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Research Article

Artificial Intelligence (AI) Applications in Higher Secondary Education in the Purba Bardhaman District of West Bengal

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Abstract

Education is one of the many societal sectors being transformed by artificial intelligence (AI). In current years, AI-based technologies such as intelligent tutoring systems, automated assessment tools, and personalised learning platforms have been increasingly adopted in schools around the world. In India, educational reforms and digital learning initiatives have encouraged schools to integrate advanced technologies into the process of teaching and learning. The district of Purba Bardhaman in West Bengal has a long educational tradition and a large network of schools and colleges. The introduction of AI-supported technologies in higher secondary schools can significantly improve Teaching efficacy and learning outcomes for students.

The application of artificial intelligence in higher secondary schools in Purba Bardhaman district is investigated in this lesson. The research examines the availability of digital infrastructure, the consciousness and attitudes of teachers and learners toward AI-based education, and the challenges faced in implementing such technologies. A descriptive survey method was applied for this study. Data were collected from selected higher secondary schools using questionnaires and interviews. The results indicate that while many schools have begun adopting ICT-based teaching methods, the direct implication of AI technologies is still limited. However, tutors and learners both show a positive attitude toward the implication of AI in education. The study concludes that AI has the capacity to enhance personalised learning, enhance evaluation systems, and increase student engagement. However, successful implementation requires adequate infrastructure, teacher training, and supportive educational policies.

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KEYWORDS: Artificial Intelligence (AI), Digital Learning, Education Technology, Higher Secondary Schools, Purba Bardhaman.

1. INTRODUCTION

One of the most innovative technological advancements of the modern period is artificial intelligence. Artificial intelligence (AI) refers to computer systems that are able to carry out activities like pattern recognition, language processing, problem solving, and decision making that typically need human intelligence. In recent years, the application of artificial intelligence in education has attracted significant attention among educators, policymakers, and researchers.

AI technologies have the potential to transform conventional teaching techniques into more interactive and personalised learning experiences. Artificial intelligence (AI) systems are capable of analysing learner performance data, identifying learning gaps, and delivering individualised instructional content. This method enhances academic results while allowing pupils to learn at their own pace.

Globally, AI-based technologies are now being used in classrooms by numerous educational institutions. Intelligent tutoring systems, educational chat bots, automated grading software, and virtual learning assistants are examples of AI tools that are instances of AI tools used in contemporary educational systems.

In India, the implementation of AI in the education system is gaining momentum due to government initiatives such as the **National Education Policy (NEP) 2020**, which prioritises technology innovation and digital learning in Schools. Many schools have started using smart classrooms, digital learning platforms, and AI-based educational applications to develop teaching quality.

West Bengal has also taken several initiatives to promote digital learning in schools. Programs related to Information and Communication Technology (ICT) have been introduced to improve classroom teaching and provide students with access to modern technological tools. ICT integration has been found to increase the teaching-learning process and improve educational quality in schools.

Purba Bardhaman district is known for its strong educational heritage. Historically, the region has been an important centre of learning, with educational institutions dating back to the nineteenth century.

The district has a large number of schools and colleges serving thousands of students across urban and rural areas.

Despite these developments, the use of AI in higher secondary education in the district remains limited and uneven. While some schools have introduced digital classrooms and computer labs, the implementation of AI-based learning tools is still in the early stages.

Therefore, it is vital to examine the current status of Artificial Intelligence (AI) in higher secondary schools in Purba Bardhaman district and determine the advantages and difficulties of putting it into practice.

2. REVIEW OF LITERATURE

In the sphere of education, the quick growth of artificial intelligence has garnered a lot of interest. Researchers across the world have explored the potential of AI technologies in changing traditional methods of instruction and learning. Artificial Intelligence has been recognised as an effective

instrument that can improve educational efficiency, offer individualised learning opportunities and help instructors better oversee classroom operations. Several studies have looked at the various applications of artificial intelligence in education and highlighted its potential advantages as well as challenges.

A thorough analysis of artificial intelligence applications in education was carried out by Chen, Chen, and Lin (2020). According to their analysis, AI technology can revolutionise education by offering intelligent teaching platforms and adaptable learning methods. Their research indicates that AI-based systems are capable of analysing students' learning styles and delivering customised learning materials according to each student's needs and skills. According to the study, AI tools can help teachers keep track of their pupils' development and spot learning challenges early on.

