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The Role of Artificial Intelligence in Transforming Secondary Education: Insights from Teachers in Rural, Semi-Urban, and Urban West Bengal

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ABSTRACT:

The integration of Artificial Intelligence (AI) into education is poised to revolutionize teaching-learning processes by enhancing personalization, engagement, and efficiency. This study explores the awareness, challenges, and expectations surrounding AI adoption among secondary school teachers in seven districts of West Bengal, India, encompassing Hooghly, Purba Medinipur, Purulia, Jhargram, North 24 Parganas, Nadia, and Purba Bardhaman. Employing a descriptive survey research design, data were collected from 270 teachers across 54 schools, representing rural (83%), semi-urban (7%), and urban (10%) locations.

The objectives of the study include examining ethical and privacy concerns, assessing teachers' perceptions of AI's potential to enhance educational outcomes, and evaluating professional development requirements for AI integration. Structured questionnaires were used to collect primary data. Findings reveal diverse perspectives on AI's role, with a significant interest in workshops focused on ethical implications (31%) and practical applications in lesson planning (28%). However, technical skill gaps and reluctance to participate in AI-focused training programmes emerged as critical barriers.

Teachers expressed mixed opinions about AI's impact on student engagement and personalization of learning, with 42% acknowledging its potential to enhance motivation and adaptability, while 30% showed indifference, highlighting the need for improved tools and awareness initiatives. Rural schools face unique challenges, such as limited infrastructure, further emphasizing the importance of tailored strategies for equitable AI adoption.

The study concludes that successful integration of AI in secondary education requires a holistic approach, combining targeted professional development, ethical literacy, infrastructure improvements, and awareness campaigns. Policymakers and educators must collaborate to address disparities, build trust, and demonstrate AI's benefits to ensure its effective and inclusive implementation. This research provides valuable insights into the opportunities and challenges of AI in education, offering a roadmap for future initiatives aimed at fostering its transformative potential.

Keywords: Artificial Intelligence (AI) in Education, Teacher Perceptions of AI, Secondary School Teachers

INTRODUCTION:

The rapid advancement of technology has ushered in an era where Artificial Intelligence (AI) is reshaping various facets of life, including education. AI has the potential to revolutionize teaching and learning by offering personalized learning experiences, improving student engagement, and addressing individual learning needs. The integration of Artificial Intelligence (AI) into education is rapidly transforming traditional teaching-learning paradigms, offering unprecedented opportunities for personalized learning, improved engagement, and streamlined administrative processes. As the global education landscape embraces AI-driven innovations, understanding the readiness, perceptions, and expectations of teachers is crucial for ensuring its effective and ethical implementation at the grassroots level. In the context of secondary education, teachers play a pivotal role in adopting and adapting AI technologies to meet the diverse needs of students. However, the adoption of such technologies brings forth significant challenges, particularly in regions characterized by resource constraints, limited access to infrastructure, and varying levels of teacher training and awareness. However, its integration into education, especially in resource-constrained regions, poses unique challenges. In this context, understanding the perspectives of teachers, who serve as the cornerstone of the teaching-learning process, becomes crucial.

This study focuses on exploring the multifaceted dimensions of AI adoption in secondary education within the state of West Bengal, India. West Bengal presents a unique educational landscape, where a significant proportion of schools are located in rural areas, and disparities in resources and infrastructure pose significant challenges to the seamless integration of advanced technologies like AI. Recognizing the growing influence of AI in global education, this research examines the perspectives of secondary school teachers from diverse geographical and institutional contexts across seven districts of West Bengal. In particular, this research addresses critical questions: How do teachers perceive the benefits and risks of AI in education? What training and resources are required to prepare them for effective AI implementation? How do students respond to AI-based learning tools, and what role does AI play

in enhancing their engagement and motivation? These questions are essential for designing strategies to integrate AI effectively, ensuring that it complements traditional teaching methods The objectives of the study are multifaceted, ranging from assessing teachers' perceptions of AI's role in enhancing educational outcomes to evaluating their willingness to participate in AI-focused professional development programmes. Key areas of investigation include privacy concerns, ethical considerations, the impact of AI on traditional teaching methods, and the ability of AI tools to personalize learning experiences. Additionally, the study delves into the professional training requirements for effective AI integration, as well as the perceived benefits and risks associated with AI in student learning and the teacher-student relationship.

