

Original Article

Impact of Chat Bot Use on Researcher's Cognitive Load and Work Performance: A Study of Chat Bot User's Experience as a Mediator

Ruqia Nadeem Mir,¹ Aftab Hussain²

Abstract

Objective: This study aimed to find out the impact of chat bot use on researcher's cognitive load and work performance: a study of chat bot user's experience as a mediator

Study Design: A cross-sectional study was conducted.

Place and duration of study: The present research was carried out in different research settings such as universities, research labs, and research institutions of Rawalpindi and Islamabad, Pakistan.

Material and Methods: The Cross-sectional research design was used to find out the impact of chat bot use researcher's cognitive load and work performance with the mediating effect of chat bot user's experience. The sample consisted of 300 participants, including both male and female researchers, taken from different research settings of Rawalpindi and Islamabad, through purposive sampling technique. The age range of the participants was 25-44 years. Bot Usability Scale, ⁽¹⁾ Cognitive Load Questionnaire, ⁽²⁾ Individual Work Performance Questionnaire, ⁽³⁾ and User Engagement Scale ⁽⁴⁾ were used to collect data. Pearson correlation, regression analysis and mediation analysis were done by using SPSS.

Results: The result showed that chat bot use had a weak but significant negative correlation with cognitive load ($r = -.13^*$; $p < .05$) but had no meaningful correlation with work performance ($r = .03$; $p > .05$). Furthermore, indirect impact via chat bot user's experience was found to be significant ($\beta = -.20$, $SE = .10$, 95% CI $[-.42, -.03]$), which means that chat bot user's experience completely mediates the relation between chat bot use and cognitive load but not between chat bot usability and work performance.

Conclusion: The outcomes of this study may give insights into the creation and refinement of chat bot technologies targeted to research workflows, thereby increasing their utility and efficiency.

Keywords: Chat bot use, Cognitive Load, Work Performance, User Experience, Researchers

1. Introduction

Chat bots have gained significant attention and widespread use in various fields, including customer service, healthcare, education, and administrative tasks, especially since 2016. The usage of chat bots is becoming increasingly popular. In 2019, more than 50% of US and German customers utilised chat bots at least once, with even greater rates in the UK and France. ⁽⁵⁾ Chat bots have gained significant attention in recent years especially in the field of academia and research. ⁽⁶⁾ In the educational setting, chat bots facilitate student administration, enhance lecturers' instructional efforts, and help with language acquisition. ⁽⁷⁾ In research settings, by using different chat bots, researchers are now

summarizing literature on a topic, writing abstracts for talks or the talk itself, improving publications, and identifying gaps in specific study fields. ⁽⁸⁾ According to Schmidhuber et al. ⁽⁹⁾, the usage of chat bots may have beneficial consequences for the accuracy of information retrieval activities, hence increasing the productivity of knowledge workers. According to a review by Ubah et al. ⁽¹⁰⁾, chat bots and other AI systems can improve the effectiveness of educational assignments by lowering cognitive load and improving memory. The research conducted by ⁽¹¹⁾ elucidates the significance of chat bots in augmenting student counseling, with a focus on their scalability and capacity to deliver services continuously. It is evident from this study

Post Graduate, Riphah International University Islamabad,¹ Assistant Professor, Riphah International University, Islamabad²

Correspondence: Post Graduate, Riphah International University Islamabad

Email: ruqianadeem30@gmail.com

that AI-powered chat bots have a favorable influence on efficiency, especially when assisting graduate students. The integration of chat bots in human-technology interactions, particularly in enterprise settings, aims to enhance work performance by reducing labor costs and increasing productivity.⁽⁶⁾

According to a study conducted by Talan and Kalinkara,⁽¹²⁾ using AI chat bots like Chat GPT can help students improve their time management abilities by efficiently arranging projects and homework. The study shows that AI chat bots can outperform students in specific educational tasks, leading to better time management and personalized learning experiences.

AI chat bots have emerged as a significant educational tool capable of thoroughly addressing learners' different academic and research needs.⁽¹³⁾ In Pakistan, 90% of scholars are familiar with the practice of ChatGPT in research activities. 86% of scholars used 3.5 (Basic version) of ChatGPT for their research and only 14% used 4 (Plus version) of ChatGPT for their research work.⁽¹⁴⁾ The usage of chat bot in various field's tasks increase the efficiency and productivity of users. However, there is a lack of comprehensive understanding regarding the extent to which chat bot usage, has impacted research practices in relation to the cognitive processes altered by the human interaction with information technology in Pakistan. This study seeks to fill this gap by examining how chat bots usage affect researcher's cognitive load and work performance and how user's experience with chat bot affects the relationship of chat bot use and its impact on the research workflow and the researcher's cognitive load. This study will help the chat bot developers to optimize and improve chat bot tools specifically designed for research purposes in order to enhance

the research efficiency and researcher's cognitive load and work performance.

