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Exploring Barriers to the Adoption of Generative Artificial Intelligence Tools among University Students: A Perspective from Innovation Resistance Theory

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ABSTRACT : Information and Communication Technology (ICT) has made tremendous progress and seen astounding advancements, particularly with the emergence of Generative Artificial Intelligence (GAI) tools such as ChatGPT and Sora. As one of the quintessential representatives of ICT, generative AI tools carry the potential to revolutionize education and significantly influence the future. They can help students access personalized learning experiences, virtual tutors, specific programming skills, and engagement opportunities. However, the tools have not been widely used, and limited studies have explicitly focused on the primary barriers leading to technological resistance among some university students. Additionally, a dedicated theoretical framework for analyzing the main barriers is scarce. The principal objective of this study is to propose a conceptual model based on Innovation Resistance Theory (IRT) to measure the main barriers to generative AI tools usage among university students. Two methodologies, literature acquisition and validation, were utilized to validate the new conceptual model. Notably, this study is among the first to include the constructs of Information Quality Barrier (IQB) and Job Relevance Barrier (JRB) in IRT. The study aims to address the lack of a conceptual model for measuring the main barriers to the use of generative AI tools among university students. Additionally, it will help identify the shortcomings of generative AI tools in practice, which can be used to develop more effective tools for educational purposes.

KEYWORDS: Artificial Intelligence (AI), ChatGPT, Innovation Resistance Theory (IRT), barrier, Generative Artificial Intelligence (GAI)

I. INTRODUCTION

Over the past decade, Information and Communication Technology (ICT) has undergone tremendous progress and astounding advancements, especially in some educationally advanced countries [1-4]. Generative AI tools are state-of-the-art, AI-powered language models that can produce sophisticated texts, images, videos, or other forms of multimedia that are nearly indistinguishable from those created by humans [5]. As one of the quintessential representatives of ICT, generative AI tools carry the potential to revolutionize education and significantly influence the future [6-9]. Even though some studies have suggested that generative AI tools may impact university students in terms of their assignments, personalized learning, motivation, and other aspects, there are also challenges related to their information accuracy, ethics, privacy, and other factors [10-13]. Some surveys also found that the tools have not been extensively employed among students for various reasons [10, 14, 15]. In one investigation of healthcare undergraduate students in Malaysia, the proportion of students who depended highly on generative AI tools was 9.3%, with the majority of students (45.8%) utilizing them to assist particular areas of assignments, while the percentage of students who did not use it reached to 41.1% [10]. However, until now, few studies have explicitly focused on the main barriers that lead to generative AI tool resistance among university students, and a dedicated theoretical framework to analyze the main barriers is scarce. Therefore, it is essential to investigate the attitudes and behaviors of university students towards the use of generative AI tools. This specific context can offer valuable insights into the development and implementation of impactful AI tools in the higher education system. The principal objective of the current study is to propose a conceptual model to measure the main barriers to generative AI tools usage among university students.

II. LITERATURE REVIEW

Since their inception, generative AI tools have sparked a research frenzy in numerous countries, such as the United States, China, Germany, India, and Malaysia [16-22]. Previous studies possessed divergent research foci, for example, the history of generative AI [17], digital leadership and technology integration [5], usage and limitations [23], AI-driven infodemic threat [24], and the future of large language models [25]. Simultaneously, generative AI tools have already attracted considerable attention from multiple industries, including but not limited to: Data Science [26], Healthcare [27, 28], Computer Programming [18], Science Learning Media [29], Business [30, 31],

Human Resource Management [32], Drawing [33], Art and Design [34, 35], and Education [6, 9, 13, 22, 36, 37]. Prior researchers have also explored the influence of the tools on education from various perspectives, such as AI-human collaboration [38], prospects and challenges [9, 20, 25], using generative AI tools for self-determined learning [13], traditional textbooks [39], healthcare education [10, 28, 40], and risks or threats [38, 41]. There is also a study that assessed the potential and constraints of OpenAI's ChatGPT for educational, academic, and research purposes by examining its various capabilities [9]. Generative AI tools can assist teachers in planning lessons [6, 41], generating suggestions for formative assessment campaigns [42], interacting in conversations [41], shifting roles [43], integrating technology into classrooms [44], facilitating students to acquire personalized learning experiences [6, 9], virtual tutor [45], specifically answering [38], programming skills [41], engagement opportunities [46], related information searching [38], and so on. According to past research, generative AI tools can provide enormous benefits and non-negligible opportunities for multiple industries or groups of people, particularly for the education industry and university students.

In terms of research methodologies, interview method [22, 40], case study [47], literature review method [21, 48], topic modeling algorithm [49], quantitative method [50], content analysis [45] and mixed method [51] were implemented to examine generative AI tools related studies. Some researchers reminded that users should be aware of the limitations or difficulties of plagiarism, non-discrimination, ethical problems, privacy issues and others when using generative AI tools [26, 38, 41, 42, 44].

