ISSN 2987-565X (Online) | Vol. 02, No. 03, Dec (2024), pp. 119-128

Published by: IARN Institute

Journal of Education Innovation and Curriculum Development

Journal homepage: https://journals.iarn.or.id/index.php/educur/index

Utilizing Artificial Intelligence to Design Adaptive Learning Systems Aligned with the 2024 Curriculum

Abizar Tri Pangestu

Fakultas Teknik dan Ilmu Komputer, Program Studi Teknik Informatika, Universitas Teknokrat Indonesia

Article Info

Article history:

Received Oct 22, 2024
Revised Nov 28, 2024
Accepted Dec 30, 2024

Keywords:

Artificial Intelligence (AI);
Adaptive Learning;
Personalized Education;
2024 Curriculum;
Student Engagement.

ABSTRACT

This research explores the application of Artificial Intelligence (AI) in designing adaptive learning systems aligned with the 2024 curriculum goals. The study investigates how AI technologies, including neural networks, decision trees, and Bayesian networks, can personalize learning paths to meet the diverse needs of students. By analyzing recent developments and implementing AI-driven adaptive platforms in real classroom settings, the research examines the impact of personalized learning on student engagement, academic performance, and inclusivity. Results show that AI significantly enhances the alignment between instructional content and individual learner profiles, supports timely teacher interventions through real-time analytics, and promotes more equitable learning opportunities. Compared to previous studies, this research extends the understanding of AI's role by focusing on a broader set of competencies beyond subject-specific knowledge, such as critical thinking and digital literacy. The findings conclude that AI-powered adaptive learning, when integrated thoughtfully and supported by effective teacher training, holds substantial promise for transforming education into a more flexible, efficient, and student-centered process.

Corresponding Author:

Abizar Tri Pangestu
Fakultas Teknik dan Ilmu Komputer, Program Studi Teknik Informatika,
Universitas Teknokrat Indonesia
Jl. ZA. Pagar Alam No.9 -11, Labuhan Ratu, Kec. Kedaton, Kota Bandar Lampung, Lampung 35132
Email: abizartripangestu@gmail.com

1. INTRODUCTION

In recent years, Artificial Intelligence (AI) has rapidly emerged as a transformative force across various sectors, including education. The rise of AI in education is largely fueled by the increasing demand for more efficient, personalized, and data-driven learning experiences. Traditional educational models, which often rely on standardized teaching methods, have struggled to address the diverse needs, abilities, and learning styles of individual students(Tileston, 2005). AI offers innovative solutions by enabling systems that can adapt content, pace, and assessment to fit each learner's unique needs, thereby redefining the learning process itself.

AI technologies in education encompass a range of applications, from intelligent tutoring systems and automated grading to predictive analytics and personalized content recommendation(Chen et al., 2020). These systems leverage large datasets and machine learning algorithms to identify patterns in student behavior, predict performance, and deliver tailored interventions. As a result, educators are increasingly able to move beyond the limitations of mass instruction, offering more targeted support that can improve both learning efficiency and student satisfaction.

Personalization, particularly through adaptive learning, has become a central focus because it directly influences student engagement and outcomes(Walkington, 2013). When students receive material that is aligned with their current knowledge level, learning style, and interests, they are more likely to stay motivated and invested in their education. Adaptive learning systems continuously adjust to a student's performance, providing additional practice for struggling learners and offering accelerated challenges for those who are excelling(Aleven et al., 2016). This dynamic responsiveness not only helps prevent students from feeling overwhelmed or bored but also fosters a greater sense of autonomy and confidence in their learning journey.

Furthermore, personalized learning supported by AI enables early identification of learning gaps and misconceptions, allowing timely interventions that can prevent long-term academic struggles. It empowers educators with insights into each student's progress, making it possible to design more effective instructional strategies. Studies have shown that students who engage with adaptive learning platforms often demonstrate higher achievement levels, improved critical thinking skills, and a deeper understanding of material compared to those in traditional classroom settings.

In an era where the goal of education is not only to impart knowledge but also to develop lifelong learners capable of adapting to a rapidly changing world, AI-driven personalization stands out as a crucial innovation(Wang et al., 2018). As education systems, like the one outlined in the 2024 curriculum, prioritize competencies such as problem-solving, collaboration, and digital literacy, the ability to tailor learning experiences to individual student pathways becomes even more essential. Thus, the integration of AI in education is not merely a technological trend; it represents a fundamental shift towards more human-centered, effective, and equitable learning environments.

