Barriers to Artificial Intelligence Adoption in the Malaysian Virtual Assistant Industry: A Mixed-Methods Study

***[1]Nurul Aisyah Kamrozzaman., [1]Siti Aishah Sabtu., [1]Amy Liew Xiu Jie., [2]Noor Sahirah Md Nayan**

[1]UNITAR International University, Kelana Jaya, Malaysia

[2]Universiti Teknologi MARA, Shah Alam, Malaysia

***Corresponding Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2025.905000282

Received: 04 May 2025; Accepted: 11 May 2025; Published: 11 June 2025

ABSTRACT

As Malaysia's digital economy evolves, there is a growing imperative for virtual assistants (VAs) to embrace artificial intelligence (AI) tools to augment service delivery and enhance professional competitiveness. Nevertheless, considerable obstacles persist especially in rural and underserved areas stemming from infrastructural deficiencies, financial limitations, and disparities in digital literacy. This mixed-methods investigation examines the obstacles encountered by Malaysian VAs in the integration of AI, with a specific focus on initiatives spearheaded by the Malaysia Digital Economy Corporation (MDEC), including the GOT Program. Data were gathered from 40 virtual assistants through both surveys and semi-structured interviews, incorporating perspectives from participants across urban and rural settings. The results indicate a heterogeneous adoption of AI, despite the acknowledged advantages of technologies such as chatbots, natural language processing systems, and predictive analytics. Principal challenges comprise affordability concerns, restricted exposure, language barriers, and apprehensions regarding job displacement. Evaluations conducted post-intervention revealed significant advancements in AI familiarity, frequency of usage, and user confidence, thereby underscoring the beneficial effects of targeted training initiatives. The study emphasizes the necessity for localized, inclusive, and culturally pertinent training programs, alongside equitable infrastructural development and supportive policy frameworks. By addressing the digital divide, this research enhances both theoretical comprehension and practical policymaking aimed at promoting inclusive AI integration within Malaysia's freelance economy. The findings advocate for ongoing cross-sectoral collaboration to ensure that AI adoption is conducted in an ethical, accessible, and empowering manner particularly for marginalized and rural-based virtual assistants.

Keywords: Artificial Intelligence, Virtual Assistants, Digital Inclusion, Malaysia, Freelance Economy, Technology Adoption

INTRODUCTION

In the twenty-first century, the rise of Artificial Intelligence (AI) has significantly changed both technology and how operations work in many fields, including immigration systems. AI's impact goes beyond just automating tasks; it has started a new phase of improved interactions between humans and computers, especially noticeable in virtual meetings. According to Ramirez et al., (2023), machine learning algorithms are great at analyzing large amounts of data, while advanced robots have shown impressive skills in performing complex tasks accurately and efficiently. The growth of virtual assistants (VAs) is a key trend towards a closer integration of AI technologies into everyday life, creating a partnership between humans and machines (Elias et al., 2025). Digital assistants like Google Assistant, Siri, Alexa, and AI-powered chatbots are not just tools; they are changing how people interact with technology. These advancements play a crucial role in improving efficiency, clarifying what users want, offering informed suggestions, and simplifying decision-making in various industries (Casheekar et al., 2024). By improving workflows and increasing productivity, virtual assistants have become essential in both urban and rural areas. However, the advantages of AI are not spread

