Stable Diffusion Model: The Past, Present and the Future in India

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Abstract- **AI has developed greatly in recent years,but it still has some caveats and a lot of areas for growth.The aim of the study was to capture the development and usage of AI in India and what Indian people think of AI. In the study we interviewed 4 people and surveyed 29 people who work in the IT sector. Most of the people find AI very useful but they also are concerned about the Data Privacy and Ethical usage of AI.They also demand for a Regulatory Framework to emphasise responsible usage of AI. We concluded that though AI has developed quickly in recent years, there are still areas for development such as Data Privacy and Responsible AI.**

Keywords: **AI, India, Responsible AI, Regulatory Framework for AI.**

INTRODUCTION

Working of Stable Diffusion Model

At a broad level, diffusion models employ a reverse process of gradual introduction of noise to a sample from a distribution. Essentially, the sampling initiates with a noisy state represented as xT and progressively generates less noisy samples xT−1, xT−2, and so forth, ultimately culminating in the final sample x0. Each time step (t) corresponds to a distinct noise level, with it being a composite of a base signal x0 and some noise, the signal-to-noise ratio being contingent on the time step t. Throughout this discussion, we presume that the noise follows a diagonal Gaussian distribution, particularly suitable for natural images and facilitating various calculations.

In a diffusion model, the learning process aims to generate a slightly more "denoised" version tx−1 from the current sample to articulate this model by parameterizing it as a function θ(tx, t), predicting the noise component inherent in a noisy sample xt. To facilitate the training of these models, each sample in a minibatch is generated by randomly selecting a data sample x0, a time step t, and noise. These elements collectively contribute to the creation of a noised sample xt (as per Equation 17). The training objective then revolves around minimizing the mean-squared error, specifically ||θ(tx, t) − ||2, reflecting the disparity between the predicted noise and the actual noise.
(Dhariwal & Nichol, 2021)

Diffusion models belong to a category of generative models that transform Gaussian noise into samples from a learned data distribution through an iterative denoising process. These models can operate conditionally, incorporating factors such as class labels, text, or low-resolution images. A diffusion model, denoted as xˆθ, is trained based on a denoising objective expressed as:

$$Ex, c, \epsilon, twt \parallel \hat{x}\theta(\alpha tx + \sigma t\epsilon, c) - x \parallel 22 \quad (1)$$

Here, (x, c) represents data-conditioning pairs, t is sampled from $U([0, 1])$, **ε** follows N (0, I), and αt, σt, wt are functions of t influencing the quality of the generated samples. In essence, xˆθ is trained to denoise zt:= αtx + σtϵ into x using a squared error loss, with weights assigned to certain t values for emphasis.

Sampling techniques such as the ancestral sample and DDIM initiate from pure noise z1 ∼ N (0, I) and iteratively produce points zt1, . . . , ztT, where 1 = t1 > · · · > tT = 0. These points gradually decrease in noise content and are derived as functions of the x-predictions xˆ t 0:= xˆθ(zt, c).
(Saharia, et al.,2022)

Why Stable Diffusion is Needed

Diffusion models have achieved widespread success in image generation, surpassing GANs in both fidelity and diversity while avoiding issues related to training instability and mode collapse. In the realm of text-to-image synthesis, autoregressive models, GANs, VQ-VAE Transformer-based methods, and diffusion models have all demonstrated significant advancements. Notably, DALL-E 2, operating on a diffusion before CLIP text latent and cascaded diffusion

models, has concurrently emerged, producing high-resolution 1024 × 1024 images. We posit that Imagen, in contrast, offers a simpler approach, as it obviates the need for learning a latent prior while delivering superior results in both MS-COCO FID and human evaluation on DrawBench. GLIDE also adopts cascaded diffusion models for text-to-image synthesis, yet we employ large pre-trained frozen language models, which we have found to be pivotal for enhancing both image fidelity and image-text alignment. XMC-GAN similarly leverages BERT as a text encoder, but we distinguish ourselves by scaling up to considerably larger text encoders and demonstrating their effectiveness. The use of cascaded models, a prevalent strategy in the literature, has proven successful in diffusion models for generating high-resolution images.(Saharia, et al.,2022).hi

Different Models

In recent years, generative models have made remarkable strides in producing human-like natural language, high-quality synthetic images, and diverse human speech and music. These models find utility in various applications, including image generation from text prompts and the acquisition of valuable feature representations. Despite their current capability to generate realistic images and sounds, there remains ample room for improvement beyond the existing state-of-the-art. Enhanced generative models could have far-reaching impacts on graphic design, gaming, music production, and numerous other fields.