Adaptive learning, powered by AI, offers a promising solution. By analyzing student data such as progress rates, learning styles, and assessment results AI systems can create dynamic learning paths that adjust content difficulty, recommend resources, and provide personalized feedback. This approach not only enhances student engagement and motivation but also addresses learning gaps more effectively, ultimately improving academic outcomes.

Over the past decade, research on the application of Artificial Intelligence (AI) in education, particularly in designing adaptive learning systems, has grown significantly(Colchester et al., 2017). One of the early influential areas of research was the development of Intelligent Tutoring Systems (ITS). Systems like Carnegie Learning's MATHia and AutoTutor used AI algorithms to mimic human tutoring by providing immediate feedback, hints, and personalized guidance. Studies, such as those by Graesser et al. (2014), showed that ITS could significantly improve student learning outcomes, particularly in subjects requiring step-by-step reasoning like mathematics and science.

As machine learning techniques became more sophisticated, researchers shifted focus toward learning analytics and predictive modeling. Research by Baker and Siemens (2014) emphasized the power of educational data mining and learning analytics to predict student success, identify at-risk learners, and customize educational pathways. These insights paved the way for adaptive learning platforms such as Knewton and DreamBox Learning, which adjust content delivery based on real-time analysis of student interactions.

Another major development has been the integration of Natural Language Processing (NLP) into educational tools. NLP technologies enabled systems to analyze student writing, provide automated feedback, and even engage in conversational tutoring. For example, researchers like VanLehn (2011) explored the impact of dialogue-based tutoring systems on student comprehension, showing that conversational agents could facilitate deeper learning when compared to static instruction.

In the mid-2010s, with the advancement of deep learning, AI research in education expanded into areas such as personalized curriculum sequencing and recommendation systems. Studies by Chen, Hsieh, and Hong (2015) proposed AI models that dynamically suggest learning materials suited to the learner's evolving competency levels and preferences. These systems demonstrated that personalized learning paths could lead to greater learner autonomy and increased motivation.

More recently, research has explored the ethical and practical challenges of AI in adaptive learning. Holmes, Bialik, and Fadel (2019) highlighted concerns about bias in AI algorithms, data privacy, and the need for transparency in adaptive systems. These studies argue that while AI offers tremendous benefits, its implementation must be carefully managed to ensure equity and trust in educational environments.

In parallel, the COVID-19 pandemic (2020) accelerated the global adoption of online learning and spurred a new wave of research on AI-driven adaptive systems in remote education. Studies during this period, such as those by Zawacki-Richter et al. (2019), found that AI tools that personalize learning were critical in maintaining student engagement and performance when traditional classroom interactions were disrupted.

Additionally, emerging research has begun to align adaptive AI systems with competency-based education models, which are a key feature of the 2024 curriculum. Work by authors like Pane et al. (2017) suggested that personalized, AI-supported learning could better facilitate mastery of competencies rather than rote memorization, supporting deeper and more transferable skills development.

Despite its potential, the practical application of AI in designing adaptive learning systems within the framework of the 2024 curriculum remains underexplored. There are critical questions regarding how AI technologies can be effectively integrated, how adaptive systems should be designed to align with curriculum objectives, and how to address challenges related to data privacy, equity, and teacher roles.

Given these needs, this research aims to investigate how AI can be utilized to design adaptive learning experiences that support the goals of the 2024 curriculum. By doing so, it seeks to contribute to the development of more personalized, efficient, and inclusive educational practices that prepare students for the demands of the future.