Upon the literature review, it was found that Technology Acceptance Model (TAM) [6, 36, 37, 52, 53], Unified Theory of Acceptance and Use of Technology (UTAUT) [30, 54, 55], Technology-Organization-Environment (TOE) framework [8], Integrating Technology Readiness into Technology Acceptance (TRAM) Model [56], mixed models [16], or other theoretical models were adopted in research associated with generative AI tools. However, Innovation Resistance Theory (IRT) [57] (Fig. 1) has been neglected to identify the main barriers to using generative AI tools among university students.

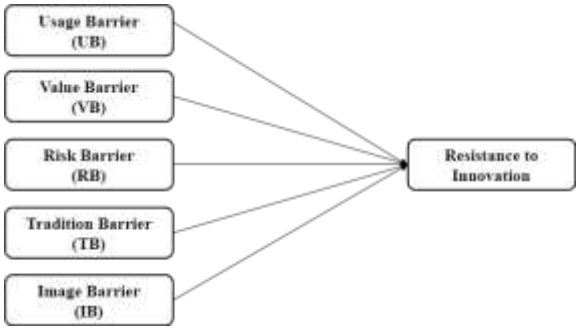

Figure. 1. The framework of Innovation Resistance Theory (IRT)

Ram and Sheth (1989) put forward the framework of IRT, which was initially used to analyze the reasons for consumer's resistance to innovative products. After that, IRT was implemented and extended to various situations like mobile payment solutions [58], ticket software [59] and mobile wallets [60] to explain the barriers to innovation. IRT has already been proven to be a suitable model for measuring the barriers to innovation. However, in the context of generative AI tools, it has not been adequately explored to investigate the barriers causing resistance, especially among university students.

Previous studies have attempted to test social influence [7, 8, 36, 54], perceived usefulness [7], [22, 36], ease of use [22, 37], performance expectancy [30, 54], credibility [22, 37], satisfaction [8], organizational culture [8], personal innovativeness [53], trust [30, 36], metacognitive self-regulated learning [36], compatibility [22], attitudes [30], effort expectancy [30], and other factors influencing consumers' use intention or acceptance of generative AI tools in different backgrounds or distinguishing target populations. Nevertheless, prior studies have neglected the relationship between Image Barrier (IB) and Resistance to Generative AI tools (RTG) and lacked sufficient data to verify it. Whether Tradition Barrier (TB) affects RTG lacks adequate evidence and has not been constructed. Even though past researchers noticed that ethical problems or privacy issues might affect the adoption of generative AI tools in certain conditions, the association between Risk Barrier (RB) and RTG needs to be further validated in the population of university students. Reviewing the literature, empirical evidence of the connection between Value Barrier (VB) and RTG remains scarce.

Until now, the relationship between the Usage Barrier (UB) and RTG is still unclear, and further exploration and more robust validations are needed. Previous research has stressed the importance of information quality for Generative AI (e.g., Generative AI tools), whereas no study has validated the relationship between the Information Quality Barrier (IQB) and RTG among university students; this study will fill this gap. Historically, the majority of existing research on job relevance (JR) has been conducted principally from the perspective of adoption, however, there is still a paucity of studies on the association between Job Relevance Barrier (JRB) and RTG.

III. CONCEPTUAL MODEL

User resistance is one of the significant factors causing the failure of almost every innovation [61]. Consequently, researchers and professionals who aim to promote the rapid spread and acceptance of new technologies must pay attention to consumer resistance since it is a crucial aspect of concern [61]. With the progress of technologies and sharp transformations of societal environments, the foundation model of IRT must be updated to accommodate new scenarios. Based on the IRT model, this study proposes a conceptual model (shown in Fig. 2) for explaining the main barriers to generative AI tool usage among university students. The detailed information for each construct will be elaborated on in the forthcoming paragraphs.

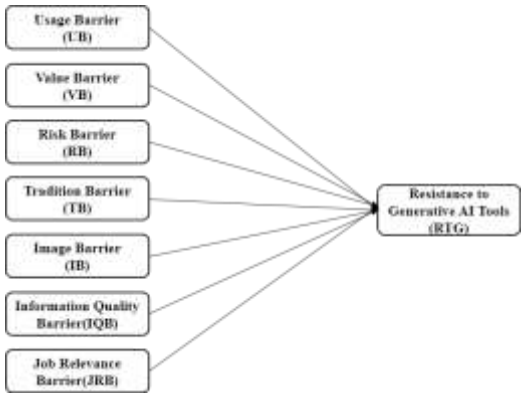

Figure. 2. A new conceptual model

Information Quality Barrier : In this study, IQB refers to the extent of lower output quality produced by generative AI tools from the perspective of university students. IQB chiefly manifests the lower information quality (e.g., inaccuracy, untimeliness or unreliability) generated by information systems (IS). Much prior research highlighted the importance of information quality created by ICT [16, 62-64], which directly affects consumers' intention to use. Hence, it can be postulated that if the quality of information generated by generative AI tools is too poor or imprecise, university students will probably resist them.

Job Relevance Barrier : In the present study, JRB relates to an individual's perception of barriers regarding the degree to which the generative AI tools are applicable to university students' jobs. In the past, job relevance was an essential factor impacting the acceptance of learning management systems (LMS) [1], AI-based Conversational Agents [65], Artificial Intelligence-Based Robots [66] and others. Drawing on the aforementioned findings and discussions, this study predicts that JRB is most probably a significant factor resulting in university students' resistance to Generative AI tools. For example, if the outcomes created by generative AI tools are irrelevant to university students' learning tasks, it is likely to lead to the rejection of Generative AI tools.

