

## AI IN LANGUAGE TEACHING: OPPORTUNITIES AND CHALLENGES FOR PUBLIC AND PRIVATE SCHOOLS IN PAKISTAN

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### **Abstract**

*Quick development in artificial intelligence (AI) has introduced possibilities to enhance English language teaching by personalized learning, automated feedback, and adaptive instructional support. Nonetheless, AI has been less integrated in secondary education, and those implemented are not equally effective, particularly in schools in developing countries, both public and private. This paper investigates the perceptions, practices, and challenges of AI usage in teaching English in secondary level in Pakistan with the aid of the AI-TPACK framework. The data collection was conducted using a structured questionnaire, administrative feedback, and classroom observations in one public and one private secondary school in the exploratory case study format. The results were interpreted with the help of descriptive statistics and a thematic analysis. The results state that although teachers have good pedagogical and content knowledge and, on the whole, positive attitudes toward AI, their levels of formal training and technological knowledge are moderate. The integration of AI is more likely to reinforce teaching than to revolutionize it, and the level of classroom implementation is higher in the case of private schools because of a better infrastructure and institutional backing. On the other hand, the public schools encounter significant challenges in terms of infrastructure, the absence of policies, and professional development that is not consistent. This paper finds that institutional preparedness and structural factors play a larger role in the adoption of AI than teacher attitudes alone, and recommends the need to coordinate policies, training, and infrastructure investment.*

**Keywords:** *Artificial Intelligence; English Language Teaching; AI-TPACK; Secondary Education; Public and Private Schools; Pakistan*

### **1. Introduction**

#### **1.1 Background of the Study**

AI has begun to affect teaching activities, especially in language learning, by providing personalized learning tools, automatic feedback, assessment, and support. The recent developments in the generative AI field have made the possibilities for English language teachers to improve the classroom experience and effectiveness more significant (Jegade, 2024). The education system globally is examining AI-based solutions to support the diverse needs and optimize the instructional outcomes of the learner (Yenuri, 2024). Nevertheless, the degree to which these tools are purposefully applied in the classroom varies widely across settings, particularly between private and public educational institutions.

Integration of AI in secondary education in developing countries, such as Pakistan, is not uniform because of the inequality in infrastructure, training, and institutional support. Whereas most private schools have easier access to digital tools, in most cases, the public school has restrictions to technology and administration (Kovalenko & Baranivska, 2024). This is why it is important to

know how teachers view and enact AI in these opposite settings in order to make effective educational planning and policy.

### 1.2 Problem Statement

Even though AI tools are increasingly available in the teaching of English language, they are not used successfully in the classroom. Numerous educators have good pedagogical and content knowledge but do not have official training, institutional support, and infrastructural resources to implement AI into teaching meaningfully. Moreover, the disparity between the systems of educational institutions, both the public and the private, may also increase the digital divide, limiting the ability to get AI-advanced learning opportunities equally. The empirical evidence comparing AI integration practices in these sectors in the local educational setting is scarce.

### 1.3 Purpose of the Study

This study will examine the perceptions, practices, and challenges associated with the implementation of AI in the English language teaching setting at the secondary level based on the AI-TPACK framework. The study aims to determine contextual factors that affect AI adoption by studying both the public and the private school environment.

Teachers, school administrators, and policymakers find the findings to be important as they offer empirical data concerning the existing readiness, gaps, and professional development requirements in institutions. The research is also a part of the developing literature on AI in education because it provides a perspective on AI in secondary schools in a comparative, context-specific view.

### 1.4 Research Questions

The study is guided by the following research questions:

1. What are teachers' perceptions of AI tools in secondary-level English language teaching?
2. How do teachers integrate AI within the AI-TPACK framework in classroom practice?
3. What institutional and infrastructural factors influence AI integration in public and private schools?
4. What challenges and opportunities do teachers and administrators perceive in implementing AI-supported instruction?