A descriptive survey research design underpins this study, ensuring a comprehensive understanding of the subject matter through data collected via structured questionnaires. The study draws upon a purposive sample of 270 teachers from 54 schools, encompassing rural, semi-urban, and urban settings, and representing various academic disciplines. By addressing the perspectives and expectations of teachers, this research aims to illuminate the opportunities and challenges associated with integrating AI into secondary education.

The findings of this study provide valuable insights into the current state of AI adoption in secondary schools, highlighting the importance of targeted training programmes, ethical awareness, and infrastructure development to ensure equitable access to AI's benefits. The study also underscores the critical need for collaboration among educators, policymakers, and technologists to address the reservations and doubts that persist among teachers regarding AI's role in education.

This research seeks to contribute to the broader discourse on AI in education by emphasizing the voices of secondary school teachers, whose acceptance and proactive engagement are key to the successful realization of AI's transformative potential. By identifying actionable strategies to bridge the gaps in knowledge, resources, and professional development, this study endeavors to pave the way for a more inclusive and effective integration of AI in secondary education.

OBJECTIVES OF THE STUDY:

The objectives of the present study are:

1. To examine concerns regarding privacy, ethical implications, and the potential impact on traditional teaching methods.
2. To study teachers' perceptions of the role of AI in enhancing educational outcomes and its potential to personalize learning experiences for students.
3. To investigate teachers' expectations from AI and their opinions on its future in education.
4. To identify the professional development and training requirements of secondary school teachers to effectively integrate AI into teaching practices.
5. To assess teachers' willingness to participate in workshops, online courses, or peer collaboration related to AI.
6. To evaluate teachers' perceptions of how students respond to AI-based tools in terms of engagement, motivation, and personalized learning opportunities.
7. To examine the perceived benefits and risks of AI on student learning and the teacher-student relationship.

METHODOLOGY OF THE STUDY:

The methodology of the present study has been given below:

1. Research Design

The present study employs a descriptive survey research design to explore the awareness, challenges, and expectations regarding the adoption of Artificial Intelligence (AI) among secondary school teachers in West Bengal. The study aims to collect data through structured questionnaires, ensuring a comprehensive understanding of the topic.

2. Population and Sampling

- **Target Population:**

The study focuses on secondary school teachers from seven districts of West Bengal, namely Hooghly, Purba Medinipur, Purulia, Jhargram, North 24 Parganas, Nadia, and Purba Bardhaman.

- **Sample Size and Chief Features of Sample:**

A total of 54 secondary schools were selected for the study, with percentage-wise representation from each district:

  - Hooghly: 54%
  - Purba Medinipur: 2%

- Purulia: 19%
- Jhargram: 2%
- North 24 Parganas: 6%
- Nadia: 15%
- Purba Bardhaman: 4%

From each selected school the researcher has collected data from 5 teachers belong to science, social science, and language and humanities stream, with percentage-wise representation:

- Science Group: 37%
- Social Science Group: 30%
- Language and Humanities Group: 33%

The study surveyed a total of 54 schools across seven districts of West Bengal, with a clear distinction between government schools and government-aided schools in the sample. The distribution is as follows:

- Government Schools: 9%
- Government-Aided Schools: 91%

The study surveyed a total of 270 teachers from 54 schools across seven districts of West Bengal, where the category wise percentage of different classes taken by the teachers are:

- Percentage of Teachers who took classes from Class IX to XII: 56%
- Percentage of Teachers who took classes from Class XI and XII only : 19%
- Percentage of Teachers who took classes from Class IX and X only : 26%

The study encompasses data collected from 54 secondary schools across seven districts of West Bengal, categorized by their geographical location into rural, semi-urban, and urban areas. The percentage distribution of schools based on location is as follows:

- Rural Schools: 83%
- Semi-Urban Schools: 7%
- Urban Schools: 10%

A significant majority (83%) of the surveyed schools are located in rural areas. This highlights the rural dominance in the educational landscape of West Bengal, where a large portion of the population resides in villages and small towns. The inclusion of rural schools offers critical insights into the unique challenges and opportunities of implementing Artificial Intelligence (AI) in areas with limited resources and infrastructure.

Urban schools make up only 10% of the sample, while semi-urban schools constitute 7%. This reflects the relatively lower proportion of urban and semi-urban educational institutions within the districts covered in the study. Urban schools, often characterized by better access to resources and technology, might present a contrasting scenario compared to rural schools.

