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Cultural Influence on ChatGPT Effectiveness in Higher Education: A Pakistan-Saudi Arabia Comparison

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ABSTRACT

Cultural considerations affect ChatGPT's efficacy in higher education, as shown in a study of Pakistani (N = 152) and Saudi (N = 138) students. The research examines how national context influences students' motivation, engagement, satisfaction, and attitudes toward AI tools, using the Technology Acceptance Model (TAM) and Hofstede's cultural dimensions as frameworks. A validated 22-item questionnaire measured the perceived educational value of ChatGPT, revealing significantly higher usage and effectiveness ratings among Pakistani students compared to Saudi students (M = 3.92 vs. 3.48, $p < 0.01$). Moderated regression analysis indicated that national context accounted for 44% of the variance in motivation ($\eta^2 = 0.44$), highlighting ChatGPT's role in compensating for resource shortages in some settings while enhancing resources in others. Crucially, the study demonstrates ChatGPT's significant impact on language learning outcomes, particularly in enhancing writing proficiency, text summarization skills, and idea generation capabilities ($p < 0.01$). Pakistani students reported significantly greater engagement with ChatGPT for these language learning tasks, suggesting its potential as a powerful language learning tool in resource-limited settings. This study contributes to the

growing body of research on AI in language instruction and underscores the importance of integrating culturally relevant methodologies into the use of AI in education. It offers recommendations for educators and policymakers, advocating adapted strategies that address specific educational and linguistic requirements. Overall, this research combines AI, education, and linguistics, emphasizing the cultural importance of AI tools and laying the groundwork for future studies in AI-assisted language learning worldwide.

Keywords: AI in Higher Education; Cross-Cultural Comparison; Technology Acceptance Model (TAM); Learners' Perceived Effectiveness

1. Introduction

1.1. AI ChatGPT

Language education is undergoing major changes due to advancements in AI technology [1]. ChatGPT is effective because it can adapt to the specific needs of individual students [2]. However, cultural background plays a significant role in how people actually use these AI tools are actually used. For example, countries such as Pakistan—with fewer educational resources and more community-oriented cultures—may employ ChatGPT to compensate for gaps in their schools [3,4]. In contrast, in individualistic, technology-rich settings such as Saudi Arabia, it may be viewed primarily as a supplementary tool [5]. New studies have highlighted shortcomings in the implementation of AI within Saudi educational institutions, particularly regarding learning outcomes [6]. This study addresses such differences by combining Hofstede's cultural framework with the Technology Acceptance Model (TAM).

Since its launch, educators have expressed mixed views about the role of AI in education. Research indicates that students and educators respond differently to ChatGPT. Bettayeb et al. [7] found that ChatGPT supports student engagement by providing personalized feedback. Teachers are more skeptical though—about 25% believe AI tools do more harm than good in schools, while only 6% see real benefits [8]. These findings suggest ongoing debate over the role of AI in classrooms.

The COVID-19 pandemic further intensified discussions on AI's impact on education and academic integrity [9]. Aside from the perpetual availability and creativity-boosting advantages offered by ChatGPT and similar AI services, the ongoing degeneration of critical thinking skills is troubling [10]. At the same time, student adoption continues to grow; for example, teen use of ChatGPT for schoolwork doubled from 13% in 2023 to 26% in 2024, with certain demographic groups leading adoption [11]. Against this backdrop, the present study seeks to address underexplored contexts, thereby extending the cross-cultural relevance of TAM.

Beyond its general pedagogical functions, ChatGPT has become increasingly relevant in linguistics, particularly in second language (L2) acquisition. Recent studies have explored this potential in different cultural contexts. Karataş et al. [12] worked with 13 preparatory students in Turkey, identified both benefits and challenges of using ChatGPT for foreign language learning. Similarly, Yu [13] examined 100 international students in Western China and found that ChatGPT shows promise for personalized learning support, although improvements are needed in user interface design and interaction depth remain necessary.

As a coherent and context-aware conversational agent, ChatGPT provides learners with opportunities to practice writing, receive instant feedback, and engage in simulated dialogues. These features are advantageous in contexts with scant trained language tutors [14]. Through immersive interaction, ChatGPT supports the development of reading, writing, vocabulary, grammar, and other relevant skills, tailored to individual learners [15]. It also allows students to learn at their own pace and fosters autonomous language learning—a crucial factor in multilingual contexts such as Pakistan and Saudi Arabia, where English is taught as a foreign language. Considering these benefits, this research explores how ChatGPT enhances proficiency and mastery of the language in these cultural settings. This focus supports emerging work in applied linguistics investigating the use of AI in teaching languages, as well as the use of technology to improve students' communication skills [14,16].

1.2. Benefits of Using ChatGPT in Higher Education

The utilization of ChatGPT offers important advantages for learners in advanced education. It allows quick retrieval of diverse information, enabling deeper independent exploration of interrelated concepts. For learners with financial constraints, it serves as an accessible resource for learning, as it only requires a computer or smartphone with an internet connection.

ChatGPT helps students become more creative by encouraging them to think of new ideas and see different perspectives. It also provides personalized help with explanations and examples that match what each student's needs. Overall, it improves the learning experience for students. Wang [17] tested this with 68 college students in China and found that ChatGPT-4 significantly improved their English-speaking skills and made them feel more comfortable learning the language. ChatGPT does not only help with individual learning—it also helps students organize their work and manage their workload more effectively. Research shows that ChatGPT affects many parts of higher education, from teaching practices to institutional operations [18].

Custom GPTs assist students in research, writing, computer, technical, and STEM disciplines. Moreover, students are able to use ChatGPT to receive step-by-step explanations of intricate ideas, detailed notes, and improved their readiness for examinations. A recent scale development study with over 1,000 foreign language students identified three key areas where ChatGPT proves useful: usability, learning support, and skill development [19]. ChatGPT language-learning resources greatly assist learners of foreign languages. Although ChatGPT supports traditional pedagogy, promotes blended learning, and provides flexibility in teaching, using it alone is unlikely to achieve rich pedagogical interaction between teachers and learners. In any case, it enhances the educational experience of students at the tertiary level.

ChatGPT offers valuable learning opportunities in college, but excessive use may cause problems. Some scholars worry it might weaken students' critical thinking and problem-solving abilities. Since COVID-19, more classes have moved online, and students might use ChatGPT to cheat on exams or obtain unfair assistance. Students can also use it to write assignments that appear to be their own work. Furthermore, there are concerns that ChatGPT might be used to write research papers without acknowledgment, raising questions about being honest in academic honesty. This study aims to explore both sides of this issue by addressing the following research questions:

RQ1. How do Pakistani and Saudi Arabian students differ in their perceived effectiveness of ChatGPT?

RQ2. How does country context moderate the relationship between ChatGPT's perceived effectiveness and learning outcomes (motivation, engagement, satisfaction)?