Usage Barrier : Ram and Sheth deemed that UB was usually caused by the incompatibility of innovations with users' existing workflows, practices, or habits [57]. According to former studies, UB is one non-negligible element when consumers select hotel booking apps [67], mobile wallets [60], Mobile Commerce [68] or other innovative offerings. In the context of generative AI tools, UB is likely an important component of resistance among university students.

Value Barrier : Consumers have no motivation to switch until an innovation provides a compelling performance-to-price ratio contrasted with competing alternatives [57]. Some investigations have demonstrated that VB had a significant effect on the adoption or use intention of Automatic Teller Machines (ATM) [57], MOOC

[69], digital payment systems [70], online shopping [71] and others. Therefore, the present study deduces that VB is likely part of the core reasons why partial university students resist Generative AI tools.

Risk Barrier : According to Ram and Sheth, for innovative commodities, four primary kinds of risk are involved: economic risk, physical risk, functional risk and social risk [57]. In one investigation of undergraduate healthcare students, they displayed worries regarding plagiarism, ethical dilemmas and other issues. When using generative AI tools in Systems Thinking (ST), intermittent inaccuracies emphasize the magnitude of clients maintaining a critical mindset toward generative AI tools' answers [72]. Some researchers expressed apprehensions about potential risks such as cheating [6], existing biases [42], bypassing plagiarism detectors [45], privacy issues [42] and so forth. Thus, this study predicts that the risk barrier is most likely an influential factor in some university students' resistance to generative AI tools.

Tradition Barrier : Ram and Sheth considered that resistance arose when an innovation necessitated purchasers to depart from existing conventions [57]. Sadiq et al. found that TB is an important factor impacting customers' intention to buy eco-friendly cosmetics [73]. For food delivery applications (FDAs), the presence of TB has been demonstrated to indicate a negative correlation with the intention to use [74]. Furthermore, Migliore et al. revealed that the primary obstacle to the acceptance of mobile payment in some countries is TB [75]. Consequently, the current study conjectures that TB is a very potentially significant contributor affecting some university students' resistance to generative AI tools.

Image Barrier : Ram and Sheth believed that IB was a perceptual question that emerged from rigid thought patterns and hindered the advancement of innovation [57]. Preliminary studies have disclosed that IB was a significant factor affecting the acceptance of digital payment systems [70], mobile wallets [60], e-commerce [76], online payment solutions [77], Internet and mobile banking [78] and the like. Based on the aforementioned discussions and outcomes, it is quite possible that IB is a prominent reason for some university students' resistance to Generative AI tools.

Resistance to Generative AI Tools : Szmigin and Foxall (1998) found three distinct forms of resistance to innovation (rejection, postponement and opposition) in the research of retail payment methods [79]. Laukkanen et al. (2008) divided those who did not use Internet banking into three different categories: postponers, opponents, and rejectors [80]. Although generative AI tools provide numerous benefits and valuable functionalities (as mentioned earlier), not all university students are favorable to accept them; this study principally focuses on barriers leading to those students who postpone, reject, or oppose generative AI tools.

IV. MODEL VALIDATION

This study utilizes two methodologies, literature acquisition and validation, to understand the potentially significant factors in measuring the main barriers to generative AI tool usage among university students. In the first stage, the present study conducts literature reviews about generative AI tools-related research, the theoretical framework of IRT and some practical applications of IRT to identify the barriers perhaps associated with resistance to generative AI tools among university students (as described in previous sections). In the second stage, compare previous literature and consult experts for advice to understand better the effectiveness, appropriateness, availability, relevance, or validation of the enhanced IRT conceptual model. To ensure rigorous constructs and accurate results, the experts are selected by referencing the following criteria (Table 1) [81-83].

Table 1 Criteria for Selecting Experts

Criteria	Details
i. degree	The expert should possess an advanced degree.
ii. experience	Have more than five years of related research or work experience.
iii. field	Being an expert in related fields, such as ICT, AI or IT.
iv. paper	Multiple published articles.

V. CONCLUSION

Notably, this study is among the first to include the constructs of IQB and JRB in an IRT model. This study contributes to identifying the significant barriers to generative AI tools among university students from the perspective of a new conceptual model developed based on the IRT model. Moreover, it is also valuable and advantageous for researchers in IS, AI, education, or other fields since the new theoretical model can facilitate investigating the factors impeding the widespread use of generative AI tools and technology development. In conclusion, this study will fill the theoretical gap where there is inadequate about the conceptual model to measure the main barriers to generative AI tool usage among university students. Additionally, the study is beneficial in detecting the insufficiencies of generative AI tools in practice. However, this study still has some limitations, such as the lack of empirical examinations and the limited number of factors introduced. Future research could conduct further empirical investigations and test the effects of different variables on innovative technological resistance behaviors.

