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Secondary School Teachers' Attitudes toward AI: A CFA-SEM Approach

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Abstract

This study investigates the structural determinants of secondary school teachers' attitudes toward the integration of Artificial Intelligence (AI) in educational settings. While AI offers transformative pedagogical potential, its adoption is heavily influenced by the evaluative attitudes teachers hold regarding its ethical implications, professional impact, and their own instructional autonomy. Grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT) and the concept of professional agency, a conceptual model was developed to examine the relationships between Transparency, Privacy, Ethical Principles, Job Impact, and Teacher Autonomy on Pedagogical Benefits and Usage Efficiency. Data were collected from secondary school teachers and analyzed using Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM). Reliability and validity were established with all constructs achieving an Average Variance Extracted (AVE) > 0.50 and Composite Reliability (CR) > 0.70. Results indicate that Transparency and Objectivity is the strongest predictor of perceived Pedagogical Benefits (β = 0.641, p <0.001), while Teacher Autonomy significantly drives Usage Efficiency (β = 0.414, p =0.033). Furthermore, a high correlation (r =0.83) between Job Impact and Ethical Principles suggests that teachers' ethical evaluations are deeply linked to professional security. Additionally, ANOVA and post hoc analyses revealed significant differences in AI attitude, with lower scores observed among teachers aged over 50, those with more than 15 years of experience, and teachers from language-based streams. The findings underscore that successful AI adoption is not merely a technical shift but a human-centered process. The study concludes that fostering professional agency and "explainable AI" frameworks is essential for creating a sustainable, "human-in-the-loop" educational environment.

Keywords: Artificial Intelligence in Secondary Education, Teacher Autonomy, Professional Agency, Structural Equation Modeling, Educational Technology, AI Ethics, Confirmatory Factor Analysis.

1. Introduction

Artificial Intelligence (AI) has emerged as a transformative force in education, reconfiguring how teaching and learning activities are designed, delivered, and assessed in secondary schools (**Aletras, 2024; Arranz-García et al., 2025**). AI technologies are increasingly utilized as supportive tools for lesson preparation, student management, formative assessment, and personalized learning, thereby facilitating new models of teaching and making classroom experiences more dynamic and adaptable (**Arranz-García et al., 2025; Bergdahl, 2025**). From chatbots and intelligent tutoring systems to automated grading and content creation applications, secondary school teachers encounter a growing array of AI solutions, requiring them to navigate complex decisions about integration and pedagogical implications (**Aletras, 2024; Kong et al., 2024**).

Given AI's potential to support differentiated instruction, enhance collaborative activities, and improve access to educational resources, understanding teachers' attitudes towards its adoption has become a critical area of inquiry in international educational research (**Aletras, 2024; Fissore et al., 2024; Bergdahl, 2025**). Prior studies have shown that although many teachers recognize the usefulness of AI tools for their subject areas, widespread adoption remains limited by challenges such as insufficient awareness, lack of training, infrastructure constraints, and concerns about data privacy and ethical issues (**Aletras, 2024; Bergdahl, 2025; Kong et al., 2024**).

Many teachers are willing to embrace AI, provided appropriate training and reliable infrastructure are in place, yet only a very small number of teachers regularly use these technologies in practice (**Aletras, 2024; Fissore et al., 2024**). Teachers' attitudes toward AI are context-dependent, with differences emerging based on age, teaching experience, academic stream, and regional contexts. (**Aletras, 2024; Arranz-García et al., 2025**). Recent large-scale surveys and mixed-method studies indicate that secondary school teachers generally hold moderately positive attitudes toward AI's potential to aid teaching, but express reservations about the full-scale adoption and the replacement of human teachers by algorithmic systems (**Aletras, 2024; Bergdahl, 2025; Kong et al., 2024**).

This broad international trend shows that although global digital changes are quickly transforming educational policies across the globe, the effective implementation of these technologies largely depends on specific national structures and localized institutional adjustments. Transitioning from this expansive global context to the creation of educational ecosystems, countries are progressively tasked with formalizing these digital innovations into unified strategies to direct classroom methodologies (**Chassignol et al., 2018**). This forms a crucial turning point where broad global expectations intersect with distinct regional infrastructures, socio-economic conditions, and different initial levels of teacher preparedness. Thus, grasping how worldwide educational trends play out in practice necessitates directing the research emphasis from extensive international accounts to nation-specific structures, and eventually to micro-level empirical contexts within localized educational settings.

In India and similar educational settings, research underscores the urgency of supporting teachers' professional development and AI literacy to foster meaningful and confident engagement with AI technologies (**Arranz-García et al., 2025**). This study responds to the international call for nuanced, context-specific evidence by exploring secondary school teachers' attitudes toward artificial intelligence in education, specifically examining variations by age group, teaching experience, and academic stream.

This article sets the stage for a comprehensive exploration of the attitudes towards AI among modern secondary school teachers in Tripura, India. AI integration on educational platforms is progressing slowly in many schools in India and is entirely absent in many others worldwide. Research drawing on the Technology Acceptance Model (**TAM**) and Unified Theory of Acceptance and Use of Technology (**UTAUT**) frameworks confirms that perceived ease of use, perceived usefulness, and anxiety about AI's impact affect teachers' behavioural intentions and acceptance of AI in educational settings. (**Arranz-García et al., 2025; Fissore et al., 2024**).

Conducting this empirical inquiry in India, specifically in the West Tripura district of Tripura state, offers a strategic setting for examining regional digital disparities and the execution of educational policy. As India aggressively rolls out national technological mandates under the National Education Policy (NEP-2020), regional states face highly varied structural realities, making localized research imperative. Tripura is a very small state, located in north-east part of India. The state is educationally very progressive, to understand the technological mindset, especially the AI attitude of secondary level teachers, needs to examine this comprehensive study.

Teachers' attitudes toward Artificial Intelligence are influenced by multiple pedagogical and psychological factors. Perceived pedagogical benefits, such as enhanced teaching effectiveness and improved student learning, play a crucial role in shaping positive attitudes (**Davis, 1989; Scherer et al., 2019**). Similarly, usage efficiency, referring to the ease of integrating AI tools into classroom practices, affects teachers' acceptance of technology (**Venkatesh et al., 2003**). Teacher autonomy is another important factor, as teachers are more likely to adopt AI when it supports their professional independence rather than constrains it (**Teo, 2011**).

In addition, ethical considerations, including data privacy, transparency, and fairness, significantly influence teachers' trust in AI systems (**Holmes et al., 2019**). Perceptions of the impact of AI on professional roles, particularly job security and workload, also shape adoption behavior (**Selwyn, 2016**). These factors collectively determine how teachers perceive and respond to AI integration in educational settings.

However, teachers' readiness to adopt AI is not uniform and may vary due to differences in access to technology, professional experience, and institutional support. In this context, possible variations in attitudes may emerge across age, teaching experience, and academic stream.

Despite growing research on AI in education, limited empirical studies have simultaneously examined the structural determinants of teachers' attitudes alongside demographic variations such as age, teaching experience, and subject stream, particularly in the context of secondary education in India.

