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The Impact of AI-Powered Project-Based Learning on Student Understanding and Critical Thinking in Social Studies

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Abstract

This study examined AI-powered problem-based learning (PBL) in social studies, focusing on knowledge acquisition, critical thinking, and adoption factors. Using qualitative methods, interviews were conducted with teachers and students engaged in AI-mediated PBL activities. Findings revealed that AI-powered PBL enhanced students' conceptual understanding in social studies by fostering interactive, context-rich learning experiences, while students exhibited stronger critical thinking and analytical abilities when working with real-world problems and historical case studies guided by AI tools. Participants emphasized that AI-enhanced PBL increased motivation and engagement through personalized feedback and adaptive learning paths. Barriers to broader implementation included limited technological access, inadequate teacher training, and concerns regarding data privacy, and teachers expressed the need for professional development to effectively integrate AI into their teaching practices. Institutional backing and clear policy guidelines were identified as essential for sustaining these innovations. The study underscored the importance of culturally and pedagogically aligning AI tools with social studies curricula to ensure they promote critical inquiry and cultural awareness. Recommendations include targeted teacher training, equitable access to technology, and the creation of culturally sensitive AI resources, aiming to maximize the transformative potential of AI-powered PBL while addressing adoption and implementation challenges. Overall, the research contributes to growing discussions on AI in education and highlights its promise for enriching social studies instruction by supporting critical thinking, engagement, and cultural awareness, ultimately cultivating globally conscious citizens prepared for complex, interconnected societies.

Keywords: *AI Powered Project Based Learning, Critical Thinking, Social Studies, Artificial Intelligence*

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Introduction

Technological advancements have fundamentally reshaped the education landscape, with Artificial Intelligence (AI) emerging as one of the most significant forces driving pedagogical innovation. AI-powered tools are increasingly utilized in classrooms to support adaptive learning, personalize instruction, and provide data-driven feedback that helps teachers and learners make informed decisions about the learning process (Holmes et al., 2019; Roll & Wylie, 2016). At the same time, Project-Based Learning (PBL) has long been recognized as a transformative approach to instruction, emphasizing student-centered learning, real-world problem-solving, and collaborative inquiry (Thomas, 2000; Bell, 2010; Kokotsaki, Menzies, & Wiggins, 2016). When these two innovations are integrated, AI's adaptive technologies and PBL's experiential design, the resulting AI-powered Project-Based Learning (AI-PBL) framework presents a powerful model for preparing students with the critical thinking, creativity, and social responsibility necessary in the 21st century (Zawacki-Richter et al., 2019).

Social Studies education stands to benefit significantly from AI-PBL. The discipline seeks to transmit historical knowledge and cultivate civic literacy, global awareness, and higher-order thinking skills that enable learners to engage meaningfully with societal issues (Parker et al., 2011; Fitchett & Heafner, 2010). However, traditional approaches to teaching Social Studies often rely heavily on rote memorization and teacher-centered lectures, which tend to disengage students and limit their ability to apply knowledge to real-world contexts (Torney-Purta, 2002). Research has consistently shown that these methods fail to promote the critical inquiry and problem-solving skills central to Social Studies (Heafner, 2004). PBL offers an alternative by embedding learning in authentic, inquiry-based tasks, where students investigate social problems, work collaboratively, and apply their learning to authentic outputs (Larmer, Mergendoller, & Boss, 2015).

When integrated with AI, the potential of PBL is further amplified. AI systems, such as intelligent tutoring, adaptive platforms, and real-time analytics, can provide personalized scaffolding that responds to diverse learner needs (Luckin, 2017; Chen et al., 2020). For example, AI-driven assessment tools can help teachers track student progress in civic reasoning or historical analysis more efficiently, while gamified AI applications can increase motivation and engagement (Brynjolfsson & McAfee, 2017). Moreover, AI can democratize access to resources by providing translations, contextual explanations, and tailored feedback for students from different linguistic and cultural backgrounds, thereby supporting inclusive Social Studies classrooms (Zawacki-Richter et al., 2019).

