



# Amalgamation artificial intelligence with primary education - student perspectives and challenges

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**Abstract:** The use of Artificial Intelligence in primary education holds tremendous potential to enhance the learning journey of children through tailored, adaptive and culturally inclusive teaching. AI can definitely help to drive engagement, motivation and creativity from the student perspective, particularly when complemented with emotionally and culturally responsive teaching methods. Yet, factors like digital inequality, digital illiteracy, and privacy issues and ethical considerations of data use impact students' access and attitudes. Moreover, it's a must prerequisite for comprehensive student development that all AI applications also enable social-emotional learning and moral development. To achieve effective integration, it is essential to address gaps in infrastructure and care and include educational policy, as well as champion inclusive, ethical, and developmentally appropriate tools, such as AI, that support primary learners in a variety of settings.

**Key Words:** Primary education, curriculum, tutoring, digital divide, transformation.

## I.INTRODUCTION

The integration of Artificial Intelligence (AI) in primary education presents a transformative potential from students' perspectives, although direct studies on student views are limited within the provided context. Nonetheless, insights can be drawn from related educational research and thematic analysis of AI's role, as well as pedagogical innovations and students' learning experiences.

### AI's Transformative Potential in Primary Education

The technologies of AI in education offer personalized and adaptive learning experiences, which can fundamentally enhance the student engagement and accommodate diverse learning needs. Students benefit from virtual tutoring, automated grading, and intelligent content generation that can tailor instruction to their unique learning pace and style. Such personalization can foster the deeper understanding and motivation, critical for primary-level learners who require varied approaches to grasp foundational concepts. Moreover, AI can break down barriers related to socio-economic or geographic disparities, promoting equitable access to quality educational resources which students might otherwise lack[1,2].

Artificial Intelligence (AI) holds substantial transformative potential in primary education by enabling personalized and adaptive learning experiences tailored to young learners' diverse needs and learning styles. At the primary level, where foundational concepts are introduced and students require varied pedagogical approaches, AI can enhance engagement, motivation, and comprehension through individualized instruction that adjusts dynamically to each student's pace and preferences.

AI-powered educational tools, such as the intelligent way of tutoring systems and the adaptive learning frameworks, analyse real-time student data to tailor content and feedback, thereby fostering deeper understanding and sustained interest. These systems create personalized learning pathways by continuously assessing students' knowledge gaps and strengths, offering customized exercises or explanations that accommodate varying cognitive and developmental stages typical at the primary school level. This adaptive nature helps in accommodating diverse learning abilities within a single classroom, thus addressing one of the significant challenges in primary education where heterogeneity is the norm rather than the exception[3-5].

Moreover, AI-enabled virtual tutors and chatbots can deliver individualized support outside traditional classroom settings, offering students opportunities for additional practice or clarification at their convenience. By automating administrative tasks like grading and monitoring, these systems free educators' time to focus at higher level on pedagogically complex activities, including creative and social aspects of learning essential in early education.

Importantly, AI can contribute to reducing socio-economic and geographic disparities in primary education. By providing scalable and equitable access to quality digital learning resources, AI tools break down traditional barriers to education, such as lack of skilled teachers or insufficient educational materials, which disproportionately affect students from underserved backgrounds. This democratization of education ensures that primary school children, regardless of context, have access to personalized instruction that might otherwise be unavailable, thus promoting educational equity and inclusion[6,7].

The thing about using interactive and fun things to teach students is that it really helps them want to learn. When we make learning fun with games and videos it is very good for students. This is because it helps them like learning and want to keep doing it. Using computers to help teach students is a way to make learning better and more fun for them. It makes school more about what the students need and want. This way students have a time, in school and actually learn things.

The thing is, there are still problems when it comes to using Artificial Intelligence in education. Even though Artificial Intelligence has some things to offer we have to deal with things like keeping student information private not having the right equipment and making sure the computer programs are fair. We also need to make sure teachers know how to use Artificial Intelligence. To really make Artificial Intelligence work in education we need to have programs that help teachers learn and policies that fix the problems that Artificial Intelligence causes. This way we can reduce the differences between students. Make things more fair, for everyone who uses Artificial Intelligence.

AI technologies can really change the way we teach and learn in education. They can give each student an experience that is just right for them. This makes learning fun and interesting for young students. AI technologies can also help teachers and students get the things they need easily. This means teachers do not have to work hard. To make the most of what AI technologies can do for students we need to keep studying how they work and be careful when we use them in schools. AI technologies, in education are very important.

