

A Study on Role of AI in Enhancing Higher Education for Sustainable Development Goals (SDGs) in Shivamogga District

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Abstract:

The growing incorporation of Artificial Intelligence (AI) in higher education is significantly influencing teaching methodologies and learning environments, particularly in the context of advancing the United Nations Sustainable Development Goals (SDGs). This study investigates how AI technologies are being employed to promote sustainability education within higher education institutions in Shivamogga District, Karnataka. It examines the role AI plays in curriculum development, educational planning, and fostering awareness of sustainability issues among students and faculty.

The research is centered around two primary objectives: first, to understand how academic institutions are integrating AI into educational strategies that align with international sustainability standards; and second, to assess the impact of AI-enhanced learning on students' knowledge, engagement, and application of sustainability principles. Data was collected through a structured survey of 50 students, offering insights into their experiences with AI platforms such as ChatGPT, Gemini, and Grammarly in academic settings. Results indicate that these AI tools contribute positively to students' academic performance and comprehension of sustainability-related topics. Participants noted improved critical thinking skills and increased motivation to engage in sustainable initiatives. Nevertheless, concerns were raised regarding issues like data security, diminished interpersonal communication, and reliance on technology.

The findings support the hypothesis that AI integration can substantially improve sustainability-focused education and awareness within higher education institutions. The study emphasizes the need for responsible AI use, highlighting the importance of faculty development, equitable access, and ethical considerations in leveraging AI to support sustainable development in academic contexts.

Keywords: Artificial Intelligence (AI), Sustainability Education, Higher Education, United Nations Sustainable Development Goals (SDGs) and Curriculum Development

Introduction

In recent years, Artificial Intelligence (AI) has become an influential force in reshaping the higher education landscape. Its applications extend far beyond automation, offering new pathways for personalized learning, academic planning, and research innovation. As institutions embrace digital transformation, AI is also being recognized for its potential to contribute to larger societal objectives, notably the United Nations Sustainable Development Goals (SDGs). These 17 goals, which include targets such as quality education, climate action, gender equality, and sustainable economic growth, serve as a global blueprint for a more equitable and sustainable future.

Higher education institutions are uniquely positioned to contribute to these goals, not only through teaching and research but by cultivating critical thinking, civic responsibility, and innovation among students. Within this context, AI presents an opportunity to enhance curriculum design, foster digital literacy, and support sustainability-oriented learning. Its capabilities in data analysis, trend forecasting, and adaptive learning make it a powerful tool for aligning educational practices with the SDGs.

This study focuses on the integration of AI in higher education institutions within the Shivamogga District of Karnataka. It investigates how colleges and universities are utilizing AI tools to promote sustainability education, both in curricular development and classroom practices. Particular attention is given to the extent of student engagement with AI technologies, their understanding of sustainability issues, and how these tools support the implementation of SDG-related content.

In addition, the study explores faculty preparedness, evaluating whether educators are equipped with the skills and training necessary to effectively incorporate AI into their teaching for sustainability. While the potential of AI in education is promising, concerns regarding ethics, digital equity, data privacy, and overreliance on technology must also be addressed. Given the increasing emphasis on education as a key lever for sustainable development, this research aims to provide timely insights into how AI adoption can strengthen the mission of higher education. By examining institutional strategies and student perspectives, the study contributes to a deeper understanding of how AI can be ethically and effectively harnessed to advance the SDGs at the local level.

Research Objectives

1. To explore the integration of AI in curriculum and teaching to support SDG-focused education in Shivamogga's higher education institutions.
2. To assess the impact of AI tools on students' engagement with sustainability and faculty readiness for AI-based teaching.

Significance of the Study

The significance of this study lies in its focus on the intersection of technology, education, and sustainability three pillars crucial for future societal development. As institutions strive to align with global priorities such as the SDGs, understanding how emerging technologies like AI can facilitate this alignment becomes essential.

This study contributes to:

1. Academic knowledge, by offering data-driven insights into AI adoption for sustainability education.
2. Institutional development, by highlighting best practices and gaps in AI integration.
3. Policy formation, by informing educational planners and policymakers on ethical and practical strategies for AI deployment.
4. Student engagement, by examining how AI influences learners' interest and involvement in sustainability issues.
5. Faculty empowerment, by assessing training needs and readiness for AI-based teaching approaches.

