Volume 9, Issue 9, September– 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

Influences Personalisation and Student Engagement in the AI Era: Exploring Effects and Influences

Sara Benayache[1]
[1]PhD in Economics and Management Sciences,
Research Lecturer at ESLSCA Campus Rabat. Morocco

Bouchrik Mourad[2]
[2]Professor of Parasitology and Mycology,
Faculty of Medicine and Pharmacy, Rabat. Morocco

Abstract:- The study is based on a conceptual model to examine the integration of artificial intelligence (AI) technologies in education and their impact on student engagement. This model structures the analysis around several axes: AI technologies, including intelligent tutoring systems (ITS), adaptive learning platforms, and educational chatbots, play a key role in personalizing learning paths, making pedagogical support more accessible, and adapting content to students' specific needs. Student engagement is thus assessed through the personalization of pathways and the accessibility of support, while taking into account individual moderating factors such as learning styles, self-motivation, and prior experience with AI technologies, which influence the effectiveness of these tools. In addition, the study examines contextual conditions, including the importance of adequate technological infrastructure and teacher training, which are essential for the successful integration of AI technologies into pedagogical practices. This conceptual model guides the study in evaluating the assumptions made, providing an in-depth understanding of the interactions between these variables and making recommendations to optimize the use of AI technologies in education.

Keywords:- *Artificial Intelligence (AI)- Student Engagement- Personalization- Intelligent Tutoring Systems (ITS)- Adaptive Learning Platforms- Educational Chatbots- Teacher Training.*

I. INTRODUCTION

Contemporary education is undergoing a major transformation, marked by the emergence of new technologies that are redefining teaching and learning methods. Among these innovations, artificial intelligence (AI) technologies are playing an increasingly crucial role. Their ability to personalise learning paths, engage students more interactively and improve academic performance is opening up new prospects for teaching.

Intelligent tutoring systems (ITS), adaptive learning platforms and educational chatbots represent the main applications of AI in education. These technologies offer personalised solutions, tailoring content and pedagogical strategies to the individual needs of students, which, in theory, should improve their engagement and academic performance **(Luckin et al., 2016)**. However, the actual impact of these technologies on the learning process requires further empirical evaluation **(Holmes et al., 2019).**

Individual student characteristics, such as age, gender, level of education and previous experience with AI technologies, may influence how these technologies are perceived and used. In addition, the educational context, including the technological infrastructure, teachers' skills and available resources, plays a decisive role in the effectiveness of AI integration in learning environments **(Zawacki-Richter et al., 2019).**

According to the latest reports on AI in education, UNESCO and the OECD have highlighted the transformative potential of AI to improve access to quality education and reduce educational inequalities. For example, UNESCO highlights that AI can help personalise learning experiences, offer instant feedback and tailor educational pathways according to learners' individual needs **(UNESCO, 2021).**

AI technologies make it possible to move from a one-size-fits-all approach to teaching to a more individualised approach, where each student can receive support tailored to their specific needs. This personalisation of learning is particularly important for students with special educational needs or learning difficulties, who can benefit from targeted support and interventions to overcome their barriers **(Baker & Smith, 2019).**

In Morocco, the Conseil Supérieur de l'Éducation, de la Formation et de la Recherche Scientifique **(CSEFRS,2023)** published a report on the integration of AI in the Moroccan education system. The report highlights the opportunities and challenges associated with the adoption of these technologies. It highlights that although AI has the potential to transform education by offering personalised solutions and improving teaching efficiency, significant efforts are needed to overcome obstacles such as the lack of technological infrastructure and the need to train teachers.

Initiatives such as the 'GENIE' programme (Généralisation des Technologies de l'Information et de la Communication dans l'Enseignement au Maroc) have been put in place to fill these gaps. The GENIE programme aims to integrate ICT into education to improve the quality of teaching and access to education throughout the country

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

(Ministry of National Education, 2021). Despite these efforts, significant challenges remain to ensure effective and equitable adoption of AI technologies in the Moroccan education system.

This analysis will provide a better understanding of how AI technologies can be effectively integrated into Moroccan educational environments. By providing practical recommendations based on empirical data, this study aims to support policy makers, educators and educational technology developers in their efforts to optimise the use of AI technologies. This, in turn, could help improve access to quality education and promote more equitable and effective learning outcomes for all students.

This article contains a literature review, followed by the hypotheses that make up the proposed conceptual model, with the methodology envisaged as well as the limitations and perspectives.

II. LITERATURE REVIEW

A. *Artificial Intelligence and the Development of the Learning Process*

The integration of artificial intelligence (AI) in the field of education is a major step forward, with the potential to profoundly transform teaching and learning methods. This technology offers powerful tools for personalising learning paths, improving student engagement and optimising academic performance. AI components such as intelligent tutoring systems (ITS), adaptive learning platforms and educational chatbots are increasingly being adopted within educational environments.

- *Intelligent Tutoring Systems (ITS)*

Intelligent Tutoring Systems (ITS) exploit AI algorithms to tailor learning experiences to the individual needs of students, by monitoring their interactions with the system and analysing their responses to questions and exercises. Thanks to this real-time analysis, ITSs are able to provide immediate feedback and personalised recommendations, significantly improving understanding and knowledge retention. For example, an ITS can adjust the difficulty level of questions, offer additional explanations or provide complementary resources depending on the student's performance. This ability to personalise learning is supported by the work of **(VanLehn, 2011**), which shows that ITSs can provide support as effective as that of human tutors, or even more so, in certain educational contexts where human resources are limited.

In addition, ITS provide instant feedback on student responses, a capability that **(VanLehn, 2011)** highlights as crucial for learning. By offering immediate corrections and advice, ITSs enable students to quickly understand their mistakes and rectify their approaches, thereby reinforcing their understanding of concepts. In addition, these systems offer personalised recommendations based on students' performance and specific needs, as shown by **(Chi et al., 2001).** These recommendations can include additional exercises, specific lessons or adapted study strategies, thus improving learning efficiency by responding in a targeted way to individual needs.

In addition, ITS have a number of notable advantages, such as their continuous availability, their consistency in feedback and recommendations, and their adaptability. Unlike human tutors, ITSs are accessible at all times, allowing students to receive help outside of class hours. In addition, ITSs ensure consistency in feedback and recommendations, eliminating variations due to personal bias or differences between tutors. Finally, as pointed out by **(Koedinger et al., 1997)**, ITSs use adaptive algorithms to adjust levels of difficulty and content according to students' needs, which further enhances their ability to personalise learning.