## 2. Literature Review

### 2.1 Artificial Intelligence in English Language Teaching

The recent advancements in artificial intelligence (AI), especially in machine learning and natural language processing, have greatly impacted English language teaching (ELT). It has been demonstrated that AI-based solutions, including automated writing feedback systems, AI-based speech recognition, chatbots, or adaptive learning tools, could help develop language skills, learner autonomy, and personalized learning (Crompton & Burke, 2023; Huong, 2024). The possibilities have also been extended through generative AI, which allows real-time content creation, conversational practice, and formative feedback, rendering AI more useful in classroom pedagogy (Vázquez-Madriral et al., 2024).

In spite of these improvements, the studies have continuously reported that AI in ELT has been applied as an auxiliary tool to supplement instead of as a pedagogically integrated resource. Efficiency-focused activities, including grading, feedback, and preparing materials, are the types of activities that teachers are likely to use AI (instead of transformative instructor activities) (Ojo, 2024).

### 2.2 Teachers' Readiness and AI-TPACK Integration

The Technological Pedagogical Content Knowledge (TPACK) framework is a commonly accepted view on studying the implementation of technology in the teaching process. In the context of AI-

enhanced education, educators need not only to have technological expertise on the usage of AI tools but on how to integrate those tools with teaching strategies and course material (Jiménez Sierra et al., 2023). According to the latest research, teachers tend to show a highly developed level of pedagogical and content knowledge, but the level of their technological confidence and training on AI remains insufficient (Bautista et al., 2024).

The consequence of this imbalance is the partial integration of AI-TPACK, whereby the teachers have positive attitudes towards AI, yet are unable to apply AI in any meaningful way in the classroom situations. It is believed that professional development is the key to eliminating this gap to help teachers shift toward the use of AI that is not only exploratory but also based on pedagogy (Aghaziarati et al., 2023; Li et al., 2025).

### **2.3 Institutional Infrastructure and the Digital Divide**

Infrastructure and institutional readiness are important predictors of the use of AI in schools. The quality of internet connection, access to digital tools, administrative guidance, and official AI guidelines have a significant impact on the ability of teachers to implement AI in the classroom (Bo, 2025; Kaya-Kasikci et al., 2023). According to studies, a digital gap between institutions that have sufficient resources and those that lack them is always evident, and it inhibits access to AI-advanced learning opportunities on an equal footing.

According to comparative research, it is also possible that private schools are more responsive to adopting AI technologies as they are better-funded and their structures are more flexible in contrast to public schools that tend to be impacted by structural and bureaucratic constraints (Chocarro et al., 2023; Kaya-Kasikci et al., 2023). Such inequalities not only influence the access to AI tools but also the chances of experimentation and professional learning of teachers.

### **2.4 Ethical and Pedagogical Challenges of AI Use**

Alongside its pedagogical value, AI integration triggers ethical and pedagogical issues. The problem of data privacy, academic dishonesty, bias of algorithms, and excessive trust in automated systems are brought up in the recent literature (Filgueiras, 2024; Ismail et al., 2023). Learning-wise, researchers are warning that AI can negatively affect the interpersonal interaction, creativity, and critical thinking of humans unless it is balanced with the proper lesson design (Yu & Guo, 2023).

Thus, the responsible use of AI is a matter of institutional policies and the knowledge of teachers, so that it does not take over the important teaching and learning activities but facilitates them.

### **2.5 Synthesis and Research Gap**

The literature reviewed indicates that AI has significant potential in improving ELT, but its usage in the classroom is limited by the lack of teacher training, unequal infrastructures, and institutional support. The majority of the studies conducted are on higher education or single-sector settings, and not many comparative studies are done at the secondary school level, especially in developing nations. Besides, not many studies combine the perceptions of teachers, institutional preparedness, and classroom practice into a single AI-TPACK magnitude.

Sealing these gaps, the current study provides a comparative study on AI implementation in both public and private secondary schools, which provides the context-specific information on how structural and pedagogical elements determine AI implementation in English language teaching.