REFERENCES

[1] Altawalbeh, Manal A. "Adoption of academic staff to use the Learning Management System (LMS): Applying extended technology acceptance model (TAM2) for Jordanian universities." *International Journal on Studies in Education (IJonSE)* 5, no. 3 (2023). https://doi.org/10.46328/ijonse.124

[2] Hapini, Awang. "Implementation Evaluation Model to Measure Virtual Learning Environment Success Factors among Malaysian Teachers," 2019. https://etd.uum.edu.my/id/eprint/8137

[3] Khan, Asharul Islam, Hafedh Al-Shihi, Zuhoor Abdullah Al-Khanjari, and Mohamed Sarrab. "Mobile Learning (M-Learning) adoption in the Middle East: Lessons learned from the educationally advanced countries." *Telematics and Informatics* 32, no. 4 (2015): 909-920. https://doi.org/10.1016/j.tele.2015.04.005

[4] Ishola Dada Muraina. "The Factors That Contribute to the Continuous Usage of Broadband Technologies Among Youth in Rural Areas: A Case of Northern Region of Malaysia," 2015. https://etd.uum.edu.my/5341/.

[5] Karakose, Turgut, Murat Demirkol, Ramazan Yirci, Hakan Polat, Tuncay Yavuz Ozdemir, and Tijen Tülübaş. "A conversation with ChatGPT about digital leadership and technology integration: Comparative analysis based on human–AI collaboration." *Administrative Sciences* 13, no. 7 (2023): 157. https://doi.org/10.3390/admsci13070157

[6] Iqbal, Nayab, Hassaan Ahmed, and Kaukab Abid Azhar. "Exploring teachers' attitudes towards using chatgpt." *Global Journal for Management and Administrative Sciences* 3, no. 4 (2022): 97-111. https://doi.org/10.46568/gjmas.v3i4.163

[7] Abdaljaleel, Maram, Muna Barakat, Mariam Alsanafi, Nesreen A. Salim, Husam Abazid, Diana Malaeb, Ali Haider Mohammed et al. "A multinational study on the factors influencing university students' attitudes and usage of ChatGPT." *Scientific Reports* 14, no. 1 (2024): 1983. https://doi.org/10.1038/s41598-024-52549-8

[8] Jo, Hyeon, and Youngsok Bang. "Analyzing ChatGPT adoption drivers with the TOEK framework." *Scientific Reports* 13, no. 1 (2023): 22606. https://doi.org/10.1038/s41598-023-49710-0

[9] Opara Emmanuel Chinonso, Adalikwu Mfon-Ette Theresa, Tolorunleke Caroline Aduke. "ChatGPT for Teaching, Learning and Research: Prospects and Challenges," (2023). https://doi.org/10.36348/gajhss.2023.v05i02.001

[10] Pallivathukal, Renjith George, Htoo Htoo Kyaw Soe, Preethy Mary Donald, Renu Sarah Samson, and Abdul Rashid Hj Ismail. "ChatGPT for Academic Purposes: Survey Among Undergraduate Healthcare Students in Malaysia." *Cureus* 16, no. 1 (2024). doi: 10.7759/cureus.53032

[11] Ibrahim, Ishaq, Ali Nasser Altahitah, Kalsom Ali, Ali Ateeq, and Mohammed Abdulrazzaq Alaghbari. "How Does Chat GPT Influence Human Capital Development Amongst Malaysian Undergraduate Students?." In *2024 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems (ICETSIS)*, pp. 213-219. IEEE, 2024. https://doi.org/10.1109/ICETSIS61505.2024.10459491

[12] Hamid, Hazrina, Khadjizah Zulkifli, Faiza Naimat, Nor Liana Che Yaacob, and Kwok Wen Ng. "Exploratory study on student perception on the use of chat AI in process-driven problem-based learning." *Currents in Pharmacy Teaching and Learning* 15, no. 12 (2023): 1017-1025. https://doi.org/10.1016/j.cptl.2023.10.001

[13] Baskara, FX Risang. "The promises and pitfalls of using chat gpt for self-determined learning in higher education: An argumentative review." In *Prosiding Seminar Nasional Fakultas Tarbiyah dan Ilmu Keguruan IAIM Sinjai*, vol. 2, pp. 95-101. 2023. https://doi.org/10.47435/sentikjar.v2i0.1825

[14] Alias, Afzanizam Bin, Nor Idalaila Binti Aziz, and Mohamad Shaufi Bin Kambaruddin. "Exploring Of Chatgpt Application Usage In TVET Institutions: A Case Study Of Diploma In Information Technology, Polytechnic Malaysia." https://www.icbe.my/wp-content/uploads/2023/10/22-1.pdf

[15] Abd Rahim, Emma Marini, Mia Emily Abd Rahim, Nurul Amilin Razawi, and Nurul Adilah Mohamed. "Students' perception on the use of ChatGPT as a language learning tool." *Idealogy Journal* 8, no. 2 (2023): 70-78. https://ir.uitm.edu.my/id/eprint/86694

[16] Niu, Ben, and Gustave Florentin Nkoulou Mvondo. "I Am ChatGPT, the ultimate AI Chatbot! Investigating the determinants of users' loyalty and ethical usage concerns of ChatGPT." *Journal of Retailing and Consumer Services* 76 (2024): 103562. https://doi.org/10.1016/j.jretconser.2023.103562