- **Sampling Technique:**

A purposive sampling method was adopted to ensure inclusion of schools from urban, semi-urban, and rural locations, providing a diverse and representative sample.

3. Data Collection Tool

- A structured questionnaire was developed to collect data, consisting of closed-ended questions.
- The questionnaire was divided into four sections to capture specific information:
    1. General Information (School type, location, classes, subjects taught)
    2. Teacher Training and Professional Development
    3. Student Engagement and Impact
    4. Overall Opinion on Artificial Intelligence (AI) in Education

4. Procedure for Data Collection and Analysis

- The study was conducted over two months (October and November 2024).

- The Primary Data were collected through in-person distribution of questionnaires and, where necessary, online surveys to ensure maximum participation.
- Respondents were secondary school teachers who voluntarily participated in the study after being briefed on its objectives and significance.
- The secondary data have been collected from different sources like research article, websites etc.
- Then the collected data have been analyzed qualitatively.

6. Ethical Considerations

- **Voluntary Participation:** Respondents were informed about the purpose of the study and participated voluntarily.
- **Anonymity and Confidentiality:** Personal details of schools and teachers were anonymized to protect their identity and ensure confidentiality.
- **Informed Consent:** Written or verbal consent was obtained from all participants before data collection.

FINDINGS AND DISCUSSION:

The details findings along with discussion of the present study have been given below:

I) **Professional Development or Training on AI and Its Effectivity into Teaching:** The findings highlight diverse perspectives on the types of professional development or training teachers believe would effectively support AI integration into teaching at secondary level in the studied areas of West Bengal. These responses underscore the multifaceted challenges and priorities that must be addressed for successful adoption of AI in education. The largest group of respondents (31%) identified the need for training on the ethical dimensions of AI. This response reflects growing concerns about issues like bias in algorithms, data privacy, and the long-term societal impacts of AI in education. Teachers recognize that ethical literacy is crucial to making informed decisions about how AI tools are used in their classrooms, ensuring that implementation aligns with equitable and inclusive values.

Workshops on ethical considerations should include practical case studies, discussions on bias detection, and strategies for safeguarding student data. Institutions should prioritize these sessions to build a foundation of responsible AI usage.

The second-largest response indicates strong interest in workshops that link AI tools directly to lesson planning and content creation (28%). Teachers value practical applications that enhance their pedagogical strategies, such as automating repetitive tasks, personalizing lesson materials, or generating data-driven insights about student performance. These workshops should provide hands-on experience with AI platforms, showcasing real-world applications that empower educators to design innovative and effective lessons. Training should emphasize aligning AI tools with curriculum goals.

A significant portion of respondents (18%) expressed a need for technical skills development, focusing on mastering specific AI platforms and software. This response suggests that many teachers feel unprepared to navigate the technical complexities of AI tools, which can hinder their integration into teaching practices. Institutions should offer detailed technical training sessions, catering to varying levels of proficiency. Step-by-step guides and continuous support resources could ensure long-term skill retention.

A smaller group (12%) emphasized the value of general workshops on AI applications in education. This category likely appeals to educators who are at an early stage of exploring AI and seek foundational knowledge about its potential and limitations. Workshops in this category should cover a broad overview of AI's role in education, highlighting innovative use cases while addressing concerns about its practical implementation.

This relatively low percentage (4%) suggests that while peer learning is valuable, it may not be seen as sufficient for building AI competency. Teachers likely prioritize formal training over informal collaboration when it comes to a complex and rapidly evolving field like AI. Structured peer learning opportunities, such as collaborative projects or AI-focused teaching communities, could complement formal training, fostering a supportive network for sharing best practices and troubleshooting challenges.

Workshops on AI Tools and Applications in Education, Technical Training on Using AI-Based Software and Platforms (8%), this category reflects a niche group interested in a combination of practical workshops and technical skills. These teachers may be particularly motivated to integrate AI but recognize the need for both conceptual and operational expertise. Tailored programs blending theoretical and technical content could address this group's dual priorities effectively.

The findings demonstrate that teachers prioritize ethical training, practical application workshops, and technical proficiency as key areas for professional development in AI integration at secondary level of education. Institutions must design comprehensive training programmes that cater to these varied needs; ensuring teachers are equipped to use AI responsibly and effectively. A balanced approach that combines ethical understanding, technical skills, and pedagogical integration will empower teachers to leverage AI's potential for transformative education.