Studies have shown that the primary incentives for utilizing chatbots are productivity, amusement, and social-relational benefits.^(16, 17)

Pedro et al.⁽¹⁵⁾ underlined the benefits of using artificial intelligence into teaching. The researchers acknowledged that AI in education may automate monotonous jobs, free up more time for challenging situations, and prepare the workforce to be AI-ready.

Chat bots can lessen cognitive burden on working memory by doing ordinary or repeated activities. This can free up cognitive resources for more complicated activities, increasing overall efficiency and productivity.⁽¹⁸⁾

According to research, chat bots can boost productivity by offering personalised support, stimulating group conversations, providing feedback, and increasing student involvement.⁽¹⁹⁾

According to Vaidyam,⁽²⁰⁾ chatbots have the potential to increase productivity and work performance. According to Wu and Yu⁽²¹⁾, AI chat bots have the potential to greatly improve student learning outcomes that could highlight the positive impact of chatbot on productivity, suggesting that using AI chatbots can improve researcher work performance.

In addition to study on chatbot usage, there is a growing interest in investigating user views and preferences about bots.⁽¹⁷⁾ User preferences for several chatbot personas discovered that consumers preferred personas that reflected productivity as well as engagement.⁽²²⁾ According to Behrooz et al.⁽²³⁾, Chatbot design, including anthropomorphic traits and explainability, has a considerable impact on user perception and engagement, which in turn influences cognitive load and productivity.

According to Cognitive Load Theory, Effective learning requires instructional materials and practices that align with human cognitive architecture. ⁽²⁾ In research field, researchers come across lot of mental effort for processing information for their research work such as reading literature reviews, identifying gaps, and analyzing data. Processing various source of information simultaneously can increase cognitive load. High task complexities of research increase the intrinsic cognitive load. According to CLT, cognitive load while doing research work can be reduced by using the effective structured means such as use of technology, time management strategies, and task prioritization. ⁽²⁴⁾ Cognitive Load Theory provides a theoretical framework for understanding how technology tools might alter the cognitive demands that humans face when doing difficult activities. The idea suggests that human cognitive resources are finite, and that how information and task demands are presented and processed can determine the amount of cognitive effort needed. In research settings, researchers routinely analyze information from various sources, evaluate literature, locate important material, and do complicated analytical tasks, all of which can place significant cognitive demands. Chat bots have the ability to alleviate some of these pressures by speeding up information processing and offering task-related assistance. However, the amount to which such technological help decreases cognitive demands may be determined by the users' interactions with the technology.

On the basis of literature review, hypotheses were formulated as

H1) Chat bot use will be negatively linked with the cognitive load of researchers.

H2) Chat bot use will be positively linked with the work performance of researchers.

H3) User experience will negatively mediate the relationship between chat bot use and researchers' cognitive load.

H4) User experience will positively mediate the relationship between chat bot use and researchers' work performance.

2. Materials & Methods

Research Design: The current study is purely quantitative in nature and it used cross-sectional research design. The sample for data collection included male and female researchers from different research settings such as universities, research institutions, and research labs.

Sample: Data was collected from 300 male and female researchers through purposive sampling technique. The sample's age range was from 25 to 44 years old .

Researchers who have completed their Post graduation, PhD, or any other education and are no longer involved in any research work were not included in the study. Only researchers who actively participated in research work and use chat bots for their research work were included in the study. Participants were informed about the goal of the study, and informed consent was obtained from them. Confidentiality was maintained, and participants had the option to withdraw from the study at any moment without expense if they were uncomfortable. After data collection, Data was analyzed using descriptive statistics. Inferential statistics, such as Pearson correlation, regression analysis and mediation analysis were used in the study to test the hypotheses and findings were reported in result section.