Literature Review:

Artificial Intelligence and Sustainable Development in Higher Education: A Regional Perspective: Over the past ten years, the application of Artificial Intelligence (AI) in higher

education has seen a steady rise, largely driven by the pursuit of more personalized, data-driven, and efficient educational models. Scholars like Luckin et al. (2016) have emphasized how AI can enhance adaptive learning, streamline administrative processes, and enrich the overall learning experience through customized feedback and targeted content delivery.

These innovations have made AI an influential factor in the ongoing digital transformation within the education sector.

Simultaneously, global education systems have been increasingly aligned with the United Nations Sustainable Development Goals (SDGs), particularly Goal 4, which focuses on ensuring inclusive and equitable quality education. As noted by UNESCO (2020), higher education institutions are vital in advancing these goals by embedding sustainable practices in teaching, research, and outreach activities. The incorporation of AI into these areas presents new opportunities to strengthen alignment between education and sustainability objectives. Recent research has examined the intersection of AI and sustainable education. Holmes et al. (2019), for instance, suggest that AI can promote interdisciplinary thinking and critical problem-solving skills—essential traits for tackling complex global issues like social inequality and climate change. Moreover, AI-based systems can assist institutions in tracking sustainability performance and generating actionable insights through real-time data analysis. In India, the use of AI in higher education is expanding, with tools such as ChatGPT, Google Gemini, and automated evaluation systems becoming increasingly common. According to Jha and Singh (2021), these technologies contribute to more efficient learning and better academic outcomes. However, challenges persist around ethical use, data security, and equitable access—particularly in rural or semi-urban areas like the Shivamogga District, where technological infrastructure may lag behind urban centers.

Another critical area of focus in the literature is faculty preparedness and institutional capacity for implementing AI tools. Studies by Mishra (2022) and Kumar et al. (2023) underscore the importance of digital infrastructure, staff training, and supportive policy frameworks in enabling effective AI integration that aligns with sustainability goals. In summary, current research supports the idea that AI can contribute significantly to sustainability education by making learning experiences more engaging, accessible, and tailored to student needs. However, the success of these efforts depends on local factors such as institutional readiness, ethical standards, and digital accessibility. This study aims to offer localized insights into how higher education institutions in Shivamogga are adopting AI to support educational objectives aligned with the SDGs.

AI and Sustainable Development in Higher Education: Broader Themes

The increasing role of AI in higher education is transforming not only how instruction is delivered but also how students interact with content and how institutions operate. Numerous studies (e.g., Holmes et al., 2019; Zawacki-Richter et al., 2019) point to AI's potential in personalizing learning, providing real-time assessment, and enhancing student engagement. As such, AI is now being viewed not just as a tool for improving academic achievement, but also as a vehicle to support broader societal objectives, including the SDGs.

Role of AI in Academic Settings: AI technologies have been shown to address key limitations in conventional teaching methods. Tools such as intelligent tutoring systems, automated grading platforms, and learning analytics dashboards allow educators to monitor student progress and deliver timely, tailored support (Baker & Inventado, 2014). Natural Language Processing (NLP) applications like ChatGPT, Grammarly, and QuillBot are now

commonly used to improve academic writing and comprehension. While these tools offer benefits, they also raise ethical concerns such as diminished critical thinking, academic dishonesty, and over-dependence on automation.

Education and the SDGs: Education plays a central role in all 17 SDGs, especially Goal 4, which prioritizes equitable and quality education. Institutions of higher learning are key players in driving sustainability by incorporating relevant content into curricula, conducting sustainability-focused research, and engaging communities (Leal Filho et al., 2018). Exposure to sustainability-related concepts in higher education has been shown to encourage students to adopt environmentally and socially responsible behaviors (Brundi et al., 2020).

AI in Sustainability-Focused Learning: Recent studies indicate that AI can support sustainability education by facilitating personalized learning pathways, supporting curriculum development, and helping measure student progress in sustainability competencies (Huang et al., 2021). AI can also be used to simulate complex global challenges, encouraging systems thinking and data-driven decision-making. Nevertheless, researchers caution against the belief that technology alone can resolve systemic educational problems. Human-centered, inclusive, and ethically governed AI use is emphasized as crucial.