### **Most effective AI technologies**

The most effective AI technologies enhancing personalized learning for primary students prominently leverage adaptive, interactive, and data-driven features designed to tailor education to individual learner needs. Within the provided context, several specific AI technologies stand out for their ability to customize learning experiences, track student progress, and provide no-time feedback in an engaging and supportive manner.

#### **1. AI-Powered Intelligent Tutoring Systems (ITS)**

Machine learning and natural language processing are employed by Intelligent Tutoring Systems to develop individualized learning settings that mimic the interactions between a tutor and a student. These systems will tailor instructional content in real-time according to each student's performance, offering explanations, responding to questions, and supporting learning through natural conversational interactions. The integration of conversational AI as "AI Learning Companions" supports interactive dialogue tailored to learners' comprehension levels and pace, which is vital in primary education for maintaining engagement and understanding[8,9].

#### **2. Personalized Curriculum Generators and Adaptive Learning Platforms**

AI-enabled platforms generate customized study plans and adaptive learning paths reflective of each student's knowledge state and learning style. By analyzing ongoing student data, these systems can modify curricular content to fit learners' evolving needs, supporting varied learning speeds and styles commonly found within primary classrooms. The use of Student Knowledge Graphs—a digital profile recording learning history and identifying weak areas—further refines the personalization, enabling targeted remediation and practice focused on individual deficits rather than a one-size-fits-all curriculum[10].

#### **3. Real-Time Progress Analytics and Dynamic Assessment Tools:**

AI technologies use tools to predict how students will do and test them in a way that changes based on their answers. This helps us get information about how students are doing give them feedback and help them when they need it. For students it is very important to keep giving them feedback so they can learn and understand new things. These special tests make the learning experience better because they pay attention to what the students need and that makes education fair for everyone. AI technologies make this happen by using analytics and adaptive testing to change the difficulty level based on students live responses, which is really helpful, for student growth.

#### **4. Natural Language Processing (NLP) for Multilingual and Interactive Support**

Natural Language Processing technologies or NLP technologies allow Artificial Intelligence to talk to learners in a way. This makes it easy for Artificial Intelligence to explain things and have a conversation, with the learner by asking and answering questions. NLP technologies are also very helpful when learners speak languages. For example in education schools NLP technologies can be used to help learners who do not speak the same language. This way everyone can. It helps to remove language problems that can make learning difficult. NLP technologies make sure that all learners can learn, no matter what language they speak.

#### **5. Machine Learning-Based Learning Analytics.**

Machine learning methods provide insights into the unique learning styles and behaviors of each individual, allowing for more flexible and personalized learning experiences. These data-driven insights empower systems to anticipate student needs, propose personalized learning interventions, and adapt pedagogical approaches—critical in managing the heterogeneity of primary student populations with varying socio-cultural and cognitive profiles[11].

Therefore, the most effective AI technologies for enhancing personalized learning in primary education combine intelligent tutoring systems with real-time adaptive assessment, advanced machine learning analytics, and natural language-based interactive interfaces. Together, they create tailored, engaging, and inclusive educational environments that respond

to each young learner's pace, style, and comprehension, ultimately supporting better learning outcomes and sustained motivation[12-17].

The evidence of the extensive AI education research broadly confirms these results, and if there are more specific studies from primary education contexts, they would further validate and refine these findings; the current evidence of comprehensive AI education research strongly suggests that these technologies are foundational to personalized learning in the primary education context.

## **II. STUDENT ENGAGEMENT AND LEARNING EXPERIENCES**

The attitudes and experiences of students towards the use of AI in primary classrooms are less common in the context but related research emphasizes the need for culturally responsive and motivational teaching contexts to foster creative thinking and engagement. Teaching methods that consider the culture of the students for example can really help students like learning and become more creative. These methods work because they think about where the students come from and what they need to learn. If we design intelligence in a way that includes everyone it can help make learning better by giving students things to learn that are, about their own culture. This makes learning more interesting. Makes students want to learn more. Artificial intelligence can help make learning better by considering the culture of the students.

Digital gamification and the use of AI-based learning media can really help students. These tools are great for getting primary students excited about learning. They make subjects like maths more fun by using things that students can see and touch. This helps students pay attention and understand things better. Digital gamification and AI-based learning media are good at doing this. They make learning more interesting for students. Help them think more clearly. Digital gamification and AI-based learning media can make a difference, in how much students want to learn.

