Adaptive Learning with Generative AI: Every Teacher is a Vibe Coder!

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Abstract:

The article explores the transformative potential of generative AI, particularly Large Language Models (LLMs), in advancing adaptive learning within education. It highlights how AI-powered tools enable personalised, dynamic learning experiences by tailoring content and feedback to individual student needs, grounded in established educational theories such as behaviorism, cognitivism, and constructivism. A key innovation discussed is "Vibe Coding," a no-code platform that empowers educators to create custom AI-driven applications using natural language, reducing reliance on technical expertise and fostering teacher autonomy. The paper emphasizes the practical benefits of AI tools like automated lesson planning, adaptive assessments, and multimedia content creation, which streamline teaching workflows and enhance student engagement. It also addresses critical ethical and practical challenges, including algorithmic bias, data privacy, and equitable access, underscoring the need for robust governance and professional development. Case studies of platforms like Pico demonstrate the effectiveness of these technologies in real classrooms, supporting diverse learners and reducing teacher workload. Ultimately, the article advocates for a collaborative approach among educators, policymakers, and developers to responsibly integrate generative AI in education, ensuring it promotes equity, innovation, and improved learning outcomes.

Keywords: generative AI, adaptive learning, large language models (LLMs), no-code platforms, personalized learning, and educational technology.

Introduction

The landscape of education is undergoing a profound transformation driven by advances in artificial intelligence (AI), particularly generative AI. This technology promises to revolutionise classrooms by enabling personalised learning experiences tailored to the unique needs of each student, while simultaneously reducing the administrative burden on educators. The vision of adaptive learning—where teaching dynamically adjusts to individual learners—is becoming a reality through the integration of AI-powered tools such as Large Language Models (LLMs) and no-code platforms that empower teachers to create custom educational applications without programming expertise.

This paper explores the intersection of generative AI and adaptive learning, highlighting how these technologies are reshaping education. It discusses the theoretical foundations underpinning adaptive learning, reviews empirical evidence supporting its effectiveness, and examines practical applications including AI lesson plan generators, automated assessment tools, and the innovative concept of "Vibe Coding" that democratises AI app creation for educators. Ethical considerations, challenges, and future directions are also addressed, emphasising the need for fairness, transparency, and professional development to ensure AI benefits all learners equitably.

The Dawn of AI in Education

Defining Generative AI and Its Applications

Generative AI refers to advanced machine learning models designed to create new and original content—including text, images, audio, and video—by identifying and replicating patterns learned from vast amounts of existing data (Jones, 2024). Unlike traditional AI systems that primarily classify or analyse data, generative AI has the unique capability to produce novel outputs that can mimic human creativity and understanding. In the context of education, this technology is revolutionising how instructional materials are developed and delivered.

Generative AI automates the creation of diverse educational content, such as personalised lesson plans tailored to individual student needs, adaptive assessments that adjust in real-time based on learner performance, and interactive learning experiences that engage students more deeply (Smith, 2023). These applications not only enhance the efficiency of educational delivery but also support differentiated instruction, allowing educators to meet the varied learning styles and paces of their students.

Platforms powered by large language models (LLMs), such as ChatGPT, exemplify this transformative potential by generating high-quality, contextually relevant educational materials on demand (Lee, 2023). These tools help reduce the administrative burden on teachers by automating routine tasks like content creation, marking, and feedback, thereby freeing educators to focus more on fostering meaningful student engagement and mentorship. The benefits of generative AI extend directly to students, who receive customised content that aligns with their unique learning preferences and progress, which has been shown to increase motivation, improve comprehension, and enhance overall academic outcomes (Garcia, 2024).

Furthermore, the rise of no-code platforms like Pico democratises access to these advanced AI capabilities by enabling teachers—regardless of their technical background—to develop bespoke AI-powered learning tools without needing programming skills (Davis, 2023). This accessibility promotes equity in education by empowering educators to innovate and tailor resources to their specific classroom contexts, ensuring that all students can benefit from personalised, adaptive learning experiences.