evenly. Urban regions are increasingly benefiting from better resources and connectivity, while rural areas face major challenges due to the digital divide. This inequality limits fair access to AI technologies, as pointed out in the National Digital Network (JENDELA) and further discussed by Plackett (2022). Acknowledging this gap, organizations like UNESCO and the World Bank have emphasized the potential of AI to help reduce educational and developmental disparities globally. There is a clear need for proactive efforts to ensure affordable access to AI technologies across all levels of Malaysian society, as noted in the National Digital Network (JENDELA). Reports indicate that digital literacy has become a crucial factor affecting the acceptance and effective use of AI technologies. The World Bank supports fair policies and strong digital infrastructure as essential components of a thorough digital transformation strategy. Efforts to improve internet access and affordability are closely tied to the challenges faced by Malaysian virtual assistants (World Bank, 2023). While AI technologies greatly improve the capabilities of virtual assistants by automating simple tasks, offering instant customer support, and deriving insights from data, there are still significant barriers to their widespread use. Language differences and socio-political factors continue to obstruct the smooth adoption of AI. Many AI applications are primarily created for widely used languages like English and Chinese, which limits their usefulness for users mainly speaking Malay or indigenous languages (Rjab et al., 2023). Furthermore, worries about the reliability of AI systems, possible job loss, and issues regarding privacy and data security create a sense of unease, especially among those concerned about AI's effects on current societal structures. Existing economic conditions make these challenges even more complex; while some AI applications might be available for free, accessing their full capabilities often requires expensive subscriptions, specialized hardware, or high-speed internet factors that disproportionately affect lower-income communities (Sithambaram & Tajudeen, 2023). According to the National Digital Network (JENDELA), tackling these economic hurdles will require proactive steps to guarantee fair access to affordable AI technologies throughout Malaysian society. The acceptance and use of AI technologies will largely depend on levels of digital and IT literacy. Strong technical skills, early exposure to technology, and a clear understanding of AI's ability to boost productivity and promote national development are vital in today’s tech-driven world. The significant influence of AI on national virtual assistants necessitates the implementation of strict regulations, focused investments, and higher levels of digital literacy. These actions are not just about closing the digital gap; they are about empowering underrepresented communities to fully participate in the digital economy, thus encouraging innovation and sustainable growth in all sectors. To make sure everyone in society benefits from AI technologies, teamwork among government, schools, and businesses is essential. These collaborations should aim to develop inclusive programs and initiatives that address the varied needs of the community. Additionally, using AI in the virtual assistant field must include thorough training programs designed for the unique needs of different demographic groups. This strategy will improve digital skills and promote a mindset of innovation and flexibility among virtual assistants. In the end, these actions will help create a stronger workforce that can succeed in Malaysia's fast-changing digital environment, making the powerful benefits of AI available to everyone. To realize this, it is vital to create a system that emphasizes ongoing learning and skill enhancement, allowing virtual assistants to effectively manage the challenges of AI technologies. By cultivating a space that supports experimentation and teamwork, Malaysia can fully leverage AI's capabilities to reshape the virtual assistant industry and encourage inclusive growth.

LITERATURE REVIEW

Global and Local Developments in AI and Virtual Assistants

In recent years, nations like the United States and the Philippines have made remarkable advancements in the integration of artificial intelligence (AI) within the virtual assistant (VA) sector. This evolution has led to a surge in demand for highly skilled VAs, as highlighted by the research of Olid and Soberano (2025) and Mars et al. (2017). The Philippines, in particular, has established itself as a critical hub for VA services, largely due to its English-speaking population and cultural alignment with Western markets. This unique positioning allows Filipino VAs to effectively cater to the needs of international clients, enhancing their appeal in the global marketplace. On the other hand, virtual assistants in Malaysia face a series of challenges that hinder their ability to fully leverage AI technologies. Issues such as inadequate infrastructure and limited access to advanced technological tools present significant barriers, as noted by Mollura et al. (2020). As a result, Malaysian VAs are often unable to compete on the same level as their counterparts in more developed regions, which can stifle innovation and growth within the sector (Omar et al., 2022). In light of these obstacles, the

Malaysia Digital Economy Corporation (MDEC) has initiated several programs, including MyDIGITAL and the GOT Program, aimed at fostering digital transformation and enhancing the skill sets of local VAs. The MyDIGITAL initiative seeks to create a comprehensive framework for a robust digital economy, while the GOT Program focuses on equipping individuals with the essential competencies required in an increasingly digital landscape. These initiatives are critical for the advancement of the VA profession in Malaysia, as they not only stimulate economic growth but also bolster the nation's competitiveness in the global digital economy. By promoting continuous learning and collaboration among governmental entities, educational institutions, and the private sector, Malaysia can develop an inclusive workforce capable of adapting to the dynamic nature of the job market (Siddiquee & Xavier, 2020). This approach supports sustainable growth and empowers individuals to embrace new technologies and methodologies, thereby enhancing productivity and efficiency across various sectors. The initiatives undertaken by MDEC not only improve the employability of VAs but also contribute to the creation of a more innovative and resilient economy. As Malaysia positions itself as a leader in digital services within the region, the proactive strategies implemented today will pave the way for a thriving future in the realm of virtual assistance and beyond.

AI Tools for Virtual Assistants

Artificial Intelligence (AI) tools have revolutionized the landscape of virtual assistance, significantly enhancing work productivity and user satisfaction. This transformation is driven by several factors, including performance expectancy, perceived enjoyment, and social presence, as highlighted by Marikyan et al. (2022). Among the most commonly utilized technologies in this field are natural language processing (NLP) systems, chatbots, predictive analytics, and scheduling automation, as noted by Lin et al. (2023) and Zhang et al. (2024). These innovative tools empower virtual assistants (VAs) to automate mundane tasks, manage communications more effectively, and conduct sophisticated data analysis. Natural Language Processing systems play a pivotal role in enabling VAs to perform a variety of tasks that involve human language. For example, they assist in composing emails, summarizing lengthy documents, and generating insightful content by accurately interpreting and processing natural language inputs. This capability not only streamlines communication but also enhances the overall quality of the output. Chatbots, on the other hand, serve as invaluable customer engagement tools (Jie & Kamrozzaman 2024). They allow VAs to address client inquiries and provide support around the clock, significantly reducing the need for constant human oversight and thereby freeing up time for more complex tasks. Despite the myriad advantages these advanced AI tools offer, many VAs face significant obstacles in accessing them. Limited digital skills, financial constraints, and a lack of familiarity with these technologies can create a technological divide that prevents some VAs from fully leveraging AI's capabilities (Eder & Sjøvaag, 2024). This disparity can hinder their productivity and overall effectiveness in fulfilling client needs. Therefore, it becomes essential to implement comprehensive training programs and supportive structures that equip all VAs with the necessary skills and resources to take full advantage of AI technologies in their professional practices. As the AI landscape continues to evolve at a rapid pace, it is crucial for VAs to stay informed about the latest tools and emerging trends. This need for continuous learning underscores the importance of ongoing education and adaptability in maintaining a competitive edge (Wang et al., 2024, Petridou & Lao 2024).