Instruments

Bot Usability Scale

Borsci et al. ⁽¹⁾ created the Bot Usability Scale (BUS) to analyse users' experiences with chat bots and perceived usability in the context of their research. The scale was chosen since the current study concentrated on scholars who actively employ chat bots as part of their research efforts. Thus, in the current study, chat bot usage refers to participants' active involvement with chat bot technology for research purposes, whereas the BUS was used to evaluate the quality and usefulness of this interaction. The BUS-11 is composed of 11 measures that reflect five dimensions: perceived accessibility to chat bot services, perceived quality of chat bot functions, perceived quality of conversation and information delivered, perceived privacy and security, and response time. Items are assessed using a 5-point Likert scale. The measure has good psychometric qualities and was designed primarily to assess interaction with chat bot systems. In this study, the phrase "chat bot use" refers to participants' use of chat bots in their research activities, with the usability of this interaction measured using the Bot Usability Scale.

Cognitive Load Questionnaire

Cognitive Load Questionnaire was developed by Felix Krieglstein and his colleagues in 2023. The questionnaire was used to assess the cognitive load of researchers. The questionnaire consisted of 15 items, divided into three sub scales; intrinsic load consist of 5 items, extraneous load consist of 5 items, and germane load consist of 5 items. All the items scored on 9 point rating scale (1 representing not applicable to 9 representing fully applicable). The alpha reliability of this questionnaire was reported to be .83 . ⁽²⁾

Individual Work Performance Questionnaire

Individual Work Performance Questionnaire was developed by Pedro J. Ramos-Villagrasa and his colleagues in 2015. The questionnaire was used to assess researcher's work performance in research workplace. The IWPQ consisted of 18 items, divided into three sub scales: task performance, contextual performance, and counterproductive work behavior. All items have a recall period of 3 months and a 5-point rating scale ("seldom" to "always" for task and contextual performance, "never" to "often" for counterproductive work behavior). The alpha reliability of individual work performance questionnaire was reported to be between 0.79 and 0.89. ⁽³⁾

User Engagement Scale

User Engagement Scale was developed by Paul Cairns in 2018. The scale was used to assess user experience of chat bot usability among researchers. The scale consisted of 12 items, divided into 4 factors; focus attention, perceived usability, aesthetic appeal, and reward. All items scored on 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). The three items of subscale perceived usability have reverse coding. The alpha reliability of user engagement scale was reported to be 0.86. ⁽⁴⁾

3. Results

Table 1 shows psychometric properties of the study variables.

Table 01

Variables	K	A	M	SD	Range		Skewness	Kurtosis
					Potential	Actual		
Bot Usability Scale	11	.67	41.09	4.57	11-55	27-53	.06	.16
Cognitive Load Questionnaire	15	.81	53.88	12.75	15-135	25-110	.88	1.69
Individual Work Performance Questionnaire	18	.72	30.67	8.28	0-72	8-63	.33	.95
User Experience Scale	12	.62	41.94	4.39	12-60	30-55	.09	.02

Note. K = No. of items, A = Alpha reliability, M = Mean, SD = Standard Deviation

Table 1 displays reliability coefficients and sample normality. All scales had good reliabilities ($\alpha = .60-.90$). The descriptive mean value revealed that the cognitive load questionnaire had the highest mean value (53.88) and the lowest mean value (30.67) for the individual work performance scale. The cognitive stress questionnaire had the biggest standard deviation (12.75). The user experience scale has the lowest standard deviation (4.39). A normal distribution of data was described as having skewness and kurtosis values ranging from +1 to -1. As a result, it was shown that parametric tests may be used to assess the hypothesis.

Relationship between Study Variables

To investigate the relationship between research variables, further Pearson correlation analysis was performed. Table 2 summarized the correlational analysis of the investigated variables.

Table 02

Pearson Correlation between all Study Variables (N = 300)

Variables	1	2	3	4
1 Chat Bot Use	-	-	-	-
2 Cognitive Load	-.13*	-	-	-
3 Work Performance	.03	.01	-	-
4 User Experience	.28**	-.14**	-.04	-

Note.* $p < 0.05$. ** $p < 0.01$.