The use of intelligence in schools can be a big help to teachers. Artificial intelligence can make teaching more interesting and fun for students from backgrounds. This can help students want to learn and be more creative. Even though we do not know what students think about intelligence in their classrooms we know that students do better when they are taught in a way that is meaningful, to them. Artificial intelligence can be a tool to help teachers do this. Artificial intelligence can help make school more enjoyable and engaging for students.

### **Tackling issues of culture in teaching and learning, and engagement of students.**

Research highlights the importance of culturally responsive teaching (CRT) that recognizes and utilizes student's culture in teaching and learning to significantly improve learning satisfaction, motivation, and creative abilities of students. CRT fosters an inclusive environment that respects diversity and promotes engagement by making learning personally relevant to students' identities and experiences[18,19]. For instance, frameworks integrating CRT with self-regulated learning (SRL) document how such combined pedagogies help cultivate student autonomy while honoring cultural context, thereby increasing levels of motivation and active participation in complex learning tasks[20].

Teacher preparation programs that emphasize CRT principles also demonstrate improved educator preparedness to manage diverse classrooms and foster culturally inclusive environments, which in turn are linked to better student performance and engagement[21]. Such educational settings encourage trust, empathy, and scaffolding aligned with student cultural contexts, essential for creative and critical thinking development[22].

## **III. ROLE OF AI IN SUPPORTING CULTURALLY RESPONSIVE AND MOTIVATIONAL LEARNING ENVIRONMENTS**

AI, particularly when designed with inclusivity and cultural relevance in mind, can be a powerful adjunct to CRT. By personalizing content and adapting to diverse cultural contexts, AI-driven systems can increase the relevance of learning materials, thus fostering deeper student interest and motivation. For example, AI algorithms can tailor prompts or problems to align with students' cultural backgrounds, interests, and prior knowledge, making abstract or challenging subjects more accessible and engaging[23]. In STEM education, AI has been shown to boost engagement by linking abstract concepts to students' real-world passions and cultural experiences, promoting both understanding and motivation.

By integrating AI with frameworks such as competency-based education, which emphasizes mastery through culturally relevant tasks and assessments, educators can create more inclusive and effective learning pathways. Culturally responsive strategies within competency-based frameworks help contextualize learning, improve self-regulation, and increase academic performance among diverse learners [24].

### **Digital Gamification and AI-Supported Learning Media**

Digital gamification and AI-enabled learning media provide another promising avenue to enhance motivation and engagement for primary students. Gamified learning turns educational content into interactive, game-like experiences that can concretize abstract concepts and stimulate interest through challenges, rewards, and narratives. This approach is particularly effective in subjects like mathematics, where AI-enhanced gamification can make numbers and problem-solving more tangible and enjoyable [25].

Furthermore, AI-driven games can adjust their level of difficulty in real-time, matching the proficiency of the individual learner and providing graduated difficulties. This customized challenge promotes flow experiences that enhance cognitive skills and sustained attention. AI-powered gamification techniques can incorporate cultural elements into the narrative and context of games, making learning experiences relevant to students' identities and backgrounds and enhancing their motivation and sense of belonging.

### **Synthesis: Toward Inclusive AI Integration in Primary Classrooms**

The research collectively suggests that the integration of AI into culturally responsive pedagogies can have synergistic impacts. The ability of Artificial Intelligence to tailor learning experiences is compatible, with Critical Race Theorists' objective to value student diversity and independence. Artificial Intelligence tools can enhance student engagement and creativity and cognitive development in classrooms when Artificial Intelligence tools are designed to be culturally inclusive and to offer motivating and meaningful content to students. Artificial Intelligence can really help students when it is used in a way that values student diversity and independence.

Teachers need to learn how to use technology and deal with students from backgrounds and motivate them. The future of education depends on this. We need to make changes to what students learn so that we can use Artificial Intelligence to help young students learn in a way that's meaningful to them. This means using Artificial Intelligence to create lessons that're fun and interesting, like games and that take into account the students' cultural backgrounds. Artificial Intelligence can be a tool, for young learners if we use it in the right way.

### **Conclusion**

The voices of students are not really heard, but a lot of research has been done on how the classroom should be a place where students feel like they belong and want to learn. This can help students be creative and want to participate. Using intelligence or AI for short is a good way to make learning more fun and interesting for primary students. AI can help make learning personal for each student create materials that're meaningful, to them and make learning fun with games and other interactive things. This can really help students learn and stay motivated. Primary students and AI can be a combination to make learning better.