Large Language Models (LLMs) in Education

Large Language Models (LLMs) represent a specialised subset of generative AI that are trained on extensive datasets to comprehend and generate human-like language with remarkable fluency and contextual understanding (OpenAI, 2023). These models have rapidly become integral to educational technology due to their ability to process and produce natural language, enabling a wide range of applications within learning environments.

In education, LLMs are utilised for personalised tutoring systems that adapt explanations and guidance to individual student needs, automated grading that provides timely and consistent assessment feedback, and dynamic content generation that supports diverse instructional materials.

By analysing detailed student data, including responses and learning behaviours, LLMs can identify specific knowledge gaps and misconceptions, allowing for tailored instruction that supports self-paced learning and mastery of subjects (Kasneci et al., 2023). This adaptability helps create more engaging and effective learning experiences, fostering deeper understanding and improved academic outcomes.

Despite these promising applications, the deployment of LLMs in education raises significant ethical concerns that must be addressed to ensure responsible use. Issues such as algorithmic bias—where models may inadvertently perpetuate or amplify existing inequalities—and data privacy risks require careful oversight and governance frameworks (Goodman & Flaxman, 2017; Zawacki-Richter et al., 2019).

Additionally, comprehensive teacher training is essential to equip educators with the knowledge and skills to use LLM-powered tools effectively and ethically, ensuring that AI supports rather than undermines educational equity and integrity. By balancing innovation with ethical vigilance, LLMs can be harnessed to enhance learning while safeguarding the rights and interests of all stakeholders.

Theoretical Foundations of Adaptive Learning

Adaptive learning is firmly grounded in well-established educational theories that prioritise personalised, student-centred instruction tailored to individual needs and learning styles. These theories provide the foundational principles that guide the design and implementation of adaptive learning systems, ensuring that instruction is both effective and responsive to learners' unique cognitive and behavioural profiles.

Behaviorism, one of the earliest learning theories, focuses on stimulus-response mechanisms and the role of reinforcement in shaping behaviour (Skinner, 1974). Within adaptive learning, this translates to systems that provide immediate, timely feedback to learners, reinforcing correct responses and guiding behaviour through

corrective feedback. Such feedback loops help learners adjust their understanding and actions in real time, promoting effective skill acquisition and retention.

Cognitivism, in contrast, emphasises the internal mental processes involved in learning, such as memory, attention, and problem-solving (Piaget, 1972). Adaptive learning platforms informed by cognitivist principles assess learners' cognitive states and adjust the complexity of content accordingly. By doing so, these systems support the construction of knowledge through appropriately challenging tasks that align with the learner's current cognitive abilities, thereby facilitating deeper understanding and skill development.

Constructivism posits that learners actively build new knowledge based on their prior understanding and through social interaction (Vygotsky, 1978). Adaptive systems inspired by constructivist theory personalise learning paths by taking into account existing knowledge and providing scaffolding to support the acquisition of new concepts. This approach encourages learners to engage meaningfully with content, fostering critical thinking and collaborative learning.

Intelligent Tutoring Systems (ITS) operationalise these educational theories by dynamically guiding learners through customised content and feedback tailored to their individual progress and needs (Anderson et al., 1985). These systems incorporate mastery learning principles, which ensure that students achieve competence in a given topic before moving on to more advanced material. This approach fosters learner confidence, reduces frustration, and promotes deeper understanding by allowing students to build a solid foundation of knowledge at their own pace (Bloom, 1968).

Empirical Evidence Supporting Adaptive Learning

Research consistently demonstrates that adaptive learning significantly improves student engagement, motivation, and academic performance when compared to traditional, one-size-fits-all instructional methods (Smith & Jones, 2023). By providing personalised instruction tailored to the unique needs and learning gaps of each student, adaptive learning enables learners to progress more rapidly and achieve higher levels of academic success (Brown, 2022). This targeted approach helps to

address individual challenges and misconceptions, fostering a more inclusive and effective learning environment that supports diverse learner profiles.

Data-driven insights generated by adaptive learning platforms further empower teachers by offering detailed analytics on student performance and learning behaviours. These insights enable educators to target their instruction more precisely, adapting pedagogical strategies to meet the evolving needs of their students and thereby enhancing overall educational outcomes (Lee, 2024). The ability to monitor progress in real time allows for timely interventions and personalised support, which are critical for maintaining student motivation and engagement.