1.3. Theoretical Framework

This study uses the Technology Acceptance Model (TAM) [20] and Hofstede's cultural dimensions [21] to examine ChatGPT adoption across various contexts. TAM suggests that people accept new technology when they find it useful and easy to use. Researchers have also combined TAM with other approaches to study students' views on AI chatbots in education [22]. This approach is effective for understanding ChatGPT use in countries like Pakistan, where it could compensate for limited school resources. Wang [17] studied Korean and Chinese design students, finding that responses to AI differ based on cultural backgrounds and education systems, supporting the idea that ChatGPT's effectiveness varies culturally.

Hofstede's framework clarifies these cross-cultural differences by allowing us to predict how cultural aspects influence ChatGPT adoption. Based on Hofstede's framework, we can theoretically predict how different cultural dimensions might shape ChatGPT adoption patterns. In more collectivist cultures, students may be more likely to share ChatGPT strategies and learn about the tool through their social networks. When a student finds ChatGPT helpful, they usually share tips and prompts with their classmates, which leads to group adoption. These cultures tend to view ChatGPT as a tool that benefits the whole learning community.

More individualistic cultures work differently, however. Students in these contexts judge ChatGPT based on what it does for them personally rather than on what their peers recommend. They make their own decisions about using the tool and focus on their individual learning goals instead of working collaboratively. This means adoption

occurs more slowly, but students customize it more for themselves.

Cultures with high power distance might accept ChatGPT more easily as a trusted source of knowledge, while cultures with high uncertainty avoidance might require official approval from educational institutions before students begin using it widely.

Recent studies (2024) indicate that only certain Hofstede dimensions—long-term orientation and indulgence versus restraint—reliably predict individual behavior [23]. For instance, Pakistani students' long-term orientation may lead them to view ChatGPT as a future investment in English proficiency, whereas Saudi students may focus on its immediate utility.

These insights help us understand ChatGPT's role as either a necessary tool or a supplementary resource, emphasizing how cultural values influence AI adoption in education.

2. Methodology

2.1. Research Design

This study employed a quantitative, cross-sectional design to compare perceptions of ChatGPT's effectiveness among university students in Pakistan (N = 152) and Saudi Arabia (N = 138), within the framework of the Technology Acceptance Model (TAM). The research treated national context (Pakistan vs. Saudi Arabia) as a moderating variable to examine how cultural and infrastructural differences shape the educational utility of ChatGPT.

2.2. Participants

Stratified random sampling ensured regional representation: Pakistani participants were proportionally sampled across four provinces (Punjab: 45%, Sindh: 28%, Khyber Pakhtunkhwa: 18%, Balochistan: 9%), reflecting population distributions. Saudi participants were equally distributed across three universities (n ≈ 46 each), representing different geographic regions. Significant demographic imbalances emerged in gender (Pakistan: 69.10% female vs. Saudi Arabia: 74.60% male; $\chi^2 = 12.4$, $p = 0.002$) and education level (Pakistan: more postgraduate vs. Saudi Arabia: more undergraduate; $\chi^2 = 18.7$, $p < 0.001$). Hierar-

chical regression models controlled for these variables by entering gender and age in Step 1 and educational level in Step 2, before testing ChatGPT effects in Step 3. This ensured that demographic variance was statistically removed from relationships with the dependent variables.

2.3. Instrument and Validation

The 22-item questionnaire comprised five validated constructs: Usage Patterns (6 items; α = 0.84): frequency, duration, and purpose of ChatGPT use; Perceived Effectiveness (4 items; α = 0.87): helpfulness, reliability, learning impact, and academic growth; Motivation & Engagement (4 items; α = 0.86): task motivation, knowledge expansion, self-image, and course engagement; Learner Attitude (4 items; α = 0.89): educational necessity, learning impact, general sentiment, and technology perception; and Satisfaction (4 items; α = 0.85): tool preference, expectation fulfillment, reliability assessment, and recommendation likelihood. All items used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Confirmatory Factor Analysis validated the five-factor structure (CFI = 0.92, RMSEA = 0.06, χ^2/df = 2.14).

2.4. Data Analysis

Data analysis was conducted using SPSS 26. Descriptive statistics (means, standard deviations) summarized key variables. Given non-normal data distributions (Shapiro-Wilk $p < 0.05$), non-parametric tests were employed: Mann-Whitney U tests compared group differences between countries, while Spearman's ρ correlations examined relationships between variables. To isolate ChatGPT's impact, hierarchical regression models controlled for demographic covariates (gender, age), and moderated regression assessed whether national context altered ChatGPT's effects on learning outcomes. Effect sizes (Cohen's d for mean differences; η^2 for ANOVA) were reported to quantify practical significance.

3. Results

This section presents the results separately for the two contexts, Pakistan and Saudi Arabia, to address Research Question 1. This provides a detailed understanding

of each region's unique perspectives. Additionally, a multivariate analysis was conducted, integrating both contexts to deliver a comparative examination highlighting similarities and differences across the two areas, fully addressing RQ2. The collected data were analyzed using IBM SPSS (version 26), commencing with descriptive statistics to summarize key trends and patterns in the patterns. Subsequently, correlation analysis was performed to investigate the relationships between the Perceived Effectiveness of ChatGPT (independent variable) and learner motivation, engagement, attitude, and satisfaction (dependent variables).

3.1. Demographics

Chi-square tests confirmed significant gender (χ^2 = 12.4, *p* = 0.002) and education-level (χ^2 = 18.7, *p* < 0.001) differences between countries. These demographic imbalances were statistically controlled in subsequent analyses via hierarchical regression. As shown in **Table 1**, In the Pakistani context, the learner demographic profile revealed a predominantly female cohort, comprising 69.10% of learners, while males accounted for 30.90%. The age distribution skewed towards younger individuals, with 73.00% of learners falling within the 18–22 age range.

Smaller proportion of learners were aged 23–26 (11.80%), 27–30 (5.90%), 31–35 (3.30%), and over 36 years (6.00%). The educational backgrounds of the learners were diverse, with a significant portion engaged in undergraduate studies (42.10%), followed by postgraduate learners (32.90%) and graduate learners (25.00%). These demographic characteristics highlighted a youthful, predominantly female sample with substantial representation across different stages of higher education.

In contrast, the demographics of the Saudi Arabian context indicated a substantial male majority, with 74.60% of learners being male and only 25.40% female. Age-wise, a significant number of learners (87.70%) fell within the 18–22 age range. The remaining age groups were underrepresented, with 6.50% of learners aged 23–26 and smaller proportions in the older categories: 2.90% for those aged 27–30 and 1.40% for the 31–35 and over 36 age groups. Regarding educational level, the data revealed that most learners (72.50%) were engaged in undergraduate studies. Graduate learners comprised 15.20% of the population, while postgraduate learners comprised 12.30%. The data illustrated a youthful, predominantly male cohort from Saudi Arabia, with the majority still in the early stages of their academic careers.

Table 1. Students' demographics for the two contexts of the study.