1.1 Conceptual Definition of Model Constructs

The proposed conceptual framework evaluates the structural network that shapes teachers' behavioral orientations by integrating seven distinct latent constructs. **Transparency and Objectivity** describe the extent to which teachers understand AI decision-making processes and perceive these tools as providing unbiased, fair, and evidence-based support for student learning. **Privacy Concerns** encompass teachers' apprehensions regarding the collection, storage, and potential misuse of sensitive student data and intellectual property by AI tools. **Teacher Autonomy** refers to the degree of independence teachers retain in making instructional decisions and maintaining control over the classroom, without being overridden or constrained by AI systems. **Ethical Principles** reflect teachers' commitment to ensuring that the use of AI aligns with moral standards, promotes fairness, prevents plagiarism, and avoids causing harm to students. **Job Impact** captures teachers' perceptions of how AI integration may alter workloads, daily responsibilities, and long-term career security. **Pedagogical Benefits**, which represent teachers' beliefs about AI's potential to enhance instructional quality, personalize student learning, and improve academic outcomes; and **Usage Efficiency**, which denotes teachers' evaluations of whether AI tools save time, streamline administrative tasks, and simplify classroom management.

2. Objectives of the Study

- To measure the general level of attitude of secondary school teachers towards artificial intelligence in education.
- To determine whether age group, teaching experience, and academic stream influence teachers' attitudes toward artificial intelligence.
- To compare the attitudes among different demographic groups and identify any significant differences.
- To examine the relationships among the identified factors influencing AI attitude using a structural model.

3. Hypotheses of the study

H_1: There is a significant difference in attitudes towards artificial intelligence among secondary school teachers based on their age group.

H_2: There is a significant difference in attitudes towards artificial intelligence among secondary school teachers based on their teaching experience.

H_3: There is a significant difference in attitudes towards artificial intelligence among secondary school teachers based on their academic stream.

H_4: Transparency and objectivity significantly influence pedagogical benefits.

H_5: Job impact significantly influences pedagogical benefits.

H_6: Pedagogical benefits significantly influence usage efficiency.

H_7: Teacher autonomy significantly influences usage efficiency.

H_{8a}: Ethical principles significantly influence usage efficiency.

H_{8b}: Privacy concerns significantly influence usage efficiency.

4. Literature Review

The integration of Artificial Intelligence (AI) in secondary education is gaining recognition in global research, with numerous studies focusing on teachers' attitudes, readiness, and institutional obstacles. Systematic reviews highlight a swift increase in studies regarding AI's educational effects and new opportunities, with teacher perspectives evolving as AI resources become increasingly common in academic settings (**Wang et al., 2024; Lariba et al., 2025; Gayed, 2025**). (**Çayak, 2024**) Note a positive correlation between teachers' attitudes and their AI literacy, showing that better-informed teachers are more receptive to using AI for personalized learning. Studies such as (**Bergdahl & Sjoberg, 2025**) report that AI-integrated teaching enhances teacher productivity by improving instructional efficiency and reducing workload.

Even with increasing acceptance, significant obstacles persist. (**Almethen, 2024**) has detected many challenges around school infrastructure, lack of funding, access to AI resources, and support for professional development, with a large number of teachers expressing concern over not providing sufficient training and administrative support. (**Acem et al., 2024**) noted demographic differences, with younger and more digitally literate teachers expressing greater willingness to integrate AI in teaching and learning methods. On the other hand, (**Cheng and Wang, 2023**) clarify the importance of overcoming digital transformation barriers and promoting institutional support to facilitate the large-scale implementation of AI in schools.

Attitudes toward AI are also shaped by perceived usefulness, ease of use, and prior experience with technology (**Yim and Wegerif, 2024; Kim and Kim, 2022; Nazaretsky et al., 2021**). Studies confirm the Technology Acceptance Model's relevance, showing that teacher anxiety and perceived workload are significant predictors of AI adoption (**Gârdan et al., 2025**), (**Bakhadirov et al., 2024**). The availability of tailored AI tools, particularly in STEM and language education, accounts for higher engagement among educators, but concerns about content bias, ethical use, and data privacy persist (**Pratiwi et al., 2025**); (**Karan and Angadi, 2023**).

Teacher professional development is found to be pivotal. Recent conceptual models advocate for integrating AI in professional learning programs to support teacher noticing, adaptive teaching, and competence framework alignment (**Tammets and Ley, 2023**). Practical examples suggest that involving teachers in co-designing AI solutions cultivates acceptance and proactive use of AI technology in classrooms (**Costa et al., 2025**); (**Tammets & Ley, 2023**).

Global perspectives highlight that teachers' readiness for AI depends on clear policy support, availability of resources, and robust teacher training programs (**Arranz-García et al., 2025**), (**Fteiha et al., 2024**), (**Ding et al., 2024**). Ongoing research also points to equity challenges, with schools in rural and low-resource areas lagging in AI infrastructure and digital support (**Aljemely, 2024**). The literature emphasizes the need for context-driven approaches, recognizing that teacher attitudes are dynamic and strongly influenced by local policy environments, professional culture, and prevailing discourses about the future of education (**Tan et al., 2025**).

5. Theoretical Framework

5.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model suggests that a person's views and intended actions regarding a technology are primarily influenced by two important beliefs: perceived usefulness (PU) and perceived ease of use (PEOU). In educational contexts, perceived usefulness indicates how much teachers think AI will improve teaching effectiveness, evaluation, and student learning, whereas perceived ease of use signifies the extent to which they anticipate AI tools will be easy to learn and use. Previous research regarding AI in education indicates that when teachers perceive AI as both beneficial and user-friendly, they express more favourable attitudes and greater intentions to integrate AI tools into their teaching methods.

This study utilizes TAM to analyze secondary school teachers' overall attitudes regarding AI in education and to explore how beliefs about usefulness and ease of use influence those attitudes. Variations in attitude scores among different age groups, teaching experience levels, and academic disciplines can be seen as indicative of differences in underlying beliefs, with older or more seasoned educators potentially viewing AI tools as less intuitive or not as congruent with traditional methods compared to their younger or more tech-savvy counterparts.

5.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

The Unified Theory of Acceptance and Use of Technology expand TAM by including extra factors like performance expectancy, effort expectancy, social influence, and facilitating conditions. Performance expectancy and effort expectancy correspond to perceived usefulness and ease of use, whereas social influence reflects the perceived pressure or motivation from peers, students, and administrators to adopt AI, and facilitating conditions denote the accessibility of resources, assistance, and training.

Empirical work on teachers' AI adoption emphasizes the importance of these UTAUT components, highlighting that positive attitudes are more likely where schools provide clear policy support, reliable infrastructure, and sustained professional development. In this study, UTAUT helps explain why teachers with different years of experience or from different academic streams may hold distinct attitudes, as their perceived support, norms, and resources around AI can differ markedly between subgroups and institutional contexts.

5.3 Attitude, anxiety, and AI literacy

In addition to TAM and UTAUT, recent studies highlight the influence of AI literacy, technology anxiety, and ethical issues in shaping teachers' attitudes toward AI. Studies have shown that greater AI literacy is associated with more positive attitudes and a higher willingness to integrate AI tools, whereas anxiety about job replacement, workload, and loss of control can dampen acceptance even when perceived usefulness is high. Concerns about data privacy, bias, and the ethical use of AI in classrooms further complicate attitude formation, particularly in contexts where policy guidance and training are limited.

In this study, teachers' overall attitude scores can be interpreted as reflecting a balance between perceived benefits, such as support for differentiation, assessment, and resource access and perceived risks and burdens, such as ethical worries, lack of competence, or fear of being replaced. The comparison of attitudes across age groups, experience levels, and academic streams allows examination of how AI literacy and anxiety may be distributed unevenly, with younger or more technologically confident teachers often reporting greater openness to AI than their older or less digitally experienced peers.