Holmes, Bialik, and Fadel (2019) investigated artificial intelligence's wider effects on learning and education systems. According to their research, data-driven educational decision-making procedures, automated assessment tools, and intelligent tutoring systems can all greatly enhance the quality of education. The authors made the case that AI can help educators by lightening their administrative burden and freeing them up to concentrate more on important educational tasks. AI can encourage more engaging and student-centred learning environments, according to their study.

Luckin (2018) investigated the connection between human teaching methods and machine intelligence. The study stressed that artificial intelligence should be viewed as a supporting tool that improves the teaching-learning process rather than as a substitute for educators. AI-based teaching tools, according to Luckin, can assist educators in better comprehending the learning styles of their students and offering them individualised instruction. The study also demonstrated how interactive and adaptable learning environments made possible by AI technologies might aid students in understanding difficult subjects.

After conducting a thorough analysis of the literature on artificial intelligence in education, Zawacki-Richter and his associates (2019) found a number of key domains in which AI technologies are used. These include learning analytics, automated grading systems, intelligent tutoring systems, and educational data mining. According to the report, AI technology can increase educational institutions' productivity by automating repetitive processes like performance evaluation and grading. Additionally, by offering tailored feedback and learning suggestions, AI has the ability to improve students' educational experiences, the researchers stressed.

The potential of artificial intelligence in educational institutions was examined by Baker and Smith (2019). According to their research, teachers can more successfully examine student performance data and pinpoint learning gaps with the use of AI-based solutions. The authors claim that AI solutions can help with massive classroom management and give students instant feedback, both of which can enhance the educational process. The study also highlighted how AI technologies might help educators create creative teaching strategies.

The use of digital technologies in education has grown dramatically in India in the last several years. The possibilities

and difficulties of integrating artificial intelligence into Indian education were investigated by Sharma and Srivastava (2022). According to their research, AI technology can facilitate digital learning settings and increase access to high-quality education. However, the researchers also noted a number of obstacles to the adoption of AI, such as uneven access to digital resources, a lack of teacher training, and a lack of technological infrastructure.

Online learning platforms and AI-supported educational tools have enhanced students' access to educational resources, according to Kumar's (2021) study on the function of digital learning technologies in the Indian educational system. In order to improve educational outcomes, the study stressed the significance of combining digital tools with conventional teaching techniques. Kumar added that the successful integration of AI-based learning systems in classrooms depends on teacher training initiatives.

The significance of teachers' digital competency has also been emphasised by studies on technology integration in the classroom. The Technological Pedagogical Content Knowledge (TPACK) framework, developed by Mishra and Koehler (2006), describes how educators can successfully incorporate technology into their lessons. According to the paradigm, effective technology integration necessitates striking a balance between subject content knowledge, pedagogical understanding, and technological expertise. This paradigm has grown to be a crucial theoretical starting point for research on the use of technology in the classroom.

The wider societal ramifications of artificial intelligence in education were investigated by Selwyn (2019). The study stressed that although AI presents several chances to enhance teaching methods, it also brings up significant difficulties with data privacy, morality, and digital inequality. Selwyn contends that educators and legislators need to make sure that the use of AI in the classroom does not widen the already-existing digital divide between children from various socioeconomic backgrounds.

The function of artificial intelligence in education has been the subject of much research; however, the majority of these studies have concentrated on technologically advanced educational systems or higher education institutions. Particularly in India's rural and semi-urban areas, there is very little study on the application of AI technology in secondary and higher secondary schools. The use of AI technologies is still restricted in places like Purba Bardhaman, where many schools are currently building their digital infrastructure.

In order to close this research gap, the current study looks at how artificial intelligence is used in Purba Bardhaman district higher secondary schools.

The study's objectives are to examine the accessibility of digital infrastructure, instructors' and students' knowledge of and attitudes regarding AI-based teaching resources, and the difficulties in integrating AI into the classroom. By examining these facets, the study hopes to add to the expanding corpus of research on artificial intelligence in education and offer guidance for future policy and educational planning.

3. OBJECTIVES OF THE STUDY

The major objectives of this study are:

1. To examine the availability of digital infrastructure in higher secondary schools in the Purba Bardhaman district.
2. To analyse the level of awareness about Artificial Intelligence among teachers and students.
3. To study the use of AI-based tools in the learning processes.
4. To identify the advantages of AI integration in school education.
5. To analyse the challenges faced by schools in implementing AI-based technologies.