[17] Cao, Yihan, Siyu Li, Yixin Liu, Zhiling Yan, Yutong Dai, Philip S. Yu, and Lichao Sun. "A comprehensive survey of ai-generated content (aigc): A history of generative ai from gan to chatgpt." *arXiv preprint arXiv:2303.04226* (2023). https://doi.org/10.48550/arXiv.2303.04226

[18] Biswas, Som. "Role of ChatGPT in Computer Programming.: ChatGPT in Computer Programming." *Mesopotamian Journal of Computer Science* 2023 (2023): 8-16. https://doi.org/10.58496/MJCSC/2023/002

[19] Rudolph, Jürgen, Shannon Tan, and Samson Tan. "War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education." *Journal of Applied Learning and Teaching* 6, no. 1 (2023). https://doi.org/10.37074/jalt.2023.6.1.23

[20] Kasneci, Enkelejda, Kathrin Seßler, Stefan Küchemann, Maria Bannert, Daryna Dementieva, Frank Fischer, Urs Gasser et al. "ChatGPT for good? On opportunities and challenges of large language models for education." *Learning and individual differences* 103 (2023): 102274. https://doi.org/10.1016/j.lindif.2023.102274

[21] Ray, Partha Pratim. "ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope." *Internet of Things and Cyber-Physical Systems* (2023). https://doi.org/10.1016/j.iotcps.2023.04.003

[22] Mukred, Muaadh, M. Umi Asma, and Burkan Hawash. "Exploring the acceptance of ChatGPT as a learning tool among academicians: a qualitative study." *J. Komunikasi Malays. J. Commun.* 39, no. 4 (2023): 306-323. https://doi.org/10.17576/JKMJC-2023-3904-16

[23] Azaria, Amos. "ChatGPT usage and limitations." (2022). https://doi.org/10.31219/osf.io/5ue7n

[24] De Angelis, Luigi, Francesco Baglivo, Guglielmo Arzilli, Gaetano Pierpaolo Privitera, Paolo Ferragina, Alberto Eugenio Tozzi, and Caterina Rizzo. "ChatGPT and the rise of large language models: the new AI-driven infodemic threat in public health." *Frontiers in Public Health* 11 (2023): 1166120. https://doi.org/10.3389/fpubh.2023.1166120

[25] Liu, Yiheng, Tianle Han, Siyuan Ma, Jiayue Zhang, Yuanyuan Yang, Jiaming Tian, Hao He et al. "Summary of chatgpt-related research and perspective towards the future of large language models." *Meta-Radiology* (2023): 100017. https://doi.org/10.1016/j.metrad.2023.100017

[26] Hassani, Hossein, and Emmanuel Sirmal Silva. "The role of ChatGPT in data science: how ai-assisted conversational interfaces are revolutionizing the field." *Big data and cognitive computing* 7, no. 2 (2023): 62. https://doi.org/10.3390/bdcc7020062

[27] Cascella, Marco, Jonathan Montomoli, Valentina Bellini, and Elena Bignami. "Evaluating the feasibility of ChatGPT in healthcare: an analysis of multiple clinical and research scenarios." *Journal of medical systems* 47, no. 1 (2023): 33. https://doi.org/10.1007/s10916-023-01925-4

[28] Sallam, Malik. "ChatGPT utility in healthcare education, research, and practice: systematic review on the promising perspectives and valid concerns." In *Healthcare*, vol. 11, no. 6, p. 887. MDPI, 2023. https://doi.org/10.3390/healthcare11060887

[29] Prananta, Arie Wahyu, Nugroho Susanto, Arif Purwantoro, and Nur Fuadah. "ChatGPT Artificial Intelligence Integration in Science Learning Media: Systematic Literature Review." *Jurnal Penelitian Pendidikan IPA* 9, no. 7 (2023): 315-321. https://doi.org/10.29303/jppipa.v9i7.4386

[30] Emon, Md Mehedi Hasan. "Predicting Adoption Intention of ChatGPT-A Study on Business Professionals of Bangladesh." (2023). https://doi.org/10.21203/rs.3.rs-3749611/v1

[31] George, A. Shaji, and AS Hovan George. "A review of ChatGPT AI's impact on several business sectors." *Partners Universal International Innovation Journal* 1, no. 1 (2023): 9-23. https://doi.org/10.5281/zenodo.7644359

[32] Budhwar, Pawan, Soumyadeb Chowdhury, Geoffrey Wood, Herman Aguinis, Greg J. Bamber, Jose R. Beltran, Paul Boselie et al. "Human resource management in the age of generative artificial intelligence: Perspectives and research directions on ChatGPT." *Human Resource Management Journal* 33, no. 3 (2023): 606-659. https://doi.org/10.1111/1748-8583.12524

[33] Wu, Chenfei, Shengming Yin, Weizhen Qi, Xiaodong Wang, Zecheng Tang, and Nan Duan. "Visual chatgpt: Talking, drawing and editing with visual foundation models." *arXiv preprint arXiv:2303.04671* (2023). https://doi.org/10.48550/arXiv.2303.04671