Table 01: Professional Development or Training on AI and Its Effectivity into Teaching

Category of Professional Development or Training	**Percentage of Respondents**

Workshops on AI Tools and applications in Educations, Technical Training on using AI - based Software and Platforms	8
Workshops on AI Tools and applications in Educations, Training on AI in Lesson Planning and Content Creation	28
Technical Training on Using AI - based Software and Platforms	18
Workshops on AI Tools and applications in Educations	12
Understanding the Ethical Implications of AI in Education	31
Peer Learning and Collaboration opportunities	4

Source: Primary Data

II) **Interest of Teachers in Participating Online Courses or Workshops on AI for Education:** The figure 01 illustrates survey results regarding willingness to participate in online courses or workshops on Artificial Intelligence (AI) for education. A minority of respondents (23%) express clear interest in participating in these online courses. This indicates that while some individuals see the value of AI in education and are motivated to learn, they may represent a smaller, specialized audience. A significant majority (66%) are not willing to participate in such courses. This resistance could stem from a lack of awareness about AI's relevance in education, doubts about the quality of these courses, or a general reluctance towards online learning. A smaller group (11%) remains undecided, contingent on the course content and format. This segment represents an opportunity for course designers to tailor content and delivery methods to attract this potential audience.

The overwhelming "No" response highlights a challenge for educational institutions and content creators to better communicate the benefits and applications of AI in education. The "Maybe" category suggests that well-designed, engaging, and practically relevant courses could convert more participants. The relatively small "Yes" group underscores the niche appeal of the topic, requiring targeted marketing and outreach to tech-savvy or education-focused audiences.

This analysis shows a significant need to bridge the knowledge gap and build interest around AI-focused educational opportunities.

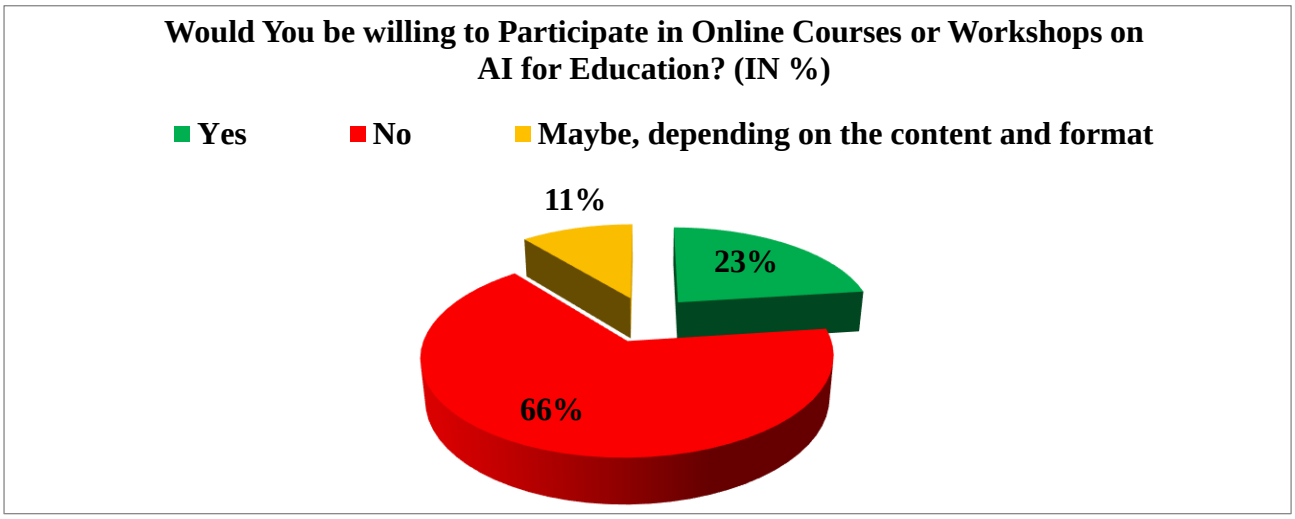

Figure 01: Interest of Teachers in Participating Online Courses or Workshops on AI for Education, **Source:** Primary Data

