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Opportunities and Challenges of Using AI Tools to Implement the Constructivist Approach in Social Science for Secondary Students: A Review Paper

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Abstract:

The rapid advancement, progression and improvement of technology, which is Artificial Intelligence (AI) in education, has provided new opportunities for transforming teaching and learning processes. In the context of secondary school education, AI-driven tools offer influential means to implement the constructivist approach that promotes active, inquiry-based, and learner-centred learning. This study explores how AI-driven tools can enhance constructivist pedagogy in the social sciences by encouraging exploring, collaborating, and critical reflection among the learners. The need for this study arises from the shift in education from rote memorisation towards meaningful knowledge construction, learning and real-world understanding. In this research, a descriptive research approach using secondary data will be adopted. This study will involve a systematic review and analysis of existing literature, reports, and datasets related to the classroom observations, educators' and learners' experiences, and AI-assisted instructional practices. The findings reveal that AI tools, such as intelligent tutoring systems, virtual simulations, and adaptive learning platforms, support individualised learning, improve conceptual clarity, and foster deeper engagement with social, economical, geographical and historical concepts. However, challenges such as confined teacher expertise, insufficient digital infrastructure, data privacy concerns, and an overreliance on technology pose barriers to effective implementation. The study concludes that the integration of AI-based tools within a constructivist approach can significantly enrich Social Science learning by making it more interactive, reflective, and learner-centred. To ensure sustainable adoption, professional development, ethical guidelines, and equitable access to AI-based educational resources and materials are essential for fostering a better understanding of the subject matter.

Keywords: *Artificial Intelligence, AI-Driven tools, Constructivist Pedagogy, Social Science, Secondary School.*

Introduction:

The twenty-first century has witnessed a substantial transformation in the field of education, driven by rapid advancements in the field of Artificial Intelligence and in digital technologies. These innovations are reviving traditional classroom practices by conducting teaching and learning in a better way from the viewpoint of learners. The AI tools, such as adaptive learning platforms, intelligent tutoring systems, and natural language processing models, are reshaping the way in which teachers provide knowledge and students construct meaning (Zawacki-ki-Richter, Marin, Bound, & Gouverneur, 2019). Mainly in secondary-level social science subjects, these developments hold special consequence as this discipline deals not only with facts, economics and human society but also with interpretation. Reasoning and social understanding among the students. Thus, the incorporation of AI within a constructivist framework provides an opportunity to align a technological innovation with deeper pedagogical goals of inquiry, collaboration, and critical reflection.

Constructivism as a learning theory emphasises that learners actively construct their own knowledge through experience, exploration, and social interaction rather than transmitting information (Pigate, 1970; Vygotsky, 1978). This approach values authentic task, dialogue, and reflection processes through which learners relate new knowledge to prior understanding and to the social world they live in. In the context of social science, constructivist pedagogy aims to develop higher-order skills such as critical thinking, problem-solving, and ethical awareness. The integration of AI tools can strengthen these outcomes by creating a learning environment where students with real-world problems interpret multiple perspectives and test hypotheses in interactive and adaptive digital spaces (Fosnot & Perry, 2013). E.g. AI-enabled virtual simulations can help learners visualise historical change, economic relationships, or explore cultural interactions that are usually lacking in conventional teaching.

Recent empirical studies suggest that AI adapts and data-analytic capabilities allow teachers to personalise instruction and monitor learning progress in real time (Guo, Yi, Liu, 2024). This kind of personalisation fits well with the constructivist approach because it places

the learner at the centre of learning, allowing a flexible path based on their prior knowledge, learning speed, and thinking style. Likewise, AI-driven tools and digital assistants can promote continuous dialogue, reflective questioning, and feedback of inquiry-based learning (Darwin, Rai, & Sharma, 2023). By encouraging students to articulate their reasoning, justify opinions, and engage with counterarguments, these tools nurture intellectual curiosity and deeper conceptual understanding (Berson & Berson, 2024).