Barriers to AI Implementation: Despite its potential, implementing AI in educational settings faces several hurdles. These include limited faculty training, infrastructural challenges, resistance to change, and concerns about data security and algorithmic bias (Luckin et al., 2016). AI should be seen as a complement to, rather than a replacement for, human educators.

Indian and Local Context – Shivamogga District: India's National Education Policy (NEP) 2020 promotes the integration of digital and AI technologies in the education sector. While institutions in urban areas are progressing rapidly, less is known about AI adoption in regional settings like the Shivamogga District. Understanding how institutions in these areas are implementing AI is essential for evaluating both the opportunities and limitations of AI-driven sustainable education at the grassroots level.

Literature Gaps

While international studies offer broad insights into AI and SDG integration, few have focused specifically on student and faculty perceptions in semi-urban or rural Indian districts like Shivamogga. Moreover, there is a lack of empirical data on how AI tools are being practically applied to promote sustainability education in these regions. This study aims to bridge that gap by offering localized, data-driven insights.

Research Methodology

Research Design:

This study adopts a quantitative and descriptive research design, aiming to understand the extent and impact of AI integration in higher education institutions in Shivamogga District, specifically in the context of sustainability-focused education and awareness of Sustainable Development Goals (SDGs). The study gathers primary data to evaluate the perceptions of both students and faculty members regarding the effectiveness, usage, and ethical implications of AI tools in their academic environment.

Study Area:

The research was conducted in Shivamogga District, Karnataka, focusing on various government, aided, and private colleges affiliated with Kuvempu University and other recognized institutions offering undergraduate and postgraduate courses in commerce,

management, and related disciplines.

Population and Sample Size: The target population includes students and faculty members from higher education institutions in Shivamogga District.

1. **Sample Size:** A total of 50 students were selected using convenience sampling, a non-probability sampling method suitable for exploratory studies. Future phases may expand to include faculty members for a comparative analysis.

2. The sample included students from both undergraduate (B.Com, BBA) and postgraduate (M.Com, MBA) and Faculty members.

Data Collection Method

1. Primary Data: Collected using a structured questionnaire distributed physically and digitally.
2. The questionnaire contained Likert scale items (Strongly Agree to Strongly Disagree) and multiple-choice.
3. It was divided into key sections: demographic details, usage of AI tools, perception of AI in relation to SDGs, ethical concerns, and impact on learning.
4. Secondary Data: Gathered from published journals, government reports, institutional websites, and previous research studies related to AI, education, and SDGs.

Data Analysis Tools

1. The collected data were analyzed using SPSS (Statistical Package for the Social Sciences) and Microsoft Excel.
2. Descriptive statistics (mean, percentage, frequency) were used to summarize responses.
3. An independent t-test was conducted to determine if there were statistically significant differences in perceptions based on gender.
4. Reliability of the instrument was tested using Cronbach's Alpha.

Variables Considered

1. **Independent Variables:** Use of AI tools (e.g., ChatGPT, Gemini, Grammarly), faculty training, academic planning with AI.

2. **Dependent Variables:** Awareness of SDGs, student engagement, critical thinking, participation in sustainability activities, perceived ethical concerns.

Data Analysis Structure

Once responses are collected:

1. Use SPSS or Excel to calculate:
2. Frequencies and percentages (demographics and tool usage)
3. Mean and standard deviation (perception and ethical concern sections)
4. Perform independent sample t-tests to compare perceptions based on gender or course level.
5. Use Cronbach's Alpha to test the reliability of your Likert scale items:

Reliability Statistics	
Cronbach's Alpha	N of Items
.876	50

Statistically Significant Differences Found ($p < .05$)