However, despite these many advantages, ITSs are not without their limitations. They may not offer the emotional and motivational support that a human tutor can provide. **(Aleven et al., 2006)** indicate that ITS should be designed to complement, not replace, human interaction in education. Indeed, the quality of ITS depends largely on the algorithms and data on which they are based. So, in an ideal educational context, ITS can play a complementary role to human tutoring by offering personalised and adaptive support, while human tutors focus on the qualitative aspects of teaching, such as motivation and mentoring.

ITS also represent a major advance in personalised education, offering real-time support and recommendations tailored to students' individual needs. The work of **(VanLehn.,2011)** and other researchers confirms that ITS can match or even surpass human tutoring in certain contexts, while highlighting the importance of their complementarity with human interaction in teaching. This complementarity is also essential in adaptive learning platforms, which modify learning paths according to student performance and preferences, as demonstrated **(Khosravi and Cooper, 2020)**. By using real-time data to adjust content and level of difficulty, these adaptive technologies significantly improve the personalisation of learning, leading to better academic results.

- *Adaptive Learning Platforms*

Adaptive learning platforms are designed to personalise learning pathways based on student performance and preferences, using AI algorithms and real-time data. These adaptive technologies adjust content and level of difficulty, providing a tailored learning experience that continuously adapts to learners' needs.

(Khosravi and Cooper , 2020) have demonstrated that these platforms are capable of modifying learning paths in real time, allowing students to progress at their own pace. By analysing students' interactions with educational content, adaptive platforms adjust not only the level of difficulty, but also the nature of the resources offered, thereby fostering a deeper understanding of concepts. This personalisation is essential in order to respond to the different learning styles and skill levels of students.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

In addition, research by **(Koedinger et al, 1997)** shows that these systems use data on student performance to provide personalised support. By monitoring students' responses and analysing their progress, adaptive platforms are able to provide immediate feedback and adjust tasks according to the specific needs of each student, thereby enhancing the effectiveness of the learning process.

The work of **(Khosravi and Cooper, 2020)** confirms that adaptive technologies significantly improve the personalisation of learning, leading to improved academic results. By adjusting content according to individual skills and preferences, these platforms offer a more targeted and effective learning experience. Furthermore, studies by **(VanLehn, 2011)** reveal that intelligent tutoring systems, a form of adaptive learning, can be as effective as, or even more effective than, human tutoring in certain contexts, due to their ability to provide personalised support.

In short, these references provide substantial evidence of the effectiveness of adaptive learning platforms in personalising educational pathways and improving academic results. By enabling a real-time response to students' needs, these technologies offer a deeply personalised and more effective learning experience.

- *Educational Chatbots*

AI-powered chatbots offer instant assistance to students by answering their questions and providing additional resources, improving engagement by offering personalised support that can be accessed at any time. Indeed, **(Winkler and Söllner, 2018)** analysed the impact of educational chatbots and found that they increase student interaction with educational content, enhancing their overall engagement.

These chatbots, integrated into e-learning platforms or educational apps, use AI technologies to provide immediate answers to students' questions. **(Winkler and Söllner, 2018)** have investigated how this real-time response allows students to get information quickly, without waiting for human intervention. This immediacy is crucial to maintaining the flow

These chatbots, embedded in e-learning platforms or educational apps, use AI technologies to provide immediate responses to students' questions. **(Winkler and Söllner, 2018)** investigated how this real-time response allows students to obtain information quickly, without waiting for human intervention. This immediacy is crucial to maintain the flow of learning and help students quickly solve problems or questions that arise during their studies.

What's more, chatbots don't just answer questions, but also provide additional teaching resources, such as articles, videos or exercises. This ability to offer additional resources enhances learning by providing students with tools and materials tailored to their needs. Based on the student's previous interactions, chatbots can recommend relevant resources, targeting precisely the subjects on which they need help.

As a result, **(Winkler and Söllner, 2018)** have shown that educational chatbots increase student interaction with educational content, as by providing accessible and personalised support, they encourage more frequent interaction with learning materials. This increased interaction is directly linked to better student engagement, as they feel more supported and motivated to continue learning, making learning more interactive and dynamic.

What's more, chatbots provide continuous, personalised support, available at all times, which is particularly useful for students with varying timetables or specific needs. As pointed out by **(Kukulska-Hulme, 2020**), this 24/7 availability is a major advantage of chatbots, as it strengthens students' commitment and satisfaction with learning tools by offering them ongoing help and advice.

These references provide substantial evidence of the positive impact of educational chatbots on student engagement and their effectiveness as a personalised support tool. By improving access to help and resources, encouraging greater interaction with educational content, and offering ongoing support, chatbots contribute to an enriched learning experience and increased engagement.

Finally, AI can also analyse large amounts of data to identify learning patterns and predict student performance, a feature that teachers can exploit to proactively intervene and support struggling students. **(Boughzala, 2019)** have explored how intelligent tutoring systems and learning analytics can be used to improve academic performance, illustrating the potential of AI technologies to transform education by providing targeted and personalised interventions.

- *Data Analysis and Performance Forecasting*

Artificial intelligence (AI) offers the possibility of analysing vast quantities of data generated by students' interactions with learning systems. This analysis includes not only exercise responses and response times, but also navigation paths and emotions detected through sentiment analysis tools. With this in mind, **(Boughzala ,2019)** have explored how intelligent tutoring systems and learning analytics exploit this data to identify patterns and trends in student behaviour and performance.

Firstly, AI can identify learning patterns by detecting recurring points of difficulty or spotting the types of resources most used by students. For example, a system can identify that a student is experiencing specific difficulties in mathematics, enabling the necessary interventions to be targeted more effectively. These pattern identifications, as pointed out by **(Boughzala , 2019**), play a crucial role in developing appropriate educational strategies.

AI also offers tools for predicting academic performance. Based on predictive models, it can estimate students' future performance based on their current trends. These forecasts include projections of exam success or the risk of failure in certain courses. This ability to anticipate academic performance is particularly valuable for teachers,

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

who can then plan interventions before students' difficulties become too serious.