Table 2 displays the findings of the bivariate correlation, which was used to assess the relationship between the research variables in the current investigation. The result depicted that bot usability had weak but significant negative correlation ($r = -.13^*$; $p < .05$) with cognitive load. This indicated that as the bot usability increases, cognitive load tend to decrease. A non-significant weak positive correlation was found between bot usability and individual work performance ($r = .03$; $p > .05$). This indicated no meaningful association between bot usability and individual work performance. A very weak non-significant positive association was also found between cognitive load ($r = .01$; $p > .05$) and individual work performance. This also revealed no significant relationship between cognitive load and individual work performance. There was a small but substantial positive association between chat bot utilization and user experience ($r = .28^{**}$; $p < .01$). There was a small but significant negative connection between cognitive load and user experience ($r = -.14^{**}$; $p < .01$). This indicated that as the chat bot use increases, user experience tends to increase and as the user experience increases, cognitive load tend to decrease. No significant correlation was found between work performance and user experience ($r = -.04$; $p > .05$). A result of non-significant correlation between work performance and other variables can be justified with previous literature that showed that chat bots can increase productivity for certain users, they do not always predict better work performance for everyone, showing that effectiveness varies depending on the task and user environment. ⁽²⁵⁾

Mediation Analysis on the Study Variables

To investigate the mechanism behind the association between chat bot use and cognitive load, a mediation study was performed, with user

experience serving as the mediator. The mediation model was developed using the study's conceptual framework and Cognitive Load Theory as a theoretical basis. Specifically, the study investigated whether chat bot use was connected with cognitive load indirectly through user experience, as well as calculating the direct influence of chat bot use on cognitive load.

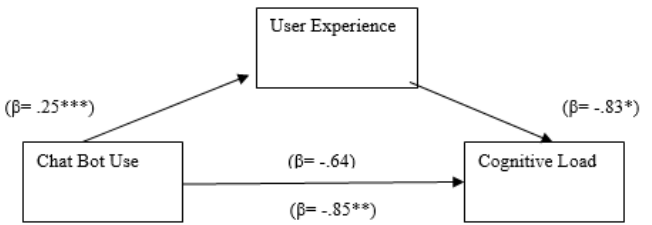
Table 03

The mediating effect of User Experience in the relationship between Chat bot Use and Cognitive Load (N = 300)

Paths	B	SE	95% CI		t	p
			LL	UL		
Chat bot use → cognitive load	-.85	.35	-1.54	-.16	-2.42	.01
Chat bot use → cognitive load	-.64	.36	-1.36	.07	1.76	.07
Chat bot use → user experience → cognitive load	-.20	.10	-.42	-.03	-	-

The result of Table 04 depicted that the relationship between chat bot usability and user experience were significant ($t = 5.13$; $p < 0.001$), suggesting that chat bot usability positively influenced user experience. The relationship between user experience and cognitive load were also significant ($t = -2.005$; $p = .04$), suggesting that user experience negatively influenced cognitive load. The total effect of chat bot usability on cognitive load as significant ($t = -2.42$; $p = .01$). The direct effect of chat bot usability on cognitive load was not significant ($t = -1.76$; $p = .07$) whereas the indirect effect of chat bot usability via user experience on cognitive load was significant with respect to the bootstrapped confidence interval (95% CI $-.42, -.03$), suggesting that user experience significantly mediated the relationship between chat bot usability and cognitive load

Figure 1: path diagram of mediation in the relationship between chat bot use, cognitive load, and chat bot user’s experience



The conceptual model proposes that chat bot use may influence researchers’ cognitive load both directly and indirectly through user experience. The direct pathway represents the potential influence of chat bot-supported task processing on cognitive load, whereas the indirect pathway proposes that chat bot use first influences users’ experience with the technology, which subsequently affects their cognitive load. This conceptualization is consistent with Cognitive Load Theory, which emphasizes the importance of how information and task demands are processed in determining the cognitive resources required to perform a task. Therefore, user experience was incorporated into the model as a potential explanatory mechanism linking chat bot use with cognitive load.

4. Discussion

Overall, the results confirmed the relationship between chat bot use, cognitive load, and user experience. However, the results contradicted the assumption about relationship between chat bot use, work performance, and user experience.

The first hypothesis suggested that the deployment of chat bots will have a detrimental impact on researchers' cognitive burden. The results supported this theory (see table 2). The findings are consistent with earlier research, which has shown that chat bots can reduce cognitive stress on working memory by automating frequent or repeated tasks. This can free up cognitive resources for harder tasks, boosting efficiency and productivity. ⁽¹⁸⁾ Chat bots can help you manage many jobs at once, which would otherwise be too much for

working memory. Chat bots relieve users of some of the cognitive strain, allowing them to focus on other vital aspects of their work. It should be noted that it may also increase felt pressure, affecting brain function.⁽²⁶⁾

