

Leveraging Ethical Artificial Intelligence for Sustainable Development: A Framework for Responsible Innovation with Reference to the Udupi Region

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Abstract: *The integration of ethical Artificial Intelligence (AI) into sustainable development strategies presents a transformative opportunity for regional advancement, particularly in emerging economies. This study presents a comprehensive framework for responsible innovation by integrating ethical AI principles with sustainable development initiatives. By understanding current use and potential of AI, its awareness, as well as the ethical concerns related to AI adoption in the educational context, the study highlights how AI can be deployed to support sustainable goals while ensuring ethical sensitivity in the education sector. Through survey interviews, policy analysis, and regional data, the research identifies key enablers and barriers to the adoption of ethical AI in Udupi.*

Keywords: Ethical Artificial Intelligence, Sustainable Development, Technological Advancements.

I. INTRODUCTION

The rapid advancement of artificial intelligence (AI) has transformed numerous sectors worldwide, including healthcare, agriculture, education, and governance. AI holds immense potential to accelerate progress toward sustainable development initiatives. Its deployment must be guided by ethical considerations to ensure inclusivity, equity, and long-term societal well-being. Ethical AI emphasizes transparency, accountability, fairness, as well as value for human rights, which are critical in fostering responsible innovation.

In regions like Udupi, a coastal district in the state of Karnataka, India, the integration of ethical AI poses good scope for sustainability. This region has a good cultural heritage, growing educational institutions, and a strong presence in agriculture and fisheries. It shows a unique case study to explore how technology fulfills the local needs without compromising ethical standards. By focusing on ethical frameworks and region-specific challenges, this paper proposes a model for leveraging AI responsibly, ensuring that innovation advances development goals that are inclusive and sustainable.

II. LITERATURE REVIEW

2.1 Responsible AI Governance: A Systematic Literature Review

Batool et al. (2023) conducted a systematic literature review to examine existing AI governance frameworks. Their study identified key questions regarding accountability, governance elements, timing within the AI development lifecycle, and execution mechanisms. The findings highlight the need for new models that align with Responsible AI (RAI) principles, emphasizing the scope of ethical considerations in AI development and deployment.



2.2 Broadening the Perspective for Sustainable AI: Comprehensive Sustainability Criteria and Indicators

Rohde et al. (2023) proposed the SCAIS Framework, which includes 19 sustainability criteria and 67 indicators for AI systems. This interdisciplinary approach provides a holistic perspective on sustainable AI, addressing societal, environmental, and economic consequences. The framework aims to facilitate the development of standards and tools to support the conscious development and application of AI systems, promoting sustainability in AI practices.

Khan et al. (2021) conducted a systematic literature review to investigate the significance of AI principles and identify challenges impacting the adoption of AI ethics principles. Their study revealed that transparency, privacy, accountability, and fairness are the most common AI ethics principles. The findings also highlight challenges such as a lack of ethical knowledge and vague principles, suggesting the need for a maturity model to assess the ethical capabilities of AI systems and provide best practices for further improvements.

Artificial Intelligence Ethics: An Inclusive Global Discourse?

Roche et al. (2021) examined the inclusivity of global AI ethics discourse, revealing the underrepresentation of perspectives from the Global South and women. Their findings suggest that the dominance of Western viewpoints in AI ethics may lead to frameworks that are not universally applicable. This underscores the need for inclusive ethical guidelines that consider diverse cultural and societal contexts, ensuring equitable AI development and deployment worldwide.

2.3 Artificial Intelligence: The Global Landscape of Ethics Guidelines

Jobin et al. (2019) conducted a comprehensive analysis of global AI ethics guidelines, identifying common principles such as transparency, justice and fairness, non-maleficence, responsibility, and privacy. However, they also noted significant divergence in how these principles are interpreted and implemented across different regions and sectors. This highlights the necessity for adaptable ethical frameworks that can be custom-made for specific regional and cultural contexts, ensuring responsible AI practices that align with local values and priorities.