Statement Interpretation	p-value	Interpretation
Faculty members are trained to integrate AI technologies for promoting the SDGs.	0.002 (Levene's test), but p = 0.373 / 0.389 (t-test)	Variance differs significantly, but the mean difference is NOT significant.
Higher education institutions in Shivamogga are committed to using AI for sustainable development	0.000	Significant positive difference.
AI ensures data and privacy protection	0.012 / 0.013	Significant positive difference.
AI might lead to academic dishonesty or misuse (e.g., plagiarism).	0.006 / 0.008	Significant concern found.
Courses using AI tools encourage me to think critically about environmental and social issues.	0.043 / 0.041	Significant difference in agreement.
The use of AI in learning motivates me to participate in sustainability-related activities.	0.002	Significant positive impact.
improves academic content understanding	0.022 / 0.026	Significant improvement
AI-powered personalized learning recommendations are helpful.	0.031 / 0.040	Significant agreement.
AI-generated feedback helps me improve academically	0.023 / 0.025	Significant positive effect.

Not Statistically Significant ($p > .05$): For all other statements (e.g., about engagement, critical thinking reduction, academic dishonesty, job loss, etc.), the p-values were greater than .05, meaning the difference between groups was not statistically significant. Notes:

1. Levene's Test (Sig.) checks if variances are equal. If $p < .05$, use the "Equal variances not assumed" row.
 2. t-test (Sig. 2-tailed) tells you if there's a significant difference between the two groups.
 3. Positive Mean Difference = Group 1 scored higher; negative = Group 2 scored higher.
- Statistically Significant Differences ($p < .05$): These are the items where the differences between groups are statistically meaningful ($p < .05$), meaning there's a

high likelihood the differences are real and not due to chance.

4. Faculty training for SDGs using AI:

- a. Levene's test shows a significant variance difference ($p = 0.002$), indicating unequal variability between groups.
- b. However, the t-test results ($p = 0.373 / 0.389$) show no significant mean difference. This suggests that even though the variability differs between groups, their opinions on training for SDGs are not significantly different.

5. Higher education institutions in Shivamogga using AI for sustainable development:

- a. p -value = 0.000, indicating a significant positive difference between the two groups. One group strongly believes in the commitment of HEIs to AI for sustainability.

6. AI ensures data and privacy protection:

- a. p -value = 0.012 / 0.013, indicating a significant positive difference in how much one group trusts AI to protect privacy and data.

7. AI might lead to academic dishonesty or misuse:

- a. p -value = 0.006 / 0.008, suggesting that one group has a significant concern about AI being misused, such as plagiarism.

8. AI tools encourage critical thinking:

- a. p -value = 0.043 / 0.041, indicating a significant difference in agreement. One group feels more strongly that AI courses promote critical thinking about environmental and social issues.

9. AI motivates participation in sustainability activities:

- a. p -value = 0.002, showing that AI is significantly motivating one group to engage more in sustainability-related activities.

10. AI improves understanding of academic content:

- a. p -value = 0.022 / 0.026, showing significant improvement in understanding academic content with AI support.

11. AI-powered personalized learning recommendations are helpful:

- a. p -value = 0.031 / 0.040, indicating a significant positive response about the helpfulness of AI recommendations.

12. AI-generated feedback improves academic performance:

- a. p -value = 0.023 / 0.025, suggesting that AI feedback has a positive effect on academic improvement.

Non-Significant Differences ($p > .05$)

For all the other statements, the p -values were greater than 0.05, meaning there was no statistically significant difference between the groups:

- This indicates that the opinions or experiences between the two groups (e.g., about engagement, job loss fears, critical thinking reduction, etc.) are not statistically different

Notes on the Statistical Tests:

1. Levene's Test (Sig.) checks whether the variability (spread of values) is equal between the two groups. If $p < 0.05$, it suggests the variances are not equal, and the results should be interpreted using the "Equal variances not assumed" row in the t-test.
2. The t-test (Sig. 2-tailed) tells you whether the mean difference between the groups is statistically significant. A p -value less than 0.05 means there's a statistically significant

difference.

3. A positive Mean Difference indicates that Group 1 has a higher mean score than Group 2, and vice versa for a negative difference.

Recommendations:

1. Institutional Strategy and Policy Formulation: Higher education institutions (HEIs) should develop a comprehensive policy for the integration of AI that balances technological advancement with ethical considerations. This policy should cover key areas such as data governance, digital rights, and the transparency of AI tools utilized in education.