### **Making sense of Social-Emotional Learning and Moral Development**

A student's attitude towards the use of Artificial Intelligence is probably affected by technology that can be used for learning and understanding people. Research has shown that it is really important for kids to learn about feelings and how to be a person in school which helps them be kind to others take responsibility for what they do and get along with people. The use of Artificial Intelligence tools, in primary school education should help kids learn these things, which will help them become responsible and make choices while they are learning.

### **Issues that impact student perception and experience**

The use of Artificial Intelligence offers benefits. However there are some challenges that could affect the students' point of view in a way. Artificial Intelligence could stop students from using it in primary education. Even though we have made progress it is still hard for some people to get access to Artificial Intelligence tools and the internet. This means some students will not be able to use Artificial Intelligence.

Students can be directly affected or indirectly via their teachers by ethical concerns such as data privacy and over-reliance on AI. Overdependence on AI could inadvertently reduce opportunities for critical thinking, creativity, and social-emotional skills development—core competencies especially vital in early education[26].

Incorporating Artificial Intelligence (AI) into primary education holds the promise of significant transformation, yet it also presents considerable challenges that affect how students perceive and experience their education. Key among these are persistent issues like the digital divide, digital literacy deficiencies, ethical concerns, and risks of over-reliance, all of which can shape student attitudes negatively or hamper effective AI utilization in early learning environments.

## **IV. DIGITAL DIVIDE AND ACCESS INEQUITIES**

Unequal access to AI-enabled tools and reliable internet connectivity remains a critical barrier affecting students' ability to benefit equally from AI technologies. In many contexts—particularly rural or socioeconomically disadvantaged regions—limited technological infrastructure restricts students' opportunities to engage with AI-powered educational resources. For instance, reports highlight that in rural educational settings, regulations such as smartphone bans and insufficient access to digital devices curtail AI use, thereby reinforcing educational inequalities and marginalizing certain student groups during formative years. This digital divide directly affects student perceptions, as those without consistent access may feel excluded or frustrated by their inability to leverage AI tools, worsening motivational issues and engagement challenges [27].

### **Low Digital Literacy and Its Impact on Engagement**

Even when access is available, limited digital literacy among young learners can present a significant challenge. Primary students frequently do not possess the skills required to effectively use AI tools, which can result in feelings of frustration, confusion, or a lack of engagement. Research highlights that a lack of preparedness and digital skills among learners reduces their ability to effectively engage with AI systems. This shortfall can compromise the advantages of personalization and instant support provided by these technologies [28]. In addition, the insufficient training and absence of institutional support often leave teachers unprepared to effectively guide students in using AI tools, which intensifies the challenges students face in adopting AI [29]. As a result, digital literacy becomes essential for improving students' outlooks and creating a more interactive learning environment supported by AI.

### **Ethical Concerns and Data Privacy**

From students' vantage point, ethical considerations surrounding AI use—particularly data privacy and security—affect their comfort and trust levels in the technology. Students' readiness to interact freely with AI systems can be indirectly affected by worries regarding the collection, storage, and utilization of their data. Large-scale reviews acknowledge apprehensions regarding algorithmic bias, data privacy violations, and the transparency of AI decisions, all of which may provoke skepticism or anxiety among students and educators alike [30,31]. Concerns about surveillance or misuse of their data might make students think that AI tools in schools are not safe and do not follow rules. Students may worry that their data could be used in ways they do not agree with. This could make them feel uneasy about using AI tools in settings. Safety and ethics are important to them.

### **Risks of Over-Dependence on AI Affecting Core Skills**

The main problem with using Artificial Intelligence is that it can stop people from learning skills like thinking for themselves being creative and getting along with others. When kids are little they need to learn these skills and if they use Artificial Intelligence too much they might not practice solving problems on their own or playing with other kids, which is necessary for learning everything. People are worried that Artificial Intelligence could make education less personal because it replaces the relationship between teachers and students of helping it and that these computer systems could hurt the places where kids learn and grow. Artificial Intelligence can affect how students feel if they think it is holding back their creativity or taking away time with people. The use of Artificial Intelligence in schools is an issue because it can change the way students learn and interact with each other and their teachers and that is why people are concerned about the impact of Artificial Intelligence, on education and the skills that students need to learn, like critical thinking and social skills.

