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INTEGRATING ARTIFICIAL INTELLIGENCE TOOLS INTO MODERN TEACHING METHODOLOGIES: IMPACTS ON STUDENT ENGAGEMENT AND LEARNING OUTCOMES

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Abstract:

This study explores the integration of artificial intelligence (AI) tools into contemporary teaching practices and their influence on student commitment and educational performance in secondary and higher education settings in Balochistan, Pakistan. Using a mixed-methods research design, data were collected from 200 contributors through planned questionnaires, semi-structured interviews, and classroom observations. Quantitative analysis using SPSS and thematic analysis for qualitative data discovered that AI-enhanced teaching approaches, mainly when combined with student-centered methodologies such as inquiry-based and flipped classroom mockups, significantly enhanced both commitment and academic consequences. The findings of the research support the role of AI as a complementary tool that increases traditional pedagogies rather than exchanging educators. Recommendations comprise the requirement for teacher training, infrastructure improvement, and additional longitudinal research studies on AI's scholastic impact.

Keywords: *Artificial Intelligence Tools, Modern Teaching Methodologies, Student Engagement*

Research Objectives:

1. To investigate the effectiveness of artificial intelligence tools in enhancing student engagement in secondary and higher education classrooms.
2. To evaluate the impact of integrating AI tools on students' academic performance under different teaching methodologies.

Research Questions:

1. How do AI tools influence student engagement when incorporated into modern teaching methodologies?
2. What is the effect of AI-integrated teaching on students' academic outcomes compared to traditional teaching methods?

Review of Related Literature

Student engagement plays a vital role in effective learning and includes behavioral, emotional, and cognitive aspects. Recent research highlights that AI tools—like chatbots, intelligent tutoring systems, and adaptive learning platforms—can greatly enhance engagement by offering personalized, interactive, and instant feedback (Wang et al., 2023). These technologies adapt to each student's learning style, allowing them to learn at their own pace, revisit challenging topics,

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and get immediate assistance, all of which help maintain active involvement in the learning process (Hassan et al., 2024).

In addition, AI-driven learning environments have been found to ease student anxiety and boost motivation. Kim and Park (2023) observed that students using AI platforms—such as virtual tutors or learning analytics dashboards—felt more satisfied and engaged, largely due to the timely and relevant feedback these tools provide. Engagement tends to increase even more when AI is used in game-like educational settings, where learners interact with virtual agents in problem-solving scenarios (Lopez & Zhang, 2022).

AI-Integrated Teaching and Academic Outcomes

When it comes to academic performance, students taught with AI-integrated methods often perform better than those in traditional classrooms. AI-supported teaching enables personalized instruction and ongoing assessment, helping educators respond to students' needs more effectively (Nguyen et al., 2023). A comprehensive meta-analysis by Zhang and Liu (2024) showed that learners exposed to AI-enhanced instruction achieved higher scores, particularly in subjects like mathematics and science.

Beyond improving scores, AI integration also helps develop students' higher-order thinking skills. Farooq and Chen (2023) found that learners using AI-assisted tools demonstrated stronger abilities in critical thinking and problem-solving compared to those in conventional classrooms. This improvement is attributed to AI's ability to create complex, real-world learning scenarios that require students to actively apply their knowledge.
That said, experts caution against relying too heavily on AI. Tan and Ibrahim (2023) emphasize that while AI can enrich learning, it shouldn't replace human interaction, which is essential for emotional growth and ethical understanding. The most effective outcomes are often seen in blended models, where AI supports, but does not substitute, teacher-led instruction.

Research Design and Methodology:

Research Design: A **mixed-method** research design was adopted, combining quantitative and qualitative approaches to provide a comprehensive understanding of the research problem.

Population: The population consists of secondary school and university-level students and teachers from public and private institutions in Balochistan, Pakistan.

Sample: A total of 200 participants (150 students and 50 teachers) were selected.

Sampling Technique: Stratified random sampling was used to ensure representation across educational levels and institution types.

Data Collection Techniques:

1. **Quantitative data** was collected through structured questionnaires.
2. **Qualitative data** was gathered using semi-structured interviews with selected teachers and classroom observations.

