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Article

Utilising artificial intelligence chatbots for conducting research in the fifth industrial revolution

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Abstract: Artificial intelligence chatbots can be used to conduct research effectively and efficiently in the fifth industrial revolution. Artificial intelligence chatbots are software applications that utilize artificial intelligence technologies to assist researchers in various aspects of the research process. These chatbots are specifically designed to understand researchers' inquiries, provide relevant information, and perform tasks related to data collection, analysis, literature review, collaboration, and more. The purpose of this study is to investigate the use of artificial intelligence chatbots for conducting research in the fifth industrial revolution. This qualitative study adopts content analysis as its research methodology, which is grounded in literature review incorporating insights from the researchers' experiences with utilizing artificial intelligence. The findings reveal that researchers can use artificial intelligence chatbots to produce quality research. Researchers are exposed to various types of artificial intelligence chatbots that can be used to conduct research. Examples are information chatbots, question and answer chatbots, survey chatbots, conversational agents, peer review chatbots, personalised learning chatbots and language translation chatbots. Artificial intelligence chatbots can be used to perform functions such as literature review, data collection, writing assistance and peer review assistance. However, artificial intelligence chatbots can be biased, lack data privacy and security, limited in creativity and critical thinking. Researchers must be transparent and take in consideration issues of informed content and data privacy and security when using artificial intelligence chatbots. The study recommends a framework on artificial intelligence chatbots researchers can use to conduct research in the fifth industrial revolution.

Keywords: artificial intelligence; chatbots; research; fifth industrial revolution; software application

1. Introduction and background

Jee (2023) asserted that artificial intelligence (AI) chatbots can be used to conduct research effectively and efficiently in the fifth industrial revolution (5IR). However, AI chatbots can be effective and efficient if researchers are using it ethically in conducting literature review and retrieving information resources that can enable researchers to be productive in their research projects. AI chatbots, also known as AI chatbots or simply chatbots, are software applications that use AI technologies to simulate human-like conversations with users through text or speech interactions (AlAfnan et al., 2023). These chatbots are designed to understand natural language input from users, interpret their intents and requests, and generate appropriate responses in real-time. AI chatbots are used across a wide range of applications and industries, including customer service, e-commerce, healthcare, education, and research. They serve as virtual assistants, customer support agents, information

providers, and task automators, helping streamline processes, enhance user experiences, and improve efficiency in various domains in the 5IR (Labadze et al., 2023).

According to AlAfnan et al. (2023) 5IR refers to the collaboration between AI and human intelligence (HI) to ensure that certain activities such as research are conducted effectively and efficiently. In the 5IR, the strength of AI can collaborate with the strength of HI in conducting sound and ethical research. This refers to a situation where researchers can use AI chatbots to produce quality research projects (Lavidas et al., 2024). Unlike in the 4IR, where AI can be used independently without human intervention. However, in using this AI tools such as ChatGPT, QuillBot, Grammarly, AskJenna, IBM Watson assistant, Siri, google assistant among others, researchers must ensure that they apply themselves so that reliable research projects can be produced using such AI chatbots (Jee, 2013).

In the context of research, AI chatbots are software applications that utilize AI technologies to assist researchers in various aspects of the research process. These chatbots are specifically designed to understand researchers' inquiries, provide relevant information, and perform tasks related to data collection, analysis, literature review, collaboration, and more (Labadze et al., 2023). AI chatbots in research are often programmed with capabilities such as natural language processing (NLP), machine learning, and knowledge representation to comprehend and respond to researchers' queries effectively. They can assist researchers in conducting literature reviews by searching through vast databases of academic papers, summarizing key findings, and identifying relevant sources based on specific research topics or keywords (Williams, 2024). Additionally, AI chatbots can aid in data collection by interacting with participants through conversational surveys or interviews, recording responses, and organizing data for analysis. Furthermore, AI chatbots in research may assist researchers in hypothesis generation, experimental design optimization, data analysis, writing assistance, collaboration management, and ethical considerations. They can streamline research workflows, enhance productivity, and facilitate communication and collaboration among research team members in the 5IR (Adamopoulou and Moussiades, 2020).

1.1. Problem statement

The problem that led to this study is that the use of AI chatbots for conducting research might make students to over depend on them. Over dependence on AI chatbots can then affect how students conduct their research. This is because through the use AI chatbots, they may not only use it for writing, literature review and formatting but they can use it even on issues that need critical thinking (Akgun and Greenhow, 2021). Once researchers over-depend on AI chatbots, they are not going to be critical thinkers anymore because AI chatbots can then be used to analyse and interpret academic events and activities. Once researchers over rely on AI chatbots, even their academic creativity fades away because AI chatbots are intelligent enough to be creative in writing and analysing academic documents (Lopez, 2022).