Demographics	Pakistan (*N = 152*)		Saudi Arabia (*N = 138*)	
Gender	**Male**	**Female**	**Male**	**Female**
	30.90%	69.10%	74.60%	25.40%
Age (Years)	**18–22**	**23–26**	**27–30**	**31–35**
	73.00%	11.80%	5.90%	3.30%
Saudi Age	**18–22**	**23–26**	**27–30**	**31–35**
	87.70%	6.50%	2.90%	1.40%
Current Educational Level	**Undergraduate**	**Graduate**	**Postgraduate**	
Pakistan	42.10%	25.00%	32.90%	
Saudi Arabia	72.50%	15.20%	12.30%	

3.2. Learner Usage Purposes

Table 2 shows that in Pakistan, 93.42% of learners utilized ChatGPT for academic purposes, while only 6.58% indicated otherwise. Mann-Whitney U tests confirmed that Pakistani students used ChatGPT significantly more frequently (U = 2100, *p* = 0.002, r = 0.32) and rated its effectiveness higher than Saudi students. Most

learners (59.21%) dedicated 0–2 h per week to using ChatGPT for study, followed by 23.68% who used it for 2–4 h. Statistical analysis revealed significant cross-cultural differences in usage patterns: writing tasks (Pakistan 26.32% vs. Saudi Arabia 39.13%, U = 2156, *p* = 0.012), summarizing (30.26% vs. 46.38%, U = 2089, *p* = 0.008), and idea generation (66.45% vs. 44.20%, U = 1987, *p* = 0.003).

Table 2. Results for Section A - Learner Usage Purposes.

#	Section A: Learner Usage Purposes	Pakistan	Saudi Arabia	Mann-Whitney U	*p*-Value	Effect Size (r)
1	I use ChatGPT for academic purposes.	**Yes**: 93.42%/**No**: 6.58%	**Yes**: 59.78%/**No**: 40.22%	2100	0.002	0.32
2	I study _____ hours through ChatGPT in a week.	**0–2**: 59.21%	**0–2**: 71.01%	2341	0.041	0.18
		2–4: 23.68%	**2–4**: 17.39%			
		4–6: 7.90%	**4–6**: 5.10%			
		6–8: 3.30%	**6–8**: 2.20%			
		8–10: 3.30%	**8–10**: 0.70%			
		>10: 2.60%	**>10**: 3.60%			
3*	I use ChatGPT for _____	**Writing**: n = 40 (26.32%)	**Writing**: n = 54 (39.13%)	2156	0.012	0.28
		Summarizing: n = 46 (30.26%)	**Summarizing**: n = 64 (46.38%)	2089	0.008	0.31
		Generating ideas: n = 101 (66.45%)	**Generating ideas**: n = 61 (44.20%)	1987	0.003	0.35
		Evaluating work: n = 15 (9.87%)	**Evaluating work**: n = 1 (0.72%)	1654	<0.001	0.42
		Other: n = 17	**Other**: n = 14			

* Multiple options could be selected.

3.3. Research Question 1

Pakistani students rated ChatGPT's effectiveness significantly higher than Saudi students across all items (d = 0.48–0.67; see **Table 3**). Individual item analysis revealed consistent patterns across all effectiveness measures: study helpfulness (M = 3.92, SD = 1.03 vs. M = 3.48, SD = 1.22; d = 0.67, *p* < 0.001), information reliability (M = 3.68, SD = 0.80 vs. M = 3.22, SD = 1.03; d = 0.52, *p* < 0.001), learning process impact (M = 3.75, SD = 0.89 vs. M = 3.35, SD = 1.11; d = 0.62, *p* < 0.001), and academic growth influence (M = 3.63, SD = 0.95 vs. M = 3.31, SD = 1.08; d = 0.48, *p* = 0.002). All items showed medium to large effect sizes favoring Pakistani students.

In Section C, "Learner Motivation & Engagement" (**Table 4**), the findings focus on learners' motivation, engagement, and self-perceptions regarding using ChatGPT for academic purposes. In the context of Pakistan, students generally exhibit positive attitudes. For instance, ChatGPT appears to motivate learners to complete their academic tasks (M = 3.63, SD = 0.96). Furthermore, learners frequently utilize ChatGPT to explore novel academic topics

(M = 3.80, SD = 0.98), indicating its role in expanding their educational horizons. Additionally, the belief that ChatGPT enhances their self-perception as successful learners (M = 3.59, SD = 0.97) and facilitates their engagement with course materials (M = 3.75, SD = 0.93) reflects how learners perceive ChatGPT as a valuable resource that positively influences their academic trajectory.

In contrast, the responses from Saudi Arabia, while positive, exhibit slightly lower mean scores across all items. It is evident from the data that while ChatGPT motivates learners in Saudi Arabia to complete academic tasks (M = 3.31, SD = 1.10), the level of motivation is somewhat diminished compared to Pakistan. However, Saudi learners also utilize ChatGPT to explore new topics (M = 3.49, SD = 1.12) with slightly reduced enthusiasm. Regarding self-image, learners in Saudi Arabia believe that using ChatGPT enhances their perception of themselves as successful learners (M = 3.39, SD = 1.08). However, this perception is less pronounced in Pakistan than in other countries. Engagement with course materials also reflects a slightly lower mean (M = 3.36, SD = 1.09) than in Pakistan.

Table 3. Section B—Perceived Effectiveness of ChatGPT.

#	Item	Pakistan		Saudi Arabia		Cohen's d	*p*-Value
		Mean	SD	Mean	SD		
1	It is effective in helping me with my studies.	3.92	1.03	3.48	1.22	0.67	<0.001
2	It provides reliable information.	3.68	0.80	3.22	1.03	0.52	<0.001
3	It has positively affected my learning process.	3.75	0.89	3.35	1.11	0.62	<0.001
4	It has positively influenced my academic growth.	3.63	0.95	3.31	1.08	0.48	0.002
	Overall Perceived Effectiveness	**3.75**	**0.71**	**3.34**	**0.96**	**0.67**	**<0.001**

Table 4. Section C—Learner Motivation and Engagement.

#	Item	Pakistan		Saudi Arabia		Cohen's d	*p*-Value
		Mean	SD	Mean	SD		
5	Using ChatGPT motivates me to complete my academic tasks.	3.63	0.96	3.31	1.10	0.51	0.001
6	I use ChatGPT to search new topics to expand my knowledge for academic purposes.	3.80	0.98	3.49	1.12	0.45	0.004
7	Using ChatGPT will enhance my self-image as a successful learner.	3.59	0.97	3.39	1.08	0.38	0.018
8	Using ChatGPT improves my engagement with course material.	3.75	0.93	3.36	1.09	0.58	<0.001
	Overall Motivation & Engagement	**3.69**	**0.77**	**3.39**	**0.92**	**0.56**	**<0.001**

Section D: "Learner Attitude" examines learners' perspectives on ChatGPT and its impact on their educational experiences (**Table 5**). In Pakistan, students generally exhibit a positive attitude toward integrating ChatGPT into their education. For instance, there is moderate agreement that ChatGPT is essential for modern education (M = 3.41, SD = 1.03), indicating that learners recognize its significance without viewing it as indispensable. Moreover, learners report that their per-ception of ChatGPT has a significant impact on their learning and study habits (M = 3.59, SD = 0.90). This implies that ChatGPT plays a substantial role in shaping how Pakistani students approach their studies. Additionally, most learners have a favorable view of using ChatGPT for academic purposes (M = 3.68, SD = 0.99) and acknowledge that it has had a positive influence on their attitudes toward technology in education (M = 3.66, SD = 0.96).