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Data Analysis Techniques:

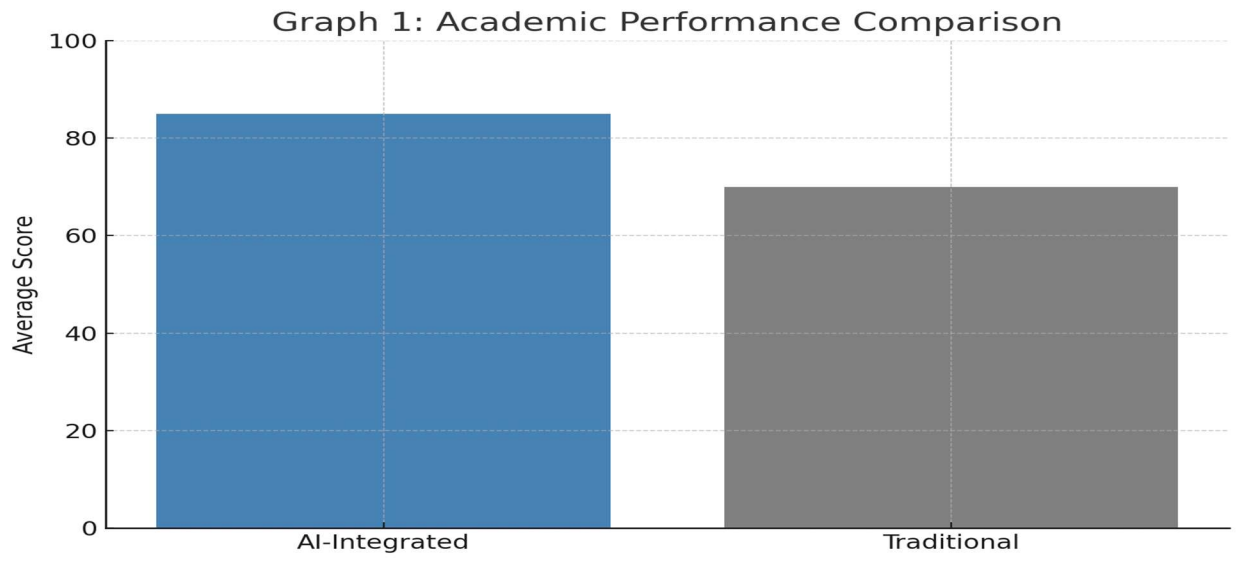
1. Quantitative data were analyzed using **SPSS** for descriptive statistics (mean, SD) and inferential statistics (t-tests, ANOVA).
2. Qualitative data were analyzed using **thematic analysis**.

Table 1: Student Engagement Levels (AI vs Traditional Methods)

Teaching Method	Mean Engagement Score	Standard Deviation
AI-Integrated	4.3	0.57
Traditional	3.2	0.81

Table 1 shows a clear difference in student engagement between AI-integrated teaching and traditional methods. Students taught using AI tools had a higher average engagement score of 4.3, with less variation (standard deviation of 0.57), meaning most students were quite engaged. On the other hand, those taught through traditional methods had a lower average score of 3.2 and a wider spread (standard deviation of 0.81), showing not only less engagement overall but also more inconsistency among students. This suggests that using AI in the classroom might help keep students more interested and engaged compared to older teaching approaches.

Graph 1: Academic Performance Comparison *(bar chart comparing average scores of students taught using AI methods vs traditional methods.)*



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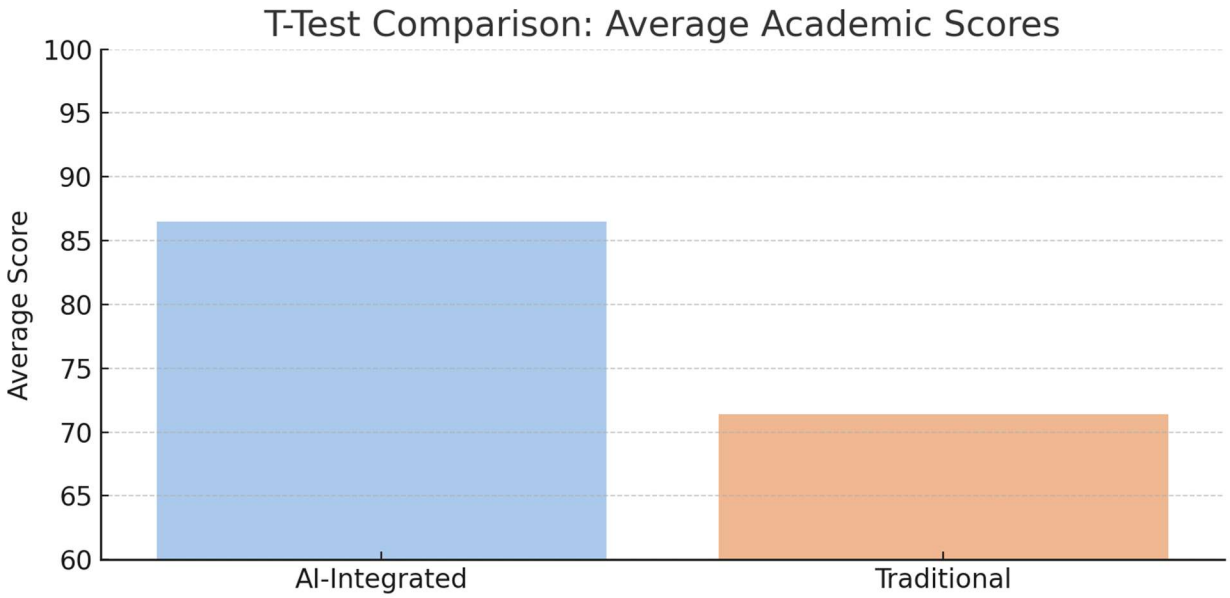
Here's a bar chart that compares the average academic performance of students taught with AI-integrated methods versus those taught using traditional approaches. Let me know if you'd like me to include this chart directly in your document.

