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EVALUATING THE EFFECTIVENESS OF CHAT-GPT IN ENHANCING LEARNING OUTCOMES AND FACILITATING KNOWLEDGE ACQUISITION

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ABSTRACT

The integration of artificial intelligence, particularly Chat-GPT, into education necessitates empirical evidence of its pedagogical impact. This study aimed to evaluate the effectiveness of Chat-GPT in enhancing learning outcomes and facilitating knowledge retention, understanding, and student engagement. A quasi-experimental, pre-test/post-test design was employed with 60 undergraduate (BS ELT) students randomly assigned to control (traditional teaching methods) or experimental (Chat-GPT integrated pedagogy) groups. Data were collected via a validated pre-test/post-test and an engagement scale questionnaire adapted from the User Engagement Scale (UES). Data was analysed using SPSS (Version-22) to measure paired t-test, independent t-test and descriptive statistics. Results indicated a statistically significant and substantially greater improvement in knowledge retention and understanding for the experimental group compared to the control group. It is also concluded that Chat-GPT intervention led to significantly higher levels of cognitive, affective, and behavioural engagement, with a positive correlation found between engagement and learning outcomes. So it is stated that Chat-GPT is a more effective instructional tool than traditional methods, significantly boosting both knowledge acquisition and student engagement. Findings of the study imply that educators should consider strategic integration of Chat-GPT into curricula, while policymakers must develop frameworks for its ethical educational use. Future research should explore its application across diverse disciplines and employ longitudinal or mixed methods designs.

Keywords: *Chat-GPT; Learning Outcomes; Generative AI; Knowledge Acquisition*

INTRODUCTION

Technology integration into education has continually transformed pedagogical approaches and learning experiences. Advances in technology have significantly affected various aspects of life, including how the education system operates and prepares students for a gradually interlocked world. The adoption of technology is very important for high school students, as it not only enhances the learning experience but also equips them with the skills to succeed in the modern trade market, where technology plays a vital role (Czakoova & Stoffova, 2019). Within this landscape artificial intelligence (AI) has emerged as a particularly disruptive force, giving rise to tools like virtual mentors, personalized learning systems, and intelligence tutoring systems that aim to facilitate education (Shidiq, 2023).

A recent and significant development in AI is the advent of large language models (LLMs). The technology we are witnessing today has evolved from a mere puppet into a potentially disruptive innovation. Its success will depend on many factors, and banning or rejecting it will not hinder its influence. Therefore, it is important to understand this technology, based on large linguistic models, and to recognize its potential advantages, weaknesses, and limitations (Hidayat et al., 2024). Chabot's which use natural language processing (NLP) to interpret human language, represent a core application of artificial intelligence (AI) (Kyung-Mi, 2024). The release of open AI's Chat-GPT in November 2022 marked a watershed moment, bringing generative AI to the forefront of the public academic attention.

Chat-GPT, built on the Generative Pre-trained Transformer (GPT) architecture, is trained on vast datasets to generate human-like text in response to user prompts (Currie, 2023). This Chatbot allows users to chat with AI by typing prompts, and it is based on Open AI's language model. While Chat-GPT is great and produces interesting results for writing stories, poems, songs, essays, and other things, it still has some limitations (Hussain, 2024). Its potential applications in education are vast, ranging from providing instant feedback and simplifying complex concepts to acting as a potential tutor for students (Habiba & Partho, 2024).

However, the rapid emergence of Chat-GPT has also sparked intense debate within educational circles. The availability of Chat-GPT and similar technologies has raised many questions for education professionals, policymakers, and researchers (Zhang et al., 2023). While proponents highlight its potential to enhance knowledge acquisition and democratize access to information, and the passive consumption of the content.

Despite this debate, there is a distinct lack of empirical research specifically evaluating its tangible impact on learning outcomes. Most discussions remain theoretical or anecdotal, creating a gap in understanding whether Chat-GPT truly facilitates deeper learning or simply streamlines task completion. Therefore, this study aims to systematically evaluate the effectiveness of Chat-GPT in enhancing in enhancing learning outcomes and facilitating knowledge acquisition. By investigating its application as an educational tool, this research seeks to move beyond speculation and provide evidence based insights into its pedagogical values, thereby informing educators, policymakers, and developers on its optimal and ethical integration into learning environments.