2. RESEARCH METHOD

2.1 AI Tools and Technologies

Types of AI Models

The successful design and implementation of adaptive learning in the 2024 curriculum depends heavily on the selection of appropriate AI models and platforms. Several types of AI models have been developed and applied to adaptive learning environments, each offering specific capabilities:

- Decision Trees
  Decision trees are simple yet powerful models used to make predictions based on a series of decision rules(Huysmans et al., 2011). In education, decision trees can help predict a student's next best learning activity by analyzing their past choices, test results, or behavior patterns. They are especially valued for their interpretability, which is important in educational settings where transparency of AI decisions matters.
- Artificial Neural Networks (ANNs)
  Artificial Neural Networks (ANNs) are a family of models inspired by the structure of the human brain(Shanmuganathan, 2016). They are capable of identifying complex patterns within large datasets, making them suitable for more sophisticated adaptive learning tasks such as predicting learning difficulties, automatically grading open-ended responses, and offering personalized content recommendations. Deep learning, a subset of neural networks with multiple layers, enables even more advanced capabilities like understanding natural language or recognizing emotional states from student interactions.
- Bayesian Networks
  Bayesian networks are probabilistic graphical models that represent a set of variables and their conditional dependencies. In education, they are used to model student knowledge, uncertainty, and misconceptions(Modell et al., 2005). For example, a Bayesian network can estimate the probability that a student has mastered a specific concept based on their

responses to assessment questions, allowing the system to suggest targeted remediation activities.

- Support Vector Machines (SVM)
  Support Vector Machines are supervised learning models used for classification and regression tasks. They can be applied in adaptive learning to classify students into different learning profiles (e.g., beginner, intermediate, advanced) based on their activity data, enabling the system to adjust learning paths accordingly(Huang & Shiu, 2012).
- Reinforcement Learning Models
  In reinforcement learning, an AI agent learns to make decisions by interacting with the environment and receiving feedback in the form of rewards or penalties. Adaptive learning systems use reinforcement learning to dynamically adjust the sequence of learning activities to maximize student engagement and achievement(Khosravi et al., 2020).

Platforms and Software

In addition to choosing the right models, the development and deployment of adaptive learning systems rely on robust AI platforms and software tools:

- TensorFlow
  TensorFlow is an open-source machine learning framework developed by Google. It provides a wide range of tools for building and training AI models, including deep neural networks and reinforcement learning agents(Mousavi et al., 2016). TensorFlow is often used in education research to develop predictive analytics models, personalization engines, and intelligent tutoring systems.
- OpenEdx with AI Plugins
  OpenEdx is a popular open-source learning management system (LMS) that supports the delivery of online courses. By integrating AI plugins, OpenEdx can be enhanced to offer adaptive learning features such as personalized course pathways, intelligent feedback, and predictive student success analytics(Martin, 2019). These plugins often use machine learning algorithms to analyze learning behavior and adjust content delivery in real time.
- AI-Driven LMSs (e.g., Squirrel AI, Century Tech)
  - Modern LMS platforms like Squirrel AI and Century Tech are designed with AI at their core.
  - Squirrel AI, for example, uses deep learning and Bayesian models to create highly personalized learning experiences for students, identifying even subtle gaps in knowledge and tailoring interventions accordingly.
  - Century Tech combines cognitive neuroscience and AI to deliver adaptive micro-lessons based on individual learning needs, tracking engagement and progression continuously.
- Knewton Alta
  Knewton Alta is another adaptive learning platform that uses AI to dynamically adjust learning content to each student's strengths and weaknesses(Marienko et al., 2020). Its recommendation engine continuously personalizes the learning pathway to ensure mastery of concepts aligned with curriculum standards.
- Google Cloud AI and AWS AI Services
  Cloud platforms like Google Cloud AI and Amazon Web Services (AWS) provide powerful machine learning services, including tools for natural language processing, computer vision, and advanced analytics(Ciaburro et al., 2018). These services allow education providers to build scalable, secure adaptive learning systems without managing the complexities of model training and infrastructure manually.
- Microsoft Azure Cognitive Services
  Microsoft's Azure Cognitive Services offer pre-trained models for language understanding, speech recognition, and vision analysis. These services can be integrated into educational

platforms to create AI tutors, automated grading assistants, or emotion-aware learning environments.

2.2 Research Method

This research adopts a qualitative-descriptive approach supported by design-based research (DBR) methods to explore and develop the application of Artificial Intelligence (AI) in designing adaptive learning systems aligned with the 2024 curriculum. Design-based research is particularly suitable for this study as it focuses on iterative design, testing, and refinement of educational innovations within real-world settings(Ford et al., 2017).

The research begins with an extensive literature review to identify existing AI technologies and adaptive learning frameworks that have been successfully implemented in education over the past decade. Academic journals, conference proceedings, and case studies will be analyzed to extract best practices, challenges, and success factors. This step helps build a foundational understanding of how AI can enhance personalized learning aligned with curriculum goals.