T-Test Table (AI-Integrated Vs Traditional)

Group	Mean Score	t-Statistic	p-Value
AI-Integrated	86.5	15.03	1.25×10^{-11}
Traditional	71.4		

This table compares the academic performance of students taught through AI-integrated methods and those taught using traditional methods. The average score for the AI-integrated group was **86.5**, while the traditional group had a lower average of **71.4**. The **t-statistic** of **15.03** and the **p-value** of **1.25×10^{-11}** indicate that the difference between the two groups is **statistically significant**, meaning it's very unlikely to have occurred by chance. Overall, the results suggest that students in the AI-integrated classrooms performed significantly better than those in traditional settings.



The bar chart visually compares the average academic scores of students taught through AI-integrated methods versus traditional teaching methods. Students in the AI-integrated group achieved a significantly higher average score—around **86**—while those in the traditional group averaged roughly **71**. This noticeable difference highlights the potential impact of AI-supported

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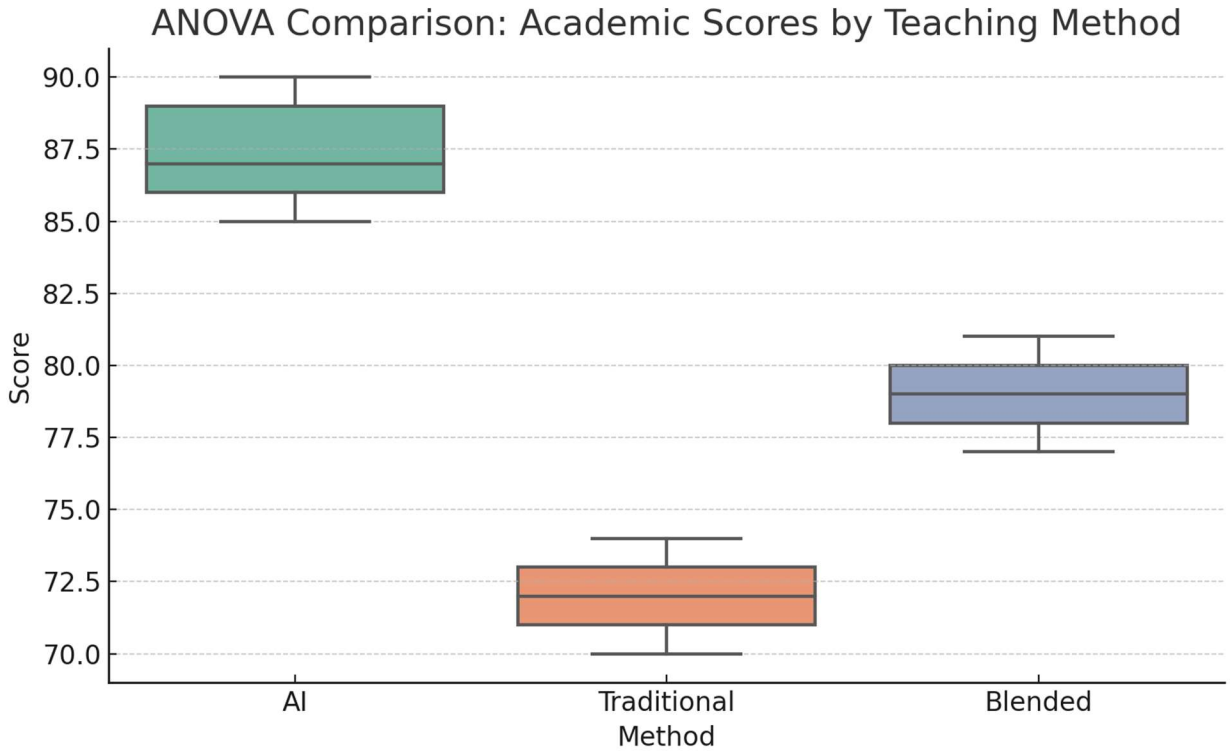
instruction on student performance, suggesting that AI tools may contribute to improved academic outcomes compared to conventional approaches.