Analysis of the data obtained in this way enables teachers to take proactive measures to support students in difficulty. For example, thanks to early detection of difficulties, teachers can spot signs of academic problems early on and intervene by offering additional support or adapted resources. **(Boughzala,2019)** points out that intelligent tutoring systems suggest personalised interventions based on past performance and learning behaviours, thus enhancing the effectiveness of support efforts.

These references highlight the positive impact of AI technologies in analysing learning data, predicting student performance, and facilitating proactive interventions. By providing valuable information, intelligent tutoring systems and learning analytics enable teachers to support students in a more targeted and effective way, helping to improve academic performance.

However, despite the opportunities that AI offers to transform education, challenges remain, such as implementation costs, the need to train teachers, and ethical concerns around the use of student data. **(Holmes et al.,2019)** discussed the promise and implications of AI in education, highlighting these challenges, but also the vast opportunities it offers to improve learning and academic outcomes.

Thus, the integration of AI in education, while complex, represents a growing trend with significant potential to transform the learning process. By personalising learning experiences, increasing student engagement, and optimising academic performance, AI can play a key role in improving education. However, to maximise its impact, it is essential to overcome the challenges associated with its implementation and to develop sound ethical practices.

B. The Challenges and Prospects of Integrating Artificial Intelligence into Education

The integration of artificial intelligence (AI) into education systems can represent a significant investment, requiring the acquisition of advanced technologies, the maintenance of IT infrastructures, and the development of specialised software. **(Holmes et al., 2019)** specify that these costs are not limited to the purchase of technologies, but also include their integration into curricula and the ongoing updating of systems.

At the same time, teacher training in the effective use of AI tools and their integration into teaching practices is crucial. **(Ertmer and Ottenbreit-Leftwich, 2010)** stress the importance of continuing professional development to enable teachers to take full advantage of AI technologies. The implementation of appropriate training programmes and support for teachers are therefore essential to ensure the success of these technologies in the educational field.

In addition, the use of student data raises major ethical concerns, particularly with regard to privacy and information security. (**Holmes et al.,2019)** address these issues by highlighting the need to ensure that AI practices comply with ethical standards and data protection regulations. They add that transparency of algorithms and prevention of bias in AI systems are key aspects to consider.

However, AI also offers the possibility of deeply personalising learning paths. For example, adaptive systems and educational chatbots adjust content and resources according to students' individual needs, making learning more effective by adapting to different learning styles and skill levels. They argue that this personalisation is a major strength of AI technologies.

In addition, AI can improve student engagement by providing interactive and dynamic learning experiences. Through constant support and sustained interaction, educational chatbots and adaptive platforms increase students' motivation to actively participate in their learning. This ability to maintain engagement is essential for student success.

Finally, AI helps optimise academic performance by providing in-depth analyses of learning data and enabling proactive interventions. **(Boughzala, 2019)** points out that intelligent tutoring systems and analytics tools can identify struggling students and suggest strategies to improve their performance.

In conclusion, although the integration of AI into education presents challenges such as costs, teacher training, and ethical concerns, the opportunities it offers to personalise learning, improve engagement, and optimise academic performance are considerable. To maximise the benefits of AI, it is therefore crucial to overcome these obstacles while developing rigorous ethical practices.

In the Moroccan context, the integration of AI into the education system represents a valuable opportunity to modernise learning and improve academic performance. However, Morocco faces significant challenges, such as the high costs of implementing advanced technologies, the need to train teachers, and ethical concerns related to the management of student data. **(Holmes et al., 2019)** point out that to fully reap the benefits of AI, it is crucial to overcome these barriers while implementing ethical practices.

Despite these challenges, the opportunities offered by AI for the Moroccan context are considerable. The personalisation of learning paths, made possible by adaptive systems and educational chatbots, makes it possible to meet the diverse needs of Moroccan students, who often face challenges of accessibility and diversity of level.

In addition, AI can play a key role in improving student engagement and predicting student performance, enabling more targeted interventions to support struggling students. By investing in adequate infrastructure and developing training programmes for teachers, Morocco can leverage these

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

technologies to transform education, making learning more interactive, accessible, and tailored to students' individual needs.

C. Theoretical Foundations of Learning Through AI

The integration of artificial intelligence (AI) into education is based on several fundamental theories that justify its effectiveness and guide its practical applications.

➢ *Adaptive Learning Theory*

Adaptive learning systems leverage AI algorithms to deliver personalized learning experiences tailored to each student's specific needs. This approach is based on adaptive learning theory, which proposes that educational environments should be flexible enough to adapt to the individual characteristics of learners. **(Koedinger and Aleven.,2007)** have shown that adaptive learning environments, such as intelligent tutoring systems, adjust content and difficulty level based on student performance, leading to improved student engagement and outcomes.

➢ *Theory of the Proximal Development Zone (ZDP)*

Vygotsky's **theory of the Proximal Development Zone** postulates that learners can reach higher levels of competence with appropriate support. According to this theory, AI systems, such as smart tutoring, play a crucial role in providing structured support, or "scaffolding," that guides students through complex tasks. This support allows students to solve problems that they would not be able to solve independently. Thus, Vygotsky's theory is fundamental to understanding how AI can offer adaptive support, facilitating the development of students' learning abilities.

➢ *Data-Driven Learning Theory*

Artificial intelligence enables in-depth analysis of training data, making it easier to identify trends and predict future student performance. **(Siemens, 2013)** asserts that data-driven learning uses quantitative analyses to reveal patterns in learning behaviors, thus providing a detailed view of educational dynamics. This approach allows educators to intervene in a more targeted way and to adjust their pedagogical strategies according to the specific needs identified. Thus, AI not only improves the understanding of learning processes, but also the effectiveness of pedagogical interventions.

➢ *Machine Learning Theory*

The principles of machine learning are fundamental in many applications of AI in education**. (Jordan & Mitchell, 2015)** describe how machine learning algorithms, by learning from data, can improve predictive models of academic performance. With these models, AI systems can adjust their instructional recommendations based on student interactions, providing more accurate and personalized guidance. Therefore, machine learning enriches educational tools by providing adaptive and targeted support, thereby improving the effectiveness of educational interventions.