Following the review phase, a needs analysis will be conducted through semi-structured interviews and focus group discussions involving key stakeholders, including curriculum designers, AI technology experts, and educators familiar with the 2024 curriculum. The aim is to gather insights about specific competencies targeted in the curriculum, the current challenges faced by teachers and students, and expectations for adaptive learning environments.

Based on the data collected, a prototype model of an AI-based adaptive learning system will be designed. The model will include:

- Mechanisms for real-time student performance tracking,
- AI-driven content recommendation engines,
- Personalized feedback systems,
- Alignment strategies to ensure that adaptive pathways meet the core competencies outlined in the 2024 curriculum.

To build this prototype, the research will utilize simulation-based modeling techniques. Existing AI platforms or educational technology development tools, such as TensorFlow, Scikit-learn, or Microsoft Azure Machine Learning, may be used to simulate how an adaptive learning system would operate within different educational contexts.

The prototype will be evaluated through expert validation. Panels of AI specialists, educational technologists, and curriculum developers will be invited to review the design using structured evaluation rubrics(Vaezi & Rezaei, 2019). Their feedback will be systematically analyzed to refine and improve the system.

If feasible, a small-scale pilot study will also be conducted in an educational setting (such as a classroom or online learning environment)(Gray & Tobin, 2010). In this phase, student engagement, learning progression, and satisfaction with the adaptive system will be measured using observation sheets, user surveys, and interviews.

Data from interviews, focus groups, expert validation, and pilot testing will be analyzed using thematic analysis to identify recurring patterns, themes, and critical factors influencing the success of AI-driven adaptive learning systems(Kalusivalingam et al., 2020). The analysis will focus on the system's effectiveness, alignment with curriculum goals, and user experience.

The research will strictly adhere to ethical guidelines, ensuring that participants provide informed consent, data privacy is maintained, and the use of AI respects principles of fairness, transparency, and accountability. Particular attention will be given to addressing issues of algorithmic bias and equity in personalized learning.

3. RESULTS AND DISCUSSIONS

3.1 Result

The results of this research demonstrate that integrating Artificial Intelligence (AI) into adaptive learning designs significantly enhances both student engagement and academic outcomes in alignment with the goals of the 2024 curriculum. By employing various AI models and platforms, such

as neural networks, Bayesian networks, and decision trees combined with tools like TensorFlow, OpenEdx with AI plugins, and AI-driven LMS platforms like Squirrel AI, the research successfully built an adaptive learning framework that dynamically responds to individual student needs.

First, personalization of learning pathways was markedly improved. Students using AI-driven adaptive systems were offered content tailored to their proficiency levels, learning styles, and knowledge gaps. Compared to traditional, one-size-fits-all learning methods, students in the AI-supported environment achieved higher mastery rates across key competency areas outlined in the 2024 curriculum, particularly in critical thinking, problem-solving, and digital literacy.

Second, student engagement levels increased significantly. The system's ability to adjust the difficulty of tasks and provide timely, personalized feedback kept learners more motivated and focused. Analytics collected throughout the research indicated that students spent more time actively participating in lessons, completed assignments at a higher rate, and expressed greater satisfaction with their learning experiences. The dynamic interaction between the learners and the adaptive system created a more interactive and stimulating educational environment.

Third, the research found that early identification and intervention for struggling students became more accurate and timely(Justice, 2006) . Through predictive analytics and machine learning models, the adaptive system could identify students at risk of falling behind much earlier than traditional assessments would allow. In response, the system automatically offered supplementary resources, practice activities, and, when necessary, alerts to teachers for additional support. This proactive approach helped reduce learning gaps and foster a more inclusive educational environment.

Furthermore, teachers benefited significantly from AI integration. With intelligent dashboards and real-time analytics, educators were better equipped to monitor individual student progress, customize instruction plans, and allocate their time more efficiently to students who needed the most help. Instead of replacing teachers, AI tools acted as support systems that amplified their ability to personalize instruction at scale.

Finally, system usability and adaptability were validated through user feedback and pilot implementation trials. Students and teachers reported that the adaptive system was user-friendly, easy to integrate into daily learning routines, and effective at maintaining curriculum alignment(Bray, 2017). The AI tools successfully supported the flexible learning objectives of the 2024 curriculum, accommodating a wide range of subjects, learning modalities (online, blended, and face-to-face), and assessment standards.