[34] Zhu, Sijin, Zheng Wang, Yuan Zhuang, Yuyang Jiang, Mengyao Guo, Xiaolin Zhang, and Ze Gao. "Exploring the impact of ChatGPT on art creation and collaboration: Benefits, challenges and ethical implications." *Telematics and Informatics Reports* 14 (2024): 100138. https://doi.org/10.1016/j.teler.2024.100138

[35] Guo, Chao, Yue Lu, Yong Dou, and Fei-Yue Wang. "Can ChatGPT boost artistic creation: The need of imaginative intelligence for parallel art." *IEEE/CAA Journal of Automatica Sinica* 10, no. 4 (2023): 835-838. https://doi.org/10.1109/JAS.2023.123555

[36] Dahri, Nisar Ahmed, Noraffandy Yahaya, Waleed Mugahed Al-Rahmi, Ahmed Aldraiweesh, Uthman Alturki, Sultan Almutairy, Anna Shutaleva, and Rahim Bux Soomro. "Extended TAM based acceptance of AI-Powered ChatGPT for supporting metacognitive self-regulated learning in education: A mixed-methods study." *Heliyon* 10, no. 8 (2024). https://doi.org/10.1016/j.heliyon.2024.e29317

[37] Masadeh, Ra'ed, S. Majali, Maha Alkhaffaf, Ramayah Thurasamy, Dmaithan Almajali, Khalid Altarawneh, Ala'asaeb Al-Sherideh, and Ibrahim Altarawni. "Antecedents of adoption and usage of ChatGPT among Jordanian university students: Empirical study." *International Journal of Data and Network Science* 8, no. 2 (2024): 1099-1110. https://doi.org/10.5267/j.ijdns.2023.11.024

[38] Fui-Hoon Nah, Fiona, Ruilin Zheng, Jingyuan Cai, Keng Siau, and Langtao Chen. "Generative AI and ChatGPT: Applications, challenges, and AI-human collaboration." *Journal of Information Technology Case and Application Research* 25, no. 3 (2023): 277-304. https://doi.org/10.1080/15228053.2023.2233814

[39] Ateeq, Ali, Mohannad Moufeed Ayyash, Marwan Milhem, Mohammed Alzoraiki, and Qadri Kamal Alzaghal. "From Textbooks to Chatbots: The Integration of Chatgpt in Modern University Pedagogy." *Journal of Theoretical and Applied Information Technology* 102, no. 4 (2024). http://www.jatit.org/volumes/Vol102No4/11Vol102No4.pdf

[40] Eysenbach, Gunther. "The role of ChatGPT, generative language models, and artificial intelligence in medical education: a conversation with ChatGPT and a call for papers." *JMIR Medical Education* 9, no. 1 (2023): e46885. https://doi.org/10.2196/46885

[41] Rahman, Md Mostafizer, and Yutaka Watanobe. "ChatGPT for education and research: Opportunities, threats, and strategies." *Applied Sciences* 13, no. 9 (2023): 5783. https://doi.org/10.3390/app13095783

[42] Baidoo-Anu, David, and Leticia Owusu Ansah. "Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning." *Journal of AI* 7, no. 1 (2023): 52-62. https://doi.org/10.61969/jai.1337500

[43] Ausat, Abu Muna Almaududi, Berdinata Massang, Mukhtar Efendi, Nofirman Nofirman, and Yasir Riady. "Can Chat GPT replace the role of the teacher in the classroom: A fundamental analysis." *Journal on Education* 5, no. 4 (2023): 16100-16106. https://doi.org/10.31004/joe.v5i4.2745

[44] AlAfnan, Mohammad Awad, Samira Dishari, Marina Jovic, and Koba Lomidze. "Chatgpt as an educational tool: Opportunities, challenges, and recommendations for communication, business writing, and composition courses." *Journal of Artificial Intelligence and Technology* 3, no. 2 (2023): 60-68. https://doi.org/10.37965/jait.2023.0184

[45] Lo, Chung Kwan. "What is the impact of ChatGPT on education? A rapid review of the literature." *Education Sciences* 13, no. 4 (2023): 410. https://doi.org/10.3390/educsci13040410

[46] Cotton, Debby RE, Peter A. Cotton, and J. Reuben Shipway. "Chatting and cheating: Ensuring academic integrity in the era of ChatGPT." *Innovations in education and teaching international* 61, no. 2 (2024): 228-239. https://doi.org/10.1080/14703297.2023.2190148

[47] Tlili, Ahmed, Boulus Shehata, Michael Agyemang Adarkwah, Aras Bozkurt, Daniel T. Hickey, Ronghuai Huang, and Brighter Agyemang. "What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education." *Smart Learning Environments* 10, no. 1 (2023): 15. https://doi.org/10.1186/s40561-023-00237-x

[48] Montenegro-Rueda, Marta, José Fernández-Cerero, José María Fernández-Batanero, and Eloy López-Meneses. "Impact of the implementation of ChatGPT in education: A systematic review." *Computers* 12, no. 8 (2023): 153. https://doi.org/10.3390/computers12080153