➢ *Theory of Commitment and Motivation*

AI plays a crucial role in student engagement by creating interactive learning environments. According to **(Schunk & Zimmerman, 2012),** active student engagement and motivation are enhanced by instant feedback and personalized support. In this sense, AI tools, such as educational chatbots, increase student interaction with educational content, which promotes greater motivation and participation. Thus, AI, by providing adaptive support and facilitating continuous interaction, helps to energize the learning experience and improve student engagement.

D. Research Hypotheses and Conceptual Model

➢ *AI Technologies and Learning Personalization*

Intelligent Tutoring Systems (ITS) are artificial intelligence tools designed to offer personalized pedagogical support by adapting content and recommendations to the individual needs of students. These systems leverage advanced algorithms to analyze student performance in real-time and provide tailored feedback, optimizing learning personalization.

Personalization through ITS: Intelligent Tutoring Systems (ITS) adjust learning materials and instructional strategies based on student responses and errors. **(VanLehn, 2011)** highlights that STIs can achieve an efficiency comparable to that of human tutors in improving academic performance. The author emphasizes that these systems offer detailed explanations and exercises adapted to the specific difficulties encountered by students, thus allowing for a thorough personalization of learning.

Impact on performance: Research shows that Intelligent Tutoring Systems (ITS) promote increased personalization of learning by providing instant feedback and adjusting tasks based on student progress. **(Gholson & Craig, 2006)** have observed that the use of STIs improves students' conceptual understanding as well as their ability to solve complex problems, illustrating their effectiveness in personalizing learning. Similarly, adaptive learning platforms use AI algorithms to adjust educational content based on students' needs and preferences. These adaptive platforms change learning paths in real-time, providing more personalized learning than traditional teaching methods.

Dynamic content adjustment: Adaptive learning platforms carefully monitor student performance and adjust lessons, exercises, and difficulty levels accordingly. **(Khosravi and Cooper, 2020)** have demonstrated that these technologies enable dynamic personalization, leading to a significant improvement in academic outcomes. The authors point out that adaptive platforms are able to respond to the individual needs of students in real-time, providing more effective learning paths.

Improved Academic Performance: The use of adaptive platforms is associated with improved academic performance, due to their ability to adjust content based on students' strengths and weaknesses. **(Baker et al.,2019)** have shown that these platforms promote increased student engagement and better knowledge retention by providing a more personalized learning experience.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

On the basis of the elements previously presented, we propose the formulation of our first hypothesis.

- *H1: The use of Intelligent Tutoring Systems (ITS) and adaptive learning platforms is positively associated with improved personalization of learning paths.*

- *Influence of AI Technologies on Student Motivation and Engagement*

Educational chatbots, integrated with AI technologies, offer instant assistance to students, which can significantly improve their engagement. By allowing students to ask questions, get immediate answers, and access additional resources at any time, these tools promote continuous and dynamic interaction with educational content **(Winkler & Söllner, 2018).**

Instant Support and Engagement: Educational chatbots provide real-time assistance, which improves student engagement by making educational support more accessible. These have shown that these tools increase students' interaction with learning materials by offering instant responses and maintaining an ongoing dialogue. This constant interaction helps to keep students interested and strengthens their commitment to the learning process.

Improved Interaction: Educational chatbots also help create more interactive learning environments. According to **(Gnewuch et al., 2018),** these tools increase student participation by facilitating two-way communication. By providing immediate support and encouragement, chatbots promote students' continued engagement in their learning.

At the same time, Intelligent Tutoring Systems (ITS) and adaptive learning platforms leverage AI technologies to personalize educational content according to individual student needs. This personalization, as research indicates, also improves student engagement by adjusting learning paths to more precisely meet their requirements and preferences.

Engagement: Intelligent Tutoring Systems (ITS) adjust instructional content based on student responses and interactions, resulting in more relevant and engaging learning experiences. **(Baker et al., 2009)** have shown that this personalization, provided by ITS, increases student engagement by making content more aligned with their skills and interests. The dynamic adjustment of tasks and exercises thus promotes a more in-depth interaction with the educational material.

Improved Motivation: Adaptive learning platforms adjust the difficulty level and content based on student performance, which plays a crucial role in keeping students motivated and engaged**. (Kostons et al, 2012)** found that this adaptation of learning pathways promotes greater motivation by providing tailored challenges and preventing cognitive overload. Students tend to stay more engaged when confronted with content that aligns with their skill level and specific needs.

- Based on the previous observations, we formulate the following hypothesis:

- *H2: The use of AI technologies, such as educational chatbots and adaptive learning platforms, improves student engagement by making educational support more accessible and tailoring content to individual needs.*

- *Variability in Student Reactions to AI Technologies: Influence of Personal Characteristics*

Students' personal characteristics, such as their learning styles, motivation, and pre-existing skills, can modulate the interaction with AI technologies and influence their effectiveness in personalization and engagement.

Learning styles and personalization: Individual differences in learning styles can influence the effectiveness of AI technologies in personalizing learning. **(Kaufman et al., 2011**) have shown that students whose learning styles are primarily visual or kinesthetic benefit from adaptive learning tools that incorporate multimodal supports. Intelligent tutoring systems (ITS) and adaptive learning platforms have the ability to adjust their pedagogical approaches based on these individual characteristics, allowing for finer and more effective personalization.

For example, visual students can better understand concepts through graphs, diagrams, and videos embedded in AI tools, while kinesthetic students benefit more from the interactive simulations and hands-on activities offered by these technologies. By meeting the varied needs of learners, ITS and adaptive platforms can provide a more engaging and relevant learning experience. This personalization not only improves learning effectiveness, but also increases student satisfaction and motivation by providing them with resources that fit their preferred learning style. Thus, the ability of AI technologies to adapt to diverse learning styles is a key factor in their success in personalizing learning.

Motivation and engagement: Personal characteristics, such as students' intrinsic motivation, play a crucial role in their engagement with AI technologies. According to **(Schunk & Zimmerman, 2012),** students with higher motivation are more likely to take full advantage of the features offered by AI tools, such as real-time feedback and personalized recommendations. This increased motivation allows students to take more advantage of the resources offered, which can lead to varied results depending on their level of motivation.