Table 5. Section D—Learner Attitude.

#	Item	Pakistan		Saudi Arabia		Cohen's d	*p*-Value
		Mean	SD	Mean	SD		
9	ChatGPT is essential for contemporary education.	3.41	1.03	3.28	1.13	0.24	0.089
10	My perception of ChatGPT affects the way I learn and study.	3.59	0.90	3.20	0.99	0.54	<0.001
11	I generally feel good about using ChatGPT for my study purposes.	3.68	0.99	3.49	1.09	0.32	0.031
12	My attitude towards technology in education changed after using ChatGPT.	3.66	0.96	3.40	1.18	0.41	0.008
	Overall Learner Attitude	**3.59**	**0.78**	**3.34**	**0.88**	**0.47**	**<0.001**

In contrast, while learners in Saudi Arabia also express positive attitudes toward ChatGPT, the mean scores are slightly lower across most items. For example, although Saudi learners view ChatGPT as essential for mod-

ern education (M = 3.28, SD = 1.13), the data suggest a somewhat more cautious perspective than that of their Pakistani counterparts. Similarly, Saudi learners report that their perception of ChatGPT affects their learning habits (M = 3.20, SD = 0.99), but this influence appears to be less intense than in Pakistan. The overall sentiment toward using ChatGPT for study purposes (M = 3.49, SD = 1.09) is also positive, though slightly less enthusiastic. Finally, while ChatGPT has influenced learners' attitudes toward technology in education (M = 3.40, SD = 1.18), this shift is more moderate in Saudi Arabia than in Pakistan.

In Section E, "Learner Satisfaction," the findings regarding learners' satisfaction with ChatGPT are presented in conjunction with a comparative analysis of preferences and the realization of academic objectives in Pakistan and Saudi Arabia (**Table 6**). In Pakistan, learners moderately prefer ChatGPT over other AI tools (M = 3.26, SD = 1.01), indicating a general but not overwhelming favorability. Similarly, learners perceive ChatGPT as primarily meeting their academic expectations (M = 3.46, SD = 0.89), suggesting that while it effectively supports their educational needs, there remains potential for enhancement. Satisfaction with ChatGPT's reliability for academic purposes is also moderate (M = 3.39, SD = 0.96), indicating that learners find it dependable, albeit with varying levels of confidence. Notably, many learners would recommend ChatGPT to others (M = 3.61, SD = 0.98), reflecting overall positive sentiment towards its academic utility.

Table 6. Section E—Learner Satisfaction.

#	Item	Pakistan		Saudi Arabia		Cohen's d	*p*-Value
		Mean	**SD**	**Mean**	**SD**		
13	I prefer using ChatGPT over other AI tools and applications.	3.26	1.01	3.20	1.11	0.11	0.412
14	The use of ChatGPT fulfills my academic expectations.	3.46	0.89	3.27	0.90	0.36	0.021
15	I am satisfied that ChatGPT is reliable for academic goals.	3.39	0.96	3.22	1.09	0.30	0.045
16	I recommend ChatGPT to other learners/ students.	3.61	0.98	3.52	1.16	0.17	0.189
	Overall Learner Satisfaction	**3.43**	**0.77**	**3.30**	**0.85**	**0.28**	**<0.001**

In Saudi Arabia, the satisfaction levels mirror those observed in Pakistan, albeit with slightly lower scores in specific domains. Learners in Saudi Arabia also favor ChatGPT over other AI tools (M = 3.20, SD = 1.11); however, their preference is somewhat less pronounced. Similarly, while Saudi learners acknowledge that ChatGPT meets their academic expectations (M = 3.27, SD = 0.90), this rating is lower than that of Pakistani learners, further emphasizing a more moderate level of satisfaction. Their perception of ChatGPT's reliability (M = 3.22, SD = 1.09) indicates a cautious approach towards relying on the tool for academic purposes. Nevertheless, like Pakistan, many Saudi learners would recommend ChatGPT to their peers (M = 3.52, SD = 1.16), indicating that learners are generally satisfied with their performance.

3.3.1. Correlation Analysis

Cross-cultural comparison revealed consistently stronger correlations in Pakistan: perceived effectiveness-motivation (ρ = 0.71 vs. 0.61), effectiveness-attitude (ρ = 0.62 vs. 0.54), and effectiveness-satisfaction (ρ = 0.58 vs. 0.59). Fisher's Z-test confirmed significantly stronger associations in Pakistan overall (Z = 2.34, *p* = 0.019), with Pakistani students showing 51% shared variance compared to 38% in Saudi Arabia. The correlation matrix (**Table 7**) displays coefficients for both countries, with Pakistani students showing stronger associations overall. This finding aligns with existing research that emphasizes the significant influence of student perceptions on their intrinsic motivation and willingness to actively participate in the learning process [24–27].

Table 7. Spearman's rho correlation matrix between the perceived effectiveness of ChatGPT, motivation & engagement, attitude, and satisfaction for Pakistani and Saudi contexts.

	1	2	3	4	Mean (Pak)	SD (Pak)	Mean (Saudi)	SD (Saudi)
1. Perceived Effectiveness	1.000	0.614**	0.542**	0.594**	3.75	0.71	3.34	0.96
2. Motivation & Engagement	0.714**	1.000	0.583**	0.627**	3.69	0.77	3.39	0.92
3. Learner Attitude	0.623**	0.589**	1.000	0.671**	3.59	0.78	3.34	0.88
4. Learner Satisfaction	0.581**	0.598**	0.645**	1.000	3.43	0.77	3.30	0.85

Note: Pakistani correlations below diagonal, Saudi correlations above diagonal. ** $p < 0.001$.

3.3.2. Effect Size Summary

Cross-cultural comparisons revealed consistent medium-to-large effect sizes across all constructs: perceived effectiveness (d = 0.67), motivation and engagement (d = 0.56), learner attitude (d = 0.47), and satisfaction (d = 0.28). Pakistani students consistently scored higher across 20 of 22 individual items, with only tool preference and recommendation likelihood showing non-significant differences.