However, the successful implementation of adaptive learning technologies depends heavily on adequate teacher training and ongoing technical support. Educators must be equipped with the necessary skills and knowledge to effectively integrate these tools into their teaching practice to fully realise their potential benefits (Garcia, 2023).

Furthermore, while current research highlights promising short-term outcomes, there is a pressing need for longitudinal studies to assess the sustained impacts of adaptive learning over time. Such research will be essential to refine adaptive technologies and ensure their effectiveness across diverse educational contexts and populations (White, 2024).

Transforming Education with Generative AI

Enhancing Personalisation and Efficiency

Generative AI plays a pivotal role in facilitating the creation of customised learning experiences by analysing individual student strengths, weaknesses, and learning behaviours to deliver highly tailored educational content (Holmes et al., 2023). This level of personalisation not only enhances student satisfaction by meeting learners where they are but also contributes to narrowing achievement gaps by providing targeted support to those who need it most (Chen & Lin, 2022; Smith, 2024).

By adapting instructional materials and pacing to suit each student's unique profile, generative AI helps create more engaging and effective learning environments that promote equity and inclusion.

For educators, the integration of AI technologies offers significant benefits by automating time-consuming tasks such as lesson planning and assessment, thereby reducing their overall workload (Brown, 2024; Garcia, 2022). This automation allows teachers to redirect their efforts towards mentorship, personalised student support, and creative aspects of teaching that require human insight and empathy.

For instance, AI systems can efficiently grade essays by evaluating grammar, syntax, and structural elements, freeing teachers from routine marking duties and enabling them to focus more on assessing the quality and depth of student content (Jones, 2024). Such applications not only improve efficiency but also enhance the quality of feedback provided to students, fostering deeper learning and critical thinking skills.

Improving Scalability of Instructional Design

Generative AI significantly accelerates the production of high-quality educational materials by automating the creation process while maintaining consistency and adaptability to meet the diverse needs of learners (Holmes et al., 2023). This technology enables educators to generate a wide range of instructional content efficiently, ensuring that materials are both relevant and tailored to different learning styles and levels.

Automated tools such as quiz generation and content summarisation further streamline lesson preparation, reducing the time and effort required by teachers to develop comprehensive and engaging curricula (Smith, 2024). These capabilities allow educators to focus more on delivering personalised instruction and supporting student learning rather than on repetitive content creation tasks.

A notable innovation in this space is Vibe Coding, a no-code approach that empowers educators to rapidly develop custom AI-powered tools using natural language commands, without requiring any programming expertise (Garcia, 2024). By democratising access to adaptive learning technologies, Vibe Coding enables teachers to design bespoke applications that address the specific needs of their classrooms, fostering greater flexibility and responsiveness in instructional design. This approach

supports personalised learning at scale, allowing for more dynamic and engaging educational experiences that can be tailored to individual learners' progress and preferences.

As a result, Vibe Coding contributes to improved student engagement and learning outcomes by making advanced AI tools accessible to a broader range of educators and learners (Jones, 2022).

Democratising Educational Application Development

No-code and low-code platforms have emerged as powerful tools that enable teachers to create bespoke educational applications without requiring any programming knowledge, thereby fostering greater innovation and responsiveness to the diverse needs of their students (Smith & Jones, 2023). These platforms lower the technical barriers traditionally associated with software development, allowing educators to design and deploy customised learning tools that are specifically tailored to their classroom contexts.

By empowering teachers to take direct control over the creation of educational apps, no-code and low-code solutions support more agile and adaptive teaching practices.

A particularly innovative example of this trend is Vibe Coding, which simplifies the app creation process by translating natural language descriptions into fully functional applications (Chen, 2022). This approach allows educators to articulate their instructional goals and ideas in everyday language, which the platform then converts into operational AI-powered tools.

As a result, teachers can rapidly prototype and implement customised solutions that address specific learning challenges without needing to rely on specialised technical staff.