## **3. METHODOLOGY**

### **3.1 Research Design**

The current study employed an exploratory case study design to investigate the application of artificial intelligence in teaching the English language in secondary schools. To conduct a detailed

investigation of the AI implementation in the real educational environment, the case study approach was selected to compare a state and a privatized school environment. Although the case study method is traditionally qualitative, the use of structured questionnaires and further descriptive statistical analysis can be justified by the exploratory goals of the investigation, which enable the identification of general trends in how teachers perceive the issue and their instructional approaches.

### **3.2 Sample and Population**

The data were collected in two secondary schools in Sahiwal, Pakistan. The Divisional Public School (DPS) Sahiwal, which is a representative of the public sector, and the Beaconhouse School System, Sahiwal Campus, which is a representative of the private sector. The sample was a combination of English language teachers and administrative staff of both schools. There was no possibility of demographic data collection because there was no external force making the participation voluntary and thus preserving the anonymity of the participants.

### **3.3 Data Collection Instrument**

A structured questionnaire was used to collect the data according to the AI-TPACK framework. The tool was made of close-ended statements, the scale of which was based on a five-point Likert scale (Strongly Disagree to Strongly Agree). The questionnaire addressed the most important areas, such as Technological Knowledge (TK), Pedagogical Knowledge (PK), Content Knowledge (CK), AI-TPACK integration, instructional opportunities, and implementation issues. Another section was that of administrative responses, which were on institutional preparedness, provision of training, and infrastructure.

### **3.4 Data Collection Procedure**

The questionnaire was sent through an electronic survey portal and made available to the participants through the formal channels of communication. Before the data collection process began, the objectives of the investigation were informed to the participants, and they gave informed consent. Anonymity was also guaranteed in both directions, and the respondents were allowed to withdraw at any given time. The amount of time taken to complete data collection was achieved within a limited timeframe, and responses were obtained to be analyzed.

### **3.5 Data Analysis**

The data collected were transferred to SPSS and Microsoft Excel to be subjected to analysis. Response entries were checked for completeness, and cases with systemically missing values were not included in the analytic dataset. Statistical tools such as frequency counts and percentages were used to summarize the responses given by the administrators and teachers. Lastly, the results were discussed according to the given research purposes and in the framework of the concept of AI-TPACK.

## **4. RESULTS AND FINDINGS**

### **4.1 Faculty Data Analysis**

#### **4.1.1 Demographic Profile of Faculty**

Table 4.1. Table 4.1 presents the demographics of the respondents among the faculty. The sample consisted of teachers who were in both public and private secondary schools, and most of them indicated moderate and extensive experience in pedagogy. The variability in terms of the size of the classes was remarkable, with educators in the public sector recording more instances of higher cohorts compared to their counterparts in the private sector.

Table 4.1 Frequency Distribution of Demographic Variables

<b>School Sector</b>				
<b>Valid</b>	<b>Frequency</b>	<b>Percent</b>	<b>Valid Percent</b>	<b>Cumulative Percent</b>
Public	4	26.7	26.7	26.7
Private	11	73.3	73.3	100.0
Total	15	100.0	100.0	
<b>Teaching Experience</b>				
0-5 years	6	40.0	40.0	40.0
6-10 years	2	13.3	13.3	53.3
11+ years	7	46.7	46.7	100.0
Total	15	100.0	100.0	
<b>Subject Taught</b>				
English	11	73.3	73.3	73.3
Urdu	4	26.7	26.7	100.0
Total	15	100.0	100.0	
<b>Average Class Size</b>				
Below 30	11	73.3	73.3	73.3
31-50	4	26.7	26.7	100.0
Total	15	100.0	100.0	

Instructors recruited in the private sector in the present sample amounted to 73.3 percent of the sample, and almost half of them had over eleven years of pedagogical experience. Most (73.3) of the respondents were English teachers, and they kept their classes of less than thirty students. By contrast, faculty members in the public sector were more likely to provide higher numbers of cohorts, hence highlighting differences in contexts that were related to sectors.

#### 4.1.2 Technological Knowledge (TK) of Faculty

The overall level of technological knowledge of faculty members is moderate, as it is indicated by descriptive statistics. Although teachers claim to be well acquainted with generative AI technology and use AI applications in their personal lives, the average scores of formal training on AI and confidence in troubleshooting seem to be lower than expected.