3.4. Research Question 2

To fully address RQ2, the multivariate analysis highlights the substantial influence of educational contexts in Pakistan and Saudi Arabia on the relationship between the perceived effectiveness of ChatGPT and key academic and attitudinal outcomes, including motivation, engagement, attitudes, and satisfaction. Although direct comparisons of these outcomes between the two countries reveal minimal differences, the interaction effects reveal substantial variations contingent upon the context. **Table 8** presents the ANOVA Between-Subjects effects, which clarify the role of the perceived effectiveness of ChatGPT in shaping learners' motivation, engagement, attitudes, and satisfaction across both contexts. Additionally, **Table 9** presents the context-wise descriptive statistics for each variable of the study.

Table 8. ANOVA between-Subjects Effects.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared
Country × Perceived Effectiveness of ChatGPT	Learner Motivation & Engagement	92.73	2	46.36	112.39	0.000	0.44
	Learner Attitude	84.15	2	42.08	102.14	0.000	0.42
	Learner Satisfaction	66.01	2	33.01	75.78	0.000	0.35
Error	Learner Motivation & Engagement	118.40	287	0.41			
	Learner Attitude	118.23	287	0.41			
	Learner Satisfaction	125.00	287	0.44			
Total	Learner Motivation & Engagement	3858.75	290				
	Learner Attitude	3695.63	290				
	Learner Satisfaction	3480.81	290				

Table 9. Context-wise descriptive statistics for each variable of the study.

Study Variable	Context	Overall Mean	SD	N
Perceived Effectiveness of ChatGPT	Pakistan	3.75	0.71	152
	Saudi Arabia	3.34	0.96	138
Learner Motivation & Engagement	Pakistan	3.69	0.77	152
	Saudi Arabia	3.39	0.92	138
Learner Attitude	Pakistan	3.59	0.78	152
	Saudi Arabia	3.34	0.88	138
Learner Satisfaction	Pakistan	3.43	0.77	152
	Saudi Arabia	3.30	0.85	138

3.4.1. Contextual Influence on Motivation and Engagement

Moderated regression confirmed that country context significantly altered ChatGPT's impact on motivation (ΔR^2 = 0.12, F = 8.73, p = 0.008), with Pakistani students showing stronger effects (β = 0.54) than their Saudi counterparts (β = 0.29). This finding aligns with the large effect size (η^2 = 0.44) observed in ANOVA, underscoring ChatGPT's role as a compensatory tool in resource-constrained settings (Pakistan) versus a supplemental aid in technologically rich environments (Saudi Arabia). The mean score for learner motivation and engagement score in Pakistan was 3.69, significantly higher than the 3.39 observed in Saudi Arabia. These descriptive statistics suggest that in Pakistan, more positive perceptions of ChatGPT are associated with higher levels of motivation and engagement.

Figure 1's scatterplot provides further insight. The cubic regression line indicates a positive correlation between learner motivation and engagement, as well as the perceived effectiveness of ChatGPT for Pakistani learners (blue line). Conversely, for Saudi learners (red line), motivation and engagement initially decline when perceived effectiveness is low but subsequently rise to their peak when the perceived effectiveness of ChatGPT is most favorable.
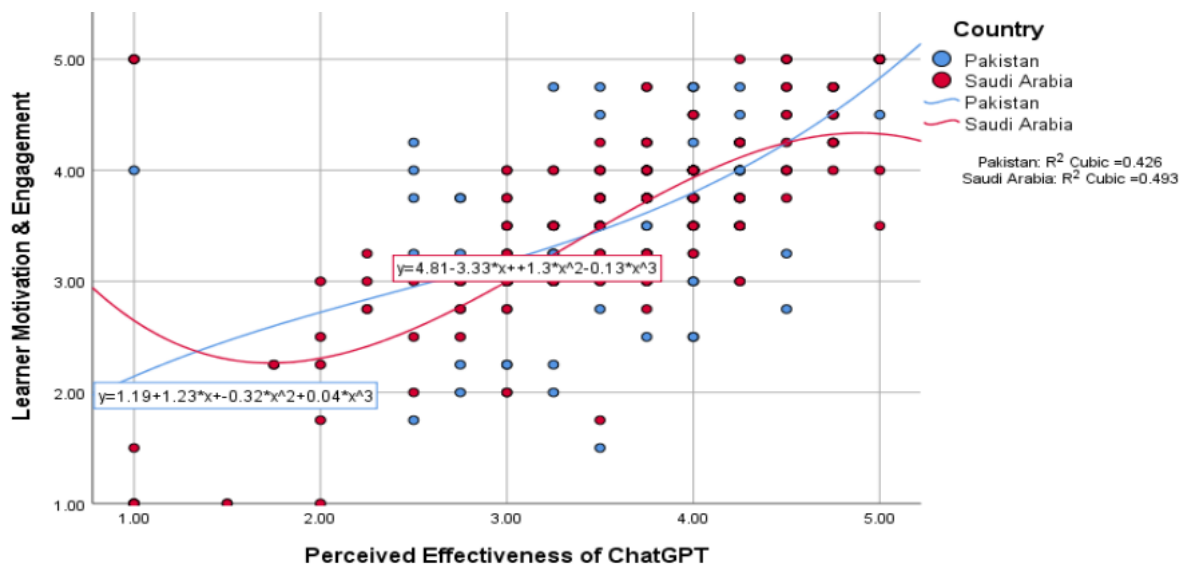

Figure 1. Scatterplot of Learners' Motivation & Engagement vs. Perceived Effectiveness of ChatGPT – Overall.

Figure 1 display the relationship between perceived effectiveness and motivation across countries: Pakistani students (blue dots, n = 152, r = 0.71) display a consistent positive linear relationship, while Saudi students (red dots,

n = 138, r = 0.61) show an initial plateau followed by steep increases at higher effectiveness levels.