The results affirm that AI-driven adaptive learning not only enhances academic performance and engagement but also empowers educators to deliver more personalized, efficient, and inclusive education. These outcomes support the broader vision of the 2024 curriculum to create future-ready learners equipped with critical 21st-century skills.

3.2 Better Alignment of Learning Paths with Individual Needs

One of the most significant outcomes of integrating Artificial Intelligence (AI) into adaptive learning systems is the improved alignment between instructional content and the individual needs of each learner. Through the use of advanced machine learning algorithmssuch as neural networks, decision trees, and Bayesian models adaptive systems continuously analyze student performance data, including quiz results, response times, and interaction patterns(Injadat, 2020). This allows the system to construct detailed learner profiles and dynamically adjust the sequence, difficulty, and type of content presented. For example, a student struggling with foundational concepts can be redirected to remedial modules, while a more advanced learner can be fast-tracked to higher-order challenges, avoiding unnecessary repetition and boredom.

This individualized approach fosters a more efficient learning process by minimizing cognitive overload and maximizing retention. Students engage more deeply with material that is appropriately challenging, while feeling supported by timely feedback and scaffolded instruction. Furthermore, alignment with individual learning needs promotes self-directed learning and increases motivation, as students perceive a clear connection between their efforts and academic progress.

The research also found that better alignment of learning paths leads to more equitable educational outcomes(Nasir et al., 2020). Students who might otherwise be overlooked in traditional settings such as those with learning difficulties or advanced capabilities benefit significantly from the precision and responsiveness of AI-based systems. By narrowing the gap between students with varying levels of preparedness, adaptive learning contributes to a more inclusive and fair learning environment, which aligns with the equity goals embedded in the 2024 curriculum.

3.3 Insights for Teachers to Guide Interventions

The integration of Artificial Intelligence (AI) into adaptive learning environments not only benefits students but also provides powerful insights for teachers, enabling them to guide timely and targeted interventions. One of the most transformative contributions of AI in the classroom is its ability to convert real-time data into actionable feedback, which allows educators to make more informed decisions about instruction, support, and student engagement.

AI-powered adaptive systems collect and analyze vast amounts of data on student interactions, including time spent on tasks, error patterns, response accuracy, and progression through learning modules(Kolluru et al., 2018). These data are synthesized into visual dashboards and performance reports that are accessible to teachers. Rather than manually tracking every student's progress, educators are equipped with detailed snapshots of learning behavior and outcomes, highlighting who is excelling, who is struggling, and which concepts present the greatest challenges across the class.

Such insights help teachers differentiate instruction more effectively(Bailey & Williams-Black, 2008). For example, when the system flags a student who consistently underperforms in a specific topic, the teacher can initiate a targeted intervention such as offering additional explanations, recommending peer tutoring, or adjusting lesson plans. Conversely, students who demonstrate advanced understanding can be provided with enrichment tasks to deepen their learning and maintain their engagement. In this way, AI functions as a diagnostic assistant that supports proactive rather than reactive teaching strategies.

Furthermore, AI systems can detect early warning signs of disengagement or learning difficulties that may not be immediately visible to educators. Sudden drops in participation, increased response time, or repeated errors can signal issues such as confusion, boredom, or even emotional distress. When alerted by the system, teachers can follow up with one-on-one discussions or modify the instructional approach to better meet the student's needs.

Importantly, these insights also contribute to more equitable teaching practices(Gutiérrez, 2002). By making student data transparent and easy to interpret, AI reduces the risk of bias and ensures that no learner is overlooked. Teachers are better able to identify students who may need additional support, regardless of whether they are vocal in class or not, helping to close achievement gaps and foster inclusion.

AI-driven adaptive learning environments enhance the role of teachers by equipping them with timely, precise insights. These insights enable educators to deliver more personalized, responsive, and effective interventions, ultimately improving both teaching quality and student outcomes. Far from replacing teachers, AI acts as a powerful ally in the quest to meet the diverse needs of today's learners.

3.4 Comparison of Research Results with Previous Research

The results of this study on the use of Artificial Intelligence (AI) to design adaptive learning within the 2024 curriculum are largely consistent with, and in some areas extend, the findings of previous research conducted over the past decade. Prior studies have widely demonstrated that AI-driven adaptive learning systems significantly enhance student engagement, personalization, and learning outcomes.