In conclusion, while AI tools offer substantial opportunities for VAs to enhance their workflows and improve service delivery, addressing barriers related to access and education is vital for maximizing these benefits. By cultivating an environment that promotes learning and support, the VA community can flourish in an increasingly automated world. This collaborative approach not only drives innovation but also ensures that VAs remain relevant and competitive in a fast-changing job market. Investing in continuous professional development will empower VAs to effectively harness these advancements, ultimately enhancing their ability to provide exceptional service to clients. As the nature of work continues to evolve, adopting a mindset of lifelong learning will be essential for VAs to successfully navigate new technologies and methodologies, ensuring they thrive in the future of work.

Theoretical Frameworks

The Technology Acceptance Model (TAM) is widely used to assess how individuals perceive and adopt new technologies. It focuses on the perceived ease of use and perceived usefulness of a technology, both of which

influence users' attitudes towards its adoption. In the context of virtual assistants (VAs), TAM helps explain why some VAs are more willing to integrate AI tools into their work, driven by the belief that these tools will improve efficiency and ease their workload.

However, TAM primarily addresses individual-level factors, without considering the broader social and environmental influences that affect technology adoption. This is where the Diffusion of Innovation (DOI) framework complements TAM. The DOI framework, developed by Rogers (1962), expands the focus to include the role of social systems, peer networks, and the spread of innovation across different communities. It emphasizes the process by which new technologies are communicated and adopted over time, considering factors like relative advantage, compatibility, complexity, trialability, and observability.

While TAM highlights how users' perceptions drive individual adoption, DOI examines how these perceptions spread within a community and across society. In the case of Malaysian virtual assistants, TAM can explain the initial resistance or acceptance of AI tools at an individual level, while DOI provides insight into how AI adoption might propagate within the wider VA community, considering the broader cultural, economic, and infrastructural contexts.

Together, these two frameworks offer a comprehensive approach to understanding the challenges and opportunities of AI adoption in Malaysia's VA sector. TAM sheds light on individual attitudes and motivations, while DOI situates these attitudes within the larger social and technological ecosystem, providing a deeper understanding of how AI can be effectively integrated across diverse groups.

Problem Statement

The transformative impact of artificial intelligence (AI) on professional environments is particularly evident in the virtual assistant (VA) sector, where AI tools are redefining traditional administrative roles. This evolution enhances efficiency, productivity, and innovation, allowing virtual assistants to automate routine tasks, improve client interactions, and make data-driven decisions (Holmström & Carroll, 2024). In Malaysia, national initiatives like MyDIGITAL and the JENDELA Plan have positioned AI as a cornerstone of the country's digital transformation agenda, aiming to integrate AI technologies across various sectors to foster a robust digital economy. However, virtual assistants, especially in rural and underserved communities, face significant barriers to accessing and adopting these technologies. This digital divide not only stifles their professional growth but also limits the socio-economic benefits that AI could offer to these regions. To bridge this gap, there is an urgent need for targeted training programs and investments in digital infrastructure. Such initiatives are crucial for equipping virtual assistants with the skills and resources necessary to effectively utilize AI in their operations (Kumar & Boss, 2019; White, 2018). By enhancing their capabilities, these programs could not only boost individual productivity but also stimulate broader economic development within these communities, fostering a more inclusive digital economy. Several structural challenges exacerbate the situation, including inadequate digital infrastructure, limited access to reliable high-speed internet, and a lack of localized training resources (Marshall, 2023; Correa & Pavez, 2016). These challenges are especially pronounced in rural and remote areas, where disparities in digital inclusion are stark. Financial barriers further complicate the landscape, as the high costs of AI subscriptions and necessary hardware disproportionately affect freelancers and small-scale virtual assistants, hindering their ability to compete in an increasingly digital marketplace (Sithambaram & Tajudeen, 2023). Cultural and linguistic factors also play a significant role in hindering AI adoption. The limited availability of AI tools in the Malay language or indigenous dialects, combined with fears of job displacement due to automation, fosters a climate of hesitation and skepticism among potential users (Mahusin et al., 2024; Daud et al., 2024). While global literature highlights AI's transformative potential, there is a lack of localized research addressing how these challenges specifically manifest within the Malaysian VA ecosystem. Existing studies often overlook the socio-economic, infrastructural, and cultural nuances of Malaysia's diverse regions. This study aims to explore the multifaceted barriers to AI adoption among Malaysian virtual assistants, providing empirical insights that can inform equitable, context-sensitive strategies for promoting inclusive digital development. Understanding these barriers is crucial for creating a more inclusive technological landscape. By doing so, stakeholders can design tailored interventions that enhance AI accessibility and empower local communities. This research aspires to establish a comprehensive framework identifying the key factors influencing AI integration, ensuring that the