Using AI in social science classrooms is powerful because it moves learning beyond memorising facts and helps students understand people and society. AI applications such as virtual debits, digital storytelling, sentiment analysis software, and historical simulations can allow students to explore society's online opinions about the environment with policies or take part in simulated civic decisions. They build their own understanding of social issues while also learning to think critically and act ethically. Through such experiences, AI functions as a cognitive partner that fosters engagement with real-world complexities, a fundamental principle of constructivist education (Chiu & Chai, 2023).

However, the educational use of AI is accompanied by serious challenges. Studies reveal that many teachers are unfamiliar with AI technologies and lack confidence in integrating them meaningfully into classroom practice (Mallik & Gangopadhyay, 2023). The digital divide continues to hinder equitable participation; slow internet connectivity, inadequate devices, and insufficient technical support remain common in developing countries (Kong & Xir, 2022). Moreover, ethical concerns such as algorithmic bias, data privacy, and intellectual dependency pose obstacles to responsible adoption (Lee, Niu, & Chan, 2021). In social science, where multiple opinions and human judgment are essential, AI systems trained on biased data can reinforce dominant narratives (Darwin et al., 2023).

Given this crucial interplay of opportunity and constraint, the present study review aims to critically analyse how AI tools can enhance the Constructivist approach in secondary-level social sciences. It explores both pedagogical benefits and contextual challenges by synthesising contemporary research published between 2018 and 2025. To find effective AI-based practices that improve student engagement, reflection, and teamwork, while also identifying technical, ethical, and institutional barriers that make long-term use difficult. The study aligns with current educational reform priorities that advocate learner-centric, technology-supported, and

competency-based education. Therefore, establishes the foundation for a deeper investigation into the interconnections between AI constructivism and social science pedagogy. This paper explains that using AI effectively needs more than just technology; it also requires good teaching methods, ethical awareness, and equal access for all. When used carefully, AI can not only modernise social sciences but also help students become thoughtful and analytical citizens ready to live in a technology-driven world.

Review of Literature:

The relationship between Artificial Intelligence and constructivist pedagogy has become a focal point of recent educational research, especially as technology continues to reshape the classroom environment. The integration of AI into secondary-level education is increasingly seen not just as a technological innovation but as a pedagogical transformation that redefines how learners interact with knowledge. Constructivist theory, which posits that learning occurs through active engagement, reflection, and collaboration, provides a strong theoretical foundation for understanding how AI can enhance meaningful learning experiences (Piaget, 1970; Vygotsky, 1978). Rather than being mere recipients of information, learners are viewed as participants who construct understanding through exploration and dialogue. In this regard, AI functions as a catalyst that supports personalised learning, collaboration, and knowledge building, and metacognitive reflection, core elements for constructivist education (Fosnot & Perry, 2023). Several researchers argue that AI tools inherently embody constructivist principles when applied effectively in the classroom. Adaptive learning systems, intelligent tutoring programs, and natural language chatbots provide individualised feedback and allow learners to progress at their own pace based on demonstrated comprehension (Guo, Yi, & Liu, 2024). These systems identify gaps in student understanding and supply targeted scaffolding, closely mirroring Vygotsky's (1978) notion of the “zone of proximal development”, where guided interaction helps learners advance to higher levels of cognitive complexity. Moreover, AI capability to process large datasets and generate tailored responses enables continuous formative assessment supporting learners' metacognitive growth by allowing them to monitor and adjust their own learning strategies (Holmes, Bialik, & Fadel, 2022). In the domain of social science, AI tools offer particularly rich possibilities for inquiry and reflection. Social science subjects such as history, geography, economics, and civics require

interpretation, reasoning, and the ability to analyse social phenomena from multiple perspectives. Through AI-driven simulations, digital storytelling, and data visualisation tools, learners can explore complex society issues, test hypotheses, and experience cause-and-effect relationships that are otherwise abstract in textbooks (Siau & Yang, 2021). For instance, an AI-based historical similar can allow students to examine how different economic or political decisions shape outcomes, thereby developing analytical and ethical reasoning skills. Berson and Berson (2024) observed that AI-mediated inquiry activities help students engage in civic discourse and ethical reflection, two essential dimensions of constructivist social science learning. Likewise, Chiu and Chai (2023) highlight that AI-enabled collaborative platforms support group discussions and peer interactions, making the learning process dialogic and socially grounded.