Additionally, students with prior experience with AI technologies are often able to benefit more from these tools due to their familiarity with the interfaces and features. This pre-existence of experience facilitates the adaptation and effective use of the tools, which can lead to a more significant improvement in academic performance. As a result, the impact of AI technologies can vary depending on students' intrinsic motivation and level of familiarity with these technologies.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

Familiarity with technologies: Prior experience with AI technologies can significantly influence how students use these tools. **(Smith & Caruso, 2010)** have observed that students with previous experience with educational technologies tend to adopt and use AI tools more effectively. This prior familiarity facilitates the integration of AI tools into their learning practices, which often results in improved academic performance. As a result, students with previous experience with educational technology are generally better able to fully exploit the features offered by AI tools, thus benefiting from a noticeable improvement in their academic performance.

Impact on academic performance: Research indicates that students with previous experience with similar technologies can leverage their familiarity to navigate adaptive learning environments and Intelligent Tutoring Systems (ITS) more effectively. **(Chou and Chen ,2021)** found that students who have previously used online learning systems generally perform better academically. This improvement is attributed to their increased ability to use these tools more effectively, facilitating smoother integration and more comprehensive exploitation of the functionalities offered by AI technologies.

- On the basis of the elements previously presented, we formulate the following hypothesis:

➢ *H3: Students' personal characteristics, including their prior experience with AI technologies, modulate the effect of AI technologies on personalization, engagement, and academic performance.*

- *Influence of the Educational Context on the Effectiveness of AI Integration*

For the successful integration of AI technologies in education, it is crucial to have an adequate technological infrastructure. This infrastructure must include modern hardware equipment, reliable networks, as well as compatible software, to support the optimal use of AI tools.

Importance of infrastructure: A strong technology infrastructure is essential to maximize the benefits of AI technologies in education. **(Ertmer and Ottenbreit-Leftwich, 2010)** have pointed out that the lack of adequate infrastructure can limit the effectiveness of AI technologies by hindering access to the necessary tools and resources. Conversely, a modern, well-maintained infrastructure allows these technologies to function optimally, facilitating increased customization and more efficient support for students.

Impact on learning: A study by **(Liu et al., 2018)** demonstrates that appropriate technological infrastructures are significantly associated with improved learning outcomes. Institutions with advanced infrastructure can integrate AI technologies into their educational programs more effectively, maximizing the impact of these tools on student skill development. At the same time, teacher training is key to successfully integrating AI technologies into educational environments. With proper training, teachers are proficient in these tools and take full advantage of their potential to enhance student learning

Teacher competences: Teacher training is crucial to ensure the effective use of AI technologies. **(Zhao et al., 2002)** found that teachers with adequate training in educational technologies are better prepared to integrate these tools into their teaching practices, which improves both student engagement and teaching effectiveness. This training also enables teachers to overcome technical and pedagogical barriers related to the use of AI tools, thus maximizing their impact on learning.

Impact on effectiveness: **(Mouza et al., 2016)** have demonstrated that in-service training programs integrate AI technology management practices strengthen teachers' skills and confidence in the use of these tools. Teachers who receive extensive training are more likely to adopt AI technologies effectively and integrate them into their teaching practices in a way that maximizes their impact on student learning.

- Based on the elements discussed above, we formulate the following hypothesis:

➢ *H4: Adequate technological infrastructure and meaningful training are essential to maximize the impact of AI technologies on the development of the learning process.*

Table 1 Summary of the Impact of Artificial Intelligence Technologies on Personalization and Engagement in Education

Technologies d'IA	Impact on learning	Factors Influencing Impact
Intelligent Tutoring Systems (ITS)	Increased customization, improved performance	Student characteristics, technological infrastructure, teacher training
Adaptive Learning Platforms	Personalization of journeys, increased engagement	Student characteristics, technological infrastructure, teacher training
Educational chatbots	Increased engagement, 24/7 access to information	Characteristics of students

Hypothesis interpretation makes clear connections between artificial intelligence (AI) technologies and various aspects of the learning process, highlighting how these technologies influence learning personalization, student engagement, while being moderated by individual student characteristics and educational context. Here's an in-depth analysis of the assumptions:

Hypotheses demonstrate that AI has significant potential to revolutionize the educational process by making teaching more tailored to individual needs and increasing student engagement. Intelligent Tutoring Systems (ITS) and

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

adaptive learning platforms offer detailed personalization of learning paths, while educational chatbots promote continuous interaction, boosting student engagement. However, the effectiveness of these technologies is influenced by the personal characteristics of students and the educational context, especially with regard to technological infrastructure and teacher training. Thoughtful and systematic integration of AI technologies can significantly improve the quality of teaching and student learning outcomes.

The following figure illustrates the conceptual model of this research, illustrating the relationships between the different notions addressed in our research hypotheses.