III) **Perception of Teachers regarding Students' Response to AI-based Learning Tools and Resources:** The following figure 02 illustrates responses to the question of how students perceive and respond to AI-based learning tools and resources. The data is segmented into four categories: "Very negatively," "Indifferently," "Somewhat positively," and "Very positively." Below is a breakdown and discussion of the findings: A significant proportion of respondents (42%) believe that students are highly engaged and motivated when interacting with AI-based learning tools. This suggests that AI-driven tools effectively capture interest and provide valuable educational experiences. It reflects the growing role of personalized and adaptive learning features offered by AI, such as tailored feedback and interactive modules. A notable segment of respondents (28%) perceives students as moderately receptive. This could indicate that while the tools are appreciated, their full potential might not be utilized due to usability, accessibility, or training gaps. A sizable percentage of responses (30%) indicate indifference toward AI tools. This neutrality could stem from a lack of awareness about their benefits or an absence of features that cater to diverse learning styles. It also suggests that some students might not view these tools as significantly better than traditional learning methods. No respondents believe students react very negatively to AI tools. This indicates a general acceptance of AI as a component of modern education.

AI-based learning tools hold great promise in revolutionizing education by fostering engagement and motivation. However, addressing the factors behind indifference and limited positivity is crucial to maximize their impact on learning outcomes.

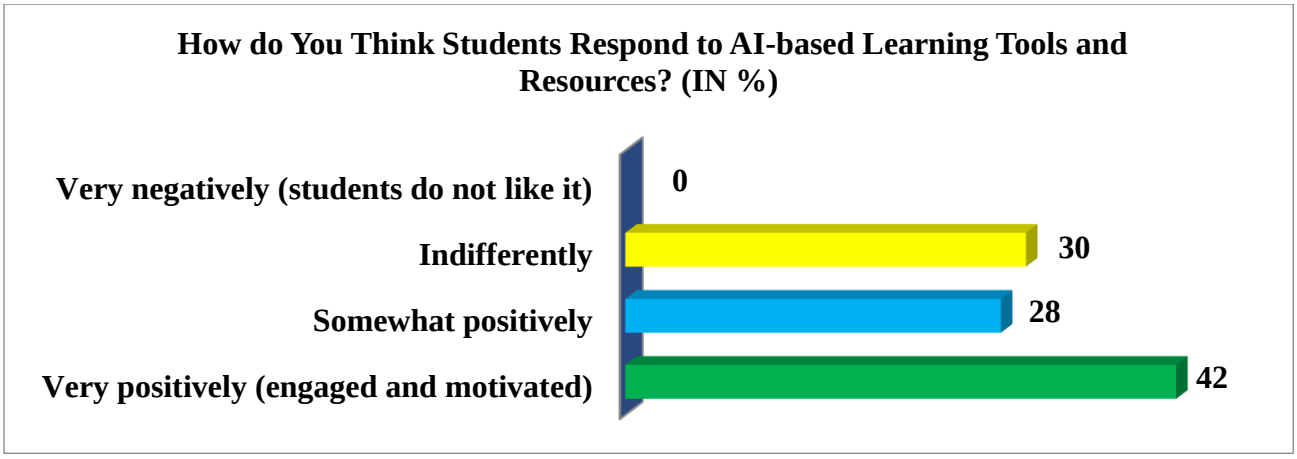

Figure 02: Perception of Teachers regarding Students' Response to AI-based Learning Tools and Resources, **Source:** Primary Data

The findings suggest that while AI-based learning tools are widely appreciated and effective for many students, a considerable portion of the target audience remains indifferent or only moderately positive. This highlights a need for:

- Improved Engagement Strategies: Developers should focus on creating more interactive and personalized experiences to appeal to a broader audience.
- Awareness Campaigns: Educational institutions need to inform students about how these tools can enhance learning outcomes.
- Feedback Systems: Incorporating student feedback into tool development could help address usability issues and improve adoption rates.
- Integration with Traditional Methods: Hybrid approaches combining AI tools with conventional teaching could cater to varied preferences.

