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Harnessing Artificial Intelligence's Potential in Rural Education Research: An Application of ChatGPT-4

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Abstract: This exploratory study delved into the capabilities of Artificial Intelligence (AI) to enhance rural education research. Specifically, it sought to operationalise the research agenda outlined by the National Rural Education Association of the United States of America and involve scholar-practitioners in conducting research that could influence policy and practice in rural education. The study explored the opportunities of AI applications, specifically the ChatGPT-4, in generating initial study ideas for the Policy and Funding support theme within the National Rural Education Association Research Agenda – 2022-2027. The focus was on meeting the needs of racially and linguistically diverse students in rural educational settings. The ChatGPT-4 successfully generated five relevant research

problems/study topics, nine research questions, and identified three possible theoretical frameworks. Four limitations were identified: (1) inaccuracy of the leading scholars, (2) the lack of contextual understanding, (3) the lack of domain expertise, and (4) a potential over-reliance on automated assistance. The results of this study highlighted the potential of ChatGPT-4 as an effective tool for researchers in the early stages of their projects. It was found that the ChatGPT-4 efficiently provided relevant research topics, questions, and theoretical frameworks. As such, it may provide several advantages in the initial research process including accuracy in generating research problems, saving time, reducing cognitive workload, and enhancing idea generation. Since the tool expedited idea generation, it may free up researchers to concentrate on other aspects of research such as critical thinking and analysis. However, the limitations included inaccuracies in identifying leading scholars, the lack of contextual understanding, insufficient domain expertise, and the risk of excessive dependence on automation. This suggests that caution should be used when utilising AI to support research as human expertise in content, context, and methodology is vital for conducting thorough research.

Keywords: AI in Education, Artificial Intelligence, ChatGPT-4, NREA Research Agenda, Research process, doctoral research

Introduction

Artificial intelligence (AI) is defined as a disruptive technology with the potential to revolutionise many disciplines and sectors, including education practice (Baidoo-Anu & Owusu-Ansah, 2023; Holmes & Tuomi, 2022), professional development (Chokshi, 2023) and education research (Paek & Kim, 2021). As Paek and Kim (2021, pp. 15–16) note: "No field is immune from an AI shock…. AIED (Artificial Intelligence in Education) has become a constant rather than a variable…We have entered an era in which education without AI cannot exist."

In China, AI transformations are being explored to promote the revitalisation of rural education (Jiang, 2021). Could applications of AI transform rural education in the United States? In this article an application of AI was used to explore and illustrate how AI might hold promise for advancing research on rural education priorities of the National Rural Education Association (NREA) in the United States. The *National Rural Education Association Research Agenda 2022-2027* (Hartman et al., 2022) presents priorities for current and future research with expectations that the pursuit of the agenda will increase educational equity and opportunity for the nation's rural students while highlighting the strengths of rural schools and communities. The agenda included a central theme of spatial and educational equity with example lines of inquiry for each of five interconnected support themes: (1) policy and funding; (2) teacher/leader recruitment, retention, and preparation; (3) college and career trajectory; (4) community partnerships and relationships; as well as (5) health and wellness. This study explored how applications of artificial intelligence (AI), specifically the ChatGPT-4, might generate initial study ideas for the support theme of Policy and Funding.

Research Problem

The rapid integration of artificial intelligence (AI) into various sectors, including education, has ushered in an era of transformative possibilities (Chen et al., 2022; Kooli, 2023; Paek & Kim, 2021; Zhai et al., 2021; Zhang & Aslan, 2021). Conversely, this situation has also presented a challenge due to the lack of research on how AI can be effectively utilised in educational research. Specifically, Chatbots (one form of AI), has emerged as a potential tool in educational research by offering capabilities to efficiently process data and automate tasks. However, as highlighted by Cotton et al. (2023), Crompton and Burke

(2023), Ivanov (2023), and Kooli (2023) concerns about bias, lack of contextual understanding, and ethical implications underscore the need for a nuanced exploration of the role of chat-bots in educational contexts and in academic research.

Research Aim and Research Questions

The purpose of this research was to explore and assess the potential of chat-bots by examining their strengths and limitations.

This study was guided by the following two research questions:

1. What potential advantages and opportunities does the ChatGPT-4 provide for rural education researchers during the initial stages of the research process?
2. What limitations exist in utilising the ChatGPT-4 for rural education researchers during the initial stages of the research process?

To address these questions, the researchers explored the opportunities and limitations provided by the artificial intelligence (AI), specifically the ChatGPT-4, to generate the initial ideas for a research study related to one of the lines of inquiry identified within the NREA research agenda (Hartman et al., 2022): *Achieving Funding Formula Equity* from the theme *Policy and Funding*.