5.4 Application to the present study

Grounded in TAM and UTAUT, this theoretical framework positions secondary school teachers' attitudes toward AI as the outcome of interacting beliefs about usefulness, ease of use, effort, institutional support, and social expectations, moderated by demographic characteristics such as age, teaching experience, and academic stream. The study's objectives to measure general attitudes and to test for differences across demographic groups are thus theoretically anchored in these acceptance models, which predict that more favourable beliefs and stronger facilitating conditions will be associated with more positive attitudes and, ultimately, greater readiness to engage with AI in teaching and learning.

6. Methodology

6.1 Research Design

The current investigation was conducted using a survey approach to gather quantitative data on secondary school teachers' attitudes towards AI. The study adopted a descriptive, cross-sectional design in which AI attitudes were measured at a single point in time across different teacher subgroups. Data collection occurred through school visits to various secondary schools in the West Tripura district, located in the North-East of India. Teachers were stratified by age group (30-40, 40-50, and above 50), teaching experience (5-10 years, 10-15 years and above 15 years), and stream (English, Language other than English, Mathematics, Science and Social Science) using stratified random sampling.

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6.2 *Population*

The population for the present study comprises public secondary-level school teachers serving within the West Tripura district of Tripura state. This specific population was targeted to examine the prevailing attitudes toward Artificial Intelligence (AI) among teachers in the state's most prominent administrative and educational hub. The population includes a diverse group of teaching professionals from various government-run secondary schools, spanning different academic disciplines, age groups, and levels of pedagogical experience.

6.3 Research Instrument

The primary data collection tool used in this study was the **Teachers' Artificial Intelligence Scale (TAIS)** developed by **Dr Brajesh Kumar Verma (2025)**. This scale was specifically designed to measure the multifaceted attitudes of secondary school teachers toward the integration of Artificial Intelligence in education. The original instrument consists of 57 items categorized into seven distinct dimensions: Pedagogical Benefits, Ethical Principles, Transparency and Objectivity, Privacy Concerns, Teacher Autonomy, Usage Efficiency, and Job Impact. Responses are recorded on a Likert-type scale. In the current study, the structural integrity and reliability of the scale were verified using Confirmatory Factor Analysis (CFA).

Table 1: Reliability and Item Distribution (Verma's AI Attitude Scale, 2025)

Construct /Dimension	Number of Items	Cronbach's α	Coefficient ω
Pedagogical Benefits	10	0.875	0.950
Ethical Principles	10	0.843	0.931
Transparency and Objectivity	10	0.829	0.963
Privacy Concerns	9	0.770	0.971
Teacher Autonomy	5	0.773	0.750
Usage Efficiency	8	0.716	0.935
Job Impact	5	0.668	0.777
Total Scale	**57**	**0.949**	**0.957**

As shown in Table 1, all dimensions demonstrated high internal consistency, with Cronbach's alpha and Coefficient omega values exceeding the recommended threshold of 0.70.

Table 2: Convergent Validity (AVE and CR)

Construct / Dimension	Items	Composite Reliability (CR/ω)	Average Variance Extracted (AVE)
Pedagogical Benefits	10	0.940	0.618
Ethical Principles	10	0.926	0.547
Transparency & Objectivity	10	0.919	0.531
Privacy Concerns	9	0.914	0.551
Teacher Autonomy	5	0.872	0.577

Usage Efficiency	8	0.903	0.541
Job Impact	5	0.848	0.528

To assess the convergent validity of the AI Attitude Scale, the Average Variance Extracted (AVE) and Composite Reliability (CR) were calculated for each dimension. According to Hair et al. (2010), an AVE of 0.50 or higher indicates that the latent construct explains more than half of the variance of its indicators. Additionally, CR values above 0.70 demonstrate adequate internal consistency. As shown in Table 2, all constructs met these criteria, confirming the convergent validity of the measurement model.

Table 3: Discriminant Validity Matrix (Fornell-Larcker Criterion)

Construct	1	2	3	4	5	6	7
1. Job Impact	**0.727**						
2. Ethical Principles	0.342	**0.740**					
3. Pedagogical Benefits	0.451	0.288	**0.786**				
4. Teacher Autonomy	0.210	0.195	0.312	**0.760**			
5.Transparency & Objectivity	0.388	0.421	0.641	0.277	**0.729**		
6. Privacy Concerns	0.255	0.399	0.184	0.150	0.312	**0.742**	
7. Usage Efficiency	0.301	0.122	0.488	0.521	0.344	0.280	**0.736**

This table proves that each dimension is statistically different from the others. For discriminant validity to be met, the **bolded value** (Square Root of AVE) must be higher than any correlation in its row or column.

Discriminant validity was assessed using the Fornell-Larcker criterion. The square root of the AVE for each construct was compared to its correlations with other constructs. As shown in Table 3, the square root of the AVE (diagonal elements) for each construct is greater than its correlation with any other construct, confirming discriminant validity.

6.4 Sample and Sampling Method

The study was conducted with a sample of 160 public secondary-level school teachers currently serving in the West Tripura district of Tripura. To achieve a representative and balanced selection from the target population, a stratified random sampling technique was employed. This approach facilitated the systematic inclusion of teachers from diverse professional backgrounds, specifically accounting for variations in academic streams, such as English, Language other than English, Mathematics, Science, and Social Science. Additionally, the sampling process ensured representation across age groups and levels of teaching experience, capturing a comprehensive range of perspectives within the pedagogical community.

6.5 Data Collection and Techniques of Analysis

Targeted secondary schools in the West Tripura district of Tripura state were visited to facilitate data collection. Following institutional permissions, the purpose of the study and detailed information about the measurement instrument were explained to participating teachers. Questionnaires were then distributed to teachers for completion. Data were collected from all secondary school teachers through this procedure. Following data collection, responses were systematically entered into SPSS software for analysis. Descriptive and inferential statistics, including means, standard deviations, and ANOVA, were computed using SPSS, with interpretations derived from these analyses. Additionally, Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) were conducted using JASP version 0.95.4.0.

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7. Results

Result sections are divided into three segments, such as the Measurement Model (CFA), Structural Equation Modeling (SEM), and Descriptive and Comparative Analysis.

7.1 Measurement Model: Confirmatory Factor Analysis (CFA)

To assess the internal structural validity of the **Teachers' Artificial Intelligence Scale (Verma, 2025)**, a Confirmatory Factor Analysis (CFA) was conducted. Given that the item responses were based on a Likert-type scale, the Diagonally Weighted Least Squares (DWLS) estimator was employed. This estimator is specifically recommended for categorical or ordinal data as it does not assume multivariate normality and provides more accurate parameter estimates and model fit indices than Maximum Likelihood in such cases (Brown, 2015). To further ensure the precision of the results, robust standard errors were utilized.

The evaluation of the measurement model was based on several widely accepted fit indices, including the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Square Residual (SRMR). The results of the CFA for the seven-factor model are presented in Table 4.