IV) Perception of Teachers on Personalizing Education of Students through AI-based Tools: The following figure 03 illustrates responses to the question of whether AI-based tools can help personalize education for individual students. The responses are categorized into four groups: "Yes, Significantly," "Yes, to Some Extent," "No," and "Not Sure." Below is a discussion of the findings: A notable portion of respondents (27%) strongly believes in the potential of AI-based tools to significantly personalize education. This highlights recognition of AI's ability to adapt content to individual needs, such as learning pace, preferences, and areas of difficulty. This group represents advocates for AI-driven innovations in education. A smaller percentage (19%) believes AI tools offer some degree of personalization, though not fully significant. This suggests that while respondents acknowledge AI's potential, they might see limitations in its current capabilities, such as lack of context sensitivity or nuanced understanding of student behavior. The largest group (38%) doubts that AI-based tools can effectively personalize education. This skepticism could stem from concerns about the effectiveness of AI, lack of trust in technology, or the perceived impersonal nature of AI when compared to human interaction. This segment highlights the need for better education about AI's capabilities and clearer demonstrations of its impact. A considerable minority (16%) remains undecided, indicating either insufficient knowledge about AI-based educational tools or uncertainty about their real-world implementation.

The responses reveal a divided perception of AI's ability to personalize education. While 46% (combining "Yes, Significantly" and "Yes, to Some Extent") see AI as a positive influence, 38% express doubts, and 16% remain unsure. This reflects a mix of optimism, skepticism, and a need for greater awareness about AI in education.

The findings suggest that while there is significant optimism regarding the role of AI in personalizing education, substantial doubts persist. Addressing these concerns through education, improved AI functionality, and practical examples of success is essential to winning broader acceptance.

Figure 03: Perception of Teachers on Personalizing Education of Students through AI-based Tools, **Source:** Primary Data

V) Teachers' Perception on 'Benefits of Using AI for Secondary School Students': The following figure 04 presents data on the perceived benefits of using artificial intelligence (AI) for secondary school students, expressed in percentages with respect to the perception of teachers. Each benefit is categorized, highlighting the key areas where AI is seen as valuable in education. Below is a detailed discussion of the figure:

This category received the highest percentage, indicating that the majority of respondents (33%) believe AI's most significant contribution is its ability to tailor learning to individual student needs. This aligns with the growing trend of adaptive learning platforms, which use AI to customize content delivery based on students' performance and learning pace. The second-highest category (29%) underscores the role of AI in enhancing student interaction and engagement through interactive educational tools. Technologies like AI-driven simulations, gamification, and virtual assistants likely contribute to making learning more dynamic and enjoyable. 21% teachers opined that AI improves Secondary School Students' Assessment Accuracy and Speed. AI's ability to streamline grading and assessments, ensuring both precision and quick feedback, is another noted advantage. This is particularly significant in large classrooms where manual evaluation can be time-consuming and prone to errors. While 12% teachers expressed that AI helps in addressing Individual Learning Needs of secondary level students. While related to personalized learning, this lower percentage may indicate that respondents see a

distinction between personalized experiences and specific interventions for unique learning challenges, such as disabilities or learning disorders. 4% teachers seem that using AI in Education by the students prepares them for Future Careers in Technology. Surprisingly, this category received the lowest percentage. This suggests that while AI is recognized for its educational utility, its role in fostering technology career readiness is not yet a widely held perspective, possibly due to the focus on immediate classroom benefits.

The data highlights a strong emphasis on AI's direct benefits in enhancing learning experiences and engagement within the classroom setting. However, it also reveals areas where AI's potential might be underappreciated, such as career readiness. This could reflect a gap in awareness or a need for more robust integration of AI-focused career education within secondary schools.