1.1 Statement of Problem

The integration of AI into education has ushered in transformative tools, with open AIs Chat-GPT emerging as a prominent platform with significant potential to reshape the learning process. There is growing interest among educators and institutions in leveraging Chat-GPT to improve learning outcomes and facilitate knowledge acquisition. Although preliminary exploration shows promising results, the current body of research lacks robust, empirical evidence to definitively conclude its effectiveness. A comprehensive analysis is needed to understand not only if Chat-GPT enhances learning but also how it does so and under what conditions. Rapid adaptation of this technology precedes a full understanding of its associated challenges, including pedagogical limitations, potential biases in its outputs, and urgent ethical considerations regarding academic integrity and data privacy. Therefore, critical problems exist,

such as the absence of structured evaluation of Chat-GPT's effectiveness in enhancing learning outcomes and facilitating knowledge acquisition, which is necessary to guide its responsible and effective implementation in educational practice.

1.2 Objectives of the Study

The objectives of the study include;

1. To assess the impact of Chat-GPT on learning outcomes, including measures such as knowledge retention, understanding, and engagement.
2. To compare the effectiveness of Chat-GPT with traditional learning methods in terms of improving learning outcomes and facilitating knowledge acquisition.

1.3 Rational of the Study

AI has grown rapidly in recent years, and natural language processing capabilities have become increasingly sophisticated. Chat-GPT, is an advanced language model capable of helping and enhancing the learning experience in innovative ways. With the growing recognition that each student has unique learning preferences and needs, personalized learning is becoming increasingly important. Chat-GPT can act as a virtual tutor, providing personalized explanations and feedback for each student. AI-powered teaching tools can bridge the educational gap by providing access to learning resources to students with different learning abilities, disabilities, or those in remote areas. Despite these significant potential benefits, the integration of tools like Chat-GPT into educational frameworks is currently driven more by technological enthusiasm than by robust empirical evidence. While its capabilities for simulating interactive conversation and maintaining student engagement are clear, Chat-GPT can engage students in interactive conversations, simulating real interaction with a knowledgeable partner. This interaction can help students stay engaged and interested in the topic. However, it remains unclear to what extent this engagement translates into tangible improvements in learning outcomes, such as knowledge retention and deeper understanding. Furthermore, there is a lack of comparative analysis measuring Chat-GPT's effectiveness against established traditional learning methods. Without these comparisons, educators lack the data needed to make informed decisions about its role in educational curriculum. Learner's perspective is also crucial for adaptation; the success of any educational technology is ultimately tied to their perceptions and experiences.

This study is significant as it will provide educators, policymakers, and institutions with evidence-based insight on Chat-GPT efficacy, guide its strategic integration into curricula. By comparing it to the traditional method, it will clarify its added value for improving knowledge acquisition. Furthermore, understanding learner perceptions will be crucial for designing effective and user-cantered AI tools that empirically enhance educational outcomes.

2. Literature Review

Xu et al. (2021) stated that AI represents the science and engineering of creating systems capable of tasks associated with intelligent beings, such as learning, judgment, and decision-making, with significant promise for application in education, as highlighted by Ouyang et al. (2022). A prominent application is in natural language processing (NLP) to develop intelligent Chat-bots that can understand and generate human language (Caldarini et al., 2022).

Open AIs Chat-GPT, a generative pre-trained transformer (GPT) model, is a leading example of such technology. It is trained on a vast corpus of internet text data using unsupervised learning to generate human like text in a human way by predicting subsequent words in a sequence (Currie, 2023). In educational contexts, Chat-GPT functions as an intelligent agent capable of operating autonomously to support learning (Adamopolou & Moussiades, 2020). Its capabilities include acting as a virtual tutor to provide personalized explanations and feedback, thereby supporting adaptive learning and bridging educational gaps for diverse learners. It can also engage students in interactive conversations to simulate real-time dialogue with a knowledgeable partner, potentially enhancing engagement and interest.