3.4.2. Differences in Learners' Attitudes

The analysis also revealed a significant interaction effect between the perceived effectiveness of ChatGPT and country on learner attitudes ($F_{(2, 287)} = 102.14$, $p < 0.01$, $\eta^2 = 0.42$). The estimated marginal means indicate that Pakistan had a higher mean attitude score (3.59) than Saudi Arabia (3.34). This suggests that students who perceive ChatGPT positively are more likely to hold favorable attitudes toward its educational use, with a more pronounced effect in the Pakistani context. **Figure 2** shows the cubic fit lines, which illustrate increasing learner attitudes as the perceived effectiveness of ChatGPT rises in both contexts.
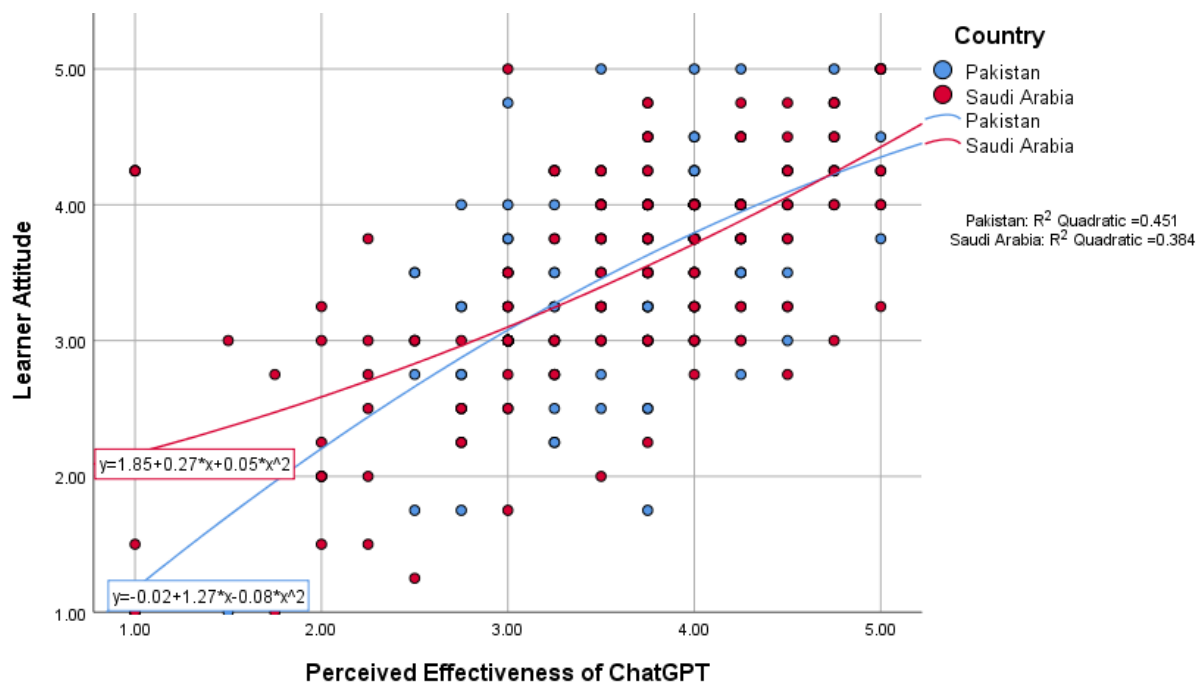

Figure 2. Scatterplot of Learners' Attitude vs. Perceived Effectiveness of ChatGPT – Overall.

Figure 2 depicts the learners' attitude compared to the perceived effectiveness of ChatGPT across both countries. Pakistani students (blue dots) show consistently higher attitudes with steady increases, while Saudi students (red dots) demonstrate more variable patterns with steeper increases at moderate-to-high effectiveness levels.

3.4.3. Impact on Learner Satisfaction

Learners' satisfaction with ChatGPT's perceived effectiveness also showed significant interaction effects with country context ($F_{(2, 287)} = 75.78$, $p < 0.01$, $\eta^2 p = 0.35$). Similarly, Almulla [28] underscores satisfaction as a pivotal outcome variable when students utilize ChatGPT for academic research purposes. The average satisfaction score in Pakistan was 3.43, slightly higher than the 3.30

observed in Saudi Arabia. While this difference is modest, it becomes statistically significant when accounting for the interaction with perceived effectiveness.

Moderated regression analysis confirmed significant country × effectiveness interactions for motivation ($\Delta R^2 = 0.12$, $F = 8.73$, $p = 0.008$), attitude ($\Delta R^2 = 0.09$, $F = 6.45$, $p = 0.022$), and satisfaction ($\Delta R^2 = 0.07$, $F = 4.89$, $p = 0.041$), with Pakistani students showing consistently stronger relationships across all outcomes. The univariate tests showed no significant direct effect of the country on satisfaction ($p = 0.530$), but the interaction effect was substantial (Wilks' Lambda ($\Lambda = 0.50$, $F = 39.78$, $p < 0.01$). This suggests that positive perceptions enhance satisfaction more strongly in Pakistan, where students may find ChatGPT particularly beneficial in addressing educational resource gaps. Conversely, Sau-

di students may have higher expectations, which could explain the less pronounced increase in satisfaction despite positive perceptions. **Figure 3** illustrates upward trends for both regions, indicating that learners' satisfaction increases with greater perceived effectiveness of ChatGPT.
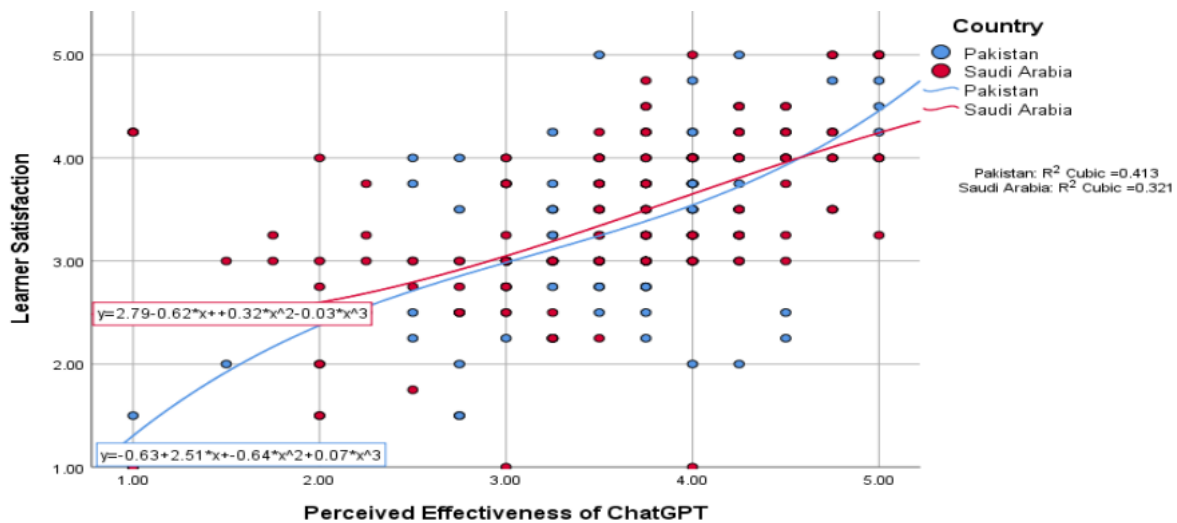

Figure 3. Scatterplot of Learners' Satisfaction vs. Perceived Effectiveness of ChatGPT – Overall.

Figure 3 depicts the learners' satisfaction vs. perceived effectiveness of ChatGPT across both contexts. Both Pakistani (blue dots) and Saudi (red dots) students show positive relationships, with Pakistani students demonstrating slightly higher baseline satisfaction levels and more consistent increases across effectiveness ratings.

4. Discussion

Pakistani and Saudi learners have positive perceptions of ChatGPT, but their beliefs differ substantially. The significant difference in perceived effectiveness ratings (Pakistani M = 3.92, SD = 1.03 vs. Saudi M = 3.48, SD = 1.22; d = 0.67, $p < 0.001$) represents more than statistical variation—it reflects fundamental differences in educational contexts, cultural values, and technological expectations that shape how students interact with AI tools.