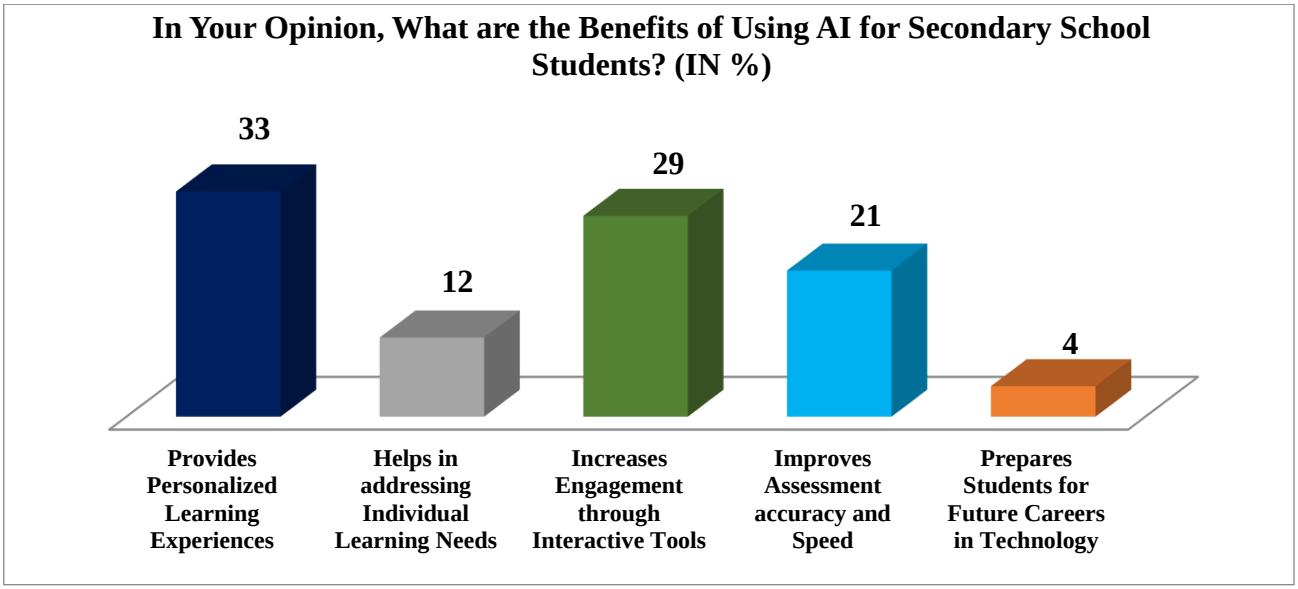

Figure 04: Teachers' Perception on 'Benefits of Using AI for Secondary School Students', **Source:** Primary Data

VI) **Overall Opinion of Teachers on the Integration of AI in Secondary Education:** The figure 05 illustrates opinions on the integration of AI in secondary education, expressed as percentages across five levels of favorability. This data reflects a spectrum of attitudes, revealing varying degrees of acceptance and resistance to AI adoption in educational settings. Below is a detailed findings along with discussion:

A significant portion of respondents (37%) hold a neutral stance, indicating either a lack of strong opinions or limited awareness about the subject. This could suggest that many people are undecided about the advantages or drawbacks of AI integration, possibly due to insufficient exposure or information. The second-largest category (24%) represents a notable degree of resistance, with almost a quarter of respondents expressing strong disapproval. This opposition could stem from concerns about AI's ethical implications, data privacy issues, potential job displacement for educators, or skepticism about its efficacy in improving educational outcomes. 17% teachers opined that integration of AI in secondary education will be somewhat favorable for teaching-learning processes at secondary level in West Bengal. This group reflects moderate support for AI in secondary education. It indicates a cautious optimism where respondents may see potential benefits but are not entirely convinced about AI's comprehensive integration without further evidence or assurance. Only a small percentage of teachers (11%) strongly support AI integration, suggesting that while there are advocates for AI in education, their numbers remain limited. This could reflect a need for more awareness campaigns and demonstrations of successful AI implementations in schools. A similar percentage of teachers (11%) to those in favorably inclined categories fall in the "somewhat unfavorable" group. These respondents may have reservations about AI's implications but do not strongly oppose its use.

The data shows a mixed but slightly skeptical outlook on AI in secondary education. With the largest group remaining neutral and a combined 35% leaning unfavorable, there appears to be significant hesitation or uncertainty about AI's role. Efforts to address this could focus on raising awareness, providing clear evidence of AI's benefits, and addressing common concerns. Conversely, the relatively low "very favorable" percentage highlights an opportunity to build broader support among educators, students, and parents through targeted initiatives.