Empirical studies between 2019 and 2025 consistently identify three main pedagogical benefits of AI use within constructivist frameworks: personalisation, collaboration, and engagement (Darwin, Rai & Sharma, 2023; Wang et al., 2024). Personalisation ensures that learners receive differentiated instruction based on prior knowledge, motivation and pace, enabling inclusive participation. Collaborative learning is enhanced through AI-supported communication channels that connect students across contexts, allowing the sharing of viewpoints and joint problem-solving. Engagement, meanwhile, is deepened through interactive simulations and gamified environments that promote intrinsic motivation and sustained curiosity (Guo et al., 2024). These opportunities demonstrate how AI can transform static content delivery into dynamic inquiry-based learning, fostering cognitive and social-emotional growth simultaneously.

Despite the Potential benefits, the literature also identifies significant challenges that hinder the effective implementation of AI-driven constructivist pedagogy. One recurring issue is teacher preparedness. Many educators lack sufficient training to integrate AI tools meaningfully into constructivist lesson design (Malik & Gangopadhyay, 2023). Without pedagogical understanding, AI may be reduced to a content–delivery tool rather than a facilitator of inquiry and reflection. Professional development programs must therefore move beyond technical proficiency toward fostering teachers' ability to design problem-based, interactive learning experiences supported by AI. Another major barrier is digital inequity.

Limited access to devices, inadequate internet connectivity, and uneven technological infrastructure continue to widen the learning gap between urban and rural or resource-poor schools (Kong & Xie, 2022). Constructivist learning requires participation and dialogue; these inequities directly affect inclusivity and learner agency.

The ethical dimension of AI use in education has also gained significant attention. Researchers caution that algorithmic bias, opaque decision-making processes, and the commodification of student data threaten fairness and trust in educational systems (Lee, Niu & Chan, 2021). In social science subjects, where values and human perspective are central, biased AI outputs can reinforce stereotypes or privilege dominant narratives, understanding the pluralism central to constructivist thought (Drwin et al., 2023). Additionally, scholars warn that overreliance on AI may diminish student autonomy and creativity if learners begin to depend excessively on algorithmic suggestion rather than their own reasoning (Yan, Lin, & He, 2023). To maintain constructivist integrity, teachers must frame AI as a partner for thinking rather than a substitute for it. Overall, the review of literature suggests a dual narrative: AI has immense potential to operationalise constructivist learning but also poses conceptual and ethical tensions. Most researchers agree that successful implementation requires alignment among technological, pedagogy, and ethics. Effective AI integration must be guided by a teacher who acts as a facilitator, not an operator, ensuring that technology supports inquiry and social interaction rather than replacing them (Holmes et al., 2022). Furthermore, while international scholarship provided valuable insights, there is still limited empirical evidence focusing.

Specifically on secondary level social science education, especially in developing contexts. Future research should examine context frameworks that adapt AI to local curricular needs, cultural, and infrastructural realities. In conclusion, the literature underscores that AI and constructivist pedagogy are not mutually exclusive but mutually reinforcing. When combined responsibly, they can create transformative learning experiences that promote active inquiry, collaboration, and ethical reasoning among secondary students, yet their integration must be supported by adequate teacher preparation, equitable access, and rigorous ethical safeguards. The next section elaborates on the methodology adopted in this review to systematically examine the opportunities and challenges identified in existing studies

Objective:

- To analyze how AI tools enhance constructivist learning experiences in social science at secondary level.
- To identify challenges of teachers and students in integrating AI tools for constructivist pedagogy.
- To explore pedagogical strategies for implementing AI-driven Ed-tech tools in social science using a constructivist approach.