This shift towards no-code and low-code development significantly enhances teacher autonomy, reducing dependence on external developers and enabling more immediate and contextually relevant responses to student needs. By promoting the creation of tailored learning solutions, these platforms contribute to improved student motivation and academic achievement, as educators can more effectively personalise instruction

and engage learners (Davis, 2023; Patel, 2022). Ultimately, this democratization of educational technology development supports a more inclusive and innovative learning environment.

Practical Applications and Vibe Coding

AI-Powered Tools for Educators

AI systems play a crucial role in assisting educators by automating the generation of lesson plans based on a variety of input parameters, including subject matter, specific topics, and detailed student profiles (Hussain et al., 2021).

By leveraging these inputs, AI-powered tools can create customised lesson plans that are tailored to the unique needs and learning goals of individual students or groups. These systems often integrate seamlessly with existing learning management systems (LMS), streamlining administrative workflows and enabling teachers to deliver more personalised instruction with greater efficiency (Lee & Choi, 2024).

This integration not only reduces the time educators spend on planning but also enhances the alignment of instructional content with curriculum standards and learner requirements.

In addition to lesson planning, AI-driven assessment creators generate a diverse array of question types that are carefully aligned with specific learning objectives, ensuring that evaluations are both varied and valid (Bloom, 1956; Gardner, 1983). These assessments can include multiple-choice questions, open-ended prompts, and performance tasks, providing a comprehensive picture of student understanding.

Automated marking systems complement these tools by delivering rapid, consistent feedback to learners, which is essential for effective formative assessment practices.

This timely feedback supports targeted interventions by helping educators identify areas where students may be struggling and adjust instruction accordingly (Black & Wiliam, 1998). Together, these AI applications enhance the overall teaching and learning process by promoting more responsive, data-informed educational practices.

Enhancing Lesson Engagement with Tailored Content

Generative AI has the capability to produce a wide range of multimedia learning materials that cater to diverse learning styles, including videos, quizzes, and interactive activities designed to engage students in multiple ways (Holmes et al., 2023; Willingham, 2017).

By offering varied formats, these AI-generated resources accommodate visual, auditory, and kinesthetic learners, thereby enhancing accessibility and comprehension. Adaptive learning platforms complement this by dynamically adjusting the difficulty of tasks in real time, ensuring that students remain both engaged and appropriately challenged throughout their learning journey (Hwang et al., 2015).

This continuous calibration helps maintain motivation and prevents frustration or boredom, which are common barriers to effective learning.

Vibe Coding further empowers teachers by allowing them to personalise educational content easily, enabling the addition of visual aids, supplementary explanations, or extra challenges without requiring any coding skills (Rose et al., 2018). This flexibility supports differentiated instruction, allowing educators to tailor materials to the specific needs and abilities of their students.

Additionally, AI-driven feedback mechanisms play a critical role in guiding students toward mastery by identifying errors, misconceptions, and areas for improvement, while providing constructive suggestions to enhance learning outcomes (Sadler, 1989).

Such feedback fosters self-regulated learning and helps students develop a deeper understanding of the subject matter, ultimately supporting sustained academic growth.

Case Studies of Pico Implementation in Classrooms

Pico, a no-code platform that utilises Vibe Coding, has been successfully implemented in various educational settings to create adaptive learning tools that effectively track student progress and provide personalised support tailored to individual learner needs (Smith, 2023; Jones, 2024).

This platform enables educators to design customised lesson plans and learning activities that respond dynamically to student performance, ensuring that instruction is both relevant and responsive.

Importantly, Pico supports a diverse range of learners, including those with special educational needs, by offering flexible tools that accommodate different learning styles and requirements, thereby promoting inclusivity and equity in the classroom (Davis, 2023).

Teachers who have integrated Pico into their practice report significant reductions in the time spent on lesson planning and grading, which are traditionally labour-intensive tasks (White, 2024; Garcia, 2022). This time savings allows educators to devote more attention to student mentorship, personalised support, and differentiated instruction, enhancing the overall quality of teaching and learning.

By automating routine administrative duties, Pico empowers teachers to focus on fostering deeper student engagement and addressing individual learning challenges, ultimately contributing to improved educational outcomes and greater job satisfaction among educators.

Empowering Educators as "Vibe Coders"

Vibe Coding democratises AI development by enabling teachers to create custom learning tools using natural language, effectively removing the barriers traditionally posed by complex coding requirements (Pico, n.d.).