III. OBJECTIVES

- To understand the current use and potential of AI technologies in promoting sustainable development in the Udupi region.
- To assess the awareness and attitudes of students toward ethical AI practices.
- To identify ethical concerns related to AI adoption in the education sector.

IV. CONCEPTUAL FRAMEWORK

Ethical Artificial Intelligence



AI in Education



Quality Education



Sustainable Development

Based on the above conceptual framework, the following hypothesis is developed.

H01: AI technologies currently used in the Udupi region do not have a significant impact on promoting sustainable development, and there is no significant potential for further AI-driven sustainability initiatives.

H11: AI technologies currently used in the Udupi region have a significant positive impact on promoting sustainable development, and there is significant potential for further AI-driven sustainability initiatives.

H02: Students in the Udupi region have low or no awareness of ethical AI practices, and their attitudes toward ethical AI use are indifferent or negative.



H12: Students in the Udupi region have high awareness of ethical AI practices, and their attitudes toward ethical AI use are positive.

H03: Ethical concerns such as data privacy, bias, and transparency do not significantly affect the adoption of AI technologies in the education sector in the Udupi region.

H13: Ethical concerns such as data privacy, bias, and transparency significantly affect the adoption of AI technologies in the education sector in the Udupi region.

V. RESEARCH DESIGN

5.1 Sample and participants' profile

In the present research, the researchers used an online survey method to collect the primary data. The questionnaire was created and circulated through forms and distributed to 500 people in the age group between 18-41. The 131 responses were received and taken for further study. Out of 131, 53 are male and 78 are female. 84 postgraduates, 07 graduates, 38 undergraduates, and others.

Statistical tools used

The study has employed the chi-square test, ANOVA, and correlation coefficient.

VI. DATA ANALYSIS AND INTERPRETATION

Descriptive Statistics

Table 1

| | Age | Gender | Qualification |
|-----------------------|--------|--------|---------------|
| N | 120 | 120 | 120 |
| Range | 3 | 1 | 2 |
| Mean | 1.13 | 1.65 | 2.29 |
| | .044 | .044 | .081 |
| Std. Deviation | .484 | .479 | .883 |
| Variance | .234 | .229 | .780 |
| Skewness | 4.417 | -.637 | -.610 |
| | .221 | .221 | .221 |
| Kurtosis | 21.380 | -1.622 | -1.447 |
| | .438 | .438 | .438 |

Source: Primary Data

The demographic details of the respondents indicate that the sample is largely homogeneous in terms of **age**, with most participants belonging to the youngest category ($M = 1.13$, $SD = 0.48$). The strong positive skewness (4.42) and very high kurtosis (21.38) confirm that the distribution is heavily concentrated in the lower age range, with little variation across participants.

For **gender**, the mean value ($M = 1.65$, $SD = 0.48$) suggests a nearly balanced representation of males and females. The skewness (-0.64) and kurtosis (-1.62) reflect a symmetric and relatively flat distribution, which is typical of binary demographic variables.

With respect to **qualification**, the average score ($M = 2.29$, $SD = 0.88$) shows that the respondents were belong to higher educational categories. The negative skewness (-0.61) and kurtosis (-1.45) suggest a concentration of participants at the upper qualification levels, though the spread is broader compared to age.

Overall, the descriptive statistics highlight that the sample primarily consists of **younger individuals with relatively higher educational qualifications**, while maintaining a **balanced gender distribution**.



Hypotheses Testing

H11: AI technologies currently used in the Udupi region have a significant positive impact on promoting sustainable development, and there is significant potential for further AI-driven sustainability initiatives.