GANs presently lead in most image generation tasks, assessed through sample quality metrics such as FID, Inception Score, and Precision. However, some of these metrics do not fully encompass diversity, and research indicates that GANs capture less diversity compared to state-of-the-art likelihood-based models. Moreover, GANs often pose challenges in training, prone to collapse without meticulous selection of hyperparameters and regularizers. While GANs represent the current state-of-the-art, their limitations hinder scalability and applicability to new domains. Consequently, substantial efforts have been directed toward achieving GAN-like sample quality with likelihood-based models. Although these models capture more diversity and are generally easier to scale and train than GANs, they still fall short in visual fidelity. (Dhariwal & Nichol, 2021)

Impact of Stable Diffusion Models

Making generative models more economically viable in terms of computational costs is particularly advantageous, especially as new classifiers can be trained and applied atop existing high-quality diffusion models. While we view this as a general benefit of these models, it also raises potential negative societal consequences. The affordability of generative models might empower malicious actors to produce fabricated news, propaganda images, or manipulated photographs. Moreover, the widespread adoption of these models could lead to job displacement in fields such as art, graphic design, animation, and photography. However, one can envision that democratizing generative models may yield positive long-term impacts, fostering the emergence of new job categories like generative photo editing.

The deliberate creation of deceptive generated images presents a more immediate concern, and ongoing research focuses on the detection and mitigation of propaganda and fake news facilitated by generative models. (Dhariwal & Nichol, 2021)

AI in India

In the future of India lies the destiny of a sixth of the world's population, a compelling reason in itself to closely monitor the country's engagement with AI. Equally fascinating is India's distinctive social, cultural, economic, and political landscape, capable of amplifying both the advantages and challenges posed by AI. With a sizable and youthful workforce, a rapidly expanding economy, and a dynamic, resilient democracy, India offers a unique opportunity for AI applications to achieve significant reach and scale, thereby contributing to the creation of abundance. AI-driven interventions have the potential to enhance public services, such as streamlining the public distribution system and reducing law enforcement costs. Additionally, AI can augment private services, ranging from AI-enabled personalized healthcare to the integration of robots in production lines. (Rao, et al., 2018)

PROCEDURE:

The primary objective of this study was to explore the utilization and limitations of artificial intelligence (AI) in India. The research encompassed a sample size of 34 participants, consisting of five individuals who were interviewed and 29 respondents who completed a survey. By conducting interviews and surveys, this research aimed to provide a comprehensive overview of the current state of AI in India.

The study sought to address the growing importance of AI in various sectors in India and the challenges hindering its widespread adoption and effectiveness by focusing on both the usage and shortcomings of AI, the research aimed to offer valuable insights that could inform policymakers, industry leaders, and researchers about the steps needed to enhance the integration and impact of AI in the Indian context.

Furthermore, the study aimed to contribute to the existing body of knowledge on AI by providing specific insights into the Indian context, which is crucial given the unique challenges and opportunities that India presents. By understanding how AI is currently being used in India and the challenges it faces, stakeholders can better formulate strategies to leverage AI for societal, economic, and technological advancement in the country.