The problem with this is the kind of researcher's academic institutions produce during the era of AI chatbots for conducting research. It is possible for researchers to

produce research where they have not contributed significantly in them. Imagine completing a dissertation and thesis while you have over used AI chatbots in the conceptualization ideas and writing of the dissertation and thesis. However, if used properly, AI chatbots can contribute meaningfully to research. Researchers can use AI chatbots for what it is supposed to do (Yetişensoy and Karaduman, 2024). AI chatbots can help researchers edit their research papers, it can be used to conduct literature reviews, researchers can use AI chatbots for collaboration, AI chatbots can be used to arrange the references and researchers can also use them for even peer reviewing their research papers. Hence, this study intends to investigate the use of AI chatbots for conducting research in the 5IR.

1.2. Purpose of the study

The purpose of this study is to investigate the use of AI chatbots for conducting research in the 5IR.

1.3. Objectives of the study

The following are the objectives of the study:

- Identify the types of AI chatbots relevant for conducting research in the 5IR.
- Examine the functions of AI chatbots in conducting research in the 5IR.
- Assess the merits of AI chatbots in conducting research in the 5IR.
- Evaluate the demerits of AI chatbots in conducting research in the 5IR.
- Assess the ethics of using AI chatbots in conducting research in the 5IR.
- Recommend a framework for using AI chatbots for conducting research in the 5IR.

2. Literature review

This section addresses the literature review based on the following themes: types of AI chatbots relevant for research, functions of AI chatbots in conducting research, merits and demerits of AI chatbots in conducting research and ethics of using AI chatbots in conducting research.

2.1. Types of artificial intelligence chatbots relevant for research

There are different types of AI chatbots that can be used to conduct research in the 5IR. According to K et al. (2018) informational chatbots are AI chatbots that can be used for conducting research. These chatbots are designed to provide information on specific topics or fields of study. Informational chatbots can answer questions, provide definitions, explain concepts, and offer references to relevant resources such as research papers, articles, or websites. ResearchBot as example of information chatbots. Essel et al. (2022) alluded that researcherBot is designed to assist researchers in navigating the vast landscape of academic literature, providing quick access to relevant papers, abstracts, and summaries. It can be helpful in conducting literature review, article summaries, citation assistance, recommend papers and journals and also research methodology support (Akgun and Greenhow, 2021).

Liu et al. (2019) articulated that question and answer (Q & A) chatbots are trained to answer specific questions posed by users. They can be customized to provide

responses based on pre-defined knowledge bases, Frequently Asked Questions (FAQs), or databases relevant to a particular research domain. Q&A chatbots are designed to respond to specific questions posed by users. They are trained in large datasets or knowledge bases and use natural language processing (NLP) techniques to understand user inquiries and provide relevant answers. IBM Watson Assistant is an example of Q&A chatbots. IBM Watson Assistant is a powerful chatbot platform that allows developers to create Q&A chatbots capable of answering a wide range of questions. It uses machine learning algorithms to understand user intents and context, enabling it to provide accurate responses (Essel et al., 2022).

Microsoft Bot Framework is an example of Q&A chatbots which offers tools and services for building intelligent Q&A chatbots that can be integrated into various platforms such as websites, mobile apps, and messaging applications. Developers can leverage Microsoft's cognitive services, including language understanding and knowledge extraction, to enhance the capabilities of their chatbots (Liu et al., 2019). Google Dialogflow as one of the Q&A chatbots provides a platform for building conversational agents, including Q&A chatbots, using natural language understanding and machine learning technologies. It offers pre-built agents and integrations with other Google services, making it easier for developers to create sophisticated chatbots with minimal coding effort (K et al., 2018).

Another Q&A chatbots is Amazon Lex, which is a service for building conversational interfaces, including Q&A chatbots, using voice and text inputs. It leverages deep learning techniques to understand natural language queries and provide accurate responses based on predefined knowledge bases or custom logic (Han et al., 2020). QuillBot is a Q&A chatbots which is an AI-powered writing assistant that can be used as a Q&A chatbot for language-related queries. It can answer questions about grammar, writing style, paraphrasing, and more, helping users improve their writing skills (Lopez, 2022). ChatGPT is another Q&A chatbots which is developed by OpenAI, it can also function as a Q&A chatbot by providing responses to user queries based on its training data. While not specifically designed for Q&A, ChatGPT's natural language understanding capabilities allow it to answer a wide range of questions across different topics (Erickson and Kim, 2020).

Pérez et al. (2020) opine that conversational agent, also known as virtual assistants or dialogue systems, engage users in natural language conversations. They can assist researchers by providing guidance, answering inquiries, facilitating discussions, and performing tasks such as scheduling meetings or setting reminders. Siri is a widely known virtual assistant developed by Apple. It is integrated into Apple's devices such as iPhones, iPads, Macs, Apple Watches, and HomePods. Users can interact with Siri using voice commands to perform tasks such as setting reminders, sending messages, making calls, or answering questions (Jee, 2023). Google Assistant is also a virtual assistant developed by Google, available on Android devices, smart speakers, smart displays, and other Google products. It uses natural language processing to understand user queries and provide relevant responses, perform tasks, and control smart home devices (Pérez et al., 2020).