Literature Review

Zhai et al. (2021) define artificial intelligence as "a machine that can simulate human intelligence…able to perceive, recognise, learn, react, and solve problems" (p. 1). Though the concept of AI was first proposed in the 1950s, people across the world now live in an era of rapid change from emerging discoveries and applications of artificial intelligence. Paek and Kim (2021) explain:

> *Today, we live in an artificial intelligence (AI) society, in which people can easily experience AI anytime and anywhere. AI has become commonplace and ubiquitous, ranging from AI speakers to high-performance robots. It has become a key driver of transformation in almost all areas, including personalised online education systems, medical services (health care, prescription/treatment), automobiles (autonomous vehicles, transportation services), manufacturing (process optimisation, smart factory), finance (investment, trading, credit evaluation), media (content, advertisement), agriculture (weather data, farm management), energy (energy management), communication (communication resource distribution), and distribution (omnichannel platform) (p. 1).*

Research concerning artificial intelligence in education (AIED) has rapidly expanded. Numerous researchers have highlighted educational uses of AI (Aithal & Aithal, 2023; Chen et al., 2022; Kooli, 2023; Paek & Kim, 2021; Zhai et al., 2021; Zhang & Aslan, 2021), including how "AI systems can facilitate online learning and make education accessible to students in remote areas, leading to more equitable and inclusive education" (Murtaza et al., 2022; Pelletier et al., 2022, as cited in Kooli, 2023, pp. 1–2).

As an AI-driven language model, chat-bots are computer programs designed to mimic human conversation (Lund et al., 2023). The chat-bots, also known as conversational artificial intelligence bots, can respond to conversations through text or voice as if they were sentient beings (Lund et al., 2023). Kooli (2023) defines the chat-bots as "automated conversational agents that use natural language processing and machine learning algorithms to interact with users in a human-like manner" (p. 3). Developed in 2018 by OpenAI, GPT (Generative Pretrained Transformer), a commonly used natural language processing technology in the education sector, is a language model trained on a massive amount of text data that enables it to learn patterns and relationships between words and sentences

and generate human-like text and answer questions. The ChatGPT, launched by OpenAI in November 2022, and other GPT models have resulted in advanced and human-like conversational AI systems. Released on March 14, 2023, GPT-4 is OpenAI's most advanced system of a GPT large language model that uses deep learning technology and artificial neural networks to generate text that is like human speech (Truly, 2023).

AI systems like chat-bots are likely to significantly impact education (Crompton & Burke, 2023; Dempere et al., 2023; Labadze et al., 2023). Areas of higher education where AI may hold enormous potential are in educational research (Crompton & Burke, 2024) and academic writing (Imran & Almusharraf, 2023). Kooli (2023, p. 1) argues that AI systems have the potential to significantly improve the efficiency and accuracy of research by rapidly analysing large datasets and uncovering intricate patterns and relationships that may be challenging for humans to discern. For example, Araujo (2020) created the Conversational Agent Research Toolkit (CART) that enables researchers to create and manage multiple versions of a chat-bot for use as stimuli in experimental studies.

However, other authors recommend caution and identify negative aspects such as biases in datasets, plagiarism, factual incorrectness, over reliance on AI, loss of skills, and privacy concerns (Ivanov, 2023). In an exploratory study, Kooli (2023) analysed the opinions of leading experts on the challenges and impact of the ChatGPT and related generative AI technologies. In asking the experts if chat-bots would transform academic research, Kooli found that AI-powered chat-bots can serve as an excellent research assistant in the academic field in the following ways (pp. 7–8):

- To efficiently collect and process substantial amounts of data and provide researchers with relevant information for their studies.
- To provide unlimited availability and capacity of production (compared to humans).
- To personalise the information they provide based on the researcher's preferences, making their research experience more objective, efficient and personalised.
- To reduce or mitigate risk of human error (e.g., subjectivity and bias) in the research process.
- To improve data quality through provision of consistent and accurate information.
- To automate repetitive and time-consuming tasks, giving researchers additional time to focus on more complex and creative aspects of their research.
- To support researchers in collaborating with colleagues and efficiently sharing information, such as gaining quick access to research databases, relevant studies and articles.
- To help reducing inequalities between researchers, particularly in countries where researchers have difficulties in financing their research and hiring research assistants, or where researchers are unable to translate their research or publish in other useful languages.

While acknowledging that the use of chat-bots in research can lead to an improved collaboration, better coordinated efforts, and higher-quality research outcomes, Kooli (2023) cautions that the chat-bots need to fulfill support needs and cannot replace the essential role of the researcher. Kooli maintains that chat-bots, like human research assistants, need close and continuous supervision, noting:

> *AI systems can be trained on biased data, leading to biased results. This can compromise the validity of research findings and harm communities. Additionally, these machines could lack the expertise and knowledge of human researchers, and may produce results that are inaccurate, incomplete, or irrelevant (p. 9).*

Moreover, Kooli (2023) cautions that chatbots may not have the ability to understand context and nuance, therefore increasing the potential to produce errors and misinterpretations of data. Unlike chat-bots, human researchers can employ creativity, critical thinking skills, and understandings of emotions, empathy, and human behavior which are essential in many areas of research. Numerous scholars (Chen et al., 2022; Kooli, 2023; Michel-Villarreal et al., 2023; Nguyen et al., 2023; Schiff, 2022) warn of the potential ethical challenges (e.g., data security, participant privacy) in using AI in education and other disciplines. Kooli concludes: "Therefore, chat-bots should not be used as a substitute for human researchers, but as a complementary tool to aid in research, under the supervision and control of human experts" (p. 9).