RESULTS:

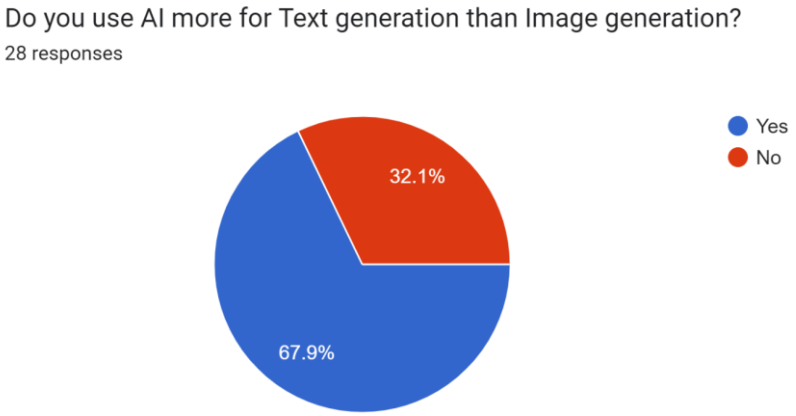
THEME	EMPIRICAL EVIDENCE 1	EMPIRICAL EVIDENCE 2
REGULATORY PRACTICES IN AI	Participant 1 stated that, "data protection, privacy and ethical AI use to foster AI development and deployment". Participant 3 stated that "data protection and thorough checks are required while using AI"	Murray(2019) in his paper titled "Regulating AI and Machine Learning: Setting the Regulatory Agenda" stated that " new technology will be largely determined by the models of regulation and governance applied to the nascent technology."
PERSONALIZED COSTUMER EXPERIENCE	Participant 1 stated that," there are significant opportunities personalized customer experiences through AI integration"	Pap(2021) in his paper titled "Artificial Intelligence (AI) Brings Enhanced Personalized User Experience" stated that "using artificial intelligence (AI) elements in culture and tourism industries can enhance traditional user experiences"
OPTIMIZATION	Participant 1 stated that, "there are significant opportunities for cost reduction, improved efficiency," Participant 2 stated that, " Challenges businesses encounter include the high cost of AI implementation"	Dutta(1996) in his paper titled "Integrating AI and optimization for decision support: a survey" Stated that "There has been a growing literature on the integration of AI and optimization techniques for decision support."
LACK OF AI COURSES	Participant 1 stated that," specialized AI courses, and upskilling programs can enhance AI education" Participant 2 stated that," To enhance AI education and skill development, initiatives such as experiential learning programs"	Moloi(2023) in his paper title "Engineering, the Profession in Trouble: Lack of Programme Development Standards That Support the AI Chatbot? A System View" Stated that "engineering programmes are adequately equipped to produce graduates who can harness the power of AI chatbots"
PRIORITISING ETHICAL FRAMEWORKS	Participant 1 stated that," addressing ethical concerns in India is becoming increasingly important" Participant 2 stated that," Prioritizing ethical frameworks can help address concerns"	Floridi(2018) in his paper titled "AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations" stated that "AI is not another utility that needs to be regulated once it is

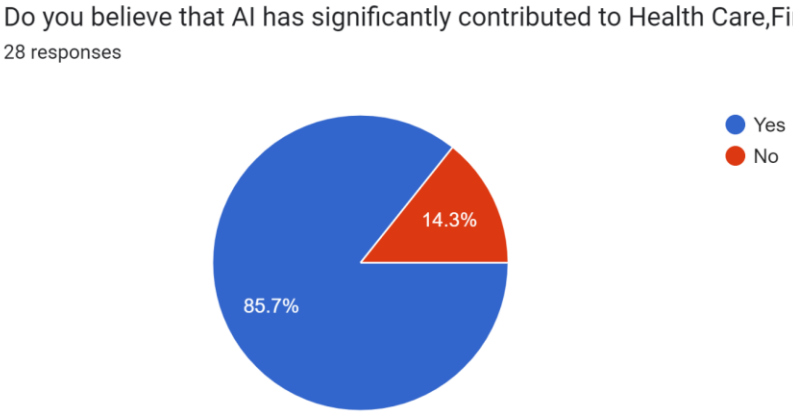
		mature. It is a powerful force, a new form of smart agency, which is already reshaping our lives, our interactions, and our environments. ”
IMPACT OF ORGANIZATION	Participant 1 stated that,” Academic institutions, research organizations, and industry collaborations play a crucial role in driving research and innovation in AI in India” Participant 2 stated that,”In India, academic institutions, research organizations, and industry collaborations play a pivotal role in fostering research and innovation in AI.”	Fouse (2020) in his paper titled “DARPA’s Impact on Artificial Intelligence” Stated that “The Defense Advanced Research Project Agency’s (DARPA) mission is to make pivotal investments leading to research breakthroughs that support national security. DARPA artificial intelligence (AI) programs have emphasized the need for machines to perceive and interact with the world around them”
LACK OF FUNDING	Participant 1 stated that,”To further stimulate innovation, increased funding for AI research could be beneficial.”	Hunter (2023) in his paper titled “The military application of artificial intelligence technology in the United States, China, and Russia and the implications for global security” stated that “multiple AI experts noted the lack of AI funding and developmental resources in Russia. Also, multiple AI experts stated that Russia may be trailing not only the US and China regarding AI development, but also other developed states ”
SKILL GAPS	Participant 2 stated that,” there are notable skill gaps”	Baral(2022) in his paper titled “Role of Digital Technology and Artificial Intelligence for Monitoring Talent Strategies to Bridge the Skill Gap” stated that “many organizations facing the skill Gaps…”
DATA PRIVACY	Participant 3 stated that,”To promote responsible AI, there should be comprehensive regulations addressing data privacy,” Participant 3 stated	Tom(2020) in his paper titled “Protecting Data Privacy in the Age of AI-Enabled Ophthalmology” stated that “The combination of Big Data and AI also offers many potential benefits for healthcare