Conceptual Framework of the Study

A conceptual framework is an organised description of the main ideas, variables, and connections in a research project. It helps the researcher understand how different factors interact with each other and influence the outcome of the study.

In the present study, the conceptual framework focuses on the relationship between Artificial Intelligence technologies, educational infrastructure, teacher readiness, and student learning outcomes in higher secondary schools in Purba Bardhaman district.

The framework assumes that the efficient application of AI in learning depends on several interconnected factors, such as technological availability, digital literacy, institutional support, and attitudes of teachers and students.

1. Availability of Technological Infrastructure

The application of artificial intelligence in education is mostly dependent on technological infrastructure. Without adequate digital resources, AI-based learning systems cannot be effectively used in schools.

Important components of technological infrastructure include:

- Availability of computer laboratories in schools
- Access to high-speed internet connectivity
- Presence of smart classrooms and digital boards
- Availability of educational software and learning platforms
- Availability of gadgets like computers, mobiles, tablets, & projectors

Schools that possess better digital infrastructure are more inclined to include AI-based learning tools in their learning practices.

2. Artificial Intelligence-Based Educational Tools

Artificial Intelligence technologies are the central element of this research framework. These tools help improve the effectiveness and efficiency of the teaching-learning process.

Key AI-based educational tools include:

- Adaptive learning systems that provide customised learning materials to students
- Intelligent teaching programs that assist pupils in solving problems
- Automated grading systems that evaluate assignments and examinations
- Educational chatbots that answer students' queries

- Learning analytics systems that analyse student performance data

These technologies support teachers and improve students' educational experience.

3. Teacher Readiness and Digital Competence

For AI to be successfully implemented in education, teachers are essential. Even if advanced technologies are available, they cannot be effectively used without proper teacher training and digital competence.

Important aspects of teacher readiness include:

- Awareness of Artificial Intelligence technologies
- Ability to use digital teaching tools and software
- Participation in training programs related to educational technology
- Positive attitude toward technology-based teaching methods
- Willingness to adopt innovative teaching practices

Teachers who possess strong digital skills are more capable of integrating AI tools into classroom teaching.

4. Student Awareness and Digital Literacy

AI-based educational solutions are primarily beneficial to students. Their ability to use digital tools and technologies significantly influences the effectiveness of AI-based learning.

Important components of student readiness include:

- Basic knowledge of computers and digital technologies
- Familiarity with online learning platforms
- Ability to interact with AI-based learning systems
- Positive attitude toward technology-assisted learning
- Motivation to use digital resources for academic improvement

AI-based teaching tools can be more effective when pupils have higher levels of digital literacy.

5. The process of teaching and learning

The process of teaching and learning represents the interaction between teachers, students, and educational technologies within the classroom environment.

Artificial Intelligence can improve this process in several ways:

- Providing personalised learning experiences for students
- Supporting teachers in explaining complex concepts
- Encouraging interactive and collaborative learning
- Letting pupils study at their own speed
- Improving classroom engagement through digital content

AI-based technologies can therefore transform traditional teacher-centred classrooms into more student-centred learning environments.

6. Learning Outcomes for Students

Learning Outcomes for Students represent the final result of the teaching–learning process. The integration of AI in the education system is expected to progress several aspects of pupils' education.

Key outcomes include:

- Improved academic performance
- Better understanding of complex subjects
- Increased motivation and engagement in learning
- Development of problem-solving and analytical skills
- Enhanced digital literacy and technological competence

Thus, AI-based education has the potential to produce more effective and meaningful learning experiences.

7. Challenges and External Factors

The conceptual framework also considers several external factors that may influence the implementation of AI in education.

These elements consist of:

- Insufficient funds in schools
- Lack of adequate Internet-based infrastructure in rural areas
- Inadequate opportunities for teacher training
- Digital divide among students from different socio-economic backgrounds
- Resistance to technological change in traditional education systems

These challenges may reduce the effectiveness of the incorporation of AI in the educational system.