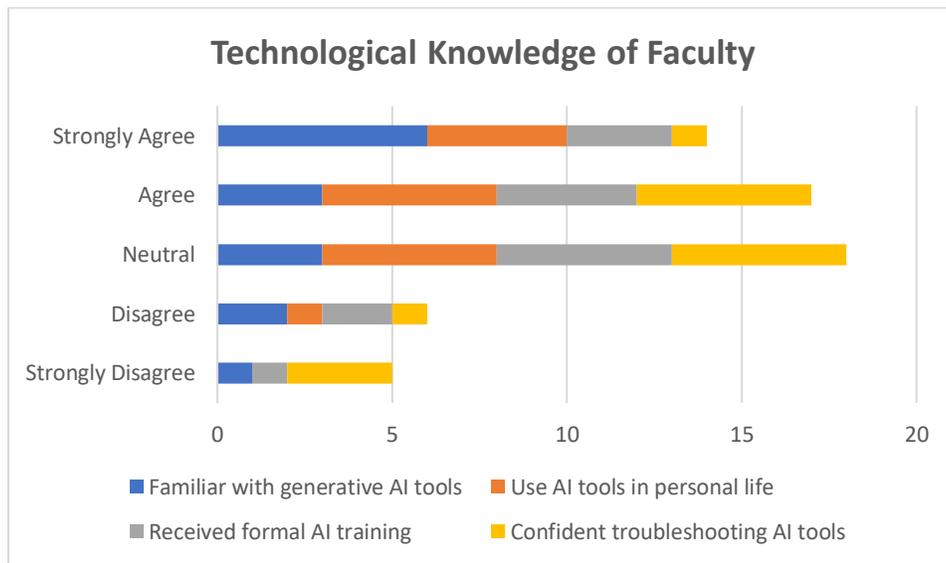


Figure 4.1 Technological Knowledge (TK) of Faculty

The faculty had moderate technological knowledge. Mean scores were higher with familiarity with generative AI tools ( $M = 3.73$ ) and personal AI use ( $M = 3.80$ ), whereas lower scores were recorded with formal AI training ( $M = 3.40$ ) and troubleshooting confidence ( $M = 3.00$ ), which showed mostly informal usage of AI.

#### 4.1.3 Pedagogical & Content Knowledge (PK & CK)

The faculty responses were of high pedagogical and content knowledge in both sectors. The mean of the scores on the curriculum knowledge, flexibility in teaching, and design of lessons inspired by the metrics of the skills is significantly high, which means that teachers have the necessary pedagogical background to be successful in teaching language. However, the given advantage does not always result in a consistent AI-inspired educational paradigm.

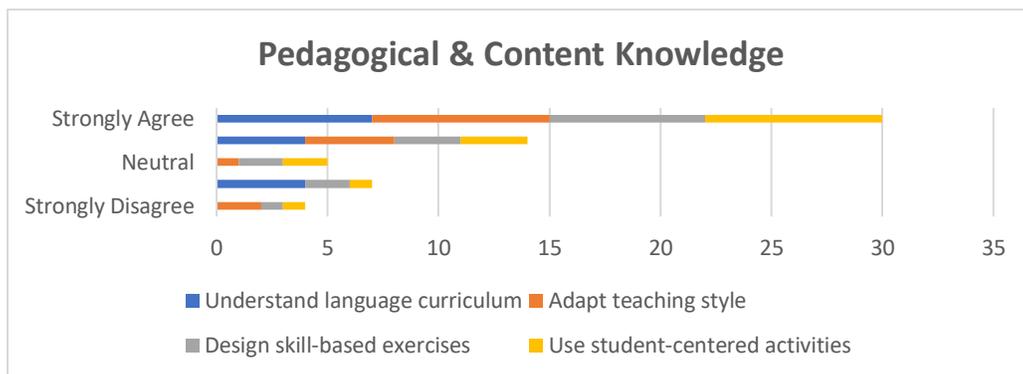


Figure 4.2 Pedagogical & Content Knowledge (PK & CK) of Faculty

The large mean scores in all PK and CK indicators ( $M = 3.87-4.07$ ) show the strong understanding of curriculum, flexibility, and implementations of student-centered activities among faculty, which point to the strong pedagogical grounds in the private and public spheres.