Institutions should also establish AI ethics committees that guide the responsible adoption and use of AI technologies. These committees would be tasked with ensuring accountability, maintaining trust within the academic community, and monitoring the ethical risks associated with AI systems.

2. Faculty Development and Skill Enhancement: It is essential for faculty members to undergo continuous professional development to effectively incorporate AI into their teaching practices. The training should extend beyond the technicalities of AI tools, focusing also on how to apply these tools to enhance sustainability education.

Professional development programs can include specialized courses that explore AI-driven sustainability simulations. Additionally, faculty should be encouraged to collaborate across different fields, particularly with the social sciences, environmental science, and sustainability studies, to integrate AI in a multidisciplinary way.

3. Curriculum Design and Innovation: AI tools should be integrated into existing sustainability-focused courses, creating dynamic learning experiences that encourage critical thinking and problem-solving within the context of environmental and social issues. Additionally, new elective courses centered on AI ethics, digital sustainability, and the role of AI in achieving the Sustainable Development Goals (SDGs) should be introduced. These courses can provide students with the knowledge necessary to navigate the ethical challenges associated with emerging technologies.

4. Promoting Student Digital Literacy and Ethical Awareness: All academic programs should incorporate digital literacy modules that teach students how to critically assess AI-generated content. Workshops and seminars focused on ethical considerations, such as algorithmic bias, digital misinformation, and the environmental effects of technology, should be part of the curriculum.

By instilling ethical awareness in students, institutions ensure that they understand not only how to use AI tools but also how to use them responsibly, keeping in mind the potential risks such as misinformation, biases, and the environmental cost of digital technologies.

5. Ensuring Equitable Access and Technological Infrastructure: To address the digital divide, HEIs must invest in the infrastructure necessary for AI integration across both urban and rural campuses. This includes providing access to essential resources such as AI software, high-speed internet, and digital devices, ensuring all students have equal access to AI-enhanced learning.

Furthermore, collaborative platforms should be developed to enable resource sharing, especially among institutions with limited technological resources, thereby ensuring equitable access to AI tools and promoting a community of shared knowledge

6. Monitoring and Ongoing Research: Institutions should implement a comprehensive

monitoring system to assess the impact of AI on learning outcomes, sustainability awareness, and SDG-related competencies. Regular feedback from both students and faculty should be gathered to refine AI integration practices, ensuring that these tools remain effective and ethical. Encouraging research on AI's potential to advance sustainable development will provide valuable insights, shaping evidence-based policies and best practices for future use.

7. Building Industry and Community Partnerships: Forming partnerships with AI technology companies, sustainability organizations, and government agencies will help HEIs stay updated on the latest trends and best practices in AI. These collaborations can also provide valuable internship opportunities for students and allow them to gain real-world experience with AI applications in sustainability fields. Additionally, industry partners can support curriculum development, research projects, and provide funding for AI infrastructure, helping to ensure the sustainability of AI-powered academic programs

Conclusion:

The integration of Artificial Intelligence (AI) in higher education represents not just a technological advancement, but a key strategy to address global challenges, such as those outlined in the UN Sustainable Development Goals (SDGs). The research conducted in Shivamogga District has shown that AI can significantly enhance sustainability education, improving student understanding of critical topics and fostering personalized learning that encourages critical thinking. However, the study also highlights the challenges related to faculty engagement, the need for comprehensive support structures, and concerns regarding the ethical implications of AI, such as the potential for over-reliance on technology and the reduction in human interactions. To navigate these challenges, institutions must approach AI integration with caution, ensuring that it aligns with both educational goals and ethical standards.

By prioritizing faculty training, establishing clear ethical guidelines, and fostering collaborations with both industry and community stakeholders, institutions can create a robust AI-powered ecosystem that promotes sustainable development and equitable access to digital education. Ultimately, AI holds the potential to transform higher education into a powerful tool for advancing sustainable development, provided its implementation is strategic, ethical, and inclusive. HEIs must now move from exploratory experimentation with AI to strategic, widespread adoption, aligning it with both academic objectives and global sustainability goals. By adopting these recommendations, institutions can not only enhance their educational offerings but also contribute to building a more equitable and sustainable future.

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