Despite these promising developments, research on AI-PBL within Social Studies education remains limited. Most AI-related studies have focused on STEM disciplines, such as mathematics, science, and computer programming, where adaptive platforms and intelligent tutoring have been widely tested (Holmes et al., 2019; Luckin et al., 2016). Meanwhile, literature on PBL has highlighted its effectiveness in improving critical thinking and collaboration in Social Studies (Parker et al., 2011; Kokotsaki et al., 2016), but these studies rarely consider the role of AI in enhancing the PBL framework. It creates a critical research gap: while both AI and PBL have been studied extensively in isolation, their intersection, particularly in the context of Social Studies, remains underexplored.

This study addresses that gap by examining how AI-powered PBL can enhance student engagement, comprehension, and critical thinking in Social Studies education. Specifically, it explores the perceptions of teachers and learners regarding AI-PBL, the opportunities and challenges it presents in practice, and its implications for curriculum design and instructional innovation. By doing so, the study contributes to the discourse on inclusive, technology-driven pedagogies that balance the strengths of human-centered teaching with the adaptive power of AI. Ultimately, the findings will guide educators, policymakers, and curriculum developers in leveraging AI-PBL to foster meaningful, future-ready Social Studies learning experiences.

Research Objectives

This study uses a qualitative research approach to explore the impact of AI-powered project-based learning (PBL) on student understanding and critical thinking in social studies. The specific objectives are:

1. To identify the experiences and perspectives of students engaged in AI-powered PBL in social studies.
2. To explore teachers' perceptions of the effectiveness of AI-powered PBL in developing understanding and critical thinking in social studies.
3. To analyze the contextual factors influencing the adoption and implementation of AI-powered PBL in social studies education.

Research Methodology

This qualitative research explored the impact of AI-PBL on students' understanding of social studies, their experiences, and teachers' perceptions, while examining contextual factors influencing their integration. It aimed to capture lived

experiences through rich, descriptive data to understand the complexities of AI in education.

Data was collected through semi-structured interviews and focus group discussions with secondary and university teachers and students involved in AI-integrated PBL. Students were selected for active participation, while teachers were chosen for their expertise. Interviews examined teachers' perspectives on AI-PBL's role in fostering understanding and critical thinking, while focus groups explored students' experiences and challenges.

Thematic analysis was used to identify patterns related to student engagement, critical thinking, and institutional support. Data triangulation, including observations and document analysis, ensured validity. Ethical protocols were strictly followed, guaranteeing participant confidentiality and informed consent. The findings provide educators, policymakers, and technology developers with insights into AI-PBL's role in social studies education.

Results and Findings

The Experience and Perspectives of Students Engaged in AI-Powered PBL in Social Studies

Integrating AI-powered Project-Based Learning (AI-PBL) in Social Studies has significantly transformed the classroom experience by fostering interactive engagement, personalized support, critical thinking, and learner confidence. Students consistently highlighted how interactive simulations, and gamified features enabled them to immerse themselves in historical and societal contexts, making abstract concepts more relatable and meaningful. These tools enhanced motivation through points, badges, and rewards and nurtured a sense of accomplishment that encouraged sustained interest in learning. Equally important, the adaptive capacity of AI allowed for personalized learning experiences, adjusting tasks to learners' strengths and weaknesses while providing immediate feedback that promotes a growth mindset and learner autonomy. Through AI-driven projects, students were also challenged to analyze complex social issues, debate policies, and collaborate on solutions, cultivating higher-order skills such as critical thinking, empathy, and problem-solving. Although some learners initially encountered technological barriers, ongoing support from teachers and peers facilitated smoother adaptation, ultimately empowering students to gain confidence in their abilities. These experiences underscore AI-PBL's potential to bridge traditional teaching gaps by combining technology-driven innovation with collaborative, inquiry-based learning, equipping students with essential skills for academic and real-world challenges.

Engagement Through Interactive Learning Activities

The students constantly reference the interactive aspect of AI PBL to explain that it was through these tools that they developed interactive and immersive learning environments. Through this, they could envision historical events or even simulate the dynamics of their society to role-play as experts who could bring abstract social studies concepts into reality. The participating design allowed students to work actively and intensively, making the subject matter more relatable and interesting.