[49] Taecharungroj, Viriya. "“What can ChatGPT do?” Analyzing early reactions to the innovative AI chatbot on Twitter." *Big Data and Cognitive Computing* 7, no. 1 (2023): 35. https://doi.org/10.3390/bdcc7010035

[50] Emon, Md Mehedi Hasan, Farheen Hassan, Mehzabul Hoque Nahid, and Vichayanan Rattanawiboonsom. "Predicting adoption intention of artificial intelligence." *AIUB Journal of Science and Engineering (AJSE)* 22, no. 2 (2023): 189-199. https://doi.org/10.53799/ajse.v22i2.797

[51] Jahan, Mudasar, Lubna Aram Azam, Farooq Ahmad, and Hina Sadia. "Reinforcement Learning Supplementing Communicative Language Teaching: Examining the Applications of ChatGPT in ELT

Classrooms." *Journal of Namibian Studies: History Politics Culture* 33 (2023): 299-330. https://doi.org/10.59670/jns.v33i.5197

[52] Foroughi, Behzad, Madugoda Gunaratnege Senali, Mohammad Iranmanesh, Ahmad Khanfar, Morteza Ghobakhloo, Nagaletchimee Annamalai, and Bita Naghmeh-Abbaspour. "Determinants of intention to use ChatGPT for educational purposes: Findings from PLS-SEM and fsQCA." *International Journal of Human–Computer Interaction* (2023): 1-20. https://doi.org/10.1080/10447318.2023.2226495

[53] Alrishan, Amal Mohammad Husein. "Determinants of Intention to Use ChatGPT for Professional Development among Omani EFL Pre-service Teachers." *International Journal of Learning, Teaching and Educational Research* 22, no. 12 (2023): 187-209. https://doi.org/10.26803/ijlter.22.12.10

[54] Salifu, Iddrisu, Francis Arthur, Valentina Arkorful, Sharon Abam Nortey, and Richard Solomon Osei-Yaw. "Economics students' behavioural intention and usage of ChatGPT in higher education: a hybrid structural equation modelling-artificial neural network approach." *Cogent Social Sciences* 10, no. 1 (2024): 2300177. https://doi.org/10.1080/23311886.2023.2300177

[55] Menon, Devadas, and K. Shilpa. "“Chatting with ChatGPT”: Analyzing the factors influencing users' intention to Use the Open AI's ChatGPT using the UTAUT model." *Heliyon* 9, no. 11 (2023). https://doi.org/10.1016/j.heliyon.2023.e20962

[56] Lin, Chien-Hsin, Hsin-Yu Shih, and Peter J. Sher. "Integrating technology readiness into technology acceptance: The TRAM model." *Psychology & Marketing* 24, no. 7 (2007): 641-657. https://doi.org/10.1002/mar.20177

[57] Ram, Sundaresan, and Jagdish N. Sheth. "Consumer resistance to innovations: the marketing problem and its solutions." *Journal of consumer marketing* 6, no. 2 (1989): 5-14. https://doi.org/10.1108/EUM0000000002542

[58] Dotzauer, Kathrin, and Fabienne Haiss. "Barriers towards the adoption of mobile payment services: An empirical investigation of consumer resistance in the context of Germany." (2017). urn:nbn:se:kau:diva-55360

[59] Chen, Chia-Chen, Chin-Hsuan Chang, and Kuo-Lun Hsiao. "Exploring the factors of using mobile ticketing applications: Perspectives from innovation resistance theory." *Journal of Retailing and Consumer Services* 67 (2022): 102974. https://doi.org/10.1016/j.jretconser.2022.102974

[60] Leong, Lai-Ying, Teck-Soon Hew, Keng-Boon Ooi, and June Wei. "Predicting mobile wallet resistance: A two-staged structural equation modeling-artificial neural network approach." *International Journal of Information Management* 51 (2020): 102047. https://doi.org/10.1016/j.ijinfomgt.2019.102047

[61] Talwar, Shalini, Manish Talwar, Puneet Kaur, and Amandeep Dhir. "Consumers' resistance to digital innovations: A systematic review and framework development." *Australasian Marketing Journal (AMJ)* 28, no. 4 (2020): 286-299. https://doi.org/10.1016/j.ausmj.2020.06.014

[62] Mhlanga, David. "Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning." In *FinTech and Artificial Intelligence for Sustainable Development: The Role of Smart Technologies in Achieving Development Goals*, pp. 387-409. Cham: Springer Nature Switzerland, 2023. https://doi.org/10.1007/978-3-031-37776-1_17

[63] Seddon, Peter, and Min-Yen Kiew. "A partial test and development of DeLone and McLean's model of IS success." *Australasian Journal of Information Systems* 4, no. 1 (1996). https://doi.org/10.3127/ajis.v4i1.379

[64] Demoulin, Nathalie TM, and Kristof Coussement. "Acceptance of text-mining systems: The signaling role of information quality." *Information & management* 57, no. 1 (2020): 103120. https://doi.org/10.1016/j.im.2018.10.006

[65] Sonntag, Martin, Jens Mehmann, and Frank Teuteberg. "AI-based conversational agents for customer service–A study of customer service representative'perceptions using TAM 2." (2022). https://aisel.aisnet.org/wi2022/adoption_diffusion/adoption_diffusion/3