According to Kooli (2023), Alexa is a virtual assistant developed by Amazon, primarily used with Amazon Echo smart speakers and other Alexa-enabled devices. Users can interact with Alexa using voice commands to play music, check the weather,

set timers, shop online, and control smart home devices. Williams (2024) opines that Cortana is a virtual assistant developed by Microsoft, available on Windows devices, Xbox consoles, and as a standalone app on mobile platforms. It assists users with tasks such as setting reminders, scheduling appointments, searching the web, and providing personalized recommendations. In the view of AlAfnan et al. (2023), ChatGPT is an AI-powered conversational agent developed by OpenAI, based on the GPT (Generative Pre-trained Transformer) architecture. It engages in text-based conversations with users, providing responses that are contextually relevant and coherent across a wide range of topics.

According to Adamopoulou and Moussiades (2020), research assistants are specifically designed to support researchers throughout the research process. They can help with tasks such as literature review, data collection, hypothesis generation, experimental design, data analysis, writing assistance, and collaboration management.

IBM Watson Discovery is a research assistant chatbot which is cognitive search and content analytics platform that can be used as a research assistant. It can ingest large volumes of unstructured data from various sources such as research papers, patents, and news articles, and provide insights, trends, and relationships to aid researchers in their work (Labadze et al., 2023).

According to Wu (2023) meta is an AI-powered research assistant platform for scientific research that helps researchers discover relevant articles, stay updated on the latest research trends, and organize their literature collections. It uses natural language processing and machine learning algorithms to analyze and categorize scientific articles, making it easier for researchers to find relevant information (Yetişensoy and Karaduman, 2024).

Scite is also a research assistant platform that uses AI to analyze scientific articles and provide citation context for research claims. It helps researchers evaluate the reliability and credibility of research findings by highlighting whether a claim has been supported, contradicted, or mentioned in subsequent research (Akgun and Greenhow, 2021).

Grammarly is an AI-powered writing assistant that helps users improve their writing by providing suggestions for grammar, punctuation, style, tone, and clarity. It can be used as a web browser extension, a desktop app, or a mobile app, allowing users to check their writing across various platforms such as emails, documents, social media posts, and more. Grammarly offers both free and premium versions, with the premium version providing additional features such as advanced grammar checking, vocabulary enhancement suggestions, and plagiarism detection. Overall, Grammarly aims to help users communicate effectively and confidently by refining their written content (Liu et al., 2019).

Survey chatbots are used to conduct surveys or gather data from respondents through conversational interactions. They can guide users through survey questions, collect responses, and store data for analysis, making the survey-taking process more engaging and accessible (Erickson and Kim, 2020). SurveyMonkey is an example of survey chatbots that offers a chatbot feature called “SurveyMonkey Genius” that helps users create surveys and collect responses through messaging platforms such as Slack and Microsoft Teams. The chatbot guides users through the survey creation process and provides real-time feedback on survey design (Pérez et al., 2020).

Typeform is a survey chatbots that allows users to create interactive surveys, forms, and quizzes. It offers a chatbot-like interface for respondents, presenting questions one at a time in a conversational format. Users can embed Typeform surveys on websites or share them via links (Dempere et al., 2023). Tars is a survey chatbot platform that enables users to create conversational surveys and forms. It offers a drag-and-drop interface for building chatbot workflows and integrates with various messaging platforms, websites, and CRMs. Tars' chatbots can be used to collect feedback, conduct market research, and generate leads (Özcan and Polat, 2023).

Homolak (2023) allude that peer review chatbots assist researchers in the peer review process by providing feedback on research manuscripts, evaluating writing quality, identifying errors or inconsistencies, and suggesting improvements to enhance the overall quality of the submission. Peer review chatbots are tools designed to assist in the peer review process by providing feedback on research manuscripts, evaluating writing quality, identifying errors or inconsistencies, and suggesting improvements. While fully automated peer review is not yet common due to the complexity of human judgment involved, there are tools that aid in aspects of the process (Xu et al., 2021).

PubPeer is a platform that allows researchers to post comments and feedback on published research articles. While not a chatbot in the traditional sense, it enables peer review by facilitating open discussions and critiques of scientific literature (Özcan and Polat, 2023). Peerage of Science is an online platform that aims to improve the efficiency and quality of peer review by connecting researchers with suitable peer reviewers. It uses algorithms to match manuscripts with potential reviewers based on their expertise and interests, facilitating the peer review process (Homolak, 2023).

According to Xu et al. (2021), language translation chatbots facilitate communication and collaboration among researchers from different linguistic backgrounds. They can translate text or speech between multiple languages, enabling researchers to access and share information across language barriers. Google Translate is one of the most widely used language translation tools. It offers text and speech translation between over 100 languages and supports various input methods, including typing, handwriting, and voice input. Google Translate also offers a chatbot feature that allows users to have conversations in different languages (van Dis et al., 2023). Microsoft Translator provides translation services for text, speech, and images across multiple platforms, including web browsers, mobile apps, and Office applications. It offers real-time translation in over 60 languages and supports conversation mode for multilingual communication (van Dis et al., 2023).