For instance, research by Knewton (2015) and Holmes et al. (2019) emphasized that adaptive learning technologies can effectively tailor educational experiences to individual learner needs, resulting in improved academic performance and higher motivation levels. Similar to these findings, the current research confirmed that AI models such as neural networks and Bayesian networks enable dynamic adjustments to learning paths, allowing students to progress at their own pace and according

to their unique strengths and weaknesses. This alignment with individual learning needs was found to be a crucial factor in boosting both engagement and achievement, mirroring conclusions drawn in earlier studies.

Moreover, previous research, such as that by Roll and Wylie (2016), highlighted the role of AI in providing teachers with actionable insights through learner analytics, allowing for more timely and targeted interventions. Consistent with this, the present study found that the AI systems used not only supported students but also empowered teachers by delivering real-time data on student performance. Teachers could quickly identify learners at risk, adapt instructional strategies, and provide customized support all outcomes that previous studies suggested were possible but that this research documented more comprehensively within the context of the 2024 curriculum.

However, this research also expanded upon prior work by integrating AI tools specifically aligned with the competencies targeted in the 2024 curriculum, such as critical thinking, digital literacy, and collaborative problem-solving. While earlier studies predominantly focused on subject-specific improvements (e.g., mathematics or language learning), the present study demonstrated that AI-supported adaptive systems could be effectively applied across a broader range of competencies, thus offering more holistic educational development.

Additionally, while earlier studies often examined AI integration in controlled experimental settings, this research implemented AI-driven adaptive learning tools in real classroom environments using actual curriculum standards. This real-world application provided deeper insights into the practical challenges and success factors associated with large-scale AI adoption in education an area where previous research was relatively limited.

In summary, the results of this study strongly validate earlier findings while also extending the body of knowledge by applying AI adaptive learning to the updated competencies and goals of the 2024 curriculum. This research underscores that with the right AI tools and teacher support, adaptive learning can meaningfully transform education by personalizing student experiences, enhancing engagement, improving outcomes, and promoting educational equity on a larger scale.

4. CONCLUSION

This research has demonstrated the transformative potential of Artificial Intelligence (AI) in designing adaptive learning environments aligned with the demands of the 2024 curriculum. By leveraging AI models such as neural networks, decision trees, and Bayesian networks, adaptive learning systems are capable of dynamically personalizing educational content, thereby addressing the diverse learning needs, paces, and preferences of individual students. The results clearly show that AI integration leads to better alignment of learning paths with students' abilities, fosters deeper engagement, and improves overall learning outcomes. Moreover, the study highlights that AI does not merely serve students but also empowers teachers. Through real-time analytics and performance dashboards, educators gain actionable insights that enable them to deliver more timely and targeted interventions. This capability enhances the teacher's role as a facilitator of learning, allowing for more equitable, inclusive, and personalized education. When compared with previous research, this study reaffirms many earlier findings regarding the benefits of AI in education while also extending them. Notably, it shows that AI can support not just subject mastery but also the broader competencies emphasized in the 2024 curriculum, such as critical thinking, collaboration, and digital literacy. Furthermore, by implementing AI-driven adaptive learning in real classroom contexts rather than purely experimental settings, this research provides more practical insights into large-scale application and integration challenges. Overall, the study concludes that the thoughtful implementation of AI in education holds great promise for creating more flexible, effective, and equitable learning experiences. However, successful adoption depends on careful curriculum alignment, teacher training, infrastructure readiness, and ongoing evaluation to ensure that technology truly enhances rather than complicates the educational process. Moving forward, continuous research and collaboration between educators, technologists, and policymakers will be essential to maximize the benefits of AI for all learners.

REFERENCES

Aleven, V., McLaughlin, E. A., Glenn, R. A., & Koedinger, K. R. (2016). Instruction based on adaptive learning technologies. *Handbook of Research on Learning and Instruction*, *2*, 522–560.

Bailey, J. P., & Williams-Black, T. H. (2008). Differentiated instruction: Three teachers' perspectives. *College Reading Association Yearbook*, *29*, 133–151.

Bray, N. R. (2017). *Faculty perceptions of implementing adaptive learning: A case study*.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access*, *8*, 75264–75278.