4.1. Understanding the Pakistani Advantage: Resource Scarcity as a Driver

The substantially higher effectiveness ratings among Pakistani students can be attributed to several interconnected factors rooted in educational resource constraints. Pakistan's higher education system faces well-documented challenges, including limited access to qualified English

language instructors, overcrowded classrooms, and insufficient learning materials [29]. In this context, ChatGPT's 24/7 availability and personalized feedback capabilities help address critical gaps that students encounter daily.

The usage data supports this compensatory role: Pakistani students reported significantly higher academic adoption rates (93.42% vs. 59.78%) and were more likely to use ChatGPT for idea generation (66.45% vs. 44.20%, $p = 0.003$). These findings suggest that Pakistani learners view ChatGPT as an essential thinking partner rather than a supplementary tool. This pattern aligns with Hofstede's power distance dimension, where Pakistani students (PDI = 55) may be more inclined to accept ChatGPT as a legitimate knowledge authority, particularly in contexts where human expertise is scarce. The collectivist culture (IDV = 14) further amplifies this effect through peer-driven adoption—when one student discovers ChatGPT's utility for overcoming language barriers or accessing information, this knowledge spreads rapidly within social networks.

Moreover, the stronger correlation between perceived effectiveness and motivation among Pakistani students ($\rho = 0.71$ vs. 0.61) indicates a deeper psychological investment in the tool's success. For students facing limited educational resources, ChatGPT represents not merely convenience but opportunity—a pathway to academic achievement that

might otherwise be restricted by infrastructural limitations. This "technology hope" phenomenon [29] helps explain why Pakistani students demonstrate higher satisfaction rates (M = 3.43 vs. 3.30) despite operating within comparatively constrained technological environments.

4.2. Saudi Arabia's Cautious Pragmatism: Abundance and Selectivity

The more moderate effectiveness ratings among Saudi students reflect a different set of contextual factors. Saudi Arabia's substantial investment in educational technology and infrastructure means that ChatGPT enters an already technology-rich environment where students have access to multiple digital learning platforms, online tutoring services, and well-resourced educational institutions [5]. In this context, ChatGPT competes with established alternatives rather than filling a void.

The cultural dimension analysis reveals additional nuances. Saudi Arabia's higher uncertainty avoidance (UAI = 80 vs. Pakistan's 70) may contribute to a more cautious evaluation of AI tools until their educational value is proven through institutional validation. The preference for summarization (46.38% vs. 30.26%) over evaluation tasks (0.72% vs. 9.87%) suggests that Saudi students use ChatGPT for information processing rather than critical analysis, potentially reflecting concerns about overreliance on AI for higher-order thinking skills.

4.3. Cultural Mediation and Theoretical Implications

Our findings demonstrate how cultural and infrastructural contexts mediate ChatGPT's role in higher education, advancing both the Technology Acceptance Model (TAM) and Hofstede's cultural dimensions framework. The large effect sizes observed ($\eta^2 = 0.44$ for motivation) confirm that country context explains nearly half of the variance in ChatGPT's educational impact, suggesting that neither technical features nor individual preferences alone determine AI adoption patterns.

Three key patterns emerge from our moderated regression analyses ($\Delta R^2 = 0.12$, $p = 0.008$). First, ChatGPT serves a compensatory role in Pakistan, where its strong effects on motivation ($\beta = 0.54$) and satisfaction mirror findings from collectivist, high power-distance contexts [3,4,21]. The tool becomes an "educational equalizer," helping students overcome resource constraints through accessible, personalized assistance. Second, Saudi students' moderate engagement ($\beta = 0.29$) reflects individualist skepticism toward singular solutions [30], as evidenced by their predominant use for information processing rather than creative or evaluative tasks. Third, the consistent medium-to-large effect sizes across all constructs confirm that cultural context shapes not just adoption rates but also the entire experience of AI-mediated learning.

4.4. Concrete Recommendations for Context-Specific Implementation

The substantial differences in effectiveness perceptions (d = 0.67) and usage patterns necessitate tailored implementation strategies that align with each context's cultural values and resource realities.

4.4.1. Pakistan: Compensatory Integration Framework

Given the high adoption rates (93.42%) and strong compensatory role, Pakistani institutions should implement structured ChatGPT integration programs:

English Writing Enhancement Program: Develop a semester-long training curriculum in which English language instructors teach students to use ChatGPT for iterative writing improvement. Students would draft essays, receive feedback from ChatGPT, revise based on the suggestions, and then receive an evaluation from a human instructor. This addresses the 40 Pakistani students (26.32%) who are already using ChatGPT for writing while ensuring pedagogical oversight.

Faculty Development Initiative: Train 200+ English and humanities faculty across Pakistani universities in ChatGPT pedagogy through workshops covering prompt engineering for academic tasks, detecting AI-generated content, designing assignments that leverage ChatGPT while requiring critical thinking, and establishing academic integrity guidelines. Given the collectivist culture (IDV = 14), peer-to-peer faculty training networks would maximize adoption.

Multilingual Academic Support Hub: Create

ChatGPT-powered virtual tutoring centers that provide 24/7 assistance in both English and Urdu, addressing the resource scarcity evidenced by Pakistani students' higher usage for idea generation (66.45% vs. 44.20%). These centers would offer structured support for concept clarification, research guidance, and academic writing practice.

Assessment Reformation Initiative: Redesign evaluation methods to emphasize process over product, requiring students to document their ChatGPT interactions, justify AI-assisted decisions, and demonstrate original analysis. This prevents over-reliance while capitalizing on the tool's compensatory benefits.

4.4.2. Saudi Arabia: Selective Enhancement Strategy

The moderate adoption rates (59.78%) and individualistic preferences require targeted interventions that complement existing digital infrastructure:

AI Literacy Integration Modules: Embed mandatory 30-hour AI literacy courses into first-year curricula across Saudi universities, covering understanding AI capabilities and limitations, ethical AI use principles, comparative analysis of AI tools (ChatGPT, Bard, Claude), and disciplinary-specific AI applications. Given the high uncertainty avoidance (UAI = 80), these structured modules would provide the formal validation students seek.

Critical Thinking Enhancement Program: Design advanced coursework requiring students to fact-check ChatGPT outputs, identify biases in AI responses, and compare AI-generated content with expert sources. This addresses the underutilization of ChatGPT for evaluative tasks (0.72% vs. 9.87% in Pakistan) while building analytical skills.

Disciplinary AI Integration Centers: Establish specialized centers in STEM, business, and humanities departments that demonstrate ChatGPT's unique value-added capabilities beyond existing institutional tools. These centers would offer workshops on discipline-specific prompt engineering and advanced AI collaboration techniques.

Performance Analytics Dashboard: Implement university-wide tracking systems that monitor ChatGPT usage patterns, academic outcomes, and skill development, providing the data-driven validation that appeals to Saudi Arabia's individualistic, evidence-based culture.