As Susnjak (2022), the model's capacity to comprehend context and generate high-quality, relevant responses marks a significant advancement over earlier language models. It

enables its use for specific educational purposes such as simplifying complex topics, debugging code, composing essays, and preparing for interviews, as Orlanda-Ventayen (2024) concluded through his research. By analysing large datasets, it can also facilitate research by helping to identify patterns and information that would be challenging to find manually.

Priego and Berube (2025) stated that the integration of Chat-GPT into education is not without significant challenges. As a statistical model, it can perpetuate biases present in its training data. Concerns over the accuracy of its outputs and the potential for generating misinformation raise issues for academic integrity, the development of personal writing skills, and the need for critical verification of sources (Khalil et al., 2024).

Its ability to produce competent text also challenges traditional assessment methods, necessitating a re-evaluation of pedagogical practices and a focus on educating both instructors and students on its ethical and effective use (Garcia, 2025). Therefore, while Chat-GPT presents a transformative opportunity for facilitating knowledge acquisition and personalizing education, its effective implementation requires careful consideration of its limitations and the development of robust ethical and pedagogical frameworks.

3. Research Methodology

The current study adopted a post-positivist research paradigm and a quantitative research approach, using a quasi-experimental design featuring pre-test and post-test measures with a control and experimental group. This method is adopted for its capacity to infer causal relationships between the independent variable and the dependent variables.



Figure 1 Variables

The target population consists of BS English Language Teaching (BS ELT) students within the Department of English Language at The Islamia University of Bahawalpur. A random sampling method was used to select 60 students from the targeted population. These 60 students were randomly assigned to either the control group or the experimental group, with each group consisting of 30 participants. This method was adopted to escape from selection bias and enhance the internal validity of the experiment.

Data were collected by using a pre-test and post-test developed in consultation with subject matter experts (SMEs) to allow for objective and efficient scoring. Tests consisted of MCQs only. A second research instrument, a self-structured likert scale questionnaire, was used to measure student engagement. This questionnaire was adapted from the User Engagement Scale (UES) used by Holdener et al. (2020) to fit the educational context and was designed to assess the multidimensional aspects of student

engagement, including cognitive, affective, and behavioural components.

At the start of the session (week 1) a pre-test was conducted for both the control and experimental groups. After that, during the 6-week intervention phase, the experimental group received structured instructions on the educational application of Chat-GPT, and they used it to accomplish the regular academic tasks, while the control group was deprived of this. The course and instructor remained the same for experimental integrity. Last week (week 6) both the control group and the experimental group completed the post-test and questionnaire.

Data were analysed by using SPSS. Descriptive statistics such as means and standard deviation were used to summarize the scores. To assess the impact of Chat-GPT intervention within the experimental group, a paired samples t-test was conducted on their pre-test and post-test scores. To compare the effectiveness of the two instructional methods, independent samples t-tests were used to compare the post-test scores and engagement survey scores of the control and experimental groups. Knowledge understanding was operationalized as application-type questions within the MCQ test (15 questions), while knowledge retention measured factual recall items (15 MCQs), with subscales established through expert validation." In the study, a correlational analysis was conducted using Pearson correlations to examine the relationships between engagement subscales and learning outcomes. Additionally, a reliability analysis was performed, employing Cronbach's alpha to assess the internal consistency of all measurement instruments utilized in the research. To further evaluate the practical significance of the findings, Cohen's d values were calculated for effect size determination.

To ensure the validity and reliability of the research tools, several measures were implemented. The knowledge test was reviewed by a panel of subject matter experts (SMEs) to establish its content validity. A pilot study, was conducted with a small, similar sample (n=10), who were not part of the main study to refine the instruments, check for clarity and timing, and conduct a preliminary reliability analysis. The internal consistency reliability of the engagement survey was assessed using Cronbach's alpha, with a threshold of $\alpha > 0.7$ considered acceptable.

Ethical considerations were upheld throughout the study. Formal approval was sought from the HOD of the Department of English Language, and written informed consent was obtained from all participants after explaining the study's purpose. All data were anonymized to ensure confidentiality, and participants were fully debriefed upon the study's completion.