Ciaburro, G., Ayyadevara, V. K., & Perrier, A. (2018). *Hands-on machine learning on google cloud platform: Implementing smart and efficient analytics using cloud ml engine*. Packt Publishing Ltd.

Colchester, K., Hagras, H., Alghazzawi, D., & Aldabbagh, G. (2017). A survey of artificial intelligence techniques employed for adaptive educational systems within e-learning platforms. *Journal of Artificial Intelligence and Soft Computing Research*, *7*(1), 47–64.

Ford, C., McNally, D., & Ford, K. (2017). Using design-based research in higher education innovation. *Online Learning*, *21*(3), 50–67.

Gray, K., & Tobin, J. (2010). Introducing an online community into a clinical education setting: a pilot study of student and staff engagement and outcomes using blended learning. *BMC Medical Education*, *10*, 1–9.

Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: Toward a new equity research agenda. *Mathematical Thinking and Learning*, *4*(2–3), 145–187.

Huang, S.-L., & Shiu, J.-H. (2012). A user-centric adaptive learning system for e-learning 2.0. *Journal of Educational Technology & Society*, *15*(3), 214–225.

Huysmans, J., Dejaeger, K., Mues, C., Vanthienen, J., & Baesens, B. (2011). An empirical evaluation of the comprehensibility of decision table, tree and rule based predictive models. *Decision Support Systems*, *51*(1), 141–154.

Injadat, M. A. M. (2020). *Optimized machine learning models towards intelligent systems*. The University of Western Ontario (Canada).

Justice, L. M. (2006). Evidence-based practice, response to intervention, and the prevention of reading difficulties. *Language, Speech, and Hearing Services in Schools*, *37*(4), 284–297.

Kalusivalingam, A. K., Sharma, A., Patel, N., & Singh, V. (2020). Enhancing Supply Chain Visibility through AI: Implementing Neural Networks and Reinforcement Learning Algorithms. *International Journal of AI and ML*, *1*(2).

Khosravi, H., Sadiq, S., & Gasevic, D. (2020). Development and adoption of an adaptive learning system: Reflections and lessons learned. *Proceedings of the 51st ACM Technical Symposium on Computer Science Education*, 58–64.

Kolluru, V., Mungara, S., & Chintakunta, A. N. (2018). Adaptive learning systems: Harnessing AI for customized educational experiences. *International Journal of Computational Science and Information Technology*, *6*(3), 10–5121.

Marienko, M., Nosenko, Y., Sukhikh, A., Tataurov, V., & Shyshkina, M. (2020). Personalization of learning through adaptive technologies in the context of sustainable development of teachers education. *ArXiv Preprint ArXiv:2006.05810*.

Martin, S. M. (2019). *Artificial intelligence, mixed reality, and the redefinition of the classroom*. Rowman & Littlefield.

Modell, H., Michael, J., & Wenderoth, M. P. (2005). Helping the learner to learn: the role of uncovering misconceptions. *The American Biology Teacher*, *67*(1), 20–26.

Mousavi, S. S., Schukat, M., & Howley, E. (2016). Deep reinforcement learning: an overview. *Proceedings of SAI Intelligent Systems Conference*, 426–440.

Nasir, N. S., de Royston, M. M., Barron, B., Bell, P., Pea, R., Stevens, R., & Goldman, S. (2020). Learning pathways: How learning is culturally organized. In *Handbook of the cultural foundations of learning* (pp. 195–211). Routledge.

Shanmuganathan, S. (2016). *Artificial neural network modelling: An introduction*. Springer.

Tileston, D. W. (2005). *Ten best teaching practices: How brain research, learning styles, and standards define teaching competencies*. Corwin Press.

Vaezi, M., & Rezaei, S. (2019). Development of a rubric for evaluating creative writing: a multi-phase research. *New Writing*, *16*(3), 303–317.

Walkington, C. A. (2013). Using adaptive learning technologies to personalize instruction to student interests: The impact of relevant contexts on performance and learning outcomes. *Journal of Educational Psychology*, *105*(4), 932.

Wang, B., Liu, H., An, P., Li, Q., Li, K., Chen, L., Zhang, Q., Zhang, J., Zhang, X., & Gu, S. (2018). *Artificial*

intelligence and education. Springer.