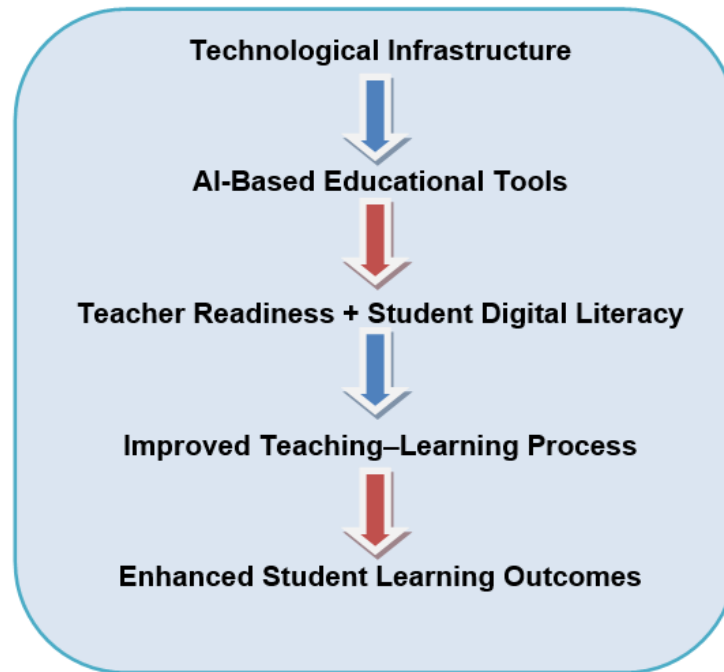
8. Relationship among Variables

The conceptual framework suggests that:

- **Technological infrastructure** and **AI tools** act as the primary enabling factors.
- **Teacher readiness** and **student digital literacy** act as supporting factors.
- These factors together influence the **process of teaching and learning**.
- Improving the process of teaching and learning ultimately leads to better student learning outcomes.

At the same time, institutional and socio-economic challenges may moderate the relationship between AI integration and learning outcomes.

Conceptual Model (Simplified Representation)



Research Questions

The study seeks to address the following questions:

1. How much digital infrastructure is present in Purba Bardhaman district's higher secondary schools?
2. How much do educators and learners know about artificial intelligence in the classroom?
3. What advantages do AI-based learning technologies seem to offer?
4. What are the primary obstacles to integrating AI technology in classrooms?

Research Gap

Although many studies have examined the Artificial Intelligence's Place in Education, most of them focus on higher education institutions or technologically advanced educational systems. Relatively little study has been done on the application of AI in higher secondary schools in rural and semi-urban regions of India.

In districts like Purba Bardhaman, there is especially little empirical research looking at the use of AI in education. In these areas, a lot of schools have issues with digital literacy, infrastructure, and technological access. In order to close this research gap, the current study looks at artificial intelligence's application in Purba Bardhaman district's higher secondary schools and evaluates the advantages and disadvantages of doing so.

4. RESEARCH METHODOLOGY

Research Design

The present study follows a descriptive survey method.

Sample

Selected higher secondary schools were used for the study in Purba Bardhaman district.

Category	Number
Schools	6
Teachers	30
Students	150
Total Respondents	180

Participants were selected through **random sampling**.

Tools for Data Collection

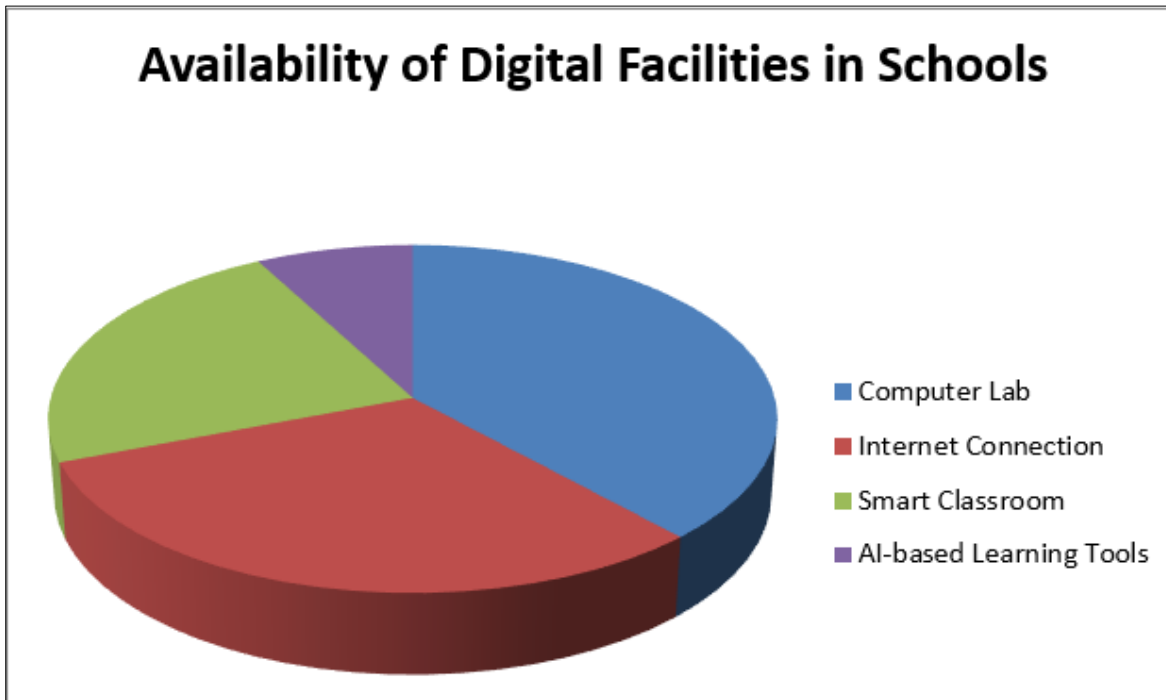
Data were collected using:

- Structured questionnaires
- Interviews
- Classroom observation

Data Analysis and Interpretation

Table 1: Availability of Digital Facilities in Schools

Digital Facility	Number of schools	Percentage
Computer Lab	5	83%
Internet Connection	4	67%
Smart Classroom	3	50%
AI-based Learning Tools	1	17%

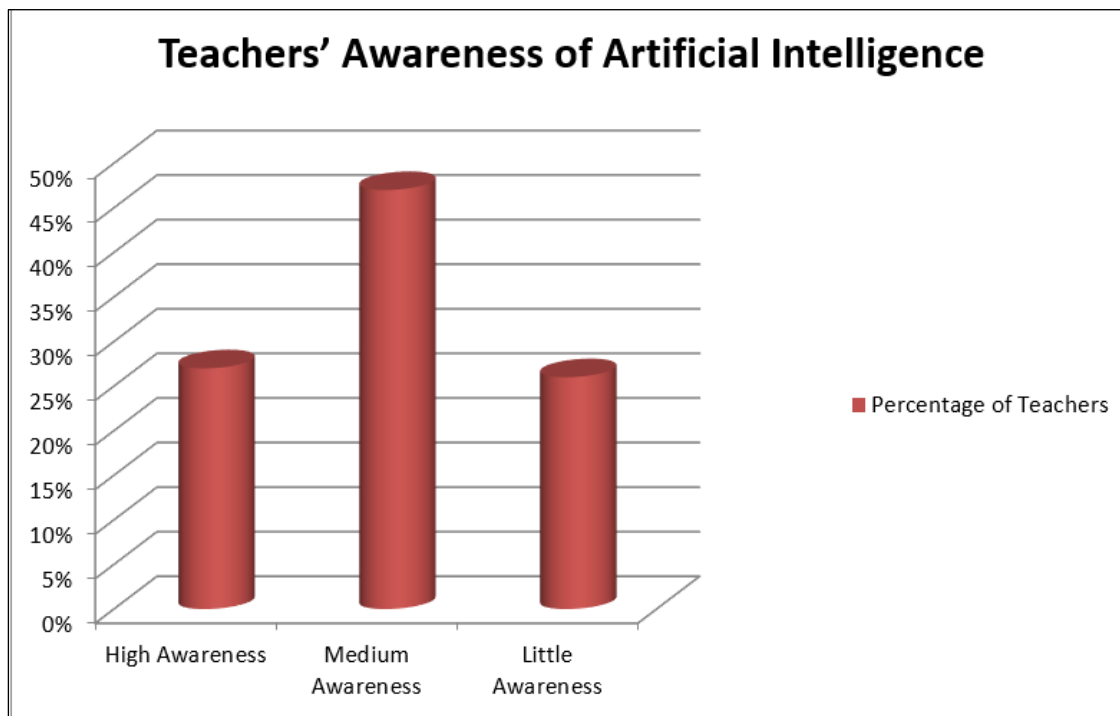


Interpretation:

The data indicate that most schools have basic digital facilities such as computer laboratories. However, advanced AI-based learning systems are still rare.