Chi-Square Test:

| | Chi-Square | df | Asymp. Sig. | Minimum Frequency | Expected Cell |
|---|----------------------|----|-------------|-------------------|---------------|
| Age of the respondent | 278.333 ^a | 3 | .000 | | |
| In your opinion, how can AI contribute to improving the education sector in the Udupi region? | 69.667 ^a | 3 | .000 | 30.0. | |

Table 2

Source: Primary Data

The Chi-Square test revealed significant differences in the distribution of responses across categories. For the variable "Age of the respondent," $\chi^2(3, N = 120) = 278.333, p < .001$, it means the respondents were unequally distributed across age groups, showing highly significant variation. Similarly, for the question "In your opinion, how can AI contribute to improving the education sector in the Udupi region?" $\chi^2(3, N = 120) = 69.667, p < .001$, with a minimum expected cell frequency of 30.0, means participants expressed diverse views on the potential role of AI in enhancing education. Overall, it shows that both age distribution and opinions on AI in education varied significantly among respondents, leading to the rejection of the null hypothesis (H01) and acceptance of the alternative hypothesis (H11).

H12: Students in the Udupi region have high awareness of ethical AI practices, and their attitudes toward ethical AI use are positive.

Table 3

| | Chi-Square | df | Asymp. Sig. | Minimum Cell Frequency | Expected |
|--|---------------------|----|-------------|------------------------|----------|
| Familiar concept of ethical AI | 87.867 ^a | 3 | .000 | 30.0. | |
| AI systems are designed and used ethically | 84.083 ^b | 4 | .000 | 24.0. | |

Source: Primary Data

The Chi-Square test revealed significant differences in participant responses regarding ethical considerations of AI. For the item "Familiar concept of ethical AI," $\chi^2(3, N = 120) = 87.867, p < .001$, with a minimum expected cell frequency of 30.0, the findings indicate that respondents' familiarity with the concept of ethical AI varied greatly across categories. Similarly, for the question "Think of ensure AI systems are designed and used ethically?" $\chi^2(4, N = 120) = 84.083, p < .001$, with a minimum expected cell frequency of 24.0, the results suggest that participants expressed significantly diverse views on ensuring the ethical design and use of AI systems. Overall, the findings confirm that both familiarity with ethical AI and opinions on its responsible implementation varied considerably among respondents, leading to the rejection of the null hypothesis (H01) and acceptance of the alternative hypothesis (H11).

Table 4

Coefficients on formal education or training related to ethical AI

| Model | Unstandardized Coefficients | | Standardized Coefficients | |
|-------|-----------------------------|-----------------|---------------------------|------|
| | B | Std. Error Beta | t | Sig. |



| | | | | | |
|---|-------|------|-------|-------|------|
| 1 (Constant) | 2.631 | .274 | | 9.606 | .000 |
| Have you received any formal education or training related to ethical AI? | -.151 | .165 | -.084 | -.917 | .361 |

Source: Primary Data

A linear regression analysis was used to examine whether receiving formal education or training related to ethical AI predicted participants' responses. It shows that the result is not statistically significant, $B = -0.151$, $t(118) = -0.917$, $p = 0.361$. This indicates that receiving formal education or training on ethical AI did not have a meaningful impact on the outcome variable.

ANOVA Test:

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|-----|-------------|------|------|
| Between Groups | 1.795 | 3 | .598 | .748 | .526 |
| Within Groups | 92.797 | 116 | .800 | | |
| Total | 94.592 | 119 | | | |

The perception of among young students on AI it could pose risks related to privacy, bias, or unfair treatment.

Table 5

Source: Primary Data

A one-way ANOVA was used to check if any differences among groups in their views regarding the given statement and it was not statistically significant, $F(3,116) = 0.748$, $p = 0.526$, implies that there is no meaningful difference between the groups. This means students across all groups shared similar views on the variable under consideration.

H13: Ethical concerns such as data privacy, bias, and transparency significantly affect the adoption of AI technologies in the education sector in the Udupi region.