According to Cox (2021), personalized learning chatbots assist researchers in acquiring new knowledge, skills, or competencies tailored to their individual learning objectives and preferences. They can recommend relevant resources, deliver adaptive learning experiences, and track progress over time. Brainly is an online learning community that connects students with peers and educators for collaborative learning. It offers a chatbot interface for students to ask questions, get instant answers, and receive personalized recommendations for further study based on their learning goals and interests (Gabriel, 2020). Quizlet is a learning platform that offers personalized study tools and resources for students. Its chatbot feature provides personalized recommendations for study materials, flashcards, and quizzes based on learners' preferences, learning history, and performance (Xu et al., 2021).

2.2. Functions of artificial intelligence chatbots in research

AI chatbots have the capabilities to before research functions. According to Gabriel (2020), AI chatbots can assist researchers in conducting literature reviews by searching through vast databases of academic papers, summarizing key findings, and identifying relevant sources based on specific research topics or keywords. Chatbots can be programmed to gather data from respondents through conversational surveys or interviews. They can interact with participants, ask questions, record responses, and store data in a structured format for analysis. Holmes et al. (2019) opine that AI chatbots can analyze existing data or literature to identify patterns, correlations, and potential research hypotheses. They can suggest new research directions based on insights derived from data analysis or literature review (Lavidas et al., 2024). Chatbots can perform basic data analysis tasks such as descriptive statistics, graphical visualization, and hypothesis testing. They can analyze research data and provide insights into patterns, trends, and relationships (Gabriel, 2020).

Lowendahl and Williams (2018) articulated that AI chatbots can help researchers in drafting research proposals, manuscripts, or reports by providing writing prompts, grammar checks, and suggestions for improving clarity and coherence. Chatbots can facilitate collaboration among research team members by coordinating tasks, scheduling meetings, sharing resources, and providing updates on project progress (Holmes et al., 2019). AI chatbots can aid in the peer review process by assisting reviewers in evaluating research manuscripts, identifying strengths and weaknesses, and providing feedback on writing quality, methodology, and interpretation of results. Chatbots can disseminate research findings to broader audiences by providing summaries, answering questions, and engaging with stakeholders through various channels such as websites, social media, or messaging platforms (Holmes et al., 2019).

2.3. Merits of artificial intelligence chatbots in research

There are advantages that come with using AI chatbots to conduct research. George and George (2023) alluded that AI chatbots can automate repetitive tasks such as literature review, data collection, and basic data analysis, saving researchers time and effort. They provide round the clock access to information and assistance, allowing researchers to work at their own pace and schedule. They can also handle multiple inquiries simultaneously, making them suitable for large-scale research projects with diverse needs. AI chatbots provide consistent responses and follow predefined protocols, reducing variability and ensuring reliability in research processes (Raj et al., 2023).

AI Chatbots can tailor responses and recommendations based on individual researchers' preferences, interests, and previous interactions. They can analyze research data and provide insights, trends, and patterns that may not be immediately apparent to researchers (Raj et al., 2023). They facilitate collaboration among research team members by coordinating tasks, sharing resources, and providing updates on project progress. They can assist researchers in accessing and navigating vast amounts of scholarly literature, databases, and other research resources more efficiently. AI chatbots can provide feedback on research proposals, manuscripts, or methodologies,

helping researchers improve the quality and rigor of their work (George and George, 2023).

2.4. Demerits of artificial intelligence chatbots in research

AI chatbots come with numerous disadvantages. Researchers should be mindful of potential biases in AI chatbots, particularly in data collection, analysis, and decision-making processes, to ensure fairness and prevent discriminatory outcomes. Chatbots may handle sensitive research data, raising concerns about data privacy and security breaches if not properly implemented and secured (Verma et al., 2023). Chatbots may struggle to understand the nuanced context of research inquiries, leading to misinterpretations or irrelevant responses. Chatbots may lack the creativity and critical thinking skills of human researchers, limiting their ability to generate novel research ideas or critically evaluate complex problems. Chatbots may have technical limitations such as language barriers, speech recognition errors, or limitations in natural language understanding, impacting their effectiveness in communication and assistance (Singh, 2023).

Researchers may become overly dependent on chatbots for research tasks, potentially reducing their own critical thinking skills and autonomy in decision-making. There may be ethical concerns surrounding the use of chatbots in research, such as transparency in their operation, informed consent for participants interacting with chatbots, and accountability for any errors or biases in their responses. Chatbots may not always provide a seamless user experience, leading to frustration or dissatisfaction among researchers if they encounter difficulties or limitations in interacting with the chatbots. Chatbots require ongoing maintenance and updates to stay effective and accurate, including updates to their training data, algorithms, and natural language processing capabilities. Despite their autonomy, chatbots may still require human oversight and intervention, particularly in complex or ambiguous research situations where human judgment and expertise are essential (Gursoy et al., 2023).

2.5. Ethics of artificial intelligence chatbots in research

There are ethics that must be considered when using AI chatbots in research. Researchers should ensure transparency in the use of AI chatbots, disclosing their purpose, capabilities, and limitations to participants and stakeholders involved in the research process (Kasani et al., 2024). This can ensure that AI is used ethically when conducting research using AI chatbots in the 5IR. This can help the researchers not to be biased and respect the privacy of participants when conducting research via AI chatbots (Williams, 2024). Researchers interacting with AI chatbots should provide informed consent, understanding the nature of their involvement, the potential risks and benefits, and their rights regarding data privacy and confidentiality (Coghlan et al., 2023).