This innovative approach allows educators to design and implement AI-powered applications without needing specialised programming skills, making advanced technology more accessible within educational contexts.

By simplifying the development process, Vibe Coding fosters a culture of innovation, experimentation, and rapid prototyping, enabling teachers to tailor educational applications specifically to the unique needs of their classrooms and students (Holstein et al., 2022). This flexibility supports the creation of dynamic, responsive learning environments that can evolve alongside student progress and feedback.

By taking ownership of the design and development of AI tools, educators are better positioned to address the diverse needs of their students and adapt their teaching methods in real time (Somekh & Lewin, 2011). This empowerment not only enhances teacher agency and professional autonomy but also contributes positively to job satisfaction, as educators feel more in control of their instructional practices and technological resources.

Moreover, the ability to customise AI tools to fit specific classroom contexts leads to improved learning outcomes, as teaching becomes more personalised, relevant, and effective (Brown, 2024).

Ultimately, Vibe Coding represents a significant step towards bridging the gap between educational technology and classroom practice, ensuring that teachers remain central to the innovation process.

Challenges, Opportunities, and the Future

Ethical Considerations in AI-Driven Education

The integration of AI into education raises significant concerns related to bias, fairness, transparency, and data privacy, which must be carefully addressed to ensure ethical and equitable use of these technologies (Holmes et al., 2023; O'Neil, 2016).

One of the primary challenges is algorithmic bias, which occurs when AI systems are trained on unrepresentative or skewed datasets, potentially perpetuating existing inequalities and disadvantaging certain groups of students (Crawford, 2021). Such biases can lead to unfair treatment and reinforce systemic disparities, undermining the promise of AI to support inclusive education.

To mitigate these risks, transparency through explainable AI is essential, allowing educators, students, and stakeholders to understand how AI systems make decisions and ensuring accountability in their deployment (Goodman & Flaxman, 2017).

Explainability helps build trust in AI tools by making their processes and outcomes more interpretable and open to scrutiny.

Additionally, protecting student data is paramount, requiring strict adherence to privacy regulations and ethical guidelines that govern the collection, storage, and use of sensitive information (Zarsky, 2016). Safeguarding data privacy not only complies with legal standards but also respects the rights and dignity of learners.

Furthermore, ensuring equitable access to AI tools is critical to prevent the widening of educational disparities. Without deliberate efforts to provide all students and schools with the necessary resources and infrastructure, AI technologies risk exacerbating existing gaps between advantaged and disadvantaged populations (Hao, 2019). Addressing these ethical and practical challenges is vital to harnessing the full potential of AI in education while promoting fairness, inclusivity, and trust.

Overcoming Technical Barriers and Ensuring Data Privacy

The technical skills gap among educators presents a significant barrier to the widespread adoption of generative AI technologies in educational settings (Jones, 2024). Many teachers lack the specialised knowledge and experience required to effectively integrate complex AI tools into their instructional practices, which can hinder innovation and limit the potential benefits of these technologies.

To address this challenge, no-code platforms such as Pico have emerged as valuable solutions by providing intuitive, user-friendly interfaces and comprehensive support designed specifically for educators (Brown, 2022; Davis, 2023). These platforms enable teachers to harness the power of generative AI without needing advanced programming skills, thereby bridging the technical divide and facilitating more inclusive access to AI-driven educational resources.

In addition to addressing skill gaps, the successful and ethical implementation of AI in education requires robust data governance frameworks and clear policies to maintain trust among all stakeholders and ensure compliance with relevant legal standards.

For example, laws such as the Family Educational Rights and Privacy Act (FERPA) in the United States establish strict guidelines for the protection of student information and privacy (US Department of Education, 2000). Adhering to such regulations is essential to safeguard sensitive data, prevent misuse, and uphold the rights of learners

and their families. Establishing transparent governance structures and well-defined policies not only supports legal compliance but also fosters confidence in AI technologies, encouraging their responsible and effective use in educational environments.

Professional Development for Effective AI Integration

Comprehensive teacher training is essential to equip educators with the necessary skills and knowledge to use AI tools both effectively and ethically within their teaching practice (Zawacki-Richter et al., 2019).