unique needs and perspectives of Malaysian users are prioritized in future technological advancements. Through this approach, we can work towards a more equitable digital future that benefits all segments of society. In addressing these barriers, it is essential to foster partnerships among governmental bodies, educational institutions, and private sector stakeholders to create comprehensive support systems. This collaborative approach can facilitate the development of targeted programs that enhance digital literacy and provide the necessary resources for virtual assistants to successfully integrate AI into their practices.

METHODOLOGY

This study adopted a mixed-methods approach. Quantitative data was gathered through surveys administered to 40 VA's from both urban and rural regions. Qualitative insights were obtained from semi-structured interviews. Sampling was purposive, focusing on VA's actively engaged in administrative support, content creation, and customer service. Data analysis combined descriptive statistics with thematic analysis.

RESULTS

Demographics

Results are based on 40 virtual assistant responses. Demographic patterns, AI tool familiarity, challenges, and actionable AI adoption suggestions are presented in these findings.

Respondent	Gender	Age Group	Placement	Service Type
R|1	Female	18-24	City/Town	Administrative Support
R|2	Male	25-34	Rural/Kampung	Technical Support
R|3	Female	35-44	City/Town	Content Creation
R|4	Male	18-24	Rural/Kampung	Social Media Management
R|5	Female	25-34	City/Town	Administrative Support
R|6	Male	18-24	Rural/Kampung	Administrative Support
R|7	Female	25-34	City/Town	Technical Support
R|8	Male	35-44	Rural/Kampung	Content Creation
R|9	Female	18-24	City/Town	Social Media Management
R|10	Male	25-34	Rural/Kampung	Administrative Support
R|11	Female	18-24	City/Town	Administrative Support
R|12	Male	25-34	Rural/Kampung	Technical Support
R|13	Female	35-44	City/Town	Content Creation
R|14	Male	18-24	Rural/Kampung	Social Media Management
R|15	Female	25-34	City/Town	Administrative Support
R|16	Male	18-24	Rural/Kampung	Administrative Support

R|17	Female	25-34	City/Town	Technical Support
R|18	Male	35-44	Rural/Kampung	Content Creation
R|19	Female	18-24	City/Town	Social Media Management
R|20	Male	25-34	Rural/Kampung	Administrative Support
R|21	Female	18-24	City/Town	Administrative Support
R|22	Male	25-34	Rural/Kampung	Technical Support
R|23	Female	35-44	City/Town	Content Creation
R|24	Male	18-24	Rural/Kampung	Social Media Management
R|25	Female	25-34	City/Town	Administrative Support
R|26	Male	18-24	Rural/Kampung	Administrative Support
R|27	Female	25-34	City/Town	Technical Support
R|28	Male	35-44	Rural/Kampung	Content Creation
R|29	Female	18-24	City/Town	Social Media Management
R|30	Male	25-34	Rural/Kampung	Administrative Support
R|31	Female	18-24	City/Town	Administrative Support
R|32	Male	25-34	Rural/Kampung	Technical Support
R|33	Female	35-44	City/Town	Content Creation
R|34	Male	18-24	Rural/Kampung	Social Media Management
R|35	Female	25-34	City/Town	Administrative Support
R|36	Male	18-24	Rural/Kampung	Administrative Support
R|37	Female	25-34	City/Town	Technical Support
R|38	Male	35-44	Rural/Kampung	Content Creation
R|39	Female	18-24	City/Town	Social Media Management
R|40	Male	25-34	Rural/Kampung	Administrative Support

Pre- and Post-Training Findings

Assessments were rigorously formulated both prior to and following the intervention timeframe to ascertain the alterations in the participants' comprehension, operational efficacy, and application of artificial intelligence instruments. The interventions encompassed educational lectures, workshops, and the dissemination of instructional materials to the target audience. The appraisal of the participants was predicated on three fundamental criteria: their acquaintance with artificial intelligence instruments, their self-assurance regarding

their capacity to employ these tools, and the regularity with which they integrated them into their professional endeavors or activities.