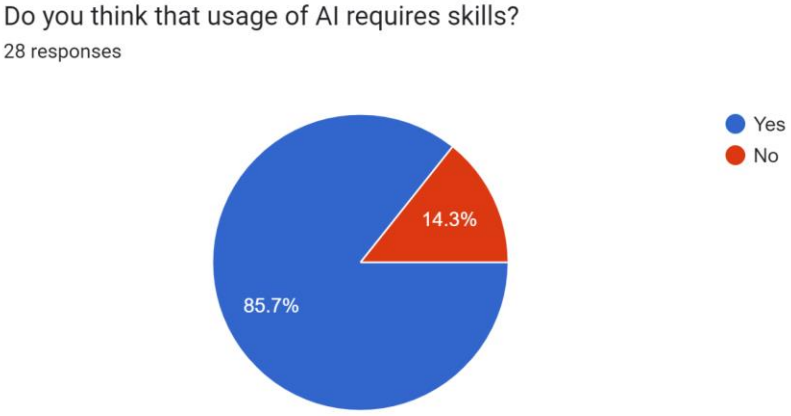
	that,"Challenges businesses face include the lack of skilled AI professionals, concerns about data security" Participant 3 stated that,"data privacy, and accountability can guide ethical AI practices"	systems, including increased productivity with decreased costs, as well as reductions in medical error. New data privacy problems have arisen with the use of this technology,"
AI TRANSPARENCY	Participant 4 stated that,"there should be robust regulations emphasizing transparency in AI systems"' Participant 4 stated that,"transparency can guide ethical AI practices"	Larsson (2020) in his paper titled "Transparency in artificial intelligence" stated that "AI transparency, recently has been claimed to be "in its infancy" "
AI STRATEGY	Participant 4 stated that,"challenges businesses face include the lack of clear AI strategies,"	Kitsios(2021) in his paper titled "Artificial Intelligence and Business Strategy towards Digital Transformation: A Research Agenda" stated that " researchers argued that further investigation is required to evaluate the magnitude of AI in the organizational planning and implementation of business strategy "
AI ROLES	Participant 4 stated that," From an educational perspective, the workforce in India is somewhat prepared for the increasing demands of AI-related roles"	Xu (2021) in his paper titled "A systematic review of AI role in the educational system based on a proposed conceptual framework", stated that "most research has investigated AIEd from the technological perspective, which cannot achieve a deep understand of the complex roles of AI in instructional and learning processes and its relationship with other educational elements."
COLLABORATION	Participant 4 stated that,"collaborations enable the development of cutting-edge AI technologies"	Ho(2023) in his paper titled "International Institutions for Advanced AI" stated that "collaborations can unlock AI's ability to further sustainable development, and coordination of regulatory efforts can reduce obstacles to innovation and the spread of benefits"
RESPONSIBLE AI	Participant 2 stated that "India's regulatory environment for	Rakova(2021) in his paper titled "Where Responsible AI meets

	artificial intelligence is in its nascent stages"	Reality: Practitioner Perspectives on Enablers for Shifting Organizational Practices" stated that "we acknowledge the nascent state of responsible AI"