#### 4.1.4 AI-TPACK Integration

The products connected with AI-TPACK integration were responses mixed. The faculty in the private sector noted that they were more engaged in AI use in order to create personalized instructional materials, curriculum-aligned assessments, and prompt feedback. Conversely, educators in the state sector showed very little integration of AI in the classroom, likely due to contextual factors, not related to pedagogical innovation.

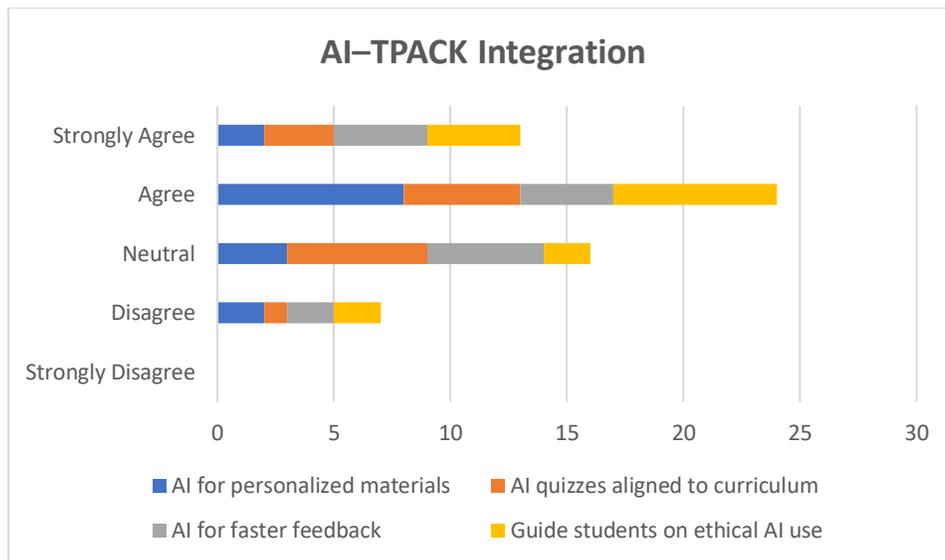


Figure 4.3 TPACK Integration

The integration of AI-TPACK was moderate ( $M = 3.66 -3.87$ ). Faculty also said they used AI to create custom materials, tests, and feedback, although more seemed to focus on how to use AI ethically. The level of integration was also more pronounced in the classrooms of the private sector as compared to the public sector.

#### 4.1.5 Opportunities and Challenges in AI Use

The fact that AI can help decrease workload and increase speaking and translation support among students was acknowledged by the faculty. However, it was found that there were continuing challenges such as the inability to connect web-based resources, not having access to digital tools, and inadequate administrative assistance, especially by teachers in the public sector. All these issues severely limit the opportunities to integrate AI in the process of daily teaching.