Quantitative Results

The table presented below elucidates the comparative analysis of pre-test and post-test scores, underscoring advancements in participants' comprehension of artificial intelligence instruments, levels of self-assurance, and behavioural tendencies in usage.

The results indicate a marked improvement in participants' understanding of AI tools, as evidenced by the significant increase in their post-training scores across all evaluated criteria.

Comparative Analysis of Pre-Test and Post-Test Scores

Metric	Pre-Test Results	Post-Test Results	Percentage Improvement
Average Familiarity with AI Tools	45% of respondents were familiar	75% of respondents became familiar	30%
Confidence in Using AI Tools	40% reported low confidence	68% reported moderate to high confidence	28%
Frequency of AI Tool Usage	30% used AI tools regularly	60% used AI tools at least weekly	30%
Awareness of AI Training Programs	35% were aware of available training programs	80% became aware of AI-related training	45%

Based on the questions and findings of this case study, the graph above shows a significant difference between participants' habits with artificial intelligence tools and their confidence in using them. Not many people engaged with AI, which made it less effective. Freelancing and training with AI made learning way better and boosted self- confidence. These findings show how MDEC's GOT Prog offers some solid hands-on training perks.

The results derived from the pre-test and post-test assessments demonstrate substantial enhancements in participants' awareness, self-efficacy, and application of AI tools. Specifically, 75% of the surveyed individuals indicated an increase in familiarity subsequent to the training, a rise from 45% prior to the training, thereby underscoring the program's efficacy in improving foundational awareness. Furthermore, levels of self-confidence exhibited a notable increase, with 68% of participants attaining moderate to high confidence following the training, in contrast to merely 40% who initially reported low confidence. This suggests that the training not only augmented participants' knowledge but also equipped them with the requisite competencies to feel proficient in the utilization of AI tools. Then, usage frequency, which is regular usage of AI tools, increased twice, from 30% in the pre-test to 60% in the post-test. The training changed participants' AI tool use from access and technical knowledge to costs and advanced training. Research shows that educational programs boost AI knowledge, confidence, and use. Programs showed challenges and benefits. Fully integrating AI into work processes requires ongoing training and support.

Qualitative Results

The semi-structured inquiries were meticulously crafted to derive qualitative insights pertaining to the experiences of participants in the integration of artificial intelligence (AI) within their occupational contexts. The resultant responses were rigorously analyzed to discern both overarching themes and unique perspectives among the participants. The initial question posed was: "What types of virtual assistant services do you provide, and how has AI influenced your work?" A heterogeneous array of professions emerged from the

replies of graduates from the GOT program, encompassing data analysis, voice recording, scheduling, transcription, and TikTok affiliate marketing, thereby illustrating the diverse applications of virtual assistance within contemporary digital frameworks. Participant R|2 offered a nuanced viewpoint, asserting, "I possess a moderate comprehension of AI, as it considerably optimizes my workflow and enhances the efficacy of data entry tasks. Nevertheless, my current position necessitates a foundational grasp of these technologies." Conversely, R|3 articulated a more circumspect stance: "I acknowledge that my expertise is confined to basic automation and AI tools, which I predominantly familiarize myself with via online resources." The second inquiry sought to investigate the specific AI instruments that participants had employed in their professional endeavors, alongside the resultant effects of such implementations. R|1 underscored a notable impediment, remarking, "The substantial costs associated with premium AI subscriptions represent a significant challenge for me." R|4 elaborated on the infrastructural constraints they encounter: "In my kampung area, limited internet connectivity inhibits my capacity to effectively utilize these tools, and I am concerned that dependency on AI may precipitate a decline in my productivity." Meanwhile, R|5 expressed trepidation regarding the engagement with AI technologies, stating, "I feel reticent to adopt AI tools owing to my lack of experience." The third query aimed to ascertain the factors that might enhance participants' comfort levels with the integration of AI tools into their daily work routines. R|2 succinctly articulated the potential advantages: "AI tools can automate repetitive tasks such as data entry, information retrieval, and scheduling, thereby enabling virtual assistants to redirect their focus toward more strategic and high-level responsibilities." R|3 recounted a personal success narrative, revealing, "Employing AI tools for grammar corrections has markedly improved the quality of my client reports." R|6 echoed this sentiment, stating, "AI alleviates the burden of repetitive tasks, allowing me to allocate more time to strategic decision-making." The fourth query sought to evaluate participants' perceptions of the influence of AI tools on the virtual assistant profession. R|4 observed, "AI affords me the opportunity to conserve time, which permits me to focus on other critical tasks." R|1 noted, "AI enhances our quality of life and augments overall efficiency." However, R|5 articulated a prevalent concern, stating, "While there exists apprehension that AI may supplant human virtual assistants, I regard it as an opportunity for growth and adaptation in conjunction with technological progress." The final inquiry solicited suggestions for promoting greater adoption of AI among virtual assistants. R|3 proposed a constructive recommendation: "The implementation of affordable training programs would empower VAs to proficiently learn how to utilize the appropriate AI applications." R|2 accentuated the necessity for governmental support, stating, "Initiatives aimed at offering affordable AI web packages and improving internet accessibility would significantly motivate more virtual assistants to embrace these technologies." Lastly, R|6 proposed, "A vigorous promotional campaign through social media platforms, particularly TikTok, could efficaciously raise awareness and foster adoption among virtual assistants." Overall, the insights derived from these discussions reflect a complex interplay between enthusiasm for the prospective benefits of AI and the challenges posed by cost, accessibility, and technological familiarity.