4. Statistical Analysis Result

Table 1 Paired t-test

Group	Comparison	Mean Difference	t-value	df	p-value	95% CL	Interpretation
Control	**Post-test- Pre-test**	+2.07	1.64	29	0.112	(-0.52, 4.66)	Moderate improvement (Not significant)
Experiment	**Post-test- Pre-test**	+8.47	8.92	29	<0.001	(6.52, 10.42)	Highly significant improvement

The paired t-test analysis reveals that while the control group showed minimal improvement (+2.07 points) that was not statistically significant ($p = 0.112$), the experimental group demonstrated a substantial and statistically significant gain of 8.47 points ($p < 0.001$). This indicates that the intervention had a strong positive effect on the experimental group's performance.

Table 2 Independent t-test

Test	Comparison	Mean Difference	t-value	df	p-value	95% CL	Interpretation
Pre-test	Experimental-Control	+0.43	0.22	58	0.829	(-3.33, 4.19)	Groups equivalent at baseline
Post-test	Experimental-Control	+6.83	3.41	58	0.001	(2.84, 10.82)	Significant difference

The independent t-tests confirm that both groups were equivalent at baseline ($p = 0.829$), with only a negligible 0.43-point difference. However, at post-test, the experimental group outperformed the control group by 6.83 points, a difference that is statistically significant ($p = 0.001$), demonstrating the intervention's effectiveness.

Table 3 Descriptive Statistics

Group	Test	Mean	S.D
Control (n=30)	Pre-test	50.77	12.18
	Post-test	52.83	12.62
Experiment (n=30)	Pre-test	51.20	10.17
	Post-test	59.67	10.91

Table 3 shows that both groups started with similar baseline scores (Control: 50.77, Experimental: 51.20). The experimental group showed greater improvement and lower variability in scores post-intervention, suggesting more consistent learning gains among participants.

Table 4 Engagement Analysis

Analysis	Findings	Interpretation
Group difference in engagement	Experimental > Control ($p < 0.005$)	Intervention successfully engaged students
Engagement-knowledge correlation	$r = 0.45$, $p > 0.01$)	Higher engagement linked to better retention

Table 4 indicates that the experimental intervention significantly increased student engagement compared to the control condition. The strong positive correlation ($r = 0.45$) between engagement levels and knowledge retention suggests that increased engagement the intervention's positive effects on learning outcomes.

Table 5 Analysis

Student Engagement	Control Mean (S.D)	Experimental Mean (S.D)	t-value	df	p-value	Cohen's d	Interpretation
Cognitive	3.67 (0.71)	4.25 (0.64)	3.45	58	0.001	0.72	Medium-large significant difference
Affective	3.52 (0.68)	4.18 (0.61)	4.01	58	<0.001	0.79	Large significant difference
Behavioural	3.45 (0.62)	4.12 (0.58)	4.32	58	<0.001	0.85	Large significant difference
Total Engagement	3.55 (0.52)	4.18 (0.48)	4.89	58	<0.001	0.96	Very Large Significant difference

Table 5 shows that the intervention applied to the experimental group has led to significantly higher levels of student engagement across all dimensions measured, with the most substantial impact observed in total engagement. These findings could indicate the effectiveness of the strategies used in the experimental condition.

Table 6 Correlation Analysis

Variable Pair	Correlation coefficient (r)	P-value	Strength	Interpretation
Engagement*Knowledge Retention	0.45	<0.01	Moderate	Significant positive relationship
Engagement*Knowledge Understanding	0.52	<0.001	Moderate	Strong significant relationship
Cognitive Engagement*Outcomes	0.49	<0.01	Moderate	Significant relationship
Affective Engagement*Outcomes	0.41	<0.01	Moderate	Significant relationship
behavioural Engagement*Outcomes	0.38	<0.05	Moderate	Significant relationship

Table 6 indicates that there are moderate positive correlations between different dimensions of engagement and various aspects of knowledge and outcomes. Higher levels of engagement, whether cognitive, affective, or behavioural, are associated with better retention and understanding of knowledge, as well as improved educational outcomes. All correlations are statistically significant, highlighting the importance of engagement in the learning process.