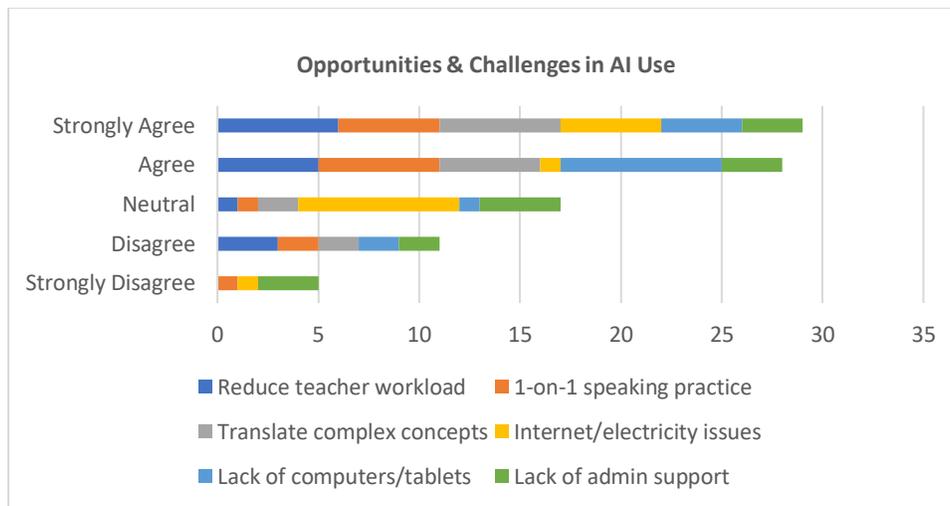


Figure 4.4 Opportunities and Challenges in AI Use

AI was recognized to potentially decrease workload and aid in learning ( $M = 3.80-4.00$ ). Nevertheless, the main obstacles were the lack of access to digital devices, the problem of the internet and electricity, and the lack of administrative assistance, especially in schools in the public sector.

#### 4.1.6 Thematic Analysis

##### Theme 1: Infrastructural Constraints

The most common barrier, reported by most, was incompetent technological infrastructure, such as poor internet connectivity, absence of IT laboratories, lack of IT devices, and the lack of classroom details like projectors. These restrictions restricted the applications of AI to lesson planning and not classroom applications, especially in state-run schools. These results have been echoed in more recent articles that have identified infrastructure as one of the key factors of AI integration in the setup of developing educational settings.

##### Theme 2: Inconsistent Administrative Support

Although some faculty expressed that they received administrative support, i.e., the appreciation of AI use and training workshops every now and then, it seemed to be inconsistent and conditional. Limited access to the internet, insufficient access to devices, and a lack of long-term institutional planning were indirect discouraging factors to AI implementation. Such a policy-practical imbalance is consistent with the recent research on uneven digital governance in schools.

##### Theme 3: Professional Capacity and Training Gaps

The responses of the faculty showed that there was a shortage of formal training and institutional knowledge about AI, leading to the use being mostly self-directed. Lack of proper pedagogical integration was also a weakness of the technological- pedagogical intersection of TPACK due to conventional attitudes and a lack of professionalism.

##### Theme 4: Ethical and Cognitive Concerns

Educators showed concern that the overuse of AI can decrease the ability of students to think independently and promote the abuse of external applications. These moral concerns are reminiscent of recent studies that place an emphasis on the necessity of managed and responsible AI applications in secondary school.

## 4.2 Administrative Data Analysis

### 4.2.1 Institutional Infrastructure and Readiness

The descriptive analysis of administrative reactions demonstrates that there is a medium institutional preparedness towards the integration of AI. The evidence of mean scores of digital infrastructure quality and teacher preparedness indicates partial preparedness, but these results indicate unequal access to reliable internet, digital devices, and technical support. Some institutions claimed they had sufficient facilities, whereas others acknowledged that their infrastructures are quite limited and they are not able to implement AI at the classroom level.

*Table 4.2 Frequency Distribution of Institutional Infrastructure and Readiness*

<b>Formal AI policy</b>					
		Frequency	Percent	Valid %	Cumulative %
Valid	Yes	2	33.3	40.0	40.0
	In Development	3	50.0	60.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		
<b>Training/workshops provided</b>					
		Frequency	Percent	Valid %	Cumulative %
Valid	Yes	3	50.0	60.0	60.0
	Occasional	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

Administrative responses indicated **moderate institutional readiness** for AI integration. Digital infrastructure and teacher preparedness were reported as mostly moderate, with variability across institutions.

### 4.2.2 Policy Framework and Training Provision

Frequency analysis showed that the presence of a formal AI policy was limited, and several of the institutions reported that there was no policy, or that they were still developing their policy. On the same note, professional training to faculty was mentioned as a phenomenon that is not systematic but still occasional, indicating that the integration of AI is yet to be integrated into institutions of professional developmental frameworks.