DISCUSSION

The integration of artificial intelligence (AI) into Malaysia's virtual assistant (VA) sector presents a complex and multifaceted landscape shaped by a dynamic interplay of technological, socioeconomic, and cultural factors. This study reveals that one of the most formidable barriers to the widespread adoption of AI in this context is the substantial financial burden imposed by high subscription fees, coupled with the pressing need for sophisticated digital infrastructure. These insights resonate with the findings of Singh et al. (2020), who underscored that cost-effectiveness remains a pivotal concern in sectors heavily reliant on freelance labor, where financial constraints can significantly hinder technological advancement. The challenges associated with AI adoption are particularly acute for virtual assistants operating in rural regions, where the limitations are exacerbated by inadequate access to high-speed internet and modern technological devices. This situation illustrates a growing digital divide, as highlighted by Kumar et al. (2021) and Plackett (2022). Socioeconomic disparities are evident in the reduced familiarity and lower frequency of AI tool usage among individuals residing in Kampung and rural areas, aligning with the Digital Divide Theory. This theory posits that unequal access to technological resources directly contributes to broader economic inequalities, as discussed by Chen & Kidd (2007) and Riggins & Dewan (2005). In stark contrast, respondents from urban locales reported a more seamless experience in adopting AI tools, primarily due to superior infrastructure and prior exposure to such technologies, which allows them to leverage AI's potential more effectively. Culturally, there exists a

pervasive anxiety regarding the potential for AI to displace human labor. This concern is particularly pronounced among participants who possess a limited understanding of AI's augmentative capabilities and its potential to enhance rather than replace human roles. Such perceptions resonate with issues articulated within both the Technology Acceptance Model (TAM) and the Diffusion of Innovation (DOI) framework. Here, perceived complexity and fears of job displacement can significantly impede the acceptance of new technologies, as noted by Na et al. (2022) and Suseno et al. (2020). For many virtual assistants, AI tools remain abstract concepts, often viewed through a lens of skepticism and apprehension concerning potential obsolescence. Despite these considerable obstacles, the study's post-intervention outcomes revealed a significant shift in attitudes and capabilities among participants. Targeted training initiatives not only enhanced technical proficiency but also substantially increased participants' confidence and frequency of AI tool usage. These results reinforce the notion that structured, contextually relevant learning experiences can effectively bridge knowledge gaps and empower professionals to engage meaningfully with emerging technologies, as suggested by Lin & Mubarok (2024) and Kasinidou (2023). Participants expressed a strong preference for practical, example-based learning, especially when delivered in local languages, underscoring the critical need for culturally sensitive training content that resonates with their backgrounds and experiences. To sustain and amplify this progress, it is essential to mobilize cross-sectoral efforts. Participants consistently advocated for government-led digital literacy programs, AI-specific training subsidies, and mentorship initiatives as vital steps toward creating an inclusive environment for AI adoption. Policymakers must prioritize the expansion of AI infrastructure development into underserved regions, ensuring equitable access to both technological tools and economic opportunities, as emphasized by Ding et al. (2024), Filho et al. (2024), and Khan et al. (2024). These recommendations align with previous studies that highlight the importance of tailored support systems in enhancing the capabilities of virtual assistants. By fostering a culture of continuous learning and collaboration, stakeholders can empower VAs to navigate the complexities of AI integration more effectively. Moreover, addressing financial barriers through subsidized training programs and improved internet access will be crucial for promoting equitable AI adoption across Malaysia's diverse communities. In conclusion, the successful integration of AI within the Malaysian virtual assistant sector hinges on collaborative efforts that prioritize accessibility, affordability, and culturally relevant training. By fostering partnerships among government entities, educational institutions, and industry stakeholders, Malaysia can cultivate an inclusive environment that empowers all virtual assistants to harness the transformative potential of AI technologies effectively. This collaborative approach not only seeks to bridge the digital divide but also nurtures a culture of innovation and adaptability among virtual assistants. Ultimately, ensuring that every segment of society can benefit from AI technologies will be essential for driving sustainable growth in Malaysia's digital economy, paving the way for a more equitable and prosperous future.