In addition, students asked for gamified elements integrated into AI-powered PBL platforms that enhanced a sense of eagerness to learn on their part. The points, badges, and rewards made an otherwise passive learning experience exciting. For many students, it is the creation of a sense of accomplishment. It motivates them to learn more about social studies, ensuring better knowledge retention and greater interest in the subject matter.

"The simulations made historical events come alive. The activities made me understand the theme much better than through lectures and books."

"The games and rewards system kept motivating me to finish tasks and learn about the subject."

Personalized Learning and Adaptive Support

The personalized benefit that most students experienced was the personalized nature of AI-PBL. The AI tools catered to how fast each student learned, or their respective weaknesses and strengths, so that they could move forward painlessly. Some students were led through concepts that they needed to get, while advanced ones were given more intricate stuff to handle. In doing this, every student was allowed to stay engaged and be confident in succeeding.

The students appreciated immediate feedback generated by AI to gain insight into what they need to improve. The ability to review and improve one's work encouraged a growth mindset and control over learning.

Personalized support improved the learners' understanding of social studies concepts and their ability to understand subjects independently.

"The AI adjusted tasks to my level, which helped me focus on where I needed improvement."

"I liked the experience of working at my own pace. If there is something that I did not get, the AI explains more."

"I really appreciated the instant response and detail on my mistakes. It was just like having a personal tutor walk me through this."

Development of Critical Thinking and Problem-Solving Skills

As mentioned by the students, AI-based PBL enhanced their students' reasoning and problem-solving skills. For instance, the tools presented demanding, real-life problems that require critical thinking for data analysis and consideration of evidence regarding sound judgments. Debating policies, trying to solve societal dilemmas, or proposing hypothetical situations promote analytical reasoning.

Students also thought that the AI-driven project collaboration made them think from various viewpoints and creatively solve multiple types of problems with more empathy. All these are part of critical thinking development; they learned all these topics in social studies and prepared for the next level of their academic career and life's challenges.

"The AI scenarios gave me a perception of making me think critically of historical and social issues and forcing me to justify my decisions."

"Cooperating with peers on AI projects made me listen to others' viewpoints more and use more rhetorical language."

Overcoming Initial Obstacles and Gaining Confidence

Most students appreciated the merits of AI-powered PBL, although they did report initial difficulties, such as adapting to new technologies and understanding how to use AI tools appropriately. However, these gradually became less significant to many, as they used the platforms more. Support from teachers and peers makes all the difference in overcoming these hurdles.

Despite early struggles, students indicated that AI-PBL eventually enhanced their confidence in their capacities. Completing complex projects and receiving constructive feedback gave them confidence in their skills and spurred participation in class lessons on social studies. This increased confidence often transcended the classroom walls and impacted attitudes and ambitions for academic pursuits.

"At first, I found the technology overwhelming, but with practice, it became easier and more enjoyable."

"The support from our teacher and classmates helped me work through my fear of using the AI tools."

Teachers' Perceptions of the Effectiveness of AI-Powered PBL in Developing Understanding and Critical Thinking in Social Studies

Teachers have recognized the integration of AI-powered Project-Based Learning (AI-PBL) as a powerful pedagogical tool that deepens students' conceptual understanding, enhances critical thinking, and reshapes classroom experiences in

Social Studies. Teachers observed that AI tools such as simulations, interactive modules, and visualizations bridged the gap between abstract concepts and lived realities, enabling students to contextualize lessons within historical and contemporary issues. By scaffolding learning through adaptive features, AI allowed students of varying skill levels to participate meaningfully, making lessons more engaging and personally relevant. Beyond comprehension, teachers highlighted AI-PBL's role in cultivating critical thinking and problem-solving skills, as students engaged in debates, group discussions, and real-world projects that required analyzing multiple perspectives and generating creative solutions. While acknowledging challenges such as limited resources, steep learning curves, and concerns over over-reliance on technology, educators emphasized that the benefits outweighed the obstacles. They noted that AI-PBL fostered student autonomy, collaboration, and confidence, with learners taking greater ownership of their work and demonstrating transferable skills such as teamwork, communication, and analytical reasoning. These insights underscore that AI-PBL is an innovative method for delivering Social Studies content and a catalyst for meaningful, student-centered learning that prepares learners for real-world challenges.