*Table 4.3 Frequency Distribution of Policy Framework and Training Provision*

<b>Digital infrastructure quality</b>					
		Frequency	Percent	Valid %	Cumulative %
Valid	Poor	1	16.7	20.0	20.0
	Moderate	3	50.0	60.0	80.0
	Excellent / Fully Prepared	1	16.7	20.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		

Total		6	100.0		
<b>Teacher preparedness for AI</b>					
		Frequency	Percent	Valid %	Cumulative %
Valid	Moderate	3	50.0	60.0	60.0
	Good	2	33.3	40.0	100.0
	Total	5	83.3	100.0	
Missing	System	1	16.7		
Total		6	100.0		

Very few members indicated that possessing formal AI policies and training opportunities is reported to be irregular and not necessarily structured to indicate that AI integration remains in its early phases of development.

#### 4.2.3 Thematic Analysis

A thematic analysis with an inductive nature of administrative responses demonstrated that four prevailing themes influence the institutional views towards the adoption of AI in secondary education.

##### Theme 1: Strategic Optimism Toward AI Integration

The administrators of both industries demonstrated a rather optimistic attitude towards AI, considering it to be a more sophisticated and required approach to teaching that is consistent with the modern educational requirements. The idea of AI was often referred to as the method of modernizing instruction, enhancing the effectiveness of the teaching process, and facilitating adaptive and paperless learning conditions. This optimistic approach in strategy is indicative of tendencies across the globe in the positioning of AI as the driver of pedagogical change.

##### Theme 2: Sector-Based Structural Advantages

The administrators in the private sector pointed to such benefits as the ability to make decisions flexibly, the ability to use paid AI platforms, motivated employees, and specialists, whereas respondents in the government sector spoke about government-assisted programs and slow digital transformations. These reactions suggest that the institutional ability to adopt AI is highly related to the governance frameworks and resource autonomy, and support the finding of sectoral differences in educational technology uptake.

##### Theme 3: Financial and Infrastructural Constraints

Although there were good feelings, administrators cited financial constraints, delayed funding, lack of hardware, and unequal digital infrastructure as inexorable obstacles. Even those institutions that have shown moderate to strong infrastructure were seen to depend on the personal devices of the teachers or the limited setups. These observations are consistent with the recent studies that found funding and infrastructure were the main barriers to sustainable AI implementation in the developing educational systems.

##### Theme 4: Ethical Awareness and Governance Concerns

Administrators showed ethical awareness regarding AI, especially student data privacy, student identity protection, and the potential to increase disparities between schools. Some of the respondents focused on the importance of clarity of ethical rules and the regulation of institutions. It indicates the increasing global anxiety that ethical governance should be added to AI implementation in education to guarantee equality and proper.

### 4.3 Self-Observation

#### 4.3.1 Observation Design

The non-participant structured observation was recorded using self-observation during two secondary schools, namely Divisional Public School Sahiwal, as Public, and Beaconhouse Sahiwal, as Private. To study the scope, regularity, and pedagogical purpose of AI and digital technologies in the classroom, 4-6 classrooms with language were observed throughout the teaching process.

#### 4.3.2 Observational Indicators and Findings

Observation Indicator	DPS (Public)	Private (Private)
Functional IT lab	Operational	Fully operational
Classroom internet access	Rare/Inconsistent	Consistently available
Use of digital devices during lessons	Occasional/Absent	Regular
AI-supported teaching activities	Not observed	Observed in most sessions
Teacher confidence using technology	Limited	High
Student interaction with AI tools	Not observed	Frequently observed

#### 4.3.3 Classroom-Level Observations

Most of the classrooms observed in the private sector included AI-integrated teaching, whereby teachers used digital tools and projectors, and AI-assisted tools to deliver lessons, provide feedback, and engage with students. Teachers were very confident in technology, and students were very much engaged with digital resources when they were performing language learning tasks. These practices indicate an institutionalized AI-TPACK integration with facilitated training and infrastructure.