Table 2: Teachers’ Awareness of Artificial Intelligence

Level of Awareness	Number of Teachers	Percentage
High Awareness	8	27%
Medium Awareness	14	47%
Little Awareness	8	26%

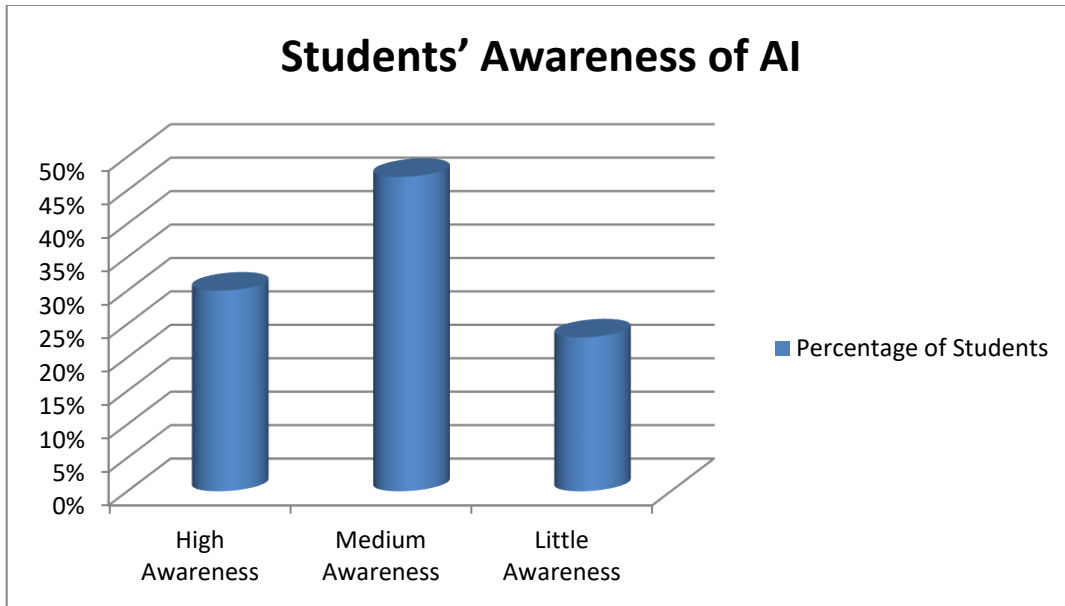


Interpretation:

Nearly half of the teachers have moderate knowledge of AI technologies, but many teachers still require training.

Table 3: Students' Awareness of AI

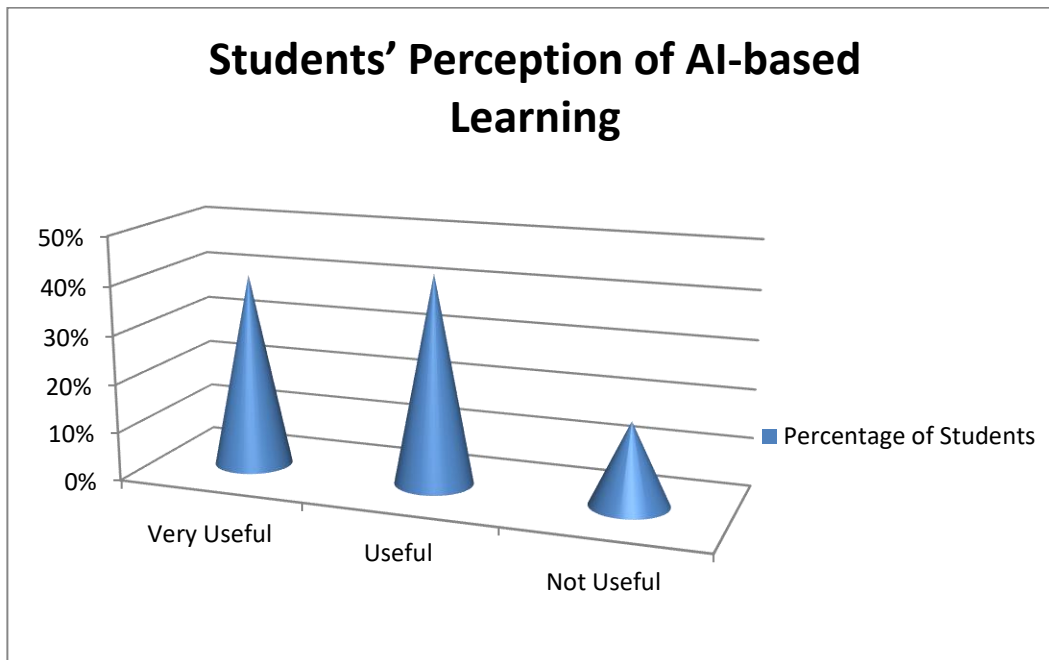
Awareness Level	Students	Percentage
High Awareness	45	30%
Medium Awareness	70	47%
Little Awareness	35	23%



Interpretation: Most students have at least some awareness of Artificial Intelligence.