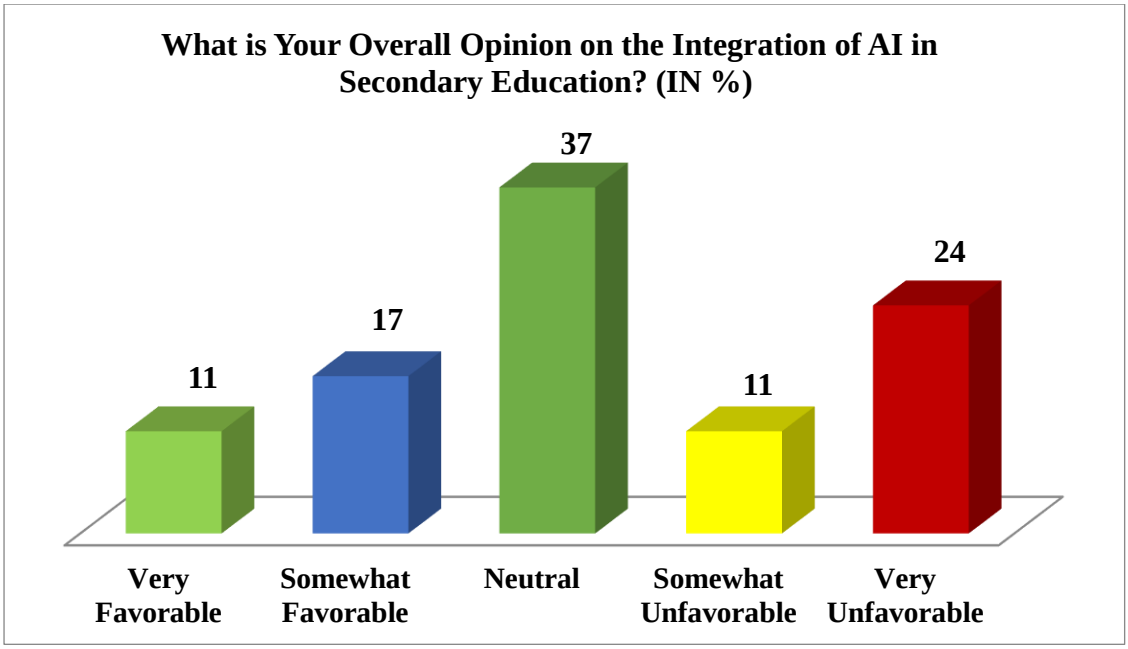

Figure 05: Overall Opinion of Teachers on the Integration of AI in Secondary Education, **Source:** Primary Data

CONCLUSION:

The integration of Artificial Intelligence (AI) in secondary education holds the potential to transform teaching practices, personalize learning experiences, and enhance overall educational outcomes. However, this study reveals that the successful adoption of AI requires addressing a range of challenges, including ethical concerns, resource constraints, and the professional development needs of teachers.

This research, conducted across seven districts of West Bengal, sheds light on secondary school teachers' perceptions, expectations, and readiness to embrace AI technologies. The findings demonstrate a complex interplay of optimism, skepticism, and gaps in awareness about AI's role in education. Teachers recognize the potential of AI to enhance engagement and personalize learning for students, as indicated by significant positive responses regarding student motivation and adaptability of AI-based tools. However, a notable proportion of teachers remain neutral or skeptical, citing limitations in technical training, ethical literacy, and resource accessibility as barriers to effective implementation.

The study underscores the critical need for targeted professional development programmes, with particular emphasis on ethical considerations and practical applications of AI in lesson planning and content creation. Teachers expressed a clear demand for workshops that combine technical skills with pedagogical strategies, highlighting the importance of equipping educators with the knowledge and tools to integrate AI effectively into their teaching practices. The findings also point to the necessity of addressing teachers' reluctance to participate in AI-related training programmes, potentially through engaging, context-relevant course designs that demonstrate tangible benefits for educators and students alike.

Another significant insight from the research is the disparity in AI adoption and perception across rural, semi-urban, and urban schools. The rural dominance in the educational landscape of West Bengal poses unique challenges, such as limited technological infrastructure and resource availability. Addressing these disparities is crucial for ensuring equitable access to AI's benefits and for fostering inclusive educational outcomes.

The study also highlights the importance of balancing the benefits and risks of AI in education. While AI tools are acknowledged for their ability to personalize learning and streamline assessments, concerns about ethical implications, data privacy, and the teacher-student relationship must be addressed to build trust and acceptance among educators. The mixed reactions to AI's potential reflect the need for awareness campaigns, clear demonstrations of successful implementations, and evidence-based practices to dispel doubts and reservations.

In conclusion, the findings of this study emphasize the importance of a holistic approach to integrating AI in secondary education. Policymakers, educators, and technologists must collaborate to design strategies that address the diverse needs and expectations of teachers while ensuring ethical and inclusive implementation. By investing in infrastructure development, targeted training programmes, and awareness initiatives, the education system can unlock the transformative potential of AI to enhance teaching-learning processes and prepare students for the demands of a technology-driven world. The insights from this research provide a valuable foundation for future studies and initiatives aimed at fostering the effective and equitable integration of AI into education.

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