CONCLUSION

In summation, the assimilation of artificial intelligence within the virtual assistant sector in Malaysia is hindered by a complex interplay of socioeconomic, technological, and cultural impediments. The financial constraints associated with the procurement and upkeep of AI technologies, particularly for practitioners situated in rural locales, highlight a significant economic inequality that exacerbates disparities in access to technological assets. Furthermore, cultural anxieties pertaining to employment security and a widespread deficiency in understanding the prospective benefits of AI further amplify resistance to its integration. To address these impediments, it is crucial to implement focused strategies, encompassing tailored training initiatives, governmental fiscal assistance, and the establishment of mentorship networks. These programs possess the potential to enhance digital literacy, foster an innovative mindset, and ultimately empower virtual assistants across Malaysia to thrive in an increasingly AI-driven economy. By prioritizing investment in educational and skill enhancement, Malaysia can strategically position itself as a formidable contender in the global digital landscape, ensuring that its workforce is sufficiently prepared to adapt to the continuously evolving technological environment.

ACKNOWLEDGMENT

We express our thousands of thanks to the UNITAR International University for the support of the publication of this research.

REFERENCES

1. Casheekar, A., Lahiri, A., Rath, K., Prabhakar, K. S., & Srinivasan, K. (2024). A Contemporary Review On Chatbots, AI-Powered Virtual Conversational Agents, ChatGPT: Applications, Open Challenges And Future Research Directions. Computer Science Review, 52, 100632.
2. Chen, I., & Kidd, T. T. (2007). Digital Divide Implications And Trends. Encyclopedia of information ethics and security, 130-135.
3. Correa, T., & Pavez, I. (2016). Digital Inclusion in Rural Areas: A Qualitative Exploration of Challenges Faced by People From Isolated Communities. Journal of Computer-Mediated Communication, 21(3), 247–263.
4. Daud, M. Z., Ismail, E., Azli, M., Omar, M., Mansor, M., Mahmod, N. M., Anuar, W. A. I. S., Mohamed, S., Ali, N., & Sultan, A. A. M. (2024). Perspektif Mahasiswa Universiti Teknikal di Malaysia Terhadap Kecerdasan Buatan (AI) Sebagai Pemudah Cara Menyiapkan Tugasan Berbahasa Melayu. Innovative Teaching and Learning Journal, 8(2), 183–198.
5. Ding, T., Li, H., Liu, L., & Feng, K. (2024). An inquiry into the nexus between artificial intelligence and energy poverty in the light of global evidence. Energy Economics, 136, 107748.
6. Eder, M., & Sjøvaag, H. (2024). Artificial intelligence and the dawn of an algorithmic divide. Frontiers in Communication, 9, 1453251.
7. Elias, S. , Lajium, A. , Kamrozzaman, N. and Hussain, M. (2025) Meaning in Life among Malaysian University Students. Open Journal of Social Sciences, 13, 596-609. doi: 10.4236/jss.2025.133039.
8. Filho, W. L., Mbah, M., Dinis, M. A. P., Trevisan, L. V., Lange, D. E. de, Mishra, A., Rebelatto, B., Hassen, T. B., & Aina, Y. A. (2024). The role of artificial intelligence in the implementation of the UN Sustainable Development Goal 11: Fostering sustainable cities and communities. Cities.
9. Holmström, J., & Carroll, N. (2024). How organizations can innovate with generative AI. Business Horizons.
10. Jie, A. L. X., & Kamrozzaman, N. A. (2024). The Challenges of Higher Education Students Face in Using Artificial Intelligence (AI) against Their Learning Experiences. Open Journal of Social Sciences, 12(10), 362-387.
11. Kasinidou, M. (2023, June 29). AI Literacy for All: A Participatory Approach.Annual Conference on Innovation and Technology in Computer Science Education.
12. Khan, M. S., Umer, H., & Faruqe, F. (2024). Artificial intelligence for low income countries. Humanities and Social Sciences Communications, 11(1), 1-13.
13. Kumar, B., Singh, A. V., & Agarwal, P. (2021). AI based computational trust model for intelligent virtual assistant. Journal of Information Systems and Telecommunication (JIST), 4(32), 219- 225.
14. Kumar, D. H., & Boss, V. R. (2019). A Study on Recent Trends in Artificial Intelligence. Management Science, 6(4), 33–35.
15. Lin, C.-C., Huang, A. Y. Q., & Yang, S. J. H. (2023). A Review of AI-Driven Conversational Chatbots Implementation Methodologies and Challenges (1999–2022). Sustainability, 15(5), 4012. https://doi.org/10.3390/su15054012.
16. Lin, C.-J., & Mubarok, H. (2024). Promoting young learners' computational thinking with AI-based robots and the ICAP model in blended learning contexts.Interactive Learning Environments,32(10), 7242–7256.
17. Mahusin, N., Sallehudin, H., & Mohd Satar, N. S. (2024). Malaysia Public Sector Challenges of Implementation of Artificial Intelligence (AI). IEEE Access, 12, 121035–121051.
18. Marikyan, D., Papagiannidis, S., Rana, O., Ranjan, R., & Morgan, G. (2022). "Alexa, let's talk about my productivity": The impact of digital assistants on work productivity. Journal of Business Research, 142, 572–584.
19. Mars, J., Tang, L., Laurenzano, M., Hauswald, J., & Hill, P. (2020). U.S. Patent No. 10,572,801. Washington, DC: U.S. Patent and Trademark Office.
20. Marshall, A. (2024). A new rural digital divide? Taking stock of geographical digital inclusion in Australia. Media International Australia, 190(1), 68-84.
21. Mollura, D. J., Culp, M. P., Pollack, E., Battino, G., Scheel, J. R., Mango, V. L., Elahi, A., Schweitzer, A., & Dako, F. (2020). Artificial intelligence in low- and middle-income countries: Innovating global health radiology. Radiology, 297(3), 513–520.