Conversely, there was little or no in-class AI use in DPS classrooms as observed. The instruction was mostly based on the old system, with little or no exposure to practical IT labs, projectors, and uninterrupted internet connectivity. Even though pedagogical competence was established by the teachers, the lack of infrastructure, coupled with little training on technical aspects, curtailed AI implementation at a classroom level. Where AI was mentioned, it was only used in preparing lessons outside of the classroom, which showed latent TPACK and not active integration.

## 5. Discussion

This study has explored applying AI in language teaching at the secondary level through the AI-TPACK model. The results suggest that teachers and administrators tend to have positive attitudes towards AI, but its successful application in the classroom is situationally limited and remains limited.

Teachers were moderately technologically aware and also used AI tools personally, although they claimed very little formal training and self-confidence in technical troubleshooting. It supports previous studies that indicate that the level of knowledge of AI in teachers does not always reflect pedagogically significant application without a systematic professional development (Zawacki-Richter et al., 2020; Bautista et al., 2024). Conversely, high levels of pedagogical and content knowledge imply the absence of instructional competence barriers; technological and institutional assistance is the missing element, which aligns with the TPACK-based research (Mamun et al., 2023).

Mediocre AI-TPACK integration indicates an intermediate stage in the process of AI adoption where AI is mainly utilized in supportive roles (e.g., personalization, assessment, and feedback). The same trends have been observed in the recent research, which has recorded that the adoption of AI in schools remains an additive instead of a transformative process (Holmes et al., 2022; Springer et al., 2024). The understanding of AI to ease the workload and improve the learning process by teachers is in line with the emergent information on AI-based instructional efficiency (Sanchez-Rodriguez et al., 2025).

Infrastructural and institutional elements became conclusive. Lack of access to the devices, poor internet connection, and lack of formal AI policies restricted the implementation in the classroom, especially in schools in the public sector. Moderate preparedness and non-systematic training are also identified in the administrative findings, which further supports the research that emphasizes the role of organizational planning and governance in integrating AI sustainably (Selwyn, 2022; OECD, 2021).

On the whole, the analysis proves the idea that the structural and contextual conditions are more likely to influence AI integration than the attitude of teachers or their pedagogical potential. It is crucial to tackle policy, training, and infrastructure gaps to shift AI from experimental to a pedagogically grounded practice of AI in secondary education.

## 6. Conclusion and Recommendations

### 6.1 Conclusion

This paper has discussed the implementation of artificial intelligence in language teaching at the secondary school level using AI-TPACK based on the perceptions of the faculty, administration reactions, and classroom observations. According to the findings, the teachers are characterized by strong levels of pedagogical and content knowledge as well as a generally positive attitude toward AI, whereas the actual implementation in the classroom is moderate and uneven. The application of AI by teachers is mostly self-directed and limited by insufficient formal training, ad hoc institutional support, and infrastructure. Sectoral differences also make it clear that the presence of good AI integration is less affected by the will or pedagogical ability of teachers, but rather by the contextual and institutional conditions.

In general, the research finds that AI in secondary education is still in the stage of a supportive and auxiliary tool and not an integrated pedagogical resource. The possibility of AI impacting language teaching and changing it cannot be achieved without the use of coordinated policy frameworks, systematic professional development, and fair access to digital infrastructure.

### 6.2 Recommendations

Based on the findings, the following recommendations are proposed:

1. **Development of the Institutional Policies.**

Institutions of learning must also develop clear policies on artificial intelligence that concern its instructional application, ethics, and data privacy, hence offering direction to classroom activities by teachers.

2. **Organized Professional Growth.**

It should be implemented regularly and experience-based to improve the technological knowledge and AI-TPACK competencies of teachers and leave the informal self-learning methods.

**3. Infrastructure Enhancement**

High-quality internet connectivity and enough digital devices are the key requirements in the sustainable implementation of artificial intelligence, especially in schools in the public sector.

**4. AI Incorporation in Pedagogical Alignment.**

Artificial intelligence tools must be aligned with curriculum goals and pedagogical plans so that they can be used to facilitate significant learning outcomes, but not standalone technological implementations.

**5. Future Research Directions**

Future research can use a longitudinal or experimental research design to examine the effectiveness of AI-assisted learning on student learning outcomes in different learning situations.

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