The second hypothesis stated that chat bot use will be positively linked with the work performance of researchers. Results showed (see table 2) no significant relationship between chat bot use and work performance among researchers. A study showed that although Chat GPT and other generative AI technologies can increase productivity for certain users, they do not always predict better work performance for everyone, showing that effectiveness varies depending on the task and user environment.⁽²⁵⁾ A research found that inappropriate command wording input in ChatGPT can lead to inaccurate academic explanation answers, as the effectiveness of ChatGPT responses is strongly based on the clarity and precision of student comments.⁽²⁷⁾

The third hypothesis stated that user experience will negatively mediate the relationship between chat bot use and researchers' cognitive load. The results supported the theory (see Table 4). The findings were consistent with prior research, which demonstrated that in today's digital age, user experience is critical for difference. Chat bots are becoming a key component of the user experience.⁽²⁸⁾ Using a chat bot improves the user experience by optimizing response speed, ease of use, and engagement, lowering cognitive load. Users noticed a considerable improvement in their ability to effectively search for academic content.⁽²⁹⁾

The forth hypothesis stated that user experience will positively mediate the relationship between chat bot use and researchers' work performance. Results contradicted the assumption. Since no significant correlation was seen between chat bot use and work performance therefore further investigation via mediation analysis was unwarranted and thus it was omitted. The lack of mediation by user experience between chat bot use and individual work performance in the Pakistani sample could stem from unique cultural and organizational factors that influence how

employees engage with technology. In Pakistan, varying levels of digital literacy, trust in technology, and different expectations for work tools may alter the impact of chat bot usage on performance, diminishing the potential mediation effect. A study conducted in Pakistan emphasised the importance of digital literacy, stating that insufficient proficiency in this area may impede the adoption of chat bots because they operate using artificial intelligence (AI) technology, which may be intimidating to learners who lack adequate digital literacy. Such inadequacies in digital skills provide obstacles for learners and may lead to disengagement.⁽³⁰⁾

This study has certain limitations that should be noted before evaluating its results. The use of selective sampling and participants from specific study contexts in Rawalpindi and Islamabad may restrict the findings' generalizability. Furthermore, the cross-sectional design and reliance on self-reported measures prevent causal conclusions from being formed. Although the participants were active chat bot users, the study did not objectively examine the frequency, length, or particular patterns of chat bot usage, which might have impacted the observed results.

Conclusion

The current study investigated the association between chat bot use, cognitive load, and work performance among researchers, with user experience serving as a mediating factor. The study found a small but significant negative connection between chat bot usage and researchers' cognitive burden, implying that chat bot use was linked with decreased reported cognitive load. User experience strongly influenced the association between chat bot use and cognitive load, emphasizing the necessity of considering users' perspectives while investigating the cognitive consequences of chat bot-assisted research activities. However, no substantial link was seen between chat bot use and researchers' work performance. Overall, the findings indicate that chat bots may be useful tools for research-related activities such as literature exploration, information retrieval, summarization, drafting, editing, and identifying relevant information, while their impact

on work performance warrants further investigation. The findings also emphasise that chat bots should support, rather than replace, researchers' critical thinking, independent judgment, and academic decision-making.

Limitations

The current study has certain limitations that should be noted when evaluating the results. Purposive sampling was used to recruit participants from chosen research settings in Rawalpindi and Islamabad, which may restrict the findings' applicability to researchers from different geographical locations, institutions, and professional contexts. Furthermore, the cross-sectional design prevents causal correlations from being established between chat bot use, cognitive load, user experience, and work performance. The study also included self-report measures, which might be impacted by participants' subjective impressions and reaction patterns. Although participants actively used chat bots for research purposes, the study did not objectively analyze the frequency, duration, or precise patterns of chat bot usage. Furthermore, researchers may utilize chat bots for a variety of reasons, including literature searching, summarization, writing, editing, and information retrieval; however, these uses were not investigated individually. Finally, because chat bot technologies are continually developing, the findings may not accurately reflect experiences with future versions or systems.

Future Recommendations

Future research should use mixed-method and longitudinal designs to gain a better understanding of the link between chat bot use, cognitive load, user experience, and work performance over time. Researchers should investigate combining objective indications of chat bot use, such as frequency, length, task type, and interaction patterns, in addition to measures of perceived usefulness and user experience. Future study may

also look at chat bot use in specific research activities including literature reviews, information retrieval, academic writing, editing, and data analysis to see whether various applications provide different results. Furthermore, characteristics such as digital literacy, past experience with AI-based technologies, technological familiarity, and user expectations should be investigated as possible impacting variables. Future study should also focus on privacy, confidentiality, information security, academic integrity, and the proper use of chat bot technology, especially when dealing with sensitive or unpublished data. Comparative studies including beginner and expert chat bot users, as well as researchers from various geographic and institutional settings, may help to better understand the broader implications of chat bot use in research environment.