Researchers must prioritize the protection of participants' data privacy and security when using AI chatbots, implementing robust measures to safeguard sensitive information and comply with relevant data protection regulations (Adiguzel et al., 2023). Researchers are accountable for the actions and decisions of AI chatbots used

in research, including any errors, biases, or unintended consequences that may arise, and should take responsibility for addressing and mitigating these issues (Williams, 2024). Researchers should ensure the integrity and trustworthiness of AI chatbots in research, maintaining accuracy, reliability, and accountability in their operation and communication with participants (Bahroun et al., 2023). Despite their autonomy, AI chatbots may require human oversight and intervention, particularly in complex or sensitive research situations where human judgment and ethical considerations are essential (Brandtzaeg and Følstad, 2018). AI chatbots must be used in the manner that they do not compromise the integrity of the research and the privacy of the participants. This can ensure the integrity of the research and its outcome in the society (Kasani et al., 2024).

3. Research methodology

This qualitative study adopts content analysis as its research methodology, which is grounded in a comprehensive literature review incorporating insights from the researchers' experiences with utilizing AI chatbots for conducting research in the 5IR. Themes and keywords such as "Artificial Intelligence", Artificial intelligence Chatbots," "Research," and "Fifth Industrial Revolution" guided the exploration of relevant literature.

The literature review process involved utilising numerous search engines, including Google Scholar, ResearchGate, Web of Science, EBSCOhost, ScienceDirect, Springer, and Sage, selected for their capacity to connect researchers with various websites hosting pertinent information. The search was refined using specific keywords, resulting in a substantial number of literature sources. The researchers systematically traversed through search results, sifting through thousands of sources to identify and access literature relevant to the study.

Documents were identified and selected based on their relevance and utility to the study. Initial screening involved scrutinising titles and abstracts to eliminate duplicates. In the subsequent round, full-text articles meeting inclusion criteria underwent further review. The researchers employed thematic analysis, following Braun and Clarke's (2006) technique, to systematically analyze qualitative data or text from prior studies. This involved examining, synthesizing, and interpreting data by categorizing it according to key research objectives related to the investigated topic.

The collected and extracted data from included articles were summarized and reported to facilitate a contextual and meaningful understanding of the issues under investigation. The resulting findings were organized into thematic categories such as "Artificial Intelligence" "Artificial intelligence Chatbot," "Research," and "Fifth Industrial Revolution," providing valuable insights into the integration of AI chatbots for conducting research in the 5IR.

Inclusion and exclusion criteria

This study employed a systematic literature search to compile relevant findings on the application of AI in conducting research in the 5IR. The researchers utilised specific search terms, including artificial intelligence, research, and Fifth Industrial Revolution. The selection criteria for inclusion were as follows:

- Articles published between 2018 and 2024;
- Empirical studies;
- Articles written in English; and
- Publications appearing in peer-reviewed scholarly journals.

The exclusion criteria encompassed articles not written in English, studies that did not focus on the application of AI in research in the 5IR, and grey literature or non-peer-reviewed publications. To identify relevant scholarly works, the researchers conducted an initial screening of abstracts to assess their alignment with the study's objectives.

Subsequently, the search criteria were refined to focus on subject areas specifically related to the application of AI in research within the 5IR, as these domains form the foundation of the study. The literature search was restricted to English-language articles published between 2018 and 2024.

The following academic databases were utilized for the literature search:

- Google Scholar.
- Web of Science.
- EBSCOhost.
- ScienceDirect.
- Springer.
- SAGE.

4. Findings of the study

This section presents the findings of this study. The findings indicate that there are various types of AI chatbots that can be used to conduct research. AI chatbots that can be used to conduct research include among others the following: information chatbots such as AskJenna; Q&A chatbots such as QuillBot and ChatGPT; Conversational agents such as Siri, Google Assistant and ChatGPT; Research assistant such as meta, scite and IBM Watson discovery; Survey chatbots such as SurveyMonkey, Typeform and Tars; Peer review chatbots such as PubPeer,; Language Translation Chatbots such as Google translate and Microsoft translator and personalized learning chatbots such as Brainly and Quizlet (Akgun and Greenhow, 2021; Erickson and Kim, 2020; Essel et al., 2022; Pérez et al., 2020).

AI chatbots can perform the following functions in research: literature review, data collection, hypothesis generation, data analysis, writing assistance, collaboration management, peer review assistance and knowledge sharing dissemination. AI chatbots have merits and demerits (Gabriel, 2020; Holmes et al., 2019). The merits of AI chatbots include the following: AI chatbots are efficient, accessible, scalable, consistent, provide personalized information, assist in research collaboration and allow access to resources (George and George, 2023; Raj et al., 2023).