Table 6

| | Chi-Square | df | Asymp. Sig. | Minimum Expected Cell Frequency |
|---|---------------------|----|-------------|---------------------------------|
| What measures do you think educational institutions should take to ensure ethical AI use? | 85.000 ^a | 4 | .000 | 24.0 |

Source: Primary Data

A Chi-Square test revealed significant differences in students' views on the measures educational institutions should adopt to ensure ethical AI use, $\chi^2(4, N = 120) = 85.00$, $p < .001$. It shows that respondents rightly support the execution of specific institutional measures, such as policy frameworks, awareness programs, and transparent practices, to promote ethical AI use in the education sector. Overall, it implies that the null hypothesis H03 is rejected and the alternative H13 is accepted.

ANOVA Test:

Misuse or unethical use of AI in your educational environment. Table 7

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|-----|-------------|-------|------|
| Between Groups | 1.431 | 2 | .715 | 1.417 | .247 |
| Within Groups | 59.069 | 117 | .505 | | |



ANOVA Test:

Misuse or unethical use of AI in your educational environment. Table 7

| | Sum of Squares | df | Mean Square | F | Sig. |
|----------------|----------------|-----|-------------|-------|------|
| Between Groups | 1.431 | 2 | .715 | 1.417 | .247 |
| Within Groups | 59.069 | 117 | .505 | | |
| Total | 60.500 | 119 | | | |

Source: Primary Data

A one-way ANOVA shows no significant difference among the groups in their experiences or awareness of misuse/unethical AI use in the educational environment, $F(2, 117) = 1.42$, $p = .247$. This suggests that students' reported experiences of AI misuse do not vary significantly across groups.

Findings:

The sample consists primarily of younger individuals ($M = 1.13$, $SD = 0.48$).

Gender distribution is nearly balanced ($M = 1.65$, $SD = 0.48$).

Respondents tend to have higher educational qualifications ($M = 2.29$, $SD = 0.88$).

Significant differences were found in age distribution ($\chi^2(3, N = 120) = 278.333$, $p < .001$).

Opinions on AI's contribution to education varied significantly ($\chi^2(3, N = 120) = 69.667$, $p < .001$).

These results support the alternative hypothesis (H11) that AI technologies have a significant positive impact on promoting sustainable development in the Udupi region.

Familiarity with ethical AI concepts varied greatly ($\chi^2(3, N = 120) = 87.867$, $p < .001$).

Views on ensuring ethical AI design and use differed significantly ($\chi^2(4, N = 120) = 84.083$, $p < .001$).

These findings support the alternative hypothesis (H12) regarding high awareness and positive attitudes toward ethical AI practices.

No differences were found among groups regarding AI risks related to privacy, bias, or unfair treatment ($F(3,116) = 0.748$, $p = 0.526$).

Significant differences were observed in students' views on measures educational institutions should take to ensure ethical AI use ($\chi^2(4, N = 120) = 85.00$, $p < 0.247$).

Suggestions:

High awareness of ethical AI is encouraging, but institutions should incorporate ethical AI modules into curricula across disciplines.

Conduct seminars, workshops, and awareness drives to reinforce the importance of transparency, fairness, and accountability in AI systems.

Introduce hands-on projects and case studies that address AI ethics in real-world educational contexts.

Develop clear AI policies covering data privacy, student consent, bias detection, and fair treatment.

Need an internal compliance committee for students to report unethical AI practices.

Provide guidelines for faculty and administrators to ensure ethical adoption.

Compare urban vs. rural educational institutions in the Udupi region to identify differences in AI adoption and ethical awareness.

Investigate the impact of AI on specific academic outcomes like performance, creativity, and critical thinking.

If AI is positively viewed, institutions must proactively focus on ethics, awareness, and responsible adoption to increase its value for sustainable educational development.



VI. CONCLUSION

The educational institutions in the Udupi region integrate AI tools to enhance learning while ensuring ethical use through clear policies, regular audits, and awareness programs. Since students show high awareness of ethical AI, but formal training is less impactful, training should be redesigned with practical applications and case studies. Institutions should also establish AI ethics committees, promote data privacy and fairness, and conduct workshops to address potential risks. It will help maximize the positive impact of AI on sustainable educational development.

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