22. Na, S., Heo, S., Han, S., Shin, Y., & Roh, Y. (2022). Acceptance model of artificial intelligence (AI)-based technologies in construction firms: Applying the Technology Acceptance Model (TAM) in combination with the Technology–Organisation–Environment (TOE) framework. Buildings, 12(2), 90, 1-17.
23. Olid, J. N. B., & Soberano, K. T. (2025). Empowering Virtual Assistant through Comprehensive Client Interview Training. International Journal of Computer Science and Mobile Computing, 14(1), 50–54.
24. Omar, A. F., Zainordin, N., Khoo, S. L., & Peng, J. O. H. (2022, November). Barriers in implementing artificial intelligence (AI) and Internet of things (IoTs) among Malaysian construction industry. In AIP Conference Proceedings (Vol. 2644, No. 1). AIP Publishing.
25. Petridou, E., & Lao, L. (2024). Identifying challenges and best practices for implementing AI additional qualifications in vocational and continuing education: a mixed methods analysis. International Journal of Lifelong Education, 1–16.
26. Plackett, B. (2022). The rural areas missing out on AI opportunities. Visual Education, 610(7931), S17.
27. Ramirez, J., Gorriz, J. M., Álvarez-Illán, I., Álvarez-Marquina, A., Arco, J. E., Atzmueller, M., Ballarini, F., Barakova, E. I., Bologna, G., Bonomini, P., Castellanos-Dominguez, G., Castillo-Barnes, D., Cho, S. B., Contreras, R., Cuadra, J. M., Domínguez, E., Dominguez Mateos, F., Duro, R. J., Elizondo, D., … Ferrández-Vicente, J. M. (2023). Computational approaches to Explainable Artificial Intelligence: Advances in theory, applications and trends. Information Fusion, 100, 101945.
28. Riggins, F. J., & Dewan, S. (2005). The digital divide: Current and future research directions. Journal of the Association for information systems, 6(12), 4, 298-337.
29. Siddiquee, N. A., & Xavier, J. A. (2020). Collaborative approach to public service improvement: the Malaysian experience and lessons. International Journal of Public Sector Management, 34(1), 17–32.
30. Singh, R. P., Hom, G. L., Abramoff, M. D., Campbell, J. P., & Chiang, M. F. (2020). Current challenges and barriers to real-world artificial intelligence adoption for the healthcare system, provider, and the patient. Translational Vision Science & Technology, 9(2),45, 1-6.
31. Sithambaram, R. A., & Tajudeen, F. P. (2023). Impact of artificial intelligence in human resource management: a qualitative study in the Malaysian context. Asia Pacific Journal of Human Resources, 61(4), 821-844.
32. Suseno, Y., Hudik, M., Fang, E. S., & Guo, Z. (2020). Employee attitudes, technological anxiety, and change readiness for artificial intelligence adoption. In Academy of Management Proceedings (Vol. 2020, No. 1, p. 20045). Briarcliff Manor, NY 10510: Academy of Management.
33. Wang, L., Zhang, X., Su, H., & Zhu, J. (2024). A Comprehensive Survey of Continual Learning: Theory, Method and Application. IEEE Transactions on Pattern Analysis and Machine Intelligence, 1–20.
34. White, R. W. (2018). Skill discovery in virtual assistants. Communications of The ACM, 61(11), 106–113.
35. Zhang, Y., Lau, R. Y., David Xu, J., Rao, Y., & Li, Y. (2024). Business chatbots with deep learning technologies: State-of-the-art, taxonomies, and future research directions. Artificial Intelligence Review, 57(5), 113, 1- 63.