Methodology

The use a descriptive research design based on the systematic review of secondary data sources to analyse the opportunities and challenges of integrating Artificial Intelligence within constructivist pedagogy for secondary level social science. Since this study reviews existing research instead of collecting new data, this method is suitable for identifying key ideas, theories, and teaching implications from 2018 to 2025, taken from the structured databases such as ERIC, Scopus, SpringerLink, Google Scholar, and ScienceDirect. The study includes about 40 relevant studies, ensuring balanced representation of theoretical and empirical work across diverse contexts. The data were examined using a thematic review approach, which involved identifying, categorising, and interpreting recurring ideas under four core themes: (1) the pedagogical affordances of AI for constructivist learning ;(2) teacher readiness and digital competence;(3) Learner engagement, collaboration, and reflection. (4) ethical, infrastructural, and equity-related challenges. Instead of relying on quantitative data analysis, the study emphasises conceptual synthesis, integrating evidence to generate broader insights about how AI can enhance or constrain constructivist learning in social science. Reliability and validity were ensured through cross-verification of findings from multiple independent studies and triangulation across conceptual, empirical, and policy perspectives. Overall, this study adopts a descriptive design based on a systematic review of secondary data sources, ensuring a comprehensive and credible synthesis of recent research on AI-driven constructivist pedagogy.

Discussion and Analysis

5.1 Opportunities for Enhancing Constructivist Pedagogy

Integrating Artificial Intelligence into education has created transformative possibilities for improving constructivist learning.

Constructivism emphasises that learners actively construct knowledge through interaction and reflection rather than passively receiving information (Piaget, 1970; Vygotsky, 1978).AI supports this process by providing adaptive, data-driven environments that respond to individual learning needs. Intelligent tutoring systems and chatbots deliver personalised feedback, while simulations and digital storytelling tools allow students to explore complex real-world phenomena. In the science subject, these tools foster critical inquiry by enabling learners to interpret data, engage in virtual debates, and analyse socio-economic trends (Berson & Berson, 2024; Chiu & Chai, 2023). Such technologies transform learning from rote memorisation into experiential exploration, aligning closely with the constructivist pedagogy of "learning by doing"

5.2 Transforming the Role of Teacher

AI has significantly reshaped the role of teachers, positioning them as facilitators and mentors rather than transmitters of information. By automating repetitive administrative tasks such as grading and progress tracking, AI enables driven learning experiences (Holmes, Bialik, & Fadel, 2022). Constructivist pedagogy depends on teacher mediation and contextual understanding, and AI can assist by providing analytics dashboards that identify students' needs and misconceptions (Mallik & Gangopadhyay, 2023). However, many teachers still face difficulties in integrating AI effectively due to limited digital literacy. Continuous professional development is therefore vital to ensure that teachers can apply AI tools meaningfully to stimulate critical thinking and collaboration.

5.3 Fostering Inquiry, Collaboration, and Reflection

AI technologies enhance constructivist processes such as inquiry, dialogue, and collaboration. AI-driven platforms and chatbots encourage questioning and reflective reasoning by guiding students through discussions and problem-solving tasks (Darwin, Rai, & Sharma, 2023). In social science classrooms, such tools allow learners to engage with moral and civic problems, building an interpretive and deep understanding of the subject matter. AI-driven tools also promote peer learning across geographical boundaries, aligning with Vygotsky's (1978) idea that knowledge is socially constructed. Additionally, adaptive feedback mechanisms encourage self-assessment and metacognitive awareness, helping learners monitor their

progress and adjust strategies (Guo, Yi, & Liu, 2024). To preserve authenticity, however, human interaction and emotional engagement must remain integral to learning environments

5.4 Ethical Infrastructural and Equity Challenges

Although AI offers many benefits, its use in education also creates several important challenges. One major issue is data privacy and security, as AI platforms collect large amounts of students' information that must be protected. Another serious concern is the digital divide, which continues to limit equal access to technology. Many rural schools still lack proper internet connections, digital devices, and technical support needed for effective AI (Kong & Xie, 2022). These gaps go against the constructivist and democratic values of education, which promote fairness and equal opportunities for all learners. To overcome these barriers, education systems must create clear ethical policies, invest in better infrastructure, and provide teacher training programs that support safe, responsible, and inclusive use of AI tools