Disclosure /Conflict of interest:

Authors declare no conflict of interest.

References:

1. Borsci S, Malizia A, Schmettow M, van der Velde F, Tariverdiyeva G, Balaji D, Chamberlain A. The Chatbot Usability Scale: The Design and Pilot of a Usability Scale for Interaction with AI-Based Conversational Agents. *Personal and Ubiquitous Computing*. 2022;26(1):95–119. doi:10.1007/s00779-021-01582-9.
2. Krieglstein F, Beege M, Rey GD, Sanchez-Stockhammer C, Schneider S. Development and Validation of a Theory-Based Questionnaire to Measure Different Types of Cognitive Load. *Educational Psychology Review*. 2023;35(1):9. doi:10.1007/s10648-023-09738-0.
3. Ramos-Villagrasa PJ, Barrada JR, Fernández-del-Río E, Koopmans L. Assessing job performance using brief self-report scales: The case of the individual work performance questionnaire. *Revista de Psicología Del Trabajo y de Las Organizaciones*. 2019;35(3):195–205.
4. O'Brien HL, Cairns P, Hall M. A practical approach to measuring user engagement with the refined user engagement

- scale (UES) and new UES short form. *International Journal of Human-Computer Studies*. 2018;112:28–39. doi:10.1016/j.ijhcs.2018.01.004.
5. Følstad A, Araujo T, Law ELC, Brandtzaeg PB, Papadopoulos S, Reis L, Baez M, Laban G, McAllister P, Ischen C, Wald R, Catania F, Meyer von Wolff R, Hobert S, Luger E. Future directions for chatbot research: An interdisciplinary research agenda. *Computing*. 2021;103(12):2915–2942. doi:10.1007/s00607-021-01016-7.
 6. Kooli C. Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions. *Sustainability*. 2023;15(7):5614. doi:10.3390/su15075614.
 7. Dokukina I, Gumanova J. The rise of chatbots—new personal assistants in foreign language learning. *Procedia Computer Science*. 2020;169:542–546.
 8. Van Dis EA, Bollen J, Zuidema W, Van Rooij R, Bockting CL. ChatGPT: Five priorities for research. *Nature*. 2023;614(7947):224–226.
 9. Schmidhuber J, Schlögl S, Ploder C. Cognitive Load and Productivity Implications in Human-Chatbot Interaction. 2021 IEEE 2nd International Conference on Human-Machine Systems (ICHMS), 1–6. 2021. doi:10.1109/ICHMS53169.2021.9582445.
 10. Ubah AE, Onakpojeruo EP, Ajamu J, Mangai TR, Isa AM, Ayansina NB, Al-Turjman F. A Review of Artificial Intelligence in Education. 2022 International Conference on Artificial Intelligence of Things and Crowdsensing (AIoTCs), 38–45. 2022. Available from: <https://ieeexplore.ieee.org/abstract/document/10102207/>.
 11. Okonkwo CW, Ade-Ibijola A. Chatbots applications in education: A systematic review. *Computers and Education: Artificial Intelligence*. 2021;2:100033. doi:10.1016/j.caeai.2021.100033.
 12. Talan T, Kalinkara Y. The role of artificial intelligence in higher education: ChatGPT assessment for anatomy course. *Uluslararası Yönetim Bilişim Sistemleri ve Bilgisayar Bilimleri Dergisi*. 2023;7(1):33–40.
 13. Masoomi HAS, Dharejo N, Mahar ZA, Nazeer MI, Khoso IA, Shah A. Significant Predictors Influencing the Adoption of ChatGPT Usage in the Academia in Sindh, Pakistan: Extension of UTAUT Model. *Pegem Journal of Education and Instruction*. 2024;14(4):135–145. doi:10.47750/pegegog.14.04.14.
 14. Arshad N, Baber MU, Ullah A. Assessing the Transformative Influence of ChatGPT on Research Practices among Scholars in Pakistan. *Mesopotamian Journal of Big Data*. 2024;2024:1–10. doi:10.58496/MJBD/2024/001.
 15. Pedro F, Subosa M, Rivas A, Valverde P. Artificial intelligence in education: challenges and opportunities for sustainable development. UNESCO; 2019.
 16. De Cicco R, Silva SC e, Alparone FR. Millennials' attitude toward chatbots: an experimental study in a social relationship perspective. *International Journal of Retail and Distribution Management*. 2020;48(11):1213–1233. doi:10.1108/IJRDM-12-2019-0406.
 17. Følstad A, Brandtzaeg PB. Users' experiences with chatbots: Findings from a questionnaire study. *Quality and User Experience*. 2020;5(1):3. doi:10.1007/s41233-020-00033-2.
 18. Montrieux H, Schellens T. The impact of tablet devices on high school students' cognitive load and learning. 12th International Technology, Education and Development Conference (INTED), 1591–1596. 2018. Available from: <https://biblio.ugent.be/publication/8545807/file/8547411>.
 19. Baskara FXR. Chatbots and flipped learning: enhancing student engagement and learning outcomes through personalised support and collaboration. *International Journal of Recent Educational Research*. 2023;4(2):223–238. doi:10.46245/ijorer.v4i2.331.
 20. Vaidyam AN, Wisniewski H, Halamka JD, Kashavan MS, Torous JB. Chatbots and conversational agents in mental health: a review of the psychiatric landscape. *Can J Psychiatry*. 2019;64(7):456–464. doi:10.1177/0706743719828977.
 21. Wu R, Yu Z. Do AI chatbots improve students learning outcomes? Evidence from a meta-analysis. *British Journal of Educational Technology*. 2024;55(1):10–33. doi:10.1111/bjet.13334.
 22. Medhi Thies I, Menon N, Magapu S, Subramony M, O'Neill J. How Do You Want Your Chatbot? An Exploratory Wizard-of-Oz Study with Young, Urban Indians. In R. Bernhaupt, G. Dalvi, A. Joshi, D. K. Balkrishan, J. O'Neill, & M. Winckler (Eds.), *Human-Computer Interaction—INTERACT 2017*