Deepening Conceptual Understanding with Engaging Learning

Teachers felt that AI-based project-based learning built the students' deeper conceptual understanding through engaging and dynamic learning. The teachers said that AI tools provided rich visualizations and simulations and rich interactive modules that made abstruse concepts in social studies presentable. "Those resources bridged the gap between 'knowing' and 'doing it or vice versa'. It indeed became easy for the student to come across the complicated ideas", the teachers affirmed.

"Interactive modules made the lessons more engaging and helped students connect concepts to their everyday lives."

"I noticed students could better articulate their understanding after working on AI-supported projects."

While the participants opined that AI tools scaffold student learning by providing information in a reasonable chunk and adapting to the students' needs, this personalized approach meant that even with varying skill levels, the students could meaningfully participate in the material. In this manner, learning in practical life is taken aback by the AI-backed PBL as it contextualizes among historical events and current issues for a deeper understanding.

Promoting Critical Thinking Through Problem-Solving Tasks

Teachers showed the effectiveness of AI-based PBL in teaching critical thinking by challenging students to analyze, evaluate, and synthesize information. They emphasized that the problem-solving activities developed by these AI tools involved navigating multiple standpoints, sifting the evidence, and suggesting solutions to intricate social and historical problems from these varied viewpoints, thus helping the students move beyond rote memorization to understand higher-order thinking.

"AI group discussions translated into hot debates, reinforcing their critical thinking."

"The creative solutions proposed by students built upon problems one would not consider in a traditional setup."

Through AI-powered PBL projects, students also exhibited a more collaborative nature, in which critical thinking was advanced. According to the teachers, the discussions provided by AI tools were often much richer in understanding. Students would come to justify their ideas and engage in constructive debates that refined their ability to think analytically and delve deeper into insights into social studies.

Mitigating and capitalizing on pedagogical challenges

While teachers acknowledged the benefits of AI-powered PBL, they also recognized challenges in its implementation. Some found that the initial learning curve for educators and students could hinder progress, especially in settings with limited technological infrastructure. Additionally, they expressed concerns about the potential over-reliance on AI tools, which could detract from teacher-student interactions and holistic learning approaches.

"The lack of resources in some classrooms made implementing AI-powered PBL fully difficult."

"It did take some time to get used to, both for me and the students, but it was absolutely worth trying."

Despite this, the teachers indicated they saw opportunities in the innovation pedagogy. They further identified that AI-p-PBL allowed them to differentiate instructions and be less concerned with messaging and discussion facilitation. Using AI tools enriched the teaching process and opened doors for further designing engaging and inclusive curricula.

Changing Student Learning Experiences and Outcomes

Reflecting on the influence AI-powered PBL has had on the student learning experience and outcomes, teachers have reported an increase in the engagement and motivation of students, especially if projects dealt with solving real social problems.

They also reported an increased autonomy because many AI-assisted tools encourage self-directed study and initiative.

It was believed to enhance students' expression and justification of ideas due to a boost in confidence and academic performance by merging AI. The skills developed in AI-PBL, namely teamwork, critical thinking, and good communication skills, were believed by teachers to be transferable across contexts for performance.

"I have realized that my students take ownership of their projects in ways they never did."

"It connected lessons to real-world issues that made learning much more meaningful for my students."