Professional associations and governmental entities are beginning to address the challenges. For example, the National Academy of Medicine (n.d.) has initiated a three-year project to create *The Artificial Intelligence Code of Conduct* (AICC). The purpose was to develop a framework guide to ensure AI algorithms and their application in health, medical care, and health research perform accurately, safely, reliably, and ethically in the service of better health for all. In May 2023, the U.S. Department of Education Office of Educational Technology published *Artificial Intelligence and the Future of Teaching and Learning: Insights and Recommendations*. A longstanding research question is reinforced in the report: Do new AI-enhanced approaches work to improve learning, and for whom and under what conditions? Consequently, among the key insights and recommendations noted in the Office of Educational Technology report is the need to strengthen the role of context in AI research and development (R&D):

As time has progressed, the focus of R&D has shifted towards developing AI models that are context-sensitive to better meet the needs of diverse learners in various settings. This evolution in the field of learning sciences has expanded beyond traditional cognitive principles to now include social learning aspects and a heightened awareness of the importance of context in the learning process. The priority now is on ensuring that AI technologies are not only effective but also safe and trustworthy for all users (p. 59)

Artificial Intelligence and Support for Conducting Research

Involving practitioners in research and engaging scholars in applicable research that informs policy and practice is crucial for closing the research-to-practice gap (Joyce & Cartwright, 2020) and enhancing research utilisation in education (Bryk, 2015; Hemsley-Brown & Sharp, 2003). AI capabilities facilitate two complex processes that can be challenging, especially for scholar-practitioners (Mullen, 2003; Perry et al., 2020) who blend practical experience with empirical research to inform policy or practice. The first challenging process is in making the conceptual transition from an issue of concern or critical interest (e.g., priorities identified in the NREA research agenda reflect such issues) to a research problem (i.e., a concise statement describing the gap in knowledge or understanding that inhibits the ability of practitioners to effectively address the issue of concern), then to research questions (i.e., concrete, empirical questions that will generate the information or understandings needed to resolve the research problem and thus better position practitioners to improve policy or practice).

A point about the potential of AI (and a related clarification/disclaimer about scholar-practitioners) is useful here. First, using AI to assist in making this conceptual transition is not a case of technology replacing humans in doing the work for the individual or team investigating an issue. On the contrary, AI can facilitate the technical process by generating options and possibilities while the human perspective remains firmly in control through both how information is requested and through selections made among possibilities (Ivanov, 2023). The related clarification/disclaimer is this: scholar

practitioners do not require this kind of support assistance because of any deficiencies on their part; rather, AI's facilitation of this technical process results in more a straight line of operations from issue to evidence to improvements, making such investigations more relevant with more viable options (i.e., it can more efficiently generate relevant empirical evidence by minimizing the time investigators spend in inquiry work not directly related to the issue at hand).

The second challenging process for the researcher is finding appropriate literature to review in order to shape the research question. Here a distinction between two different types of literature is made: the foundational literature that Patton (2014) terms the "intellectual genealogy" of the inquiry (i.e., the knowledge bases out of which the inquiry comes and to which it will eventually contribute), and the structural literature (i.e., literature that guides and provides structures for the empirical investigation by providing the basis and source for theoretical and/or conceptual frameworks that ground the study). Importantly, the authors maintain that, in addition to exploring extant work on the specific topic of inquiry, foundational literature reviewed for work investigating rural issues should be substantively and authentically rural, and that—whatever the topic of inquiry—should ground the work in a deep understanding of the rural context (Coladarci, 2007). Consequently, this viewpoint requires broad reading of rural-focused research as well as work about rural contexts, reflection, and application. This understanding, we believe, is essential to the intent of the NREA research agenda of increasing educational equity and opportunity for students while highlighting the strengths of rural schools and communities.

The applicability of AI in facilitating this kind of foundational literature review is limited (beyond what it can offer as a parallel to traditional library search engines in identifying previous work on the same topics of study). AI has significant potential in the identification and review of structural literature. Specifically, investigation of issues of policy and practice such as those raised in the NREA research agenda necessitate engagement with works from varied social science disciplines (e.g., economics, sociology, anthropology) to structure and guide empirical processes, works that are often unfamiliar to education scholar-practitioners in disciplines that are not regularly engaged as part of their professional lives.

Parallel with the point made about the conceptual transition from practical issues to research questions, this is not a case of technology taking over or doing the work for the researcher. In this instance, the contribution of AI is in scanning multiple and varied disciplines to identify potential frameworks and related investigative tools that can be applied to a specific issue within the rural context. Potential is the key factor to consider in this context. The researcher(s) is driving the process with AI serving as a form of specialized library search engine that can recommend possibilities in a way that straightforward search engines cannot, thus identifying possibilities based on what is implied in the request, not just what can be directly entered as search terms. Moreover, the contribution of AI in this part of the inquiry process both enhances the capacity of the