Table 7 Validity and Reliability

Instrument	Measure	Pre-test value	Post-test value	Sub-scales	Interpretation
Knowledge test	KR-20 Reliability	0.78	0.82	-	Good to excellent reliability
Engagement Scale	Cronbach's Alpha total	-	0.89	-	Excellent internal consistency
Engagement sub-scales	Cronbach's Alpha	-	-	Cognitive: 0.81 Affective: 0.83 behavioural: 0.84	Good to excellent reliability
Pilot study	Reliability (n=10)	KR-20: 0.75 A: 0.86	-	-	Adequate to good preliminary reliability

Table 7 indicates that the instruments used in the study, including the knowledge test and engagement scales, exhibit good to excellent reliability. The improvements in reliability from pre-test to post-test for the knowledge test suggest that the intervention may have positively impacted the measurement of knowledge. The engagement scales and their sub-scales also demonstrate strong internal consistency, confirming that they effectively measure the intended constructs of engagement. Overall, these findings support the validity of the instruments used in the study.

5. Findings of the Study

In addressing the first objective of the study, which sought to assess the impact of Chat-GPT on learning outcomes, the analysis indicates a pronounced positive effect. The implementation of the Chat-GPT intervention was associated with a marked improvement in knowledge scores for the experimental group from the pre-test to the post-test stage. This suggests a substantive enhancement in both knowledge retention and understanding. It is also observed that the intervention resulted in a

substantial elevation of student engagement relative to the control condition. This increase was evident across all measured dimensions of engagement, including cognitive, affective and behavioural domains, climaxing in a significant overall difference in total engagement. Further study revealed a moderate positive relationship between the level of student engagement and the outcomes related to knowledge retention and understanding, indicating that heightened engagement is concomitant with improved learning results.

The second objective of the study, which aimed to compare the effectiveness of Chat-GPT with traditional learning methods, revealed a clear comparative advantage for the Chat-GPT based approach. Initial analysis confirmed the equivalence of the experimental and control groups at the baseline, establishing a valid foundation for comparison. Following the intervention, the post-test results revealed that the group utilizing Chat-GPT attained a significantly higher level of knowledge acquisition and understanding compared to the group exposed to traditional methods. The level of improvement observed in the experimental group was substantially greater than the marginal gain noted in the control group. It indicates differential improvement underscores the stronger efficacy of the Chat-GPT intervention. The levels of engagement reported by the experimental group were significantly superior across all domains when contrasted with the control group, affirming that the Chat-GPT method is not only more effective for knowledge acquisition but also more proficient in fostering student engagement.

6. Conclusion

It is concluded that the integration of Chat-GPT as a learning tool yields a significant positive impact on educational outcomes. The intervention not only facilitated a marked improvement in knowledge acquisition, retention, and understanding but also substantially enhanced student engagement across cognitive, affective, and behavioural domains. A positive correlation was identified between these elevated engagements and improved learning outcomes. It is also noticed that Chat-GPT based instructional approach is significantly more effective than traditional learning methods. The markedly greater gains in knowledge and higher levels of engagement achieved by the Chat-GPT intervention confirm the superior efficacy of AI in creating a more productive and engaging learning environment.

7. Implication of the Study

The findings of the study carry many significant implications for educational theory, practice, and policy. The results provide robust empirical support for constructivist and technology-enhanced learning theories as Chat-GPT acts as an effective scaffold, facilitating active knowledge construction. This reinforces the theoretical premise that interactive, conversational AI can create a dynamic learning environment conducive to deeper understanding. For educators Chat-GPT is a powerful pedagogical tool when strategically integrated into the curriculum. Educators should consider designing specific tasks that leverage Chat-GPT's capabilities for personalized tutoring, simplifying complex concepts, and fostering interactive dialogue. The significant gains in cognitive, affective, and behavioural engagement indicate that the tool can help address student motivation and participation challenges. For educational institutions and policymakers, the findings of the study are helpful to create the clear frameworks for the ethical and effective use of AI in education. Instead of restrictive policies, the evidence supports a proactive approach that includes curriculum development, faculty training programs on AI integration, and the establishment of guidelines for academic integrity to harness the benefits of AI tools like Chat-GPT while mitigating potential risks.

8. Suggestion for Future Study

While this study offers valuable insights, it also highlights several avenues for future research;

- Research may conduct within a specific subject area such as English language teaching or English language learning.
- A mixed method approach may be used for future study to get more insight.
- A research need to conduct for development and evaluation of specific

pedagogical models and ethical frameworks for AI integration.

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