[66] AlGerafi, Mohammed AM, Yueliang Zhou, Hind Alfadda, and Tommy Tanu Wijaya. "Understanding the factors influencing higher education students' intention to adopt artificial intelligence-based robots." *IEEE Access* (2023). https://doi.org/10.1109/ACCESS.2023.3314499

[67] Kumar, Sachin, Neeraj Dhiman, Honey Kanojia, and Richa Joshi. "What resists millennials to adopt hotel booking apps? An empirical analysis based on extended innovation resistance theory." *foresight* ahead-of-print (2023). https://doi.org/10.1108/FS-10-2021-0209

[68] Moorthy, Krishna, Ching Suet Ling, Yeong Weng Fatt, Chan Mun Yee, Elaine Chong Ket Yin, Kwa Sin Yee, and Lee Kok Wei. "Barriers of mobile commerce adoption intention: perceptions of generation X in Malaysia." *Journal of theoretical and applied electronic commerce research* 12, no. 2 (2017): 37-53. https://doi.org/10.4067/S0718-18762017000200004

[69] Ma, Long, and Chei Sian Lee. "Understanding the barriers to the use of MOOCs in a developing country: An innovation resistance perspective." *Journal of Educational Computing Research* 57, no. 3 (2019): 571-590. https://doi.org/10.1177/0735633118757732

[70] Sivathanu, Brijesh. "Adoption of digital payment systems in the era of demonetization in India: An empirical study." *Journal of Science and Technology Policy Management* 10, no. 1 (2019): 143-171. https://doi.org/10.1108/JSTPM-07-2017-0033

[71] Lian, Jiunn-Woei, and David C. Yen. "Online shopping drivers and barriers for older adults: Age and gender differences." *Computers in human behavior* 37 (2014): 133-143. https://doi.org/10.1016/j.chb.2014.04.028

[72] Arndt, Holger. "AI and education: An investigation into the use of ChatGPT for systems thinking." *arXiv preprint arXiv:2307.14206* (2023). https://doi.org/10.48550/arXiv.2307.14206

[73] Sadiq, Mohd, Mohd Adil, and Justin Paul. "An innovation resistance theory perspective on purchase of eco-friendly cosmetics." *Journal of Retailing and Consumer Services* 59 (2021): 102369. https://doi.org/10.1016/j.jretconser.2020.102369

[74] Kaur, Puneet, Amandeep Dhir, Arghya Ray, Pradip Kumar Bala, and Ashraf Khalil. "Innovation resistance theory perspective on the use of food delivery applications." *Journal of Enterprise Information Management* 34, no. 6 (2020): 1746-1768. https://doi.org/10.1108/JEIM-03-2020-0091

[75] Migliore, Giacomo, Ralf Wagner, Felipe Schneider Cechella, and Francisco Liébana-Cabanillas. "Antecedents to the adoption of mobile payment in China and Italy: An integration of UTAUT2 and innovation resistance theory." *Information Systems Frontiers* 24, no. 6 (2022): 2099-2122. https://doi.org/10.1007/s10796-021-10237-2

[76] Hidayanto, Achmad Nizar, Arfian Herbowo, Nur Fitriah Ayuning Budi, and Yudho Giri Sucahyo. "Determinant of customer trust on e-commerce and its impact to purchase and word of mouth intention: A case of Indonesia." *J. Comput. Sci.* 10, no. 12 (2014): 2395-2407. https://doi.org/10.3844/jcssp.2014.2395.2407

[77] Kaur, Puneet, Amandeep Dhir, Naveen Singh, Ganesh Sahu, and Mohammad Almotairi. "An innovation resistance theory perspective on mobile payment solutions." *Journal of Retailing and Consumer Services* 55 (2020): 102059. https://doi.org/10.1016/j.jretconser.2020.102059

[78] Laukkanen, Tommi. "Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking." *Journal of Business Research* 69, no. 7 (2016): 2432-2439. https://doi.org/10.1016/j.jbusres.2016.01.013

[79] Szmigin, Isabelle, and Gordon Foxall. "Three forms of innovation resistance: the case of retail payment methods." *Technovation* 18, no. 6-7 (1998): 459-468. https://doi.org/10.1016/S0166-4972(98)00030-3

[80] Laukkanen, Pekka, Suvi Sinkkonen, and Tommi Laukkanen. "Consumer resistance to internet banking: postponers, opponents and rejectors." *International journal of bank marketing* 26, no. 6 (2008): 440-455. https://doi.org/10.1108/02652320810902451

[81] Hallowell, Matthew R., and John A. Gambatese. "Qualitative research: Application of the Delphi method to CEM research." *Journal of construction engineering and management* 136, no. 1 (2010): 99-107. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000137

[82] Atyaf Sami Noori. "A Mediated Model of E-WOM Effects towards Continuous Use Intention of Social Commerce," 2019. https://etd.uum.edu.my/id/eprint/8163

[83] Rogers, Margaret R., and Emilia C. Lopez. "Identifying critical cross-cultural school psychology competencies." *Journal of school psychology* 40, no. 2 (2002): 115-141. https://doi.org/10.1016/S0022-4405(02)00093-6