- (Vol. 10513, pp. 441–459). Springer International Publishing. 2017. doi:10.1007/978-3-319-67744-6_28.
23. Behrooz M, Ngan W, Lane J, Morse G, Babcock B, Shuster K, Komeili M, Chen M, Kambadur M, Boureau YL, Weston J. The HCI Aspects of Public Deployment of Research Chatbots: A User Study, Design Recommendations, and Open Challenges (arXiv:2306.04765). arXiv. 2023. doi:10.48550/arXiv.2306.04765.
 24. Sweller J. CHAPTER TWO - Cognitive Load Theory. In J. P. Mestre & B. H. Ross (Eds.), *Psychology of Learning and Motivation* (Vol. 55, pp. 37–76). Academic Press. 2011. doi:10.1016/B978-0-12-387691-1.00002-8.
 25. Nakavachara V, Potipiti T, Chaiwat T. Experimenting with Generative AI: Does ChatGPT Really Increase Everyone's Productivity? SSRN Electronic Journal. 2024. doi:10.2139/ssrn.4746770.
 26. Spranger MD, Krishnan AC, Levy PD, O'Leary DS, Smith SA. Blood flow restriction training and the exercise pressor reflex: A call for concern. *American Journal of Physiology-Heart and Circulatory Physiology*. 2015;309(9):H1440–H1452. doi:10.1152/ajpheart.00208.2015.
 27. Emon MMH. Predicting Adoption Intention of ChatGPT-A Study on Business Professionals of Bangladesh. 2023. Available from: <https://www.researchsquare.com/article/rs-3749611/latest>.
 28. D'Haro LF, Kim S, Yeo KH, Jiang R, Niculescu AI, Banchs RE, Li H. CLARA: A Multifunctional Virtual Agent for Conference Support and Touristic Information. In G. G. Lee, H. K. Kim, M. Jeong, & J.-H. Kim (Eds.), *Natural Language Dialog Systems and Intelligent Assistants* (pp. 233–239). Springer International Publishing. 2015. doi:10.1007/978-3-319-19291-8_22.
 29. Mamani JRC, Álamo YJR, Aguirre JAA, Toledo EEG. Cognitive services to improve user experience in searching for academic information based on chatbot. 2019 IEEE XXVI International Conference on Electronics, Electrical Engineering and Computing (INTERCON), 1–4. 2019. doi:10.1109/INTERCON.2019.8853572.
 30. Ashraf M, Hafeez R, Sajid AN. Factors affecting the adoption of Fin-tech in Pakistan based on the Unified Theory of Acceptance and Use of Technology Model: An empirical study on financial inclusion in Pakistan. *Journal of Financial Technologies (Fintech), Inclusion and Sustainability*. 2022;1(1):9–26.
 31. Amiot C. Trustworthy chatbots assisting large-scale collaboration. 2020. Available from: https://scholar.archive.org/work/p5zzdvwjprdwzl3hakziwshjam/access/wayback/https://dl.eusset.eu/bitstream/20.500.12015/4048/1/ecscw2020_dc03.pdf.
 32. Bohomolova I, Kushnir N, Moshkovska S. Using Chatbots to Approach Individual Learning Trajectories in Physics for Foreign Students. *ICTERI*, 253–263. 2021. Available from: <https://icteri.org/icteri-2021/proceedings/volume-1/20210253.pdf>.
 33. Hauptmann A, Magalhaes J, Sousa RG, Costeira JP. MuCAI'20: 1st International Workshop on Multimodal Conversational AI. *Proceedings of the 28th ACM International Conference on Multimedia*, 4767–4768. 2020. doi:10.1145/3394171.3421900.
 34. Jo H, Park DH. AI in the Workplace: Examining the Effects of ChatGPT on Information Support and Knowledge Acquisition. *International Journal of Human-Computer Interaction*. 2024;40(23):8091–8106. doi:10.1080/10447318.2023.2278283.
 35. Kc DS, Staats BR, Kouchaki M, Gino F. Task Selection and Workload: A Focus on Completing Easy Tasks Hurts Performance. *Management Science*. 2020;66(10):4397–4416. doi:10.1287/mnsc.2019.3419.
 36. King JL, Ehrenberg AJ. The Productivity Vampires. *Information Systems Frontiers*. 2020;22(1):11–15. doi:10.1007/s10796-019-09943-9.
 37. Kobiella C, López YSF, Draxler F, Schmidt A. “If the Machine Is As Good As Me, Then What Use Am I?”—How the Use of ChatGPT Changes Young Professionals' Perception of Productivity and Accomplishment (arXiv:2404.12549). arXiv. 2024. doi:10.48550/arXiv.2404.12549.
 38. Lee PY, Salim H, Abdullah A, Teo CH. Use of ChatGPT in medical research and scientific writing. *Malaysian Family Physician*. 2023;18:58. doi:10.51866/cm0006.
 39. Paas F, Van Merriënboer JG. Cognitive-Load Theory: Methods to Manage Working Memory Load in the Learning