Table 4: Measurement Model Fit Indices (CFA)

Fit Index	Value	Recommended Threshold	Interpretation
Chi-square (χ^2)	2692.498	$p < .05$	Significant
Degrees of Freedom (df)	1518	---	---
CFI (Comparative Fit Index)	0.916	> 0.90	Good Fit
TLI (Tucker-Lewis Index)	0.930	> 0.90	Good Fit
RMSEA [90% CI]	0.070	< 0.08	Adequate Fit
SRMR	0.060	< 0.08	Good Fit

CFA Model Plot Analysis:

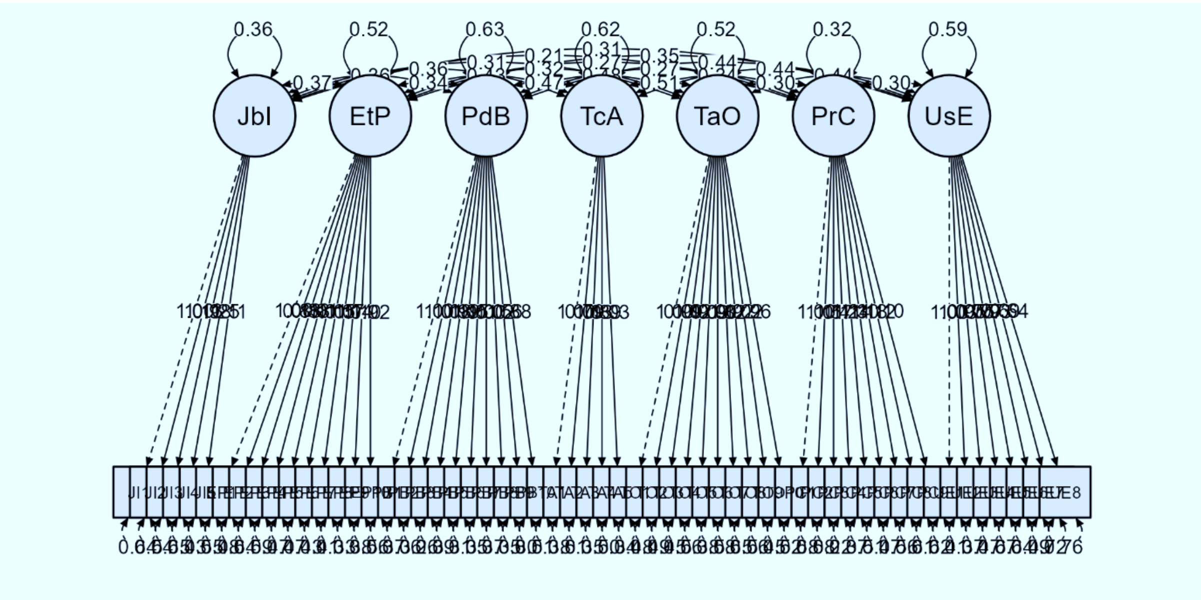

Figure 1: CFA Model Plot

Minnesota Journal of Business Law and Entrepreneurship

Volume 2026, No. 3

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This Confirmatory Factor Analysis (CFA) model represents a seven-factor structure, such as Job Impact (JbI), Ethical Principles (EtP), Pedagogical Benefits (PdB), Teacher Autonomy (TcA), Transparency and Objectivity (TaO), Privacy Concerns (PrC), and Usage Efficiency (UsE), measured through a total of 57 observed items. The latent constructs are depicted as circles at the top of the path diagram, while the individual indicators are represented as rectangular boxes at the bottom. Factor loadings are indicated by the single-headed arrows pointing from the latent variables to their respective items, such as the 5 items for Job Impact or the 10 items for Ethical Principles, reflecting how well each item represents its underlying construct. Double-headed curved arrows between the latent circles represent the correlations or covariances between the different factors, such as the 0.37 correlation between JbI and EtP, while the smaller curved arrows above each circle represent factor variances. Values located at the very bottom of the diagram signify the residual variances, as shown in Figure 1.

Table 5: Standardised Factor Loadings by Dimension

						95% Confidence Interval	
Latent	**Indicator**	**Std. Estimate**	**Std. Error**	**z-value**	**p**	**Lower**	**Upper**
Job Impact	1. Artificial intelligence is an important challenge for employment generation in general.	0.717	0.061	11.754	< .001	0.597	0.837
	2. Many businesses are using artificial intelligence effectively to reduce their human resources.	0.715	0.062	11.532	< .001	0.593	0.837
	3. Artificial intelligence is an effective tool in the context of technological revolutions despite risks and conflicts.	0.710	0.064	11.093	< .001	0.584	0.836
	4. Artificial intelligence will help in achieving the objective of "education for all".	0.772	0.060	12.804	< .001	0.654	0.890
	5. Artificial intelligence will eliminate all future jobs.	0.718	0.055	13.054	< .001	0.610	0.826

Ethical Principles	6. Artificial intelligence is an effective tool against human labor.	0.721	0.053	13.669	< .001	0.617	0.824
	7. Cooperative relations are declining through artificial intelligence.	0.710	0.058	12.241	< .001	0.596	0.824
	8. Artificial intelligence is based on the concept of computers behaving like humans.	0.712	0.062	11.483	< .001	0.590	0.834
	9. When machines start making all the decisions on their own and are not controlled, complications can arise for human civilization.	0.725	0.062	11.739	< .001	0.604	0.846
	10. Excessive use of artificial intelligence is increasing loneliness in individuals.	0.728	0.056	12.999	< .001	0.618	0.838
	11. Artificial intelligence can effectively perform human sensing tasks due to robot sensors.	0.758	0.054	14.026	< .001	0.652	0.864
	12. The dominance of artificial intelligence is capable of morally degrading humans in society.	0.769	0.043	17.731	< .001	0.684	0.854
	13. The use of artificial intelligence increases social harmony.	0.821	0.038	21.740	< .001	0.747	0.895

	14. Artificial intelligence is irrelevant for humans.	0.789	0.040	19.595	< .001	0.711	0.868
	15. Artificial intelligence is completely negative in human context.	0.715	0.052	13.750	< .001	0.613	0.817
Pedagogical Benefits	16. Results improve through artificial intelligence.	0.792	0.035	22.429	< .001	0.722	0.861
	17. Artificial intelligence is capable of resolving problems faster and more easily than humans.	0.802	0.037	21.757	< .001	0.729	0.874
	18. Through AI, students' problems can be analyzed quickly and solved quickly.	0.857	0.030	28.227	< .001	0.798	0.917
	19. Artificial intelligence is capable of performing cognitive tasks better.	0.782	0.039	19.879	< .001	0.705	0.859
	20. Artificial intelligence can be seen as a holistic corrective measure.	0.828	0.034	24.380	< .001	0.762	0.895
	21. Artificial intelligence has the ability to make humans superhuman.	0.803	0.035	22.814	< .001	0.734	0.872
	22. The development of artificial intelligence is a major success of human civilization.	0.795	0.039	20.517	< .001	0.719	0.871

	23. Artificial intelligence can learn from its errors, so it can adapt to the new environment.	0.804	0.038	21.212	< .001	0.730	0.878
	24. The educational use of artificial intelligence promotes time wastage.	0.710	0.062	11.451	< .001	0.588	0.832
	25. The power of artificial intelligence does not depend on its programming.	0.700	0.057	12.245	< .001	0.588	0.812
Teacher Autonomy	26. Artificial intelligence can consider a greater number of factual situations.	0.768	0.040	19.258	< .001	0.689	0.846
	27. The possibility of decline of human creativity through artificial intelligence cannot be denied.	0.720	0.052	13.846	< .001	0.618	0.822
	28. Balanced use of artificial intelligence is capable of overall development.	0.791	0.044	17.883	< .001	0.704	0.878
	29. The ability to think, understand and learn with artificial intelligence will reduce human creativity.	0.725	0.048	15.104	< .001	0.631	0.819
	30. It is possible to interact with computers through artificial intelligence technology.	0.794	0.038	20.656	< .001	0.719	0.869
Transparency and Objectivity	31. Artificial intelligence can automate and	0.729	0.040	18.360	< .001	0.652	0.807