RESULT GRAPHS

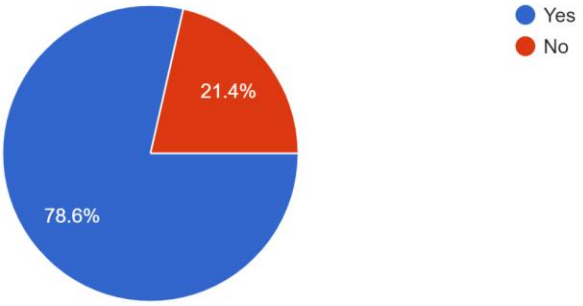






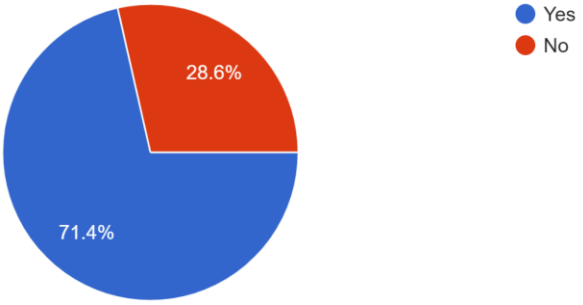
Do you think that AI is ethical to use?

28 responses



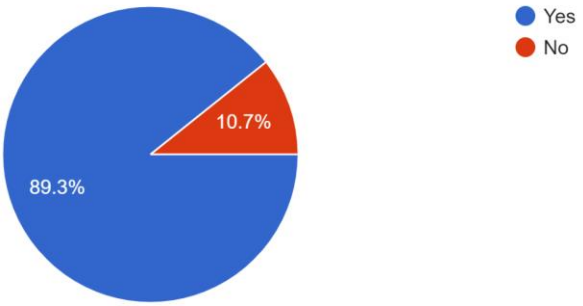
Are you concerned about the impact of AI on employement oppurtunaties?

28 responses



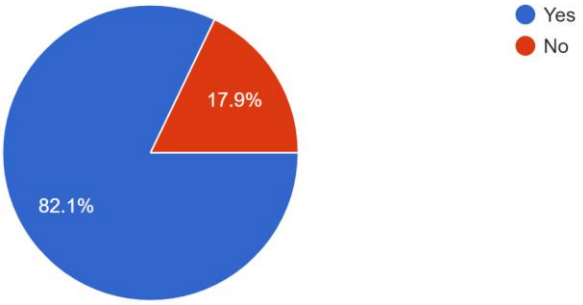
Do you think that it is right to make money using AI?

28 responses



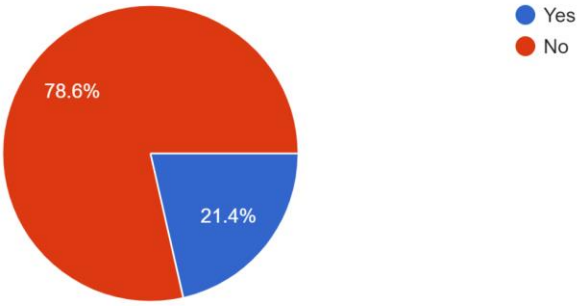
Do you think that AI is being misused?

28 responses



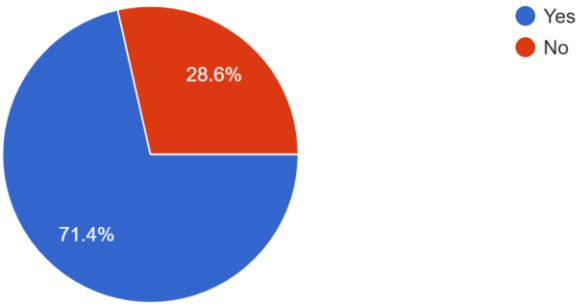
Do you think that AI is not suited for Indian Skins?

