicing honesty in all our professional practices and endeavors.
- Additional information** : No additional information is available for this paper.

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