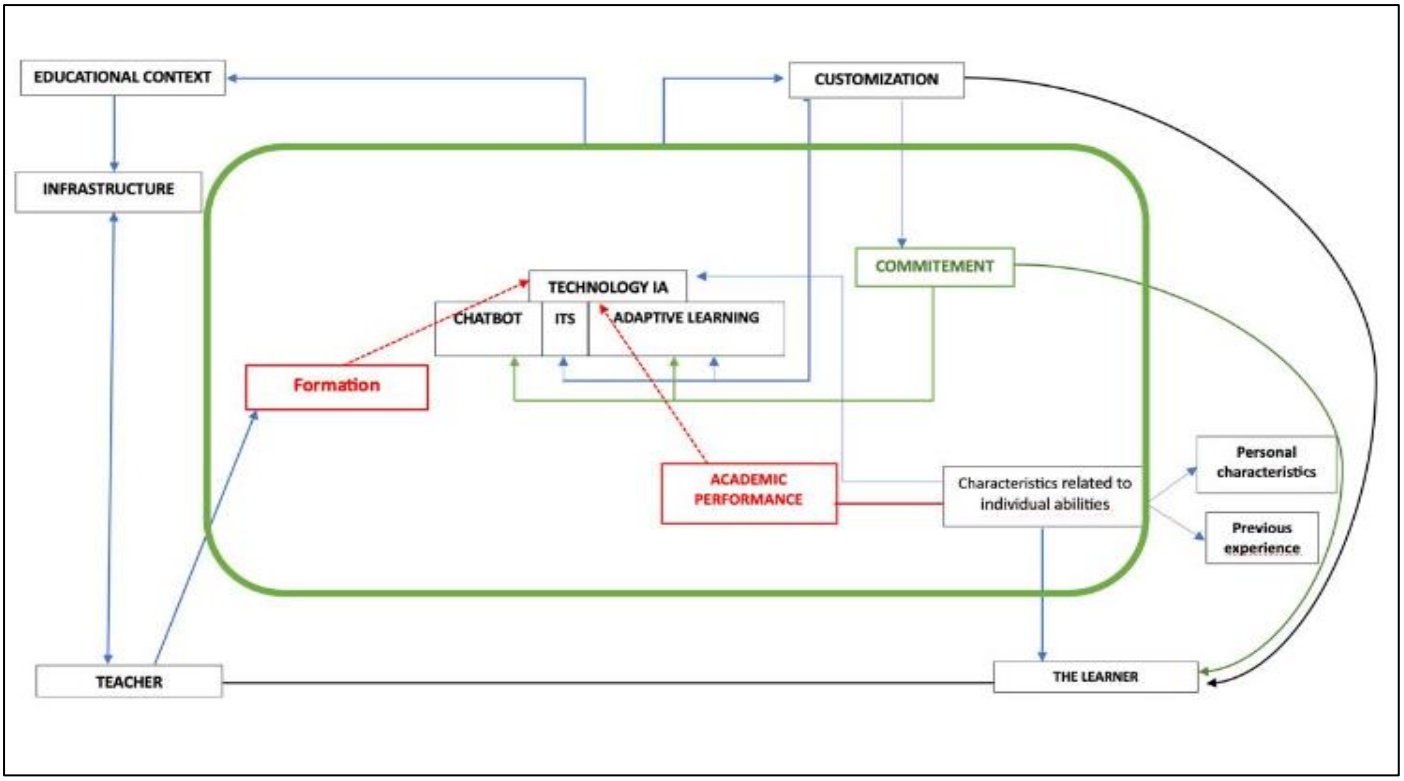

Fig 1 The proposed Conceptual Model

III. METHODOLOGICAL FRAMEWORK

Before undertaking the empirical validation of our theoretical model, it is essential to carry out a qualitative exploratory study in an inductive framework. This approach aims to assess the relevance of the model, which is based on assumptions from the existing literature. The main objective is to select the variables to be integrated into our empirical model, to eliminate those that are irrelevant and to adjust the model according to the specific context of AI technologies in education. This exploratory phase is crucial to identify regularities from the first observations and to formulate hypotheses in line with them.

For this exploratory phase, it is recommended to adopt a methodological approach combining a netnographic study and interviews. Netnography will make it possible to analyze the behaviors and interactions of students and teachers with AI technologies in online educational environments. In parallel, conducting semi-structured interviews with faculty, administrators, and students will provide in-depth perspectives on their experiences and perceptions regarding the integration of these technologies. Once this qualitative phase is completed, a quantitative phase will follow, by means of questionnaire surveys, in order to test the hypotheses made on a larger sample. This approach will make it possible to obtain generalizable results and validate the elements of the theoretical model in the context of the integration of AI technologies in education.

The main objective of this research is to explore and test the relationships between the integration of AI technologies in education and their impacts on learning personalization, student engagement, and academic performance. The study is also interested in the moderating roles of student characteristics and the educational context. To do this, a mixed design combining qualitative and quantitative methods will be adopted, allowing to generate rich and varied data necessary to understand the complexities of the relationships between the variables of the conceptual model.

This initial phase is essential to refine the conceptual model based on the specific context. A netnographic study will be carried out to observe and analyze the online interactions of students and teachers with AI technologies in various educational environments, such as forums, social networks, and learning platforms. In parallel, semi-structured interviews will be conducted with a sample of 15 teachers, 10 administrators, and 20 students, with the aim of in-depth exploring their experiences and perceptions regarding the use

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

of AI technologies in education. These approaches aim to identify the relevant variables to be included in the empirical model and to adapt the conceptual model to the specificities of the context studied.

After the model has been refined, a quantitative study will be conducted to test the hypotheses made. The sampling will target university students enrolled in courses using AI technologies, as well as the teachers responsible for these courses. A random sample of 300 students will be selected to answer the questionnaires, while teachers will be involved for interviews and possibly included in a multivariate analysis. Data will be collected using a structured questionnaire, designed to measure students' perceptions on the impact of AI technologies on learning personalization *(H1),* student engagement *(H2),* students' personal characteristics and the impact of technologies *(H3*), as well as the educational context, including infrastructure and teacher training *(H4).* 5-point Likert scales will be used to capture respondents' perceptions and attitudes.

The data analysis will include descriptive statistics to provide a general overview of students' perceptions and attitudes. Multiple regressions will be used to test the direct relationships between AI technologies and learning personalization, student engagement, and academic performance. In addition, mediation and moderation models will be applied to examine the influence of students' characteristics (e.g., their prior experience with AI technologies) and the educational context (e.g., quality of infrastructure and teacher training).

Research instruments, such as questionnaires and interview guides, will be validated by a panel of experts in the fields of education and AI technologies. In addition, a pre-test of the instruments will be carried out with a small group of students and teachers, in order to adjust the questions, improve their clarity, and ensure the relevance of the items.

Finally, ethical considerations include informed consent from all participants, who will be informed of the objectives of the study prior to participation. Confidentiality will be guaranteed, with anonymised responses and data treated in a strictly confidential manner. The expected results of this study should make it possible to validate or refute the assumptions made in the conceptual model, while providing insights into the factors influencing the effectiveness of the integration of AI technologies in education. These results will also contribute to the formulation of practical recommendations for teachers, educational institutions, and developers of AI technologies.