The demerits of AI chatbots are as follows: it can be biased, lacks data privacy and security, lack of contextual understanding, AI chatbots has limited creativity and critical thinking (Gursoy et al., 2023; Singh, 2023). Researchers should comply with the ethics of AI when using AI chatbots for research. Researchers have to be transparent, be aware of informed consent, be aware of data privacy and security.

Researchers have to be accountable and responsible for using AI chatbots ethically when conducting research (Brandtzaeg and Følstad, 2018; Coghlan et al., 2023).

5. Recommendations

This study recommends a framework that can be used to adopt the use of AI chatbots for conducting research in the 5IR. The AI chatbots has the potential to assist the researchers to produce quality research outputs as illustrated in **Figure 1**. The framework is focused on how AI chatbots can be used in conducting research in the 5IR.

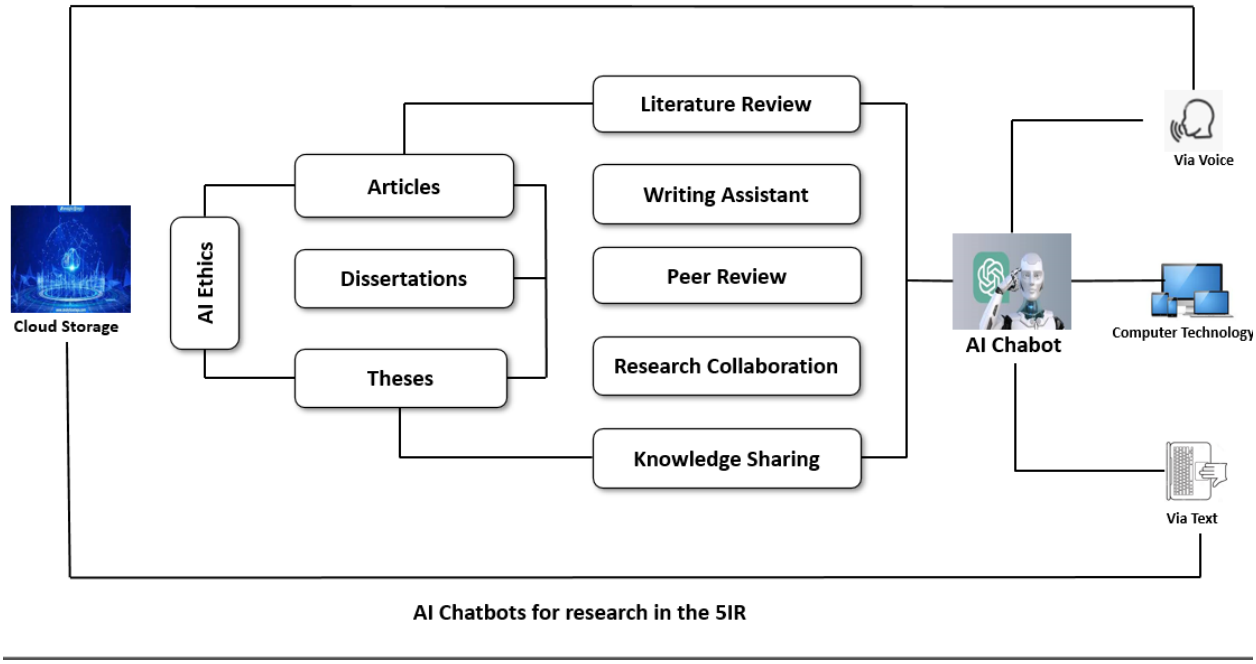

Figure 1. Framework on the use of AI Chatbots for conducting research in 5IR.

This framework begins with the researchers accessing AI chatbots for research through the following methods: via voice, researchers can use the voice technology to instantiate a conversation with the AI Chatbots. This functionality is convenient for the researchers who are disable visually to interact with AI chatbots by using voice technology. However, this functionality can be used by anyone who does not want to type when using the AI chatbots; via text functionality, researchers can also use this functionality to type whatever they want the AI chatbots to assist them with. AI chatbots could be any chatbot the researchers prefer to use to conduct their research. The multi functionality of the AI chatbots can be beneficial to even disabled researchers who can use them when conducting research in the 5IR.

The researchers can use the AI chatbots for conducting literature review when doing their research. Researchers can type any themes that are core to their research topics are AI Chatbot can harvest from various databases and research platforms to collect accurate literature for the researchers. AI chatbots can even provide specific literature reviews based on the researcher's search ability. However, should AI chatbot find it difficult to retrieve literature it will indicate its inability to do so and provide alternative platforms where researchers can access such information. AI chatbot

always indicates that what it provides is that reliable and there advise the researchers to verify that information it provides. Therefore, it becomes the responsibility of researchers to verify the literature harvested from AI chatbots.

Researchers can use AI chatbots to share their research with wider communities. Most universities, for example, publish affiliated research as open access. Through AI chatbots, such research projects can be shared and accessed easily and quickly within the online research community. AI chatbots in this way, would then assist in ensuring that the documents have no more grammatical errors and it can read well. However, it becomes the responsibility of the researchers to ensure that the correct language, for instance, English, is used in the document because often AI chatbots uses American English not British English. So, the researchers must ensure that they review the document after using the AI chatbots for editing to ensure that the document is correctly written.