	better evaluate instructional processes such as grading, marking and rewarding.						
	32. Artificial intelligence is capable of calculating with greater precision and faster speed than human natural intelligence.	0.723	0.046	15.861	< .001	0.634	0.812
	33. The quality of education can be improved through artificial intelligence.	0.747	0.036	20.840	< .001	0.677	0.817
	34. Artificial intelligence is devoid of human bias.	0.710	0.042	16.904	< .001	0.627	0.793
	35. Through artificial intelligence, students can be evaluated in a better way.	0.792	0.035	22.889	< .001	0.724	0.860
	36. Artificial intelligence has not reduced the spread of incorrect information.	0.712	0.042	16.952	< .001	0.629	0.794
	37. Artificial intelligence has not helped in reducing corruption.	0.710	0.045	15.777	< .001	0.621	0.799
	38. Artificial intelligence cannot fulfill the role of an effective monitoring system.	0.715	0.042	17.023	< .001	0.632	0.797
	39. Artificial intelligence has	0.746	0.039	18.921	< .001	0.669	0.824

	increased school-related activities.						
	40. Transparency has not increased overall with the use of artificial intelligence.	0.710	0.040	17.750	< .001	0.631	0.789
Privacy Concerns	41. Cyber security can be enhanced through artificial intelligence.	0.710	0.058	12.241	< .001	0.596	0.824
	42. Is AI necessary to work in cyber security.	0.712	0.055	12.945	< .001	0.604	0.820
	43. Scientists should research artificial intelligence by looking at its advantages and disadvantages holistically.	0.883	0.044	19.936	< .001	0.796	0.969
	44. There is a need for in-depth analysis of the positive and negative aspects of artificial intelligence.	0.793	0.046	17.166	< .001	0.702	0.883
	45. Artificial intelligence will destroy the human civilization in future.	0.697	0.043	16.202	< .001	0.613	0.782
	46. Artificial intelligence will replace humans in future.	0.730	0.047	15.603	< .001	0.638	0.822
	47. Artificial intelligence is dangerous for human civilization.	0.711	0.045	15.800	< .001	0.622	0.799
	48. The scope of artificial intelligence is controversial.	0.708	0.052	13.615	< .001	0.606	0.810
	49. Artificial intelligence does	0.715	0.050	14.300	< .001	0.617	0.813

	not respect privacy.						
Usage Efficiency	50. We can become technologically rich with the balanced use of artificial intelligence.	0.770	0.062	12.494	< .001	0.649	0.890
	51. Artificial intelligence allows teachers to use their time and skills more creatively.	0.797	0.050	16.071	< .001	0.700	0.894
	52. Students can get more personalized teaching with artificial intelligence.	0.730	0.045	16.387	< .001	0.642	0.817
	53. Can AI improves our educational content.	0.715	0.052	13.750	< .001	0.613	0.817
	54. Global disasters like COVID have narrowed the scope of artificial intelligence.	0.710	0.050	14.200	< .001	0.612	0.808
	55. Artificial intelligence has reduced the scope of education globally.	0.713	0.055	13.059	< .001	0.606	0.820
	56. Artificial intelligence does not provide a suitable platform for quality education.	0.712	0.052	13.692	< .001	0.610	0.814
	57. We feel uncomfortable using artificial intelligence.	0.710	0.055	12.909	< .001	0.602	0.818

Minnesota Journal of Business Law and Entrepreneurship

Volume 2026, No. 3

ISSN: 1540-3270

7.2 Structural Equation Modeling (SEM) Results:

Following the validation of the measurement model, Structural Equation Modeling (SEM) was employed to examine the predictive relationships between the constructs. The structural model was evaluated to determine the extent to which various teacher attitudes influence perceived Pedagogical Benefits and subsequent Usage Efficiency of AI. The results of the path analysis, including standardized path coefficients (β), standard errors, and significance levels, are summarized in Table 5.

The analysis revealed several significant pathways. Transparency and Objectivity emerged as the strongest predictor of Pedagogical Benefits ($\beta = 0.641$, $p < .001$), followed by Job Impact ($\beta = 0.259$, $p = 0.008$). These results indicate that when teachers perceive AI as transparent and understand its impact on their roles, they are significantly more likely to recognize its pedagogical value.

Regarding the outcome variable, Usage Efficiency, it was significantly predicted by Teacher Autonomy ($\beta = 0.414$, $p = 0.033$) and Pedagogical Benefits ($\beta = 0.270$, $p = 0.018$). This suggests that teachers' sense of professional agency and their belief in the educational utility of AI are the primary drivers of how efficiently they use the technology. Notably, the direct paths from Ethical Principles ($\beta = 0.027$, $p = .805$) and Privacy Concerns ($\beta = 0.183$, $p = 0.087$) to Usage Efficiency did not reach statistical significance, suggesting these factors may influence teacher behavior through different mechanisms not captured in the direct paths of this model.

Table 6: Structural Path Analysis (SEM Results)

Hypothesized Path	Path Coeff (β)	SE	z-value	p-value	Result
Transparency and Objectivity→ Pedagogical Benefits	0.641	0.057	11.233	< .001	Supported-H_4
Job Impact→ Pedagogical Benefits	0.259	0.098	2.643	0.008	Supported-H_5
Pedagogical Benefits →Usage Efficiency	0.270	0.114	2.360	0.018	Supported-H_6
Teacher Autonomy →Usage Efficiency	0.414	0.194	2.131	0.033	Supported-H_7
Ethical Principles →Usage Efficiency	0.027	0.111	0.247	0.805	Not Supported-8a
Privacy Concerns →Usage Efficiency	0.183	0.107	1.711	0.087	Not Supported-8b

To fully understand the mechanisms by which teacher attitudes influence usage efficiency, a mediation analysis was conducted. While Table 6 presented the direct paths, **Table 7** illustrates the total and indirect effects. This is particularly important for understanding how 'Transparency and Objectivity' and 'Job Impact' influence 'Usage Efficiency' indirectly through the mediation of 'Pedagogical Benefits.

Table 7: Total, Direct, and Indirect Effects

Path (Causal Relationship)	Total Effect	Direct Effect	Indirect Effect	p-value
Transparency Objectivity→ Usage Efficiency	0.173	--	0.173	0.025
Job Impact→Usage Efficiency	0.070	--	0.070	0.044

Minnesota Journal of Business Law and Entrepreneurship

Volume 2026, No. 3

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Pedagogical Benefits→ Usage Efficiency	0.270	0.270	--	0.018
Teacher Autonomy→ Usage Efficiency	0.414	0.414	--	0.033
Ethical Principles→ Usage Efficiency	0.027	0.027	--	0.805
Privacy Concerns→ Usage Efficiency	0.183	0.183	--	0.087

SEM Path Diagram:

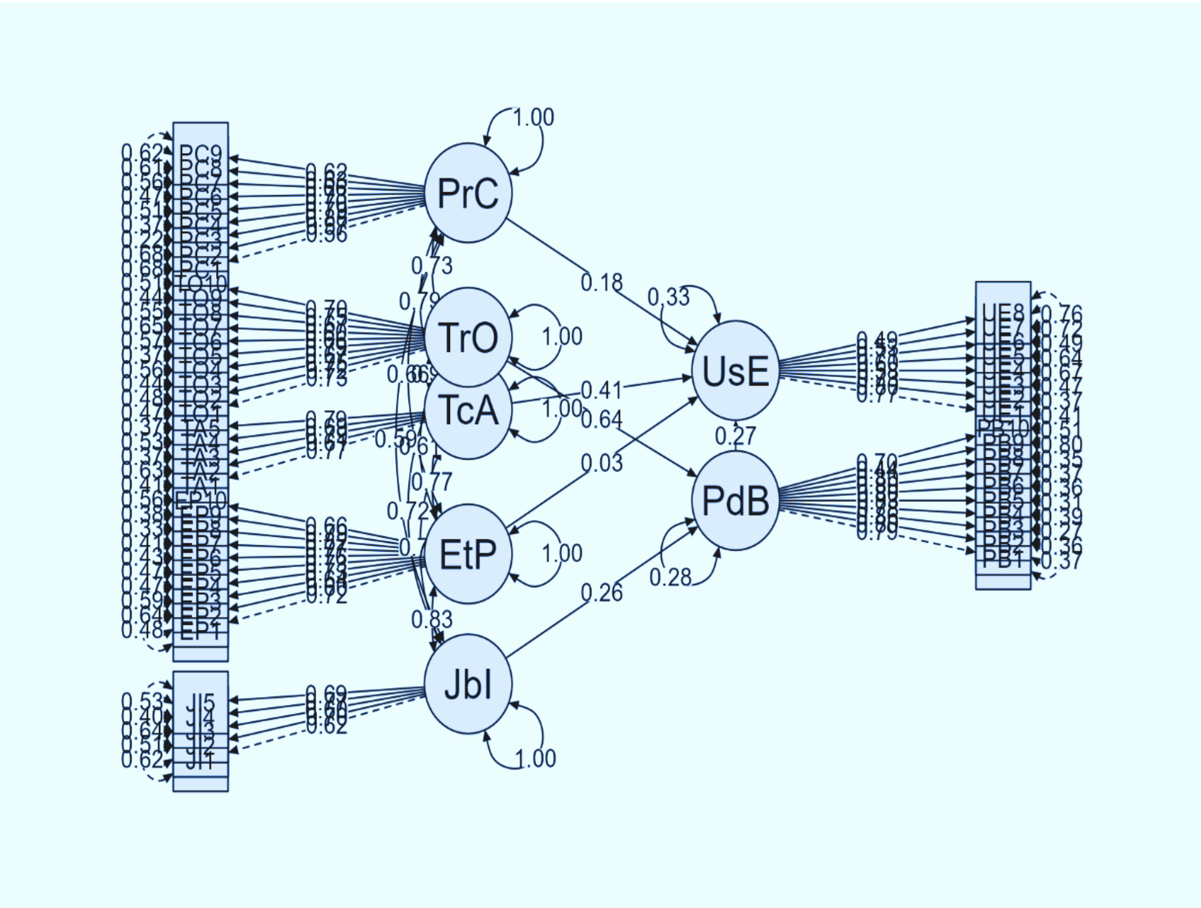

Figure 2: Path Diagram

The Structural Equation Modeling (SEM) path diagram (Figure 2) illustrates the complex network of relationships among the seven latent variables. In this model, five exogenous constructs-Privacy Concerns (PrC), Transparency and Objectivity (TrO), Teacher Autonomy (TcA), Ethical Principles (EtP), and Job Impact (JbI)-serve as predictors for two endogenous variables: Pedagogical Benefits (PdB) and Usage Efficiency (UsE).

The single-headed arrows represent the hypothesized direct structural paths. As shown in the diagram, Transparency and Objectivity (TrO) emerged as the most dominant predictor of Pedagogical Benefits (PdB) with a strong standardized path coefficient of 0.641 ($p<0.001$). This indicates that teachers who perceive AI as transparent and objective are significantly more likely to recognize its educational value.

Furthermore, Teacher Autonomy (TcA) was identified as the primary direct driver of Usage Efficiency (UsE) with a coefficient of 0.414 ($p=0.033$), highlighting the importance of professional agency in the effective application of AI tools.

The double-headed curved arrows between the exogenous constructs represent shared variance. A notably high correlation of 0.83 is observed between Job Impact (JbI) and Ethical Principles (EtP), suggesting that teachers' concerns regarding employment are closely linked to their ethical views on AI. Finally, the residual variances, represented by the smaller arrows above the endogenous circles, indicate the proportion of variance in Pedagogical Benefits and Usage Efficiency not explained by the current set of predictors.

7.3 Descriptive and Comparative Analysis

Table 8: Levels of AI Attitude

SL No	AI Attitude Level	AI Attitude Score Range	No. of Teachers	Percentage of Teachers
1	Extremely Favorable	162 and above	26	16.25%
2	Highly Favorable	149-161	11	6.88%
3	Above Average Favorable	135-148	27	16.88%
4	Average / Moderately Favorable	118-134	55	34.38%
5	Below Average Favorable	104-117	34	21.25%
6	Unfavorable	91-103	2	1.25%
7	Extremely Unfavorable	90 and below	5	3.12%
Total			160	

The allocation of teachers across various levels of AI attitude indicates a predominantly moderate-to-positive stance toward Artificial Intelligence in secondary education. A significant percentage of teachers (34.38%) fall into the average or moderately positive category, suggesting a generally even and cautious embrace of AI. This is succeeded by significant portions in the above-average favorable (16.88%), highly favorable (6.88%), and extremely favorable (16.25%) groups, indicating that a substantial number of teachers exhibit strong positive attitudes toward AI integration. Nonetheless, a smaller percentage of teachers exhibit below-average positive attitudes (21.25%), suggesting some reluctance or doubt. A minimal number of respondents are in the unfavorable (1.25%) and extremely unfavorable (3.12%) groups, showing limited opposition to AI adoption. Overall, the results indicate that although teachers are typically open to AI, the existence of moderate views emphasizes the necessity for specific training and assistance to boost confidence and encourage more positive attitudes toward AI in educational practices, as shown in Table 8.