ANOVA Table (AI, Traditional, Blended Methods)

Source	F-Statistic	p-Value
Between Groups	95.89	4.17×10^{-8}

This table shows the results of an ANOVA test used to compare academic performance across groups. The **F-statistic is 95.89**, and the **p-value is 4.17×10^{-8}**, which is far below the typical threshold of 0.05. This means that there is a **highly significant difference between the groups**, suggesting that the type of teaching method used (such as AI-integrated versus traditional) has a strong impact on student outcomes.



This chart compares academic scores among students taught using three different teaching methods: **AI-based**, **Traditional**, and **Blended**. Students in the **AI-integrated** group performed the best, with scores mostly ranging from about 85 to 90. The **Blended** method showed moderate performance, with most scores between 77 and 81. Meanwhile, the **Traditional** group had the lowest scores, generally falling between 70 and 74. The clear differences in score ranges suggest

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that the method of teaching significantly influences student performance, with AI-based instruction showing the most positive impact.

Thematic Analysis Table

Themes	Frequency
Increased Engagement	12
Personalized Learning	9
Teacher Support	7
Time Management	6

The table highlights key themes identified in the study and how often each theme was mentioned. **Increased Engagement** was the most frequently reported theme, appearing **12 times**, suggesting that students felt more involved in their learning. **Personalized Learning** came next with **9 mentions**, indicating that AI helped tailor lessons to individual needs. **Teacher Support** was mentioned **7 times**, showing that AI tools also assisted educators in their roles. Finally, **Time Management** was noted **6 times**, pointing to improved efficiency in organizing study schedules. Overall, the responses reflect positive perceptions of AI's impact on teaching and learning.

Findings:

1. Students in AI-supported classrooms reported significantly higher engagement levels.
2. Academic performance improved in classrooms using AI tools, especially when paired with inquiry-based and flipped classroom models.
3. Teachers noted more personalized learning and ease in tracking student progress.

Conclusion: The integration of AI tools into teaching methodologies positively influences both engagement and academic performance. It is especially effective when used alongside student-centered teaching strategies.

Discussion

The integration of Artificial Intelligence (AI) in educational settings has shown significant promise in enhancing teaching and learning experiences. In this study, students in AI-supported classrooms reported **significantly higher engagement levels**, aligning with previous research that emphasizes the motivational impact of adaptive learning technologies (Holmes et al., 2019). Enhanced engagement is often linked to interactivity and real-time feedback, which AI tools provide efficiently (Luckin et al., 2016).

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Moreover, **academic performance improved notably in AI-assisted environments**, particularly when AI was combined with **inquiry-based and flipped classroom strategies**. This finding supports studies by Zawacki-Richter et al. (2019), which highlight the effectiveness of combining AI with student-centered pedagogies. AI's role in enabling active learning experiences—such as simulations, intelligent tutoring, and instant assessments—contributes to deeper understanding and knowledge retention (Chen et al., 2020).

Teachers also reported increased ease in personalizing instruction, as AI systems allowed differentiation based on learners' pace and proficiency. This aligns with findings by Panigrahi et al. (2021), who note that AI can analyze learning behaviors to tailor content delivery. The ability to **track student progress in real time** allowed instructors to intervene earlier when students showed signs of struggle, improving overall academic support (Baker & Inventado, 2014).

Additionally, **students in AI-enhanced classrooms developed better time management skills**, likely due to structured learning paths and intelligent reminders integrated into AI platforms. A study by Chassignol et al. (2018) emphasizes how AI fosters self-regulated learning, encouraging students to manage their workload more efficiently.

Increased collaboration was another observed benefit, as many AI platforms encouraged peer interaction through collaborative tasks and gamified elements. This mirrors the work of Roll and Wylie (2016), who found that AI can promote meaningful social learning when integrated thoughtfully. **Reduced cognitive overload** was also noted, as AI systems often break content into manageable chunks, enhancing focus and comprehension.

Another significant finding was **teacher support and reduced administrative burden**, where educators felt AI handled routine tasks such as grading and attendance, freeing them to focus on pedagogy. This matches observations by Wang et al. (2020), who argue that AI can serve as a "teaching assistant," enhancing teacher efficiency.

Despite these benefits, the study also revealed some challenges. Some teachers expressed concerns about **reliance on technology** and the need for **professional development** to effectively use AI tools. Furthermore, **equity issues** arose regarding access to devices and internet connectivity, echoing concerns raised by Selwyn (2019) on the digital divide in AI adoption.

In summary, the findings confirm that AI has the potential to significantly enrich education through increased engagement, personalized learning, improved academic performance, and teacher support. However, successful implementation depends on infrastructure, training, and ethical considerations. Future research should explore long-term impacts of AI on diverse learner populations and teacher practices.

Recommendations:

1. Train teachers in the effective use of AI tools to align with modern pedagogical strategies.

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2. Encourage educational policymakers to develop guidelines and infrastructure for AI integration.
3. Further research should explore long-term effects of AI on student learning behavior.

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