Researchers can use AI chatbots for peer review of their research projects. Through AI chatbots, researchers can be able to connect to a pool of researchers who they can use for peer review. Such researchers can meet online based on their research interests and such research projects can be shared digitally among them so that others can peer review their documents virtually. Researchers can use the feedback they get from other researchers to make their research project perfect. AI chatbots allow researchers from cross the entire universe to connect and peer review documents for each other. Through peer review opportunities brought by AI chatbots, it gives the advantage for researchers to collaborate even on their research projects. An advantage to collaborate through AI chatbots is that researchers from all over the world can collaborate and work on one project regardless of the place and time.

The researchers can use AI chatbots to share their research to the wide communities. Most of the universities for example they are publishing any research affiliated to them open access so through AI chatbots such research projects can be shared and accessed easily and quickly within the online research community. Through AI chatbots, the researchers can produce quality research articles, dissertations and theses that can be shared and accessed universally. However, the researchers must use AI chatbots ethically so that the standard and quality of their research projects cannot be compromised. Researchers must not replace their thinking and creativity in research and academic writing with the use of AI chatbots. Researchers must submit AI generated literature without reviewing and editing it to ensure it addresses what they want it to address. Researchers must ensure that they acknowledge the use of AI chatbots in their research and indicate where and how AI chatbots were utilised in such research. If AI chatbots are used properly and ethically, they can help researchers produce quality research projects.

6. Conclusion

In conclusion, the use of AI chatbots can play a crucial role in producing quality research, especially if it is used ethically and adequately in the 5IR. AI chatbots can be used for various reasons in research including for literature search, editing, peer reviewing, collaboration and knowledge sharing among others. This tool can be efficient and effective for researchers because often they are accurate, reliable,

efficient and always available for usage by researchers. AI chatbots also connect researchers from across the world and ensure they collaborate on various projects. Hence, it is important for researchers to ensure they attend workshops on how to use AI chatbots ethically to produce credible research projects. Researchers must however ensure they don't over depend on AI chatbots to do the research on their behalf because that will affect their critical thinking and academic creativity. Researchers can only use AI chatbots to make their research projects presentable and coherent. Therefore, it is important for universities to draft policies on AI for academic purposes. It is the policy on AI that can guide the researchers on how they can use AI to conduct research. Researchers can also acknowledge how they utilised AI chatbots when conducting research and such can be documented in the university policy on AI.

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References

Adamopoulou, E., Moussiades, L. (2020). An Overview of Chatbot Technology. In: Maglogiannis, I., Iliadis, L., Pimenidis, E. (editors), Artificial Intelligence Applications and Innovations, Proceedings of IFIP International Conference on Artificial Intelligence Applications and Innovations. Springer, Cham. Volume 584.

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. Contemporary Educational Technology, 15(3), ep429. https://doi.org/10.30935/cedtech/13152

Akgun, S., & Greenhow, C. (2021). Artificial intelligence in education: Addressing ethical challenges in K-12 settings. AI and Ethics, 2(3), 431–440. https://doi.org/10.1007/s43681-021-00096-7

AlAfnan, M. A., Samira, D., Marina, J., & Koba, L. (2023). ChatGPT as an Educational Tool: Opportunities, Challenges, and Recommendations for Communication, Business Writing, and Composition Courses. Journal of Artificial Intelligence and Technology. https://doi.org/10.37965/jait.2023.0184

Bahroun, Z., Anane, C., Ahmed, V., et al. (2023). Transforming Education: A Comprehensive Review of Generative Artificial Intelligence in Educational Settings through Bibliometric and Content Analysis. Sustainability, 15(17), 12983. https://doi.org/10.3390/su151712983

Brandtzaeg, P. B., & Følstad, A. (2018). Chatbots. Interactions, 25(5), 38–43. https://doi.org/10.1145/3236669

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Coghlan, S., Leins, K., Sheldrick, S., et al. (2023). To chat or bot to chat: Ethical issues with using chatbots in mental health. Digital Health, 9. https://doi.org/10.1177/20552076231183542

Cox, A. M. (2021). Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design fictions. International Journal of Educational Technology in Higher Education, 18(1). https://doi.org/10.1186/s41239-020-00237-8

Dempere, J., Modugu, K., Hesham, A., et al. (2023). The impact of ChatGPT on higher education. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1206936

Erickson, M., & Kim, P. (2020). Can chatbots work well with knowledge management systems? Issues In Information Systems, 21(4), 53–58.