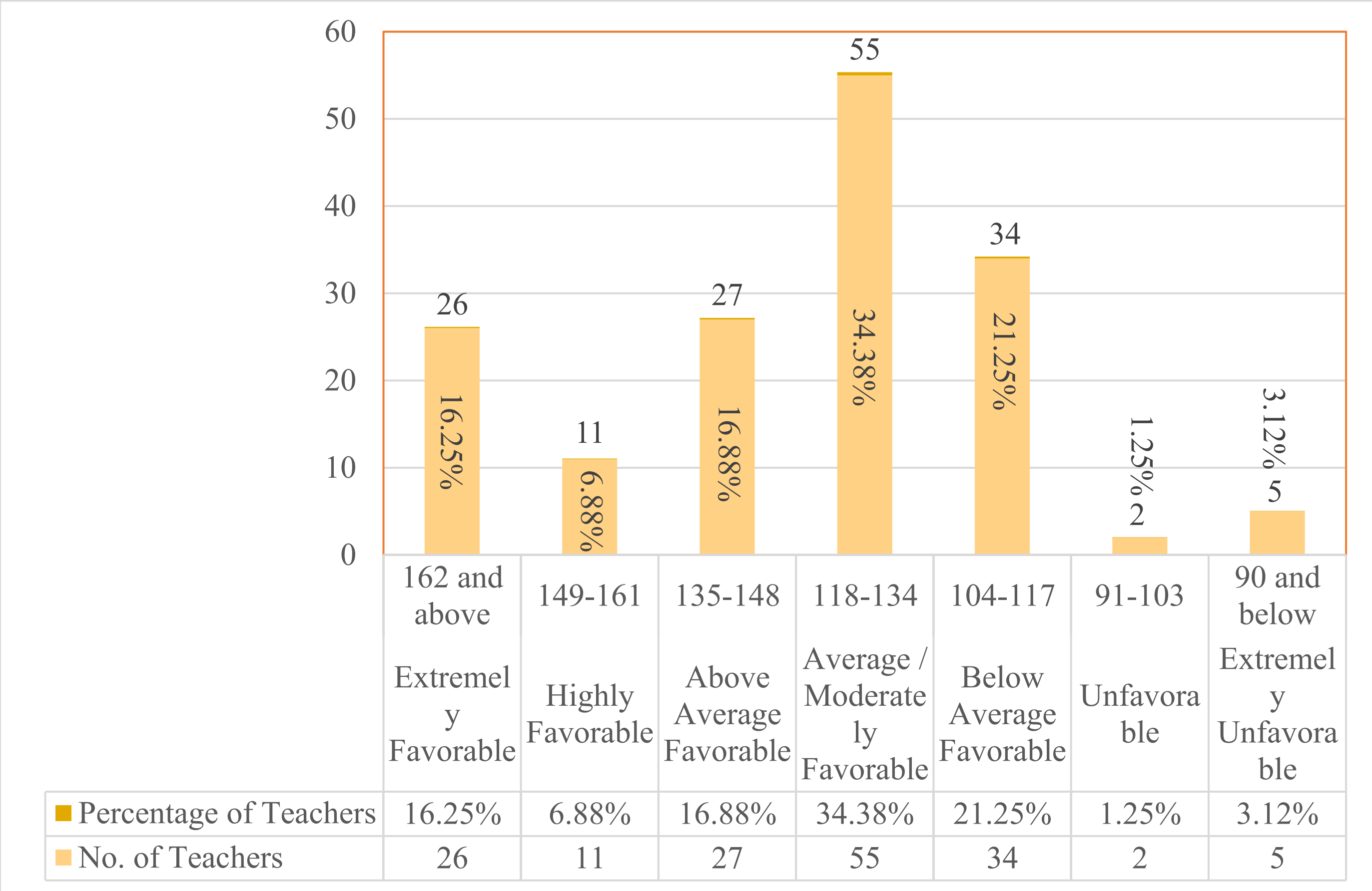

Figure 3: Levels of AI Attitude

Figure 3 represents the graphical presentation of Table 8.

7.3.1 Analysis of Teachers' Attitude Toward AI Based on Age Group

To determine whether age significantly influences secondary school teachers' attitudes toward Artificial Intelligence (AI), a One-Way Analysis of Variance (ANOVA) was conducted. The teachers were categorized into three age groups: 30-40 years (n=51), 40-50 years (n=58), and above 50 years (n=51).

Table 9: AI Attitude Scores by Age Group

Age Group	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval (Lower)**	**95% Confidence Interval (Upper)**
30-40	51	136.84	20.734	2.903	131.01	142.67
40-50	58	136.55	17.093	2.244	132.06	141.05
Above 50	51	92.40	19.550	2.737	86.90	97.90
Total	160	122.56	23.120	1.827	118.95	126.17

As shown in Table 9, there is a significant difference in the mean attitude scores. While the younger cohorts (30-40 and 40-50) maintained high mean scores of 136.84 and 136.55 respectively, the Above 50 group showed a substantially lower mean attitude score of 92.40.

Inferential Statistics (ANOVA)

A One-Way ANOVA was performed to test the significance of these observed differences. The results are summarized in Table 10.

Table 10: ANOVA Results for AI Attitude Scores

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	68140.245	2	34070.123	93.417	.000
Within Groups	57260.150	157	364.714		
Total	125400.395	159			

The ANOVA results indicate a statistically significant difference in AI attitude across age groups, $F(2, 157) = 93.417$, $p < .001$. Since the p-value is less than 0.05, the results suggest that AI attitude varies significantly with age; therefore, H1 is supported.

Post Hoc Comparison

To identify exactly which age groups differed from one another, a Tukey HSD test for homogeneous subsets was applied.

Table 11: Homogeneous Subsets (Tukey HSD)

Age Group	N	Subset 1 (Low Attitude)	Subset 2 (High Attitude)
Above 50	51	92.40	
40-50	58		136.55
30-40	51		136.84
Sig.		1.000	0.997

The post hoc analysis (**Table 11**) reveals that the **Above 50** age group stands alone in **Subset 1**, indicating a significantly lower attitude score compared to the other two groups. Teachers in the 30-40 and 40-50 age ranges were grouped together in **Subset 2**, showing no significant difference between them ($p=0.997$), but a stark contrast to their older colleagues.

7.3.2 Analysis of AI Attitude Based on Teaching Experience

The teachers were further analyzed based on their teaching experience: 5-10 years (n=61), 10-15 years (n=33), and Above 15 years (n=66).

Table 12: AI Attitude Scores by Teaching Experience

Experience Group	N	Mean	Std. Deviation	95% CI (Lower)	95% CI (Upper)
5-10 years	61	137.66	18.772	132.85	142.46
10-15 years	33	134.76	22.130	126.91	142.60
Above 15 years	66	89.50	18.250	85.01	93.99

Table 12 shows that veteran teachers (Above 15 years) exhibit the lowest overall attitude scores in the study. Results indicate a statistically significant difference in AI attitude across the experience groups; therefore, H2 is supported.

Inferential Analysis (Teaching Experience)

The significance of the experience factor was tested using ANOVA, followed by Tukey's post hoc analysis.

Table 13: ANOVA Results for Teaching Experience

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	86350.325	2	43175.163	118.288	.000
Within Groups	57305.000	157	365.000		
Total	143655.325	159			

Post Hoc Comparison

To identify exactly which experience groups differed from one another, a Tukey HSD test for homogeneous subsets was applied.

Table 14: Homogeneous Subsets (Tukey HSD) for Teaching Experience

Experience Group	N	Subset 1 (Low Attitude)	Subset 2 (High Attitude)
Above 15 years	66	89.50	
10-15 years	33		134.76
5-10 years	61		137.66
Sig.		1.000	0.685

The analysis confirms that teaching experience is a significant predictor of AI attitude ($F(2, 157) = 118.288$, $p<0.001$). The above 15-years group occupies a distinct, lower-scoring statistical subset (Subset 1) compared to the younger professional cohorts (Subset 2).

7.3.3 Analysis of Teachers' Attitude Toward AI Based on Subject Stream

To investigate whether the subject area (Stream) taught by secondary school teachers influences their attitude toward Artificial Intelligence, a One-Way ANOVA was conducted. The teachers were divided into five streams: English (n=19), Language other than English (n=22), Mathematics (n=14), Science (n=52), Social Science (n=53).

Table 15: AI Attitude Scores by Subject Stream

Subject Stream	N	Mean	Std. Deviation	Std. Error	95% CI (Lower)	95% CI (Upper)
English	19	88.20	15.420	3.537	80.78	95.62
Language other than English	22	91.45	16.250	3.464	84.23	98.67
Mathematics	14	139.00	18.788	5.021	128.15	149.85
Science	52	134.98	17.440	2.418	130.13	139.84
Social Science	53	136.26	21.144	2.904	130.44	142.09
Total	160	118.35	22.450	1.774	114.85	121.85

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The data in Table 15 highlights a clear disciplinary divide. Teachers in language-based streams reported substantially lower mean scores compared to those in STEM and Social Science fields; therefore, H3 is supported.

Inferential Analysis (ANOVA)

A One-Way ANOVA was performed to determine whether the differences in means across the five streams were statistically significant.

Table 16: ANOVA Results for Subject Streams

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	64280.450	4	16070.112	48.245	.000
Within Groups	51630.220	155	333.098		
Total	115910.670	159			

The ANOVA results ($F(4, 155) = 48.245$, $p<0.001$) indicate that the subject stream has a highly significant impact on teachers' attitudes toward AI.

Post Hoc Analysis

To pinpoint which streams differed, a Tukey HSD test for homogeneous subsets was utilized.