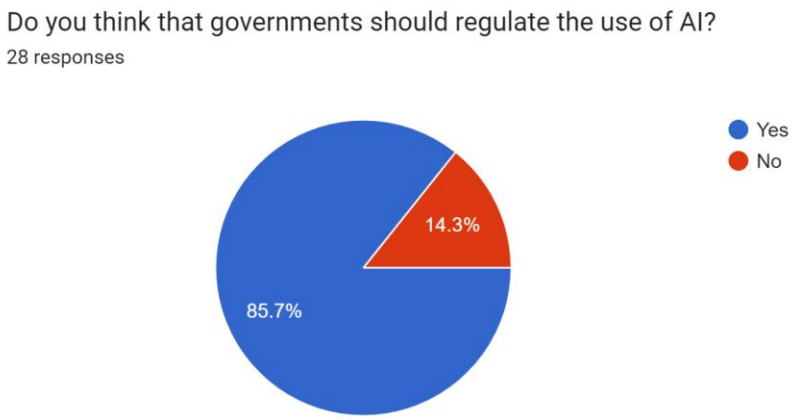
28 responses



Do you think that AI has the potential to solve complex economical, social problems?

28 responses





Discussion:

The study aimed to explore the utilization and limitations of artificial intelligence (AI) in India.

The study involved 34 participants, with five individuals interviewed and 29 respondents completing a survey. Interviews and surveys were conducted to gain insights into the usage and shortcomings of artificial intelligence (AI) in India, aiming to provide a comprehensive overview of the current state of AI in the country.

The theme that was derived post-analysis was “Regulatory Practices in AI” which was mentioned in Murray's (2019) study on “Regulating AI”. In recent years, there have been discussions and initiatives aimed at formulating a regulatory framework tailored to the unique needs and context of India.

The theme that was derived post-analysis was “Personalised Customer Experience” which was mentioned in Pap's (2021) study on “Artificial Intelligence (AI) Brings Enhanced Personalized User Experience”.AI can allow organizations to provide personalized customer experience and many organizations have utilizing this potential, they set up chatbots and AI bots to handle customer queries.

The theme that was derived post-analysis was “Optimization” which was mentioned in Dutta's (1996) study “Integrating AI and optimization for decision support: a survey ”.Though I have a lot of uses, it is not properly optimized. Most AI models run on big servers and it requires a lot of optimization to be able to run on the user's device locally.

The theme that was derived post-analysis was “Lack of AI Courses' ' which was mentioned in Moloi's (2023) study on" "Engineering, the Profession in Trouble: Lack of Programme Development Standards That Support the AI Chatbot? A System View”.The is a growing demand for AI professionals but there are not a lot of AI courses or programmes that can teach people about AI.

The theme that was derived post-analysis was “Prioritising Ethical Frameworks” which was mentioned in Floridi's (2018) study on “AI4People—An Ethical Framework for a Good AI Society: Opportunities, Risks, Principles, and Recommendations”.Many people were concerned about prioritizing ethical frameworks as AI was being misused and it requires some framework to address ethical concerns.

The theme that was derived post-analysis was the “Impact of Organization” which was mentioned in Fouse's (2020) study on “DARPA’s Impact on Artificial Intelligence”.Organizations have greatly boosted the development of AI. Most of the breakthroughs in AI were done by organizations. Organizations play a great role in the development of AI in India.

The theme that was derived post-analysis was “Lack of Funding" which was mentioned in Hunter's (2023) study on “The military application of artificial intelligence technology in the United States, China, and Russia and the implications for global security”.There is a growing need for AI but there has been a lack of funding for AI research. Most organizations require funding as it requires a lot of server resources to train and develop an AI model.