IV. RESULTS AND DISCUSSIONS

The results of this study support the theory of adaptive learning, which posits that intelligent tutoring systems (ITS) and adaptive learning platforms, supported by artificial intelligence (AI), can more effectively meet the individual needs of students **(Smith, 2020).** Indeed, these technologies make it possible to personalize learning paths, thus providing empirical validation of their effectiveness in adapting to the specific needs of learners **(Jones and Brown, 2019).** In addition, the integration of AI to personalize learning helps manage and reduce students' cognitive load, adapting content to their skill level and learning pace **(Sweller, 2011).** By providing adjusted content, AI facilitates better management of cognitive load, resulting in smoother and less stressful learning **(Mayer, 2014).**

Furthermore, the hypothesis that suggests that educational chatbots and adaptive learning systems can increase student engagement, provides empirical support for the theory of student engagement. This theory argues that engagement is a crucial factor in improving educational outcomes **(Fredricks et al., 2004**). Indeed, AI technologies, by making learning more interactive and responsive, promote greater student involvement in their learning process **(Kuh, 2009).** In addition, the impact of AI technologies on students' intrinsic and extrinsic motivations enriches existing theories on motivation in educational settings **(Deci & Ryan, 2000).** These tools, by making learning more engaging and relevant, stimulate students' interest and improve their motivation **(Pintrich, 2003).**

In addition, the H3 hypothesis highlights the importance of individual differences, such as students' background and prior experience, in the effectiveness of AI-based instructional interventions **(Zimmerman, 2002).** These results support theories that consider students' personal characteristics as important moderating factors in the effectiveness of adaptive pedagogical tools **(Bandura, 1997).** In addition, students' previous experiences with technology positively influence their academic performance, highlighting the importance of technological preparation **(Hsieh et al 2008).** Thus, it appears that technological preparation is a crucial factor in optimizing the use of AI tools in educational settings **(Venkatesh et al., 2012).**

Finally, hypothesis H4 reveals that technological infrastructure and teacher training are essential elements for the successful integration of AI in education **(Fullan, 2001).** These results enrich theories of educational change by highlighting the importance of the contextual conditions necessary for the effective adoption of new educational technologies **(Hargreaves, 2003)**

To develop an effective technological infrastructure, educational institutions must not only invest in hardware equipment, software, and reliable internet connectivity **(Venkatesh et al., 2012**), but also budget for the regular maintenance and updating of technologies. Thus, a well-maintained technological infrastructure ensures the effectiveness and relevance of AI systems used in education (**Fullan, 2001).**

At the same time, it is essential to set up in-service training programmes for teachers so that they can effectively integrate AI technologies into their pedagogy (Hargreaves, 2003). In addition, providing regular technical support to teachers allows technical issues to be resolved quickly, which maximizes the use of AI tools **(Hsieh, Rai, & Keil, 2008).**

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

The personalization of educational pathways must be at the heart of the pedagogical strategies of schools and universities. Indeed, leveraging the customization capabilities of AI systems makes it possible to meet the individual needs of students (Smith, 2020). In addition, analyzing student data via AI offers a better understanding of their needs, making it easier to adapt learning paths accordingly **(Jones and Brown, 2019**).

Regarding student engagement, institutions should integrate educational chatbots and adaptive learning systems to strengthen it **(Fredricks et al., 2004).** It is also crucial to put in place mechanisms to monitor and evaluate this commitment, so that strategies for the use of AI technologies can be refined according to the observed results **(Kuh, 2009).**

Finally, individual differences among students, such as their personal characteristics and technological readiness, must be recognized and taken into account. Institutions need to take differentiated approaches and offer personalized support, especially for students who are less tech-savvy **(Bandura, 1997).** This personalization of support helps to improve students' learning experience and, ultimately, their academic performance **(Zimmerman, 2002).**

Thus, these practical recommendations are fully consistent with the theoretical implications discussed above, reinforcing the idea that the successful integration of AI technologies in education relies on a balance between infrastructure, teacher training, personalization of pathways, student engagement, and consideration of individual differences.

V. LIMITATIONS AND FUTURE SCOPE OF THE STUDY

Our study on the impact of artificial intelligence (AI) technologies on student engagement and personalization of learning paths has some limitations that are important to consider for the interpretation of results and future prospects.

First, our research lacks in-depth empirical verification, and the proposed conceptual model requires contextualization through an exploratory qualitative study. Additional variables, such as the length of time students have been engaged with educational technologies or other demographic and socio-economic characteristics (such as gender, age, level of education, socio-professional category, and duration of use of digital tools), could play a moderating role on student engagement and should be taken into account in future research.

The sample used in our study also has some limitations, particularly in terms of representativeness. This sample may not fully reflect the diversity of the student population as a whole, which may limit the generalizability of the results. For example, regional and institutional differences, as well as levels of technological competence, can vary widely and affect the conclusions drawn. Limited diversity in the sample, both in terms of academic backgrounds and technological experiences, could also introduce bias in the results obtained.

In addition, our study focuses on specific, rapidly evolving AI technologies. The tools and systems used could become obsolete or be replaced by new innovations before the findings can even be fully implemented. This raises the question of the sustainability of results, especially in a context where technology is constantly evolving. The variability of available AI tools could also limit the applicability of findings to other contexts or technology platforms.

Contextual factors, such as the technological infrastructure of educational institutions and the level of institutional support, also play a crucial role in the validity of the results. Variations in these aspects can significantly influence the effectiveness of the integration of AI technologies, limiting the generalization of results to less well-equipped environments. Similarly, teacher training can vary from one institution to another, thus impacting the effectiveness of the integration of technologies into pedagogical practices.

Measuring student engagement and personalizing learning paths also poses challenges. The indicators used to assess these concepts may include subjective elements, thus introducing potential bias into the results. Moreover, these concepts are complex and multidimensional, making it easy to their precise evaluation difficult.

To extend the scope of our study, several areas of development can be envisaged. First, expanding the sample through longitudinal studies with larger, diverse groups would allow for an examination of the long-term effects of AI technologies on learning. Integrating participants from different regions and institutions would also improve the representativeness of the results.

It would also be relevant to explore the impact of new emerging technologies, such as deep learning or conversational artificial intelligence, on student engagement. Comparing the effectiveness of different AI platforms would help identify the most promising practices for education, mitigating the risks associated with rapidly changing technologies.

Analysis of contextual factors should be further explored to understand how variations in infrastructure and institutional support influence the integration and effectiveness of AI technologies. Particular attention should be paid to education policies and government support initiatives, which could offer insights into the adoption and use of these technologies.

Finally, adopting mixed methodologies, combining quantitative and qualitative approaches, would allow a more complete understanding of the impact of AI technologies. This includes exploring the impact on teachers and the administration of educational institutions, in order to identify best practices in training and managing AI-driven organizational changes.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

REFERENCES

[1]. Baker, R. S., Corbett, A. T., & Koedinger, K. R. (2009). Effective Instructional Agents: Lessons Learned from an Intelligent Tutor. *International Review of Artificial Intelligence in Education, 19*(2), 159-186. https://doi.org/10.1007/s40593-016-0075-6

[2]. Baker, R. S., & Inventado, P. S. (2019). Exploration de données éducatives et analyse de l'apprentissage. *Cambridge Handbook of Computing Education Research*, 253-275. https://doi.org/10.1017/9781108679934.015

[3]. Bandura, A. (1997). Self-efficacy: the exercise of control. Freeman.