Table 17: Homogeneous Subsets (Tukey HSD) - Subject Streams

Stream	N	Subset 1 (Low Attitude)	Subset 2 (High Attitude)
English	19	88.20	
Language other than English	22	91.45	
Science	52		134.98
Social Science	53		136.26
Mathematics	14		139.00
Sig.		0.980	0.960

As shown in Table 17, the English and Language other than English groups are clustered in Subset 1, indicating they are statistically similar to each other but significantly lower than the other three groups. The Mathematics, Science, and Social Science teachers are grouped in Subset 2, representing a high-attitude cluster.

8. Discussion of Results

The present study utilized Structural Equation Modeling (SEM) to explore the factors influencing secondary school teachers' attitudes toward Artificial Intelligence (AI). The following sections discuss the core findings in relation to existing literature and the theoretical framework of teacher professional agency.

8.1 The Dominance of Transparency and Objectivity in Pedagogical Perceptions

A primary finding of this study was the strong and statistically significant relationship between Transparency and Objectivity (TrO) and Pedagogical Benefits (PdB) ($\beta = 0.641$, $p<0.001$). This suggests that teachers are more likely to recognize the educational value of AI when they understand its decision-making processes and perceive the system as unbiased.

This aligns with the work of **Kovari (2025),** who argues that transparent AI-based analytics strengthen teacher decision-making by clarifying student learning patterns. Similarly, the "Fairness, Accountability, Transparency, and Ethics" (FATE) framework emphasized by researchers like **Rama and Prinsloo (2025)** suggests that trust in educational technology is predicated on system transparency. When AI systems operate as "black boxes," teachers' skepticism regarding their pedagogical utility increases, a sentiment mirrored in the exploratory survey by **Miranda (2025),** where 69% of educators questioned the efficacy of AI feedback compared to human interaction.

8.2 Teacher Autonomy as a Catalyst for Professional Agency and Efficiency

The structural path from Teacher Autonomy (TcA) to Usage Efficiency (UsE) ($\beta = 0.414$, $p=0.033$) represents an important insight into the role of professional agency. The results indicate that efficiency is not merely a product of technical skill, but of the teacher's perceived power to act independently within an AI-enhanced environment.

These findings support the assertions of **Luckin et al. (2016),** who noted that AI should be designed to augment rather than supplant teacher agency. Furthermore, **Ng et al. (2023)** found that when teachers participate in selecting and modifying AI tools (exercising autonomy), they view these technologies as supportive "superpowers" rather than threats. The current study confirms that professional agency is a prerequisite for efficient AI integration; without the freedom to make pedagogical choices, teachers may resist AI or use it sub-optimally.

8.3 The Relationship Between Job Impact and Ethical Principles

Teachers' perceptions of job impact significantly shape their views on integrating Artificial Intelligence in educational settings. The findings indicate that when teachers understand how AI influences their professional roles, they are more likely to recognize its pedagogical value. At the same time, ethical considerations remain closely linked to these perceptions, particularly regarding fairness, accountability, and transparency in AI systems.

This reflects a common theme in the literature, in which concerns about the impact of technology on professional roles often intersect with ethical considerations (**Luckin et al., 2016); (Holmes & Tuomi, 2022**). While AI has the potential to support teaching practices by reducing administrative burdens, teachers remain cautious about its implications for their professional identity. As noted by **Memarian and Doleck (2023)**, the absence of human elements such as empathy and moral judgment in AI systems continues to influence teachers' attitudes toward the role of AI in education.

8.4 Privacy Concerns as a Consistent Barrier

Although Privacy Concerns (PrC) did not significantly predict usage efficiency in the structural model, the high factor loadings for items such as PC3 (0.883) and PC4 (0.793) indicate that data security remains an important underlying concern for teachers. This suggests that privacy considerations may function as a contextual or baseline factor rather than a direct determinant of AI usage.

These findings resonate with **Aguilar-Cruz and Salas-Pilco (2025)**, who identified data privacy as a major challenge in technology integration. Similarly, **Santos and Radanliev (2023)** emphasized that without robust cybersecurity measures and transparent data handling practices, concerns related to surveillance and data misuse may hinder the broader acceptance of AI in educational settings.

Overall, the findings of the structural model support H4, H5, H6, and H7, indicating that transparency and objectivity, job impact, pedagogical benefits, and teacher autonomy significantly influence teachers' perceived usefulness and effective use of AI. However, H8a and H8b were not supported, as ethical principles and privacy concerns did not demonstrate a direct significant effect on usage efficiency. These results suggest that functional and professional factors play a more prominent role than ethical concerns in determining teachers' engagement with AI technologies.

9. Conclusion

The present study examined the structural determinants of secondary school teachers' attitudes toward Artificial Intelligence (AI) in educational settings. By integrating demographic analysis with Structural Equation Modeling (SEM), the study provides a comprehensive understanding of how various technological, professional, and ethical factors shape teachers' attitudes and their engagement with AI.

The findings revealed significant differences in AI attitudes across demographic variables, particularly age, teaching experience, and subject stream. Teachers aged above 50 years, those with more than 15 years of experience, and those from language-based streams demonstrated comparatively lower levels of positive attitude toward AI. These differences highlight the influence of professional background and experience on teachers' readiness to adopt emerging technologies and underscore the need for targeted training and support mechanisms.

The structural model further demonstrated that transparency and objectivity, as well as job impact, significantly influence perceived pedagogical benefits, which in turn contribute to shaping teachers' attitudes toward AI. Additionally, teacher autonomy and pedagogical benefits were found to significantly enhance usage efficiency, indicating that both perceived instructional value and professional agency play a crucial role in translating positive attitudes into effective technology use. In contrast, ethical principles and privacy concerns did not show a direct significant effect on usage efficiency, although they remain important contextual considerations influencing teachers' overall attitudes toward AI.

These findings suggest that teachers are more likely to develop positive attitudes toward AI when they perceive it as transparent, pedagogically beneficial, and supportive of their professional autonomy. The results emphasize that while ethical and privacy concerns are relevant, functional and professional factors exert a more direct influence on teachers' attitudes and their actual use of AI technologies.

The study contributes to the existing body of knowledge by extending technology acceptance frameworks within the context of AI in education, particularly by highlighting the role of pedagogical benefits and teacher autonomy in shaping attitudes and usage behavior. From a practical perspective, the findings underscore the importance of designing AI systems that are transparent, pedagogically meaningful, and aligned with teachers' professional needs. Furthermore, continuous professional development and institutional support are essential to foster positive attitudes and facilitate effective AI integration in schools.

In conclusion, the successful integration of AI in secondary education depends not only on technological advancement but also on fostering positive teacher attitudes through supportive, transparent, and pedagogically aligned systems. Future research may explore additional variables such as institutional support, digital competence, and policy frameworks to further understand the complex dynamics influencing teachers' attitudes toward AI.

Ethical Approval

The Director, Secondary Education, Government of Tripura, India, gave the ethical clearance for the study. Research Ethics Approval Reference Number: 13 (2–6) SE/GL-I/2024 dated: 17-09-2025.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Sreekanta Das wrote the main manuscript text, and Biswajit Chakraborty reviewed and edited the manuscript. All authors had approved the final version of the manuscript.

Funding

Not applicable

Data Availability

To protect the identity of the participants, the data cannot be shared openly. However, the data is available from the authors upon reasonable request.

Consent For Participation

Participants signed informed consent forms first, before participating in the study. All methods were carried out in accordance with the approved ethical guidelines and regulations.

Declaration Of Generative Ai

No generative Artificial Intelligence (AI) technologies were used for writing the entire text.

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