Discussion

The findings of this study underscore the crucial situational factors that influence the adoption and implementation of AI-facilitated project-based learning (PBL) in Social Studies curricula. These results reaffirm and extend the growing body of scholarship on AI integration, particularly concerning its challenges and opportunities in diverse educational contexts (Zawacki-Richter et al., 2019; Luckin et al., 2016). One of the most dominant themes to emerge was the role of technological infrastructure. Participants reported that schools with reliable internet connectivity and updated devices could maximize the benefits of AI-based PBL, while under-resourced schools faced significant barriers. This finding aligns with Warschauer and Matuchniak (2010), who emphasized that unequal access to digital technologies perpetuates long-standing educational inequities, particularly in rural or low-income communities. Addressing this digital divide is essential to democratizing innovative learning opportunities and ensuring the scalability of AI-driven pedagogies.

Another critical dimension was teacher preparedness and professional development. Teachers expressed that insufficient training and limited technical expertise constrained their ability to confidently and effectively use AI tools. This observation echoes Ertmer and Ottenbreit-Leftwich (2010), who highlighted that teacher confidence and technological self-efficacy strongly predict adoption of educational innovations. Similarly, the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) emphasizes that meaningful technology integration requires a collaboration of technological, pedagogical, and content knowledge. Teachers may fail to contextualize AI tools within curriculum demands and student needs without sustained professional development, limiting their pedagogical impact.

The findings also pointed to the importance of administrative support and institutional policy. Participants noted that supportive school leadership, clear guidelines, and available funding encouraged experimentation and innovation, while bureaucratic restrictions and policy ambiguities created reluctance among educators. It is consistent with Fullan (2007), who argued that systemic support and visionary leadership are indispensable in driving successful educational reforms. Moreover, as Tondeur et al. (2016) observed, institutional backing provides resources and legitimizes teachers' efforts to integrate new technologies into practice.

Finally, the study revealed that cultural and pedagogical alignment was vital in shaping AI-PBL adoption in Social Studies. Teachers highlighted that AI tools must scaffold knowledge and resonate with the subject's cultural and contextual dimensions. It aligns with Vygotsky's sociocultural theory (1978), which stresses the importance of cultural mediation in learning, and Hammond (2015), who argued that culturally responsive pedagogy is key to equitable technology integration. When AI applications are culturally attuned, they are more likely to enrich discussions of historical and social issues while fostering inclusive participation.

These findings highlight four interrelated factors, technological infrastructure, teacher training, systemic support, and cultural compatibility, that shaped the adoption of AI-PBL in Social Studies. This study contributes to the broader debate on whether AI can foster inclusive, equitable, and context-sensitive learning environments. By addressing disparities, enhancing teacher capacity, and creating supportive policies, educators and institutions can leverage AI not as a replacement for traditional pedagogy, but as a tool to enrich student engagement and critical inquiry in meaningful ways within specific cultural and educational contexts.

Conclusion

The study showed that AI-powered PBL has vast potential in enhancing social studies education to increase the depth of understanding among students, critical thinking, and engagement with course concepts. The teachers and students indicated several interactions and a dynamic nature regarding AI tools, personalizing learning, and allowing for contextualized exploration in history and social phenomena. Regarding students, motivation and targeted feedback improved, but teachers noticed the development of critical thinking abilities and problem-solving in learners. Several challenges are faced with AI-based PBL, including a lack of access to technological infrastructure, inadequate training for educators, and fear of data security. Furthermore, the nature of institutional support and aligning the AI tools with curricular goals became crucial in determining successful adoption. The key findings

highlight the transformative potential of AI within social studies education, provided that the challenges are adequately addressed through systemic and well-resourced interventions.

Recommendations

1. Institutions must invest in comprehensive training programs that equip educators with knowledge and skills to integrate AI-powered PBL effectively. It will include workshops, hands-on sessions, and continued support.
2. An adequate supply of technological resources by schools and institutions may ensure equal opportunity and easy access to AI for all students, irrespective of socio-economic background.
3. Clear guidelines and policies may be established to address the challenges of data privacy and security while fostering an enabling environment for AI adoption.
4. The AI tools are intended to be aligned with social studies curricula that ensure critical inquiry, cultural relevance, and global citizenship in the learning process.
5. Collaborative practices among stakeholders-cum-actors, including educators, policymakers, and technology developers, may be encouraged to address contextual barriers and co-create sustainable solutions related to AI integration in education.

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