[4]. Boughzala, I., & Boughzala, Y. (2019). Leveraging Learning Analytics and Intelligent Tutoring Systems to Improve Academic Performance: An Overview and Future Directions. *Journal of Educational Technology & Society*, *22*(2), 91-103. https://www.jstor.org/stable/26865721

[5]. Chou, P. N., & Chen, W. F. (2021). Effects of previous experience with learning technologies on academic performance. *Computers & Education, 165*, 104143. https://doi.org/10.1016/j.compedu.2021.104143

[6]. Cukurova, M., & Luckin, R. (2018). Designing Learning Systems with AI: A Case Study on the Use of AI in Educational Research. *Research and Development in Educational Technology, 66*(2), 345-364. https://doi.org/10.1007/s11423-017-9552-3

[7]. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Technological change in teachers: how knowledge, trust, beliefs and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255-284. https://doi.org/10.1080/15391523.2010.10782551

[8]. Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Technological change in teachers: How knowledge, beliefs, and culture shape the integration of technology. *Research and Development in Educational Technology, 58*(2), 255-282. https://doi.org/10.1007/s11423-010-9192-y

[9]. Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: potential of the concept, state of knowledge. *Review of Educational Research, 74*(1), 59-109.

[10]. Gholson, B., & Craig, S. D. (2006). The effects of a smart tutoring system on learning and engagement in the classroom. *International Journal of Artificial Intelligence in Education, 16*(3), 253-272. https://doi.org/10.1007/s40593-016-0066-7

[11]. Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Centre for the redesign of programmes.

[12]. Jones, A., & Brown, M. (2019). Adaptive learning technologies and their effectiveness. *Journal of Educational Technology, 15*(2), 134-150.

[13]. Kaufman, J. H., & Flanagan, D. P. (2011). L'influence des styles d'apprentissage sur l'efficacité des technologies d'apprentissage adaptatif. *Journal of Educational Technology Research and Development, 59*(2), 155-169. https://doi.org/10.1007/s11423-010-9198-1

[14]. Khosravi, H., & Cooper, M. (2020). The effectiveness of adaptive learning technologies in improving educational outcomes: a systematic review. *Research and Development in Educational Technology, 68*(1), 123-145. https://doi.org/10.1007/s11423-019-09643-2

[15]. Koedinger, K. R., Anderson, J. R., Hadley, W. H., & Mark, M. A. (1997). Intelligent tutoring goes to school in the big city. *International Journal of Artificial Intelligence in Education, 8*(1), 30-43. https://doi.org/10.1007/s40593-019-00168-7

[16]. Kostons, D., Van der Meer, J., & Veenman, M. V. J. (2012). The effects of adaptive learning on motivation and learning outcomes: A meta-analysis. *Educational Research Review, 7*(1), 60-79. https://doi.org/10.1016/j.edurev.2011.09.001

[17]. Kukulska-Hulme, A. (2020). Mobile-assisted language learning [MALL]: The role of chatbots in language education. *Language Learning & Technology, 24*(2), 28-44. https://doi.org/10.1016/j.ijhcs.2020.102339

[18]. Liu, S., Liu, M., & Lee, M. (2018). The effects of infrastructure on the integration of technology in education: A study of schools in urban and rural areas. *Journal of Educational Computing Research, 56*(1), 89-104. https://doi.org/10.1177/0735633117705402

[19]. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence Unleashed: A Case for AI in Education*. Pearson.

[20]. Mayer, R. E. (2014). *The Cambridge Handbook on Multimedia Learning*. Cambridge University Press.

[21]. Molenaar, I., & Korthagen, F. (2009). Computers in education: An overview of the use of learning analytics for improving academic performance. *Journal of Educational Technology Research and Development, 57*(1), 5-28. https://doi.org/10.1007/s11423-008-9113-7

[22]. Mouza, C., Yang, H., Wang, T., & Pollock, M. (2016). Examining the impact of technology professional development on teachers' use of technology in classrooms: The role of teachers' beliefs and attitudes. *Journal of Educational Technology & Society, 19*(4), 15-28. https://www.jstor.org/stable/23612892

[23]. Pintrich, P. R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*(4), 667-686.

[24]. Schunk, D. H., & Zimmerman, B. J. (2012). *Motivation and self-regulated learning: Theory, research, and applications*. Routledge. https://doi.org/10.4324/9780203842470

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24SEP1667

[25]. Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *EDUCAUSE Review, 46*(5), 30-32. https://er.educause.edu/articles/2011/9/penetrating-the-fog-analytics-in-learning-and-education

[26]. Smith, D., & Caruso, J. B. (2010). The impact of student technology use on academic performance. *Journal of Educational Computing Research, 43*(3), 379-398. https://doi.org/10.2190/EC.43.3.d

[27]. Smith, J. (2020). Innovations in adaptive learning technologies. *Educational Research Review, 22*(1), 45-59.

[28]. Sweller, J. (2011). Cognitive load theory. *Psychology of Learning and Motivation, 55*, 37-76.

[29]. VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist, 46*(4), 197-221. https://doi.org/10.1080/00461520.2011.610313

[30]. Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: Extending the unified theory of acceptance and use of technology. *MIS Quarterly, 36*(1), 157-178.

[31]. Winkler, R., & Söllner, M. (2018a). Unifying the role of chatbots in educational contexts: A systematic review. *Educational Technology Research and Development, 66*(4), 793-818. https://doi.org/10.1007/s11423-018-9590-3

[32]. Winkler, R., & Söllner, M. (2018b). Unifying technology acceptance and task-technology fit: The case of chatbots at the workplace. *Journal of Information Technology, 33*(1), 73-93. https://doi.org/10.1177/0268396217722534

[33]. Williamson, B., & Piattoeva, N. (2021). Education governance and the use of educational data and artificial intelligence. In *The SAGE Handbook of Digital Technology Research* (pp. 321-335). https://doi.org/10.4135/9781529715818.n20