5.5 Balancing Human and Artificial Intelligence

An emerging body of literature advocates a hybrid intelligence model that combines the strengths of AI and human educators. While AI can quickly process information and offer personalised learning, human teachers are still essential for guiding moral reasoning, ethical judgment, and real-world understanding (Holmes et al., 2022). In social sciences, this balance is especially important because understanding human behaviour and moral issues requires sensitivity and ethical thinking. Educators act as facilitators who guide students in interpreting AI outputs, ensuring that technology tools enhance rather than replace critical discourse (Berson & Berson, 2024).

5.6 Future Directions and Policy Implications

The future of AI-enabled constructivist pedagogy depends on coordinated action among educators, policymakers, and researchers. First, professional development programs must integrate AI literacy and constructivist pedagogy, empowering teachers to use intelligent tools for collaborative and inquiry-based learning. Second, curricula should embed an AI-supported project that connects academic concepts to real-world social issues. Third, equitable access to digital infrastructure must be prioritised through government initiatives and inclusive technology policy (Wahono et al., 2024). Finally, ethical frameworks must govern AI use,

ensuring transparency, accountability, and fairness. Future research should explore context-specific models that examine how AI-driven Constructivist strategies influence learners' cognitive, emotional, and civic development in diverse educational settings.

Conclusion

The present review concludes that the in integration of Artificial Intelligence into constructivist pedagogy marks a transformative advancement in the teaching and learning of social sciences at the secondary level. AI technologies such as adaptive learning systems, intelligent tutoring platforms, and conversational chatbots can effectively personalise learning, provide continuous feedback, and facilitate inquiry-based engagement that aligns with the constructivist approach of exploration, collaboration, and reflection (Guo, Yi & Liu, 2024; Berson & Berson, 2024). By allowing students to analyse real-world data, participate in virtual simulations, and engage in reflective dialogue, AI fosters learners to actively construct knowledge rather than passively take up the information. In this sense, AI helps as a powerful pedagogical partner that enables experiential, democratic, and participatory learning qualities that are central to social sciences.

However, the review also divulges significant challenges that limit the equitable and ethical adoption of literacy, lack of professional training, and limited institutional support remain critical barriers (Mallik & Gangopadhyay, 2023). Infrastructural disparities and the ongoing digital divide further intensify inequities, particularly in rural or underdeveloped areas (Kong & Xie, 2022). Moreover, issues of data privacy, algorithmic bias, and the ethical use of AI tools pose serious concerns about fairness, accountability, and transparency in educational systems (Lee, Niu, & Chan, 2021). Therefore, AI has immense potential to enhance constructivist teaching; its effectiveness ultimately depends on thoughtful human guidance, ethical governance, and inclusive implementation. Constructivist values active learning and social responsibility, and these principles should stay central to any AI use in education to make sure technology supports, not replaces, the human side of teaching and learning.

7. Recommendations

To realize the potential of AI advancing constructivist social sciences, the following recommendations are proposed:

1. Teacher Professional Development: Schools and institutions should focus on regular training programs that improve teachers' digital skills, encourage innovative teaching methods, and help them use AI tools to provide personalised and inquiry learning experiences for students

2. Curriculum Integration: Curricula should include AI-supported tools, project-based learning, and problem-solving activities that promote critical thinking, creativity, and collaborative learning.

3. Equitable Infrastructure: Policymakers must ensure equitable access to devices, digital resources, and stable internet connectivity so that all learners, irrespective of socio-economic status, benefit from AI-driven education.

4. Ethical and Inclusive Governance: Educational authorities should establish clear policies for ethical data use, algorithmic transparency, and inclusivity to prevent bias and safeguard student privacy

5. Context Specific Research: Future studies should explore localised models of AI-based constructivist teaching, examining their effects on students' cognitive growth, creative thinking, problem-solving skills, and civic engagement in different educational settings

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