- of Complex Tasks. *Current Directions in Psychological Science*. 2020;29(4):394–398. doi:10.1177/0963721420922183.
40. Rostami M, Abadi PM. The Impact of Doing Assignments with Chatbots on The Students' Working Memory. *Health Nexus*. 2023;1(1):Article 1. doi:10.61838/kman.hn.1.1.10.
 41. Shaban A, Pearson E. Evaluation of user experience and cognitive load of a gamified cognitive training application for children with learning disabilities. *Proceedings of the 17th International Web for All Conference*, 1–10. 2020. doi:10.1145/3371300.3383341.
 42. Sweller J. The Role of Evolutionary Psychology in Our Understanding of Human Cognition: Consequences for Cognitive Load Theory and Instructional Procedures. *Educational Psychology Review*. 2022;34(4):2229–2241. doi:10.1007/s10648-021-09647-0.
 43. Sweller J, Van Merriënboer JJG, Paas F. Cognitive Architecture and Instructional Design: 20 Years Later. *Educational Psychology Review*. 2019;31(2):261–292. doi:10.1007/s10648-019-09465-5.
 44. Zhai C, Wibowo S, Cowling M. Work-in-Progress—Embedding cross-cultural humorous and empathetic functions to facilitate language acquisition. 2022 8th International Conference of the Immersive Learning Research Network (iLRN), 1–4. 2022. Available from: <https://ieeexplore.ieee.org/abstract/document/9815992/>.
 45. Zhang H, Fan L, Chen M, Qiu C. The impact of SIPOC on process reengineering and sustainability of enterprise procurement management in e-commerce environments using deep learning. *Journal of Organizational and End User Computing (JOEUC)*. 2022;34(8):1–17. Randelović, I., et al., Effects of exercise programs on upper crossed syndrome: a systematic review. *Fizičko vaspitanje i sport kroz vekove*, 2020. 7(2): p. 152-68.