Table 4: Students' Perception of AI-based Learning

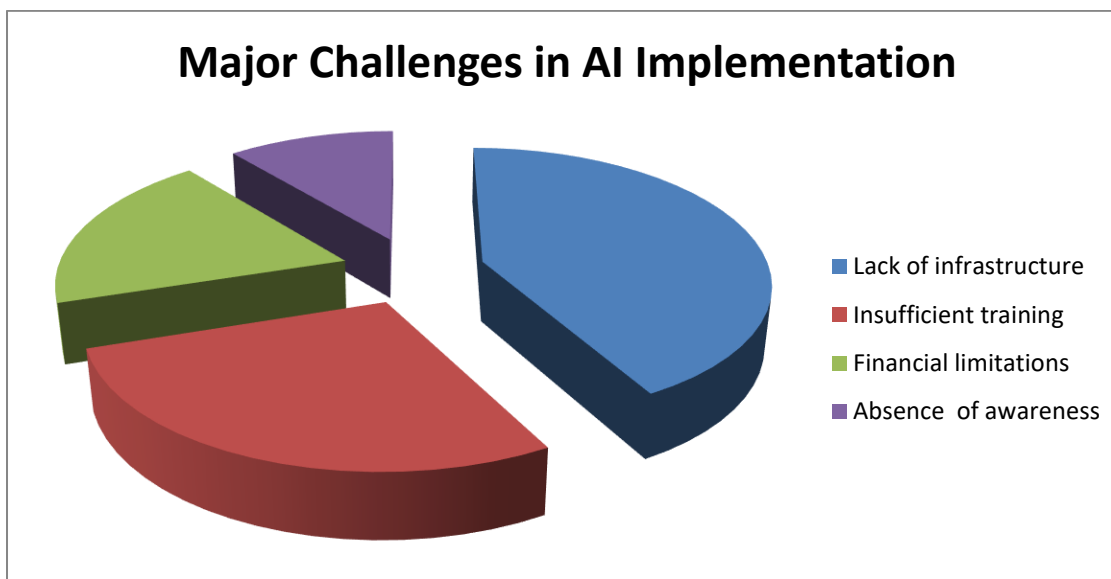
Opinion	Students	Percentage
Very Useful	60	40%
Useful	65	43%
Not Useful	25	17%



Interpretation: The majority of students believe that AI-based tools can improve learning.

Table 5: Major Challenges in AI Implementation

Challenge	Teachers (%)
Lack of infrastructure	42%
Insufficient training	28%
Financial limitations	19%
Absence of awareness	11%



5. DISCUSSION

The study's conclusions show that artificial intelligence has a great deal of potential to raise the standard of instruction in higher secondary schools. Personalised learning experiences and easier comprehension of difficult ideas are two benefits of AI technologies.

However, the report also identifies a number of obstacles to integrating AI in educational settings. Many schools still lack the essential technology infrastructure, including sophisticated computer systems and high-speed internet.

In order to successfully incorporate AI tools into classroom instruction, teachers must also receive training. Teachers may struggle to deploy AI technologies effectively without the right training.

Recommendations

1. The government should invest in digital infrastructure in schools.
2. Teacher training programs on AI-based teaching should be introduced.
3. Schools should collaborate with educational technology companies.
4. Digital literacy programs should be introduced for students.
5. AI-based educational resources should be made affordable and accessible.

6. CONCLUSION

Artificial intelligence (AI) can completely transform education by increasing the efficiency, personalisation, and interactivity of learning. In higher

secondary schools in Purba Bardhaman district, the adoption of AI technologies is still at an early stage. While basic digital infrastructure, such as computer labs and internet connectivity, is available in many schools, advanced AI-based learning tools are not yet widely used. The study shows that both educators and learners have a favourable opinion of the application of AI in the classroom. AI has the potential to significantly improve the district's educational standards with the right infrastructure development, teacher preparation, and policy support.

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