Essel, H. B., Vlachopoulos, D., Tachie-Menson, A., et al. (2022). The impact of a virtual teaching assistant (chatbot) on students' learning in Ghanaian higher education. International Journal of Educational Technology in Higher Education, 19(1). https://doi.org/10.1186/s41239-022-00362-6

Gabriel, A. (2020). Artificial intelligence in scholarly communications: An elsevier case study. Information Services & Use, 39(4), 319–333. https://doi.org/10.3233/isu-190063

George, A. S., & George, A. S. H. (2023). A Review of ChatGPT AI's Impact on Several Business Sectors. Partners Universal International Innovation Journal, 1(1), 9–23. https://doi.org/10.5281/zenodo.7644359

Gursoy, D., Li, Y., & Song, H. (2023). ChatGPT and the hospitality and tourism industry: an overview of current trends and future research directions. Journal of Hospitality Marketing & Management, 32(5), 579–592. https://doi.org/10.1080/19368623.2023.2211993

Han, J. W., Park, J., & Lee, H. (2022). Analysis of the effect of an artificial intelligence chatbot educational program on non-face-to-face classes: a quasi-experimental study. BMC Medical Education, 22(1). https://doi.org/10.1186/s12909-022-03898-3

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education. The center for curriculum redesign.

Homolak, J. (2023). Opportunities and risks of ChatGPT in medicine, science, and academic publishing: a modern Promethean dilemma. Croatian Medical Journal, 64(1), 1–3. https://doi.org/10.3325/cmj.2023.64.1

Jee, H. (2023). Emergence of artificial intelligence chatbots in scientific research. Journal of Exercise Rehabilitation, 19(3), 139–140. https://doi.org/10.12965/jer.2346234.117

K, B. P., Too, J. K., & Mukwa, C. W. (2018). Teacher Attitude towards Use of Chatbots in Routine Teaching. Universal Journal of Educational Research, 6(7), 1586–1597. https://doi.org/10.13189/ujer.2018.060719

Kasani, P. H., Cho, K. H., Jang, J. W., et al. (2024). Influence of artificial intelligence and chatbots on research integrity and publication ethics. Science Editing, 11(1), 12–25. https://doi.org/10.6087/kcse.323

Kooli, C. (2023). Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions. Sustainability, 15(7), 5614. https://doi.org/10.3390/su15075614

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. International Journal of Educational Technology in Higher Education, 20(1). https://doi.org/10.1186/s41239-023-00426-1

Lavidas, K., Voulgari, I., Papadakis, S., et al. (2024). Determinants of Humanities and Social Sciences Students' Intentions to Use Artificial Intelligence Applications for Academic Purposes. Information, 15(6), 314. https://doi.org/10.3390/info15060314

Liu, Q., Huang, J., Wu, L., et al. (2019). CBET: design and evaluation of a domain-specific chatbot for mobile learning. Universal Access in the Information Society, 19(3), 655–673. https://doi.org/10.1007/s10209-019-00666-x

Lopez, T. (2022). The benefits and drawbacks of implementing chatbots in higher education: a case study for international students Jönköping University [Master's thesis]. Jönköping University: Jönköping International Business School.

Özcan, A., & Polat, S. (2023). Artificial intelligence and chatbots in academic research. Journal of Research in Social Sciences and Language, 3(2), 81-90. https://doi.org/10.20375/0000-000f-ff1e-2

Pérez, J. Q., Daradoumis, T., & Puig, J. M. M. (2020). Rediscovering the use of chatbots in education: A systematic literature review. Computer Applications in Engineering Education, 28(6), 1549–1565. Portico. https://doi.org/10.1002/cae.22326

Raj, R., Singh, A., Kumar, V., et al. (2023). Analyzing the potential benefits and use cases of ChatGPT as a tool for improving the efficiency and effectiveness of business operations. BenchCouncil Transactions on Benchmarks, Standards and Evaluations, 3(3), 100140. https://doi.org/10.1016/j.tbench.2023.100140

Singh, D. (2023). ChatGPT: A New Approach to Revolutionise Organisations. International Journal of New Media Studies (IJNMS), 10(1), 57–63.

van Dis, E. A. M., Bollen, J., Zuidema, W., et al. (2023). ChatGPT: five priorities for research. Nature, 614(7947), 224–226. https://doi.org/10.1038/d41586-023-00288-7

Verma, G., Campbell, T., Melville, W., et al. (2023). Navigating Opportunities and Challenges of Artificial Intelligence: ChatGPT and Generative Models in Science Teacher Education. Journal of Science Teacher Education, 34(8), 793–798. https://doi.org/10.1080/1046560x.2023.2263251

Williams, K. C., & Lowendahl, J. M. (2018). 5 Best Practices for Artificial Intelligence in Higher Education. Gartner Research.

Williams, R. T. (2024). The ethical implications of using generative chatbots in higher education. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1331607

Wu, Y. (2023). Integrating Generative AI in Education: How ChatGPT Brings Challenges for Future Learning and Teaching. Journal of Advanced Research in Education, 2(4), 6–10. https://doi.org/10.56397/jare.2023.07.02

Xu, Y., Liu, X., Cao, X., et al. (2021). Artificial intelligence: A powerful paradigm for scientific research. The Innovation, 2(4), 100179. https://doi.org/10.1016/j.xinn.2021.100179

Yetişensoy, O., & Karaduman, H. (2024). The effect of AI-powered chatbots in social studies education. Education and Information Technologies, 29(13), 17035–17069. https://doi.org/10.1007/s10639-024-12485-6