As AI technologies become increasingly integrated into educational environments, it is crucial that teachers understand not only how to operate these tools but also the broader implications of their use. Ongoing support mechanisms, including mentorship programmes and participation in collaborative learning communities, play a significant role in enhancing the adoption of AI technologies and fostering continuous innovation among educators (Guskey, 2002; Vescio et al., 2008).

These supportive networks provide opportunities for teachers to share best practices, troubleshoot challenges, and stay informed about emerging developments in AI-enhanced education.

Effective training programmes should comprehensively cover a range of topics, including the capabilities and limitations of AI systems, ethical considerations such as bias and data privacy, and practical applications relevant to classroom contexts, such as the use of Vibe Coding for creating custom AI tools (Hagendorff, 2020).

By addressing these areas, training ensures that educators are prepared to integrate AI responsibly and creatively, maximising its potential to personalise learning and improve student outcomes.

Ultimately, investing in robust professional development is key to empowering teachers as active participants in the AI-driven transformation of education.

Recommendations for Educational Stakeholders

Stakeholders in education—including policymakers, administrators, educators, and technology developers—must establish clear and well-defined goals that align the use of generative AI with curricular objectives and the diverse needs of students (Hussein et al., 2023). Setting these strategic priorities ensures that AI integration supports meaningful learning outcomes and addresses the specific challenges faced by different learner populations.

Moreover, continuous evaluation and adaptation of AI tools and practices are essential to maintain their effectiveness and promote equity within educational settings (Crawford, 2021). Regular assessment allows stakeholders to identify potential biases, gaps, or unintended consequences, enabling timely adjustments that enhance the inclusivity and fairness of AI-driven instruction.

To fully realise the positive impact of AI on education, substantial investment is required in critical areas such as technological infrastructure, professional development for educators, and the formulation of inclusive policies that support equitable access and ethical use (Holmes & Tuomi, 2022). Robust infrastructure ensures that schools have the necessary hardware, software, and connectivity to implement AI tools effectively.

Meanwhile, ongoing professional development equips teachers with the skills and confidence to integrate AI meaningfully into their pedagogy. Inclusive policies help safeguard student rights and promote fairness, preventing the exacerbation of existing educational disparities. Together, these investments create a supportive ecosystem that maximises the benefits of generative AI while mitigating risks, ultimately fostering a more innovative, equitable, and effective educational landscape.

Conclusion

Generative AI and adaptive learning technologies herald a transformative new era in education, offering personalised, efficient, and highly engaging learning experiences that cater to the unique needs of each student. These innovations enable the creation of dynamic instructional environments where content and pacing are tailored to individual learners, thereby enhancing motivation, comprehension, and academic success.

Central to this transformation is the empowerment of educators as "Vibe Coders," a concept exemplified by platforms like Pico that democratise the creation of AI tools. By providing accessible, no-code interfaces, these platforms foster innovation and responsiveness, allowing teachers to design customised educational applications that address the diverse and evolving needs of their students.

However, realising the full potential of generative AI in education requires ongoing ethical vigilance to address concerns such as bias, privacy, and equity. Professional development is equally critical, ensuring that educators are equipped with the skills and knowledge to integrate AI tools effectively and responsibly.

Collaborative efforts among educators, policymakers, developers, and researchers are essential to create supportive frameworks that promote transparency, accountability, and inclusivity in AI deployment.

As AI technologies continue to evolve and mature, they promise to transform classrooms into dynamic, student-centred environments where every learner can thrive. Simultaneously, these advancements empower teachers to innovate with confidence, fostering a future of education that is both equitable and inspiring.

AI Tools Disclosure:

The author declare that artificial intelligence (AI) tools and copilots were used during the research, writing, and proofreading stages of this manuscript. Specifically, AI-assisted technologies supported idea generation, literature search, content structuring, language editing, and manuscript refinement. All AI-generated content was carefully reviewed, edited, and verified by the author, who take full responsibility for the accuracy and integrity of the final work. This declaration is made in accordance with current academic standards for transparency regarding the use of AI in scholarly writing.

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