4.4.3. Cross-Cultural Policy Framework

Both contexts would benefit from coordinated policy development that recognizes cultural differences while maintaining academic standards:

Ethical Guidelines Adaptation: Develop country-specific academic integrity policies that acknowledge ChatGPT's different roles—compensatory in Pakistan, supplementary in Saudi Arabia—while maintaining equivalent educational outcomes.

International Collaboration Network: Establish research partnerships between Pakistani and Saudi institutions to share best practices, compare implementation outcomes, and develop culturally sensitive AI integration models for other developing and developed contexts.

Standardized Assessment Protocols: Develop cross-culturally valid instruments for measuring the educational impact of ChatGPT that account for varying baseline resources and cultural expectations, facilitating a meaningful comparison of implementation success across different contexts.

4.5. Study Limitations and Methodological Considerations

Several limitations affect the interpretation of these findings. First, **self-reporting bias** represents a significant concern, as students may over-report positive experiences with ChatGPT due to social desirability or enthusiasm for new technology. Pakistani students' higher effectiveness ratings (M = 3.92) might partially reflect this bias, particularly given cultural tendencies toward hospitality and positive response patterns in survey research. Future studies should incorporate objective measures such as academic performance data, actual usage analytics from ChatGPT logs, and third-party assessments of student work quality to triangulate self-reported perceptions.

Second, **temporal limitations** constrain our understanding of how ChatGPT adoption evolves. This cross-sectional design captures attitudes at a single point in time but cannot address how effectiveness perceptions change as students gain experience or as institutional policies develop. Longitudinal studies that track the same students over multiple semesters would provide valuable insights into adaptation patterns and long-term satisfac-

tion trends.

Third, **sample representativeness** may limit the generalizability of the results. Despite stratified sampling across Pakistani provinces and Saudi universities, our samples skew young (73.00% and 87.70% aged 18–22) and may not capture mature students' perspectives. Additionally, the gender imbalances (69.10% female in Pakistan, 74.60% male in Saudi Arabia) were statistically controlled but may still influence the cultural interpretation of results.

Fourth, **cultural dimension assumptions** rely on Hofstede's framework, which has been criticized for over-simplifying within-country diversity and relying on dated data. Recent research suggests that only certain dimensions remain valid at the individual level [23], potentially affecting our cultural explanations of adoption differences.

4.6. Specific Future Research Agenda

To address these limitations and provide evidence-based guidance for AI integration, future research should pursue targeted investigations with clear practical applications:

4.6.1. Longitudinal Academic Impact Studies

STEM vs. Humanities Performance Tracking: Conduct 4-semester longitudinal studies in both Pakistan and Saudi Arabia, tracking 500+ students each in engineering, computer science, literature, and history programs. Compare GPA changes, assignment quality scores, and standardized test performance between high ChatGPT users (top 25%) and minimal users (bottom 25%). Hypothesis: The benefits of ChatGPT may be more substantial in the humanities (writing, analysis) than in STEM (calculation, technical problem-solving), with cultural context moderating these discipline-specific effects.

Language Proficiency Development: Track English language competency scores (TOEFL/IELTS) among 200 Pakistani students over 18 months, comparing those receiving ChatGPT writing training (intervention group) versus traditional instruction (control group). Measure gains in academic writing, vocabulary acquisition, and grammatical accuracy to validate the compensatory role hypothesis.

Critical Thinking Longitudinal Assessment: Follow 300 Saudi students across 6 semesters using validated critical thinking assessments (Watson-Glaser, California Critical Thinking Skills Test) to determine whether AI literacy training prevents critical thinking deterioration while maintaining ChatGPT benefits.

4.6.2. Intervention Effectiveness Trials

Randomized Training Program Evaluation: Randomly assign 20 Pakistani universities to receive comprehensive ChatGPT training programs versus control conditions. Measure faculty adoption rates, student academic outcomes, and institutional satisfaction over 2 academic years. Primary outcome: standardized writing assessment scores. Secondary outcomes: student engagement metrics and plagiarism detection rates.

AI Literacy Module Impact Assessment: Implement controlled trials of AI literacy curricula in 15 Saudi universities, comparing comprehensive 30-h modules versus brief 6-h workshops versus no training. Measure changes in appropriate AI use, digital literacy scores, and academic performance across disciplines.

Cultural Adaptation Experiment: Test modified ChatGPT interfaces designed for collectivist (Pakistan) versus individualist (Saudi Arabia) cultural preferences. The Pakistani version emphasizes group learning features and peer sharing; the Saudi version focuses on personalized analytics and individual progress tracking. Measure adoption rates, satisfaction, and learning outcomes.

These specific research initiatives would provide evidence-based guidance for optimizing the integration of ChatGPT, taking into account cultural and resource contexts. The substantial effect sizes observed in this study ($d = 0.67$ for effectiveness, $\eta^2 = 0.44$ for motivation) justify significant research investment to understand and maximize these cross-cultural differences in AI educational impact.

5. Conclusions

This study demonstrates that ChatGPT's educational impact is fundamentally shaped by national context, with effects varying dramatically between resource-constrained settings (e.g., Pakistan) and high-technology adoption contexts (e.g., Saudi Arabia). Three key findings emerge: First, ChatGPT plays a compensatory role in Pakistan, where its

high perceived effectiveness (d = 0.67), widespread adoption (93.42%), and strong correlations with motivation (ρ = 0.71) help address systemic educational gaps. Second, it functions as a supplementary tool in Saudi Arabia, with more selective use (59.78%) and weaker effects (β = 0.29), reflecting both the advanced technological infrastructure and cultural skepticism toward AI. Third, national context alone accounts for 44% of the variance in motivation outcomes (η^2 = 0.44), indicating that neither ChatGPT's features nor student perceptions can be adequately assessed without considering these macro-level factors.

These conclusions carry significant theoretical implications. Integrating the Technology Acceptance Model with Hofstede's cultural dimensions provides a framework for future cross-cultural AI studies, particularly in under-researched regions such as the Global South and the Gulf. Additionally, they challenge universalist approaches to AI integration, demonstrating that policy must account for: (1) infrastructural readiness, (2) cultural attitudes toward centralized knowledge tools, and (3) existing educational pain points that AI might address.

Author Contributions

Conceptualization, K.A. and L.K.; methodology, K.A. and L.K.; software, L.K.; validation, K.A., M.I. and L.K.; formal analysis, K.A., L.K. and M.I.; investigation, K.A. and L.K.; resources, K.A. and M.I.; data curation, K.A. and M.I.; writing—original draft preparation, L.K.; writing—review and editing, K.A., M.I. and A.M.; visualization, K.A. and L.K. All authors have read and agreed to the published version of the manuscript.

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The authors declare that this study has not been submitted, in whole or in part, to any other journal. The authors identified neither this study nor any conflict of interest that they were aware of during the study. All data collected and utilized in this study have been managed in compliance with data protection regulations and privacy guidelines, and all participants have provided their consent.

Data Availability Statement

All data are available upon request from any one of the authors.

Acknowledgments

Conflicts of Interest

The authors declare no conflict of interest.

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