### **Psychological and Societal Implications**

Student perceptions are also influenced by the broader psychosocial impacts of AI integration. Some research exploring student perspectives indicates anxiety about AI's role, including fears of replacement or reduced human agency in learning processes [32]. Concerns over misinformation from AI-generated content or mistrust in AI accuracy further complicate student experiences, especially if students lack the critical digital literacy skills to verify information [33].

### **Summary and Recommendations**

In sum, the challenges shaping student perception and experience with AI in primary education hinge predominantly on:

- Persistent digital inequities limiting access and inclusion;
- Low digital literacy impeding effective interaction and engagement;
- Ethical concerns regarding data privacy and transparency influencing trust;
- Risks of over-reliance potentially undermining vital cognitive and socio-emotional skills development;
- Psychological impacts including anxiety and mistrust related to AI's role in learning.

To positively influence student experiences and perceptions, these shortcomings need to be addressed through comprehensive strategies—including bridging digital divides, enhancing digital literacy curricula, developing ethical AI policies protecting student data, and fostering balanced AI use that complements rather than replaces critical pedagogical goals. Providing educators with sufficient training and institutional backing is just as crucial for addressing these challenges and advocating for AI as a means to enhance the educational environment while preserving key developmental skills.

By acknowledging and proactively managing these multifaceted challenges, educational systems can foster more positive student perceptions and maximize the effective, equitable use of AI technologies in primary education.

## **V. CONCLUSION**

Incorporating artificial intelligence (AI) into elementary education holds considerable potential for promoting individualized learning, boosting motivation, and elevating student involvement. From the student perspective, AI-powered adaptive learning systems can tailor educational content to individual cognitive needs, learning styles, and cultural contexts, thereby supporting metacognitive skills and learner autonomy. Such personalization is further enriched when AI integration aligns with culturally responsive pedagogies that acknowledge and incorporate students' diverse backgrounds and experiences, thus potentially transforming traditional educational methods into more inclusive and effective learning environments [34-36].

Numerous AI applications—such as intelligent tutoring systems, real-time feedback mechanisms, and emotional AI that recognizes student affective states—contribute to improving student motivation and retention by fostering adaptive challenges and personalized interaction. Gamification and dynamic content delivery enabled by AI also serve to sustain engagement and promote an active, self-regulated learning process among young learners [37].

However, realizing these benefits from the student perspective requires overcoming critical challenges. Disparities in infrastructure, including restricted access to dependable devices and internet connections, especially in economically disadvantaged or isolated regions, create a major obstacle to fair AI integration. Bridging the digital gap is crucial to guarantee that every student can take advantage of AI-supported educational opportunities [38,39].

Furthermore, students' digital literacy—along with that of educators—must be enhanced to maximize AI's potential. AI tools may be implemented superficially or ineffectively if teachers do not receive sufficient training and continuous professional development to act as facilitators and interpreters of data. Students also require support to develop

competencies to interact productively with AI-driven platforms, ensuring that technology complements rather than replaces critical human elements of instruction [40-41].

Ethical considerations are paramount in designing AI-integrated learning environments from a student-centered perspective. Safeguarding student data privacy, ensuring transparency of AI algorithms, and proactively mitigating algorithmic bias are essential to protect vulnerable learners and maintain trust in educational systems. Moreover, AI applications must be sensitive to students' social-emotional development, as overreliance on automated systems could undermine critical interpersonal and affective learning experiences. Human oversight and ethical frameworks must guide AI use to balance technological advantages with students' holistic well-being.

While explicit primary-level student voices regarding AI integration are not directly reported in the cited research, the synthesized evidence clearly points to the importance of designing AI-powered educational environments that resonate with students' cognitive, cultural, and affective needs. For meaningful educational transformation, AI must not only personalize content and provide adaptive support but also honour the diversity of learners' experiences and contribute positively to their motivation and engagement. This necessitates collaborative efforts from policymakers, educators, technologists, and communities to create inclusive, accessible, and ethical AI learning ecosystems that prioritize student perspectives and equitable outcomes.

To sum up, the incorporation of AI in primary education holds the potential to revolutionize personalized learning and boost student involvement. However, to ensure positive student experiences and equitable benefits, it is crucial to address infrastructural inequities, elevate digital literacy, and implement robust ethical safeguards that support students' social-emotional development. Future educational innovation must be rooted in frameworks that place students at the center, designing AI-enhanced environments that are culturally responsive, ethically sound, and attuned to the holistic developmental needs of learners.

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