The theme that was derived post-analysis was “Skill Gaps” which was mentioned in Baral's (2022) study on “Role of Digital Technology and Artificial Intelligence for Monitoring Talent Strategies to Bridge the Skill Gap”.Many

organizations face the issue of Skill gaps when dealing with AI development. Most skilled professionals work with organizations that pay them the most money. This creates a noticeable skill gap.

The theme that was derived post-analysis was “Data Privacy” which was mentioned in Tom's (2020) study on “Protecting Data Privacy in the Age of AI-Enabled Ophthalmology”.A lot of people’s concern was the use of their data in the development of AI. People think that the more they use AI the more data big organizations can collect from them.

The theme that was derived post-analysis was “AI Transparency” which was mentioned in Larsson's (2020) study on “Transparency in artificial intelligence”.Another one of the concerns of people was the transparency of AI. Many people were concerned about the use of their data and wanted regulations emphasizing transparency in the AI system.

The theme that was derived post-analysis was “AI Strategy” which was mentioned in Kitsios's (2021) study on “Artificial Intelligence and Business Strategy towards Digital Transformation: A Research Agenda”.Another problem that organizations face is the lack of clear AI strategies. Organizations are unclear on how to use AI for their development.

The theme that was derived post-analysis was “AI Roles” which was mentioned in Xu's (2021) study “A systematic review of AI role in the educational System based on a proposed Conceptual Framework”.There are a lot of roles of AI in education, people may be prepared for the increasing role of AI but this cannot be achieved without a deep understanding of the complex roles of AI in the learning process.

The theme that was derived post-analysis was “Collaboration” which was mentioned in Ho's (2023) study on “International Institutions for Advanced AI”.In the past, there have been many instances where collaboration enabled the development of cutting-edge AI technologies. Like when AI AI organizations collaborate with mobile manufacturing to integrate AI into their smartphones which helps in developing AI more.

The theme that was derived post-analysis was “Responsible AI” which was mentioned in Rakova's (2021) study “Where Responsible AI meets Reality: Practitioner Perspectives on Enablers for Shifting Organisational Practices”.Many people’s concern was the responsible use of AI. People demand a more regulatory environment for a more responsible use of AI.

To support the thematic analysis, a survey was conducted on 28 participants and the results were as follows; 67.9% of people use AI more for Text generation than Image generation. This might be because text-generation AI is more developed and is more easily available than Image generation AI. 85.7% of people believe that AI has significantly contributed to health care, Finance, etc. AI has helped a lot in health care such as detecting cancer and in finances as predicting the price of goods in the market, etc. 85.7% of the people think that usage of AI requires skills and might be very good at generating text and images but generating good results requires giving good prompts. That's why AI requires skills to use. 78.6% of people think that AI is ethical to use. This might be because AI is generating something new and not just copying other people's works but currently it can’t generate results as good and authentic as real people. 71.4% of people are concerned about the impact of AI on employment opportunities. This might be because AI is developing quickly and producing results very close to real people. 89.3% of people think that it is right to make money using AI. This might be because AI is not copying others' work but instead is generating new stuff..82.1% of people think that AI is being misused. This might be because AI can generate content very quickly and are free to use them. And people can use AI to create misleading content. 78.6% of people think the AI is not suited for Indian Skins. This might be because most of the AI is developed in foreign countries like the US, and they use datasets that don't contain a very diverse set of data. 71.4% of people think that AI has the potential to solve complex economic and social problems. This might be because AI has developed very quickly in recent years and can do things that we didn’t even imagine AI could do this early. 85.7% of people think that the government should regulate the use of AI. This might be because people think that AI can be misused and think that regulations enforced by the government can solve most of these problems.

We can conclude from the survey and interviews that AI is very useful and has developed very quickly in recent years but it does have a lot of caveats and opportunities for development. We also can conclude that people find AI very helpful but demand some regulatory frameworks to foster responsible AI.

CONCLUSION:

The study aimed to explore the utilization and limitations of artificial intelligence (AI) in India. The study involved 34 participants, with five individuals interviewed and 29 respondents completing a survey. Interviews and surveys were

conducted to gain insights into the usage and shortcomings of artificial intelligence (AI) in India, aiming to provide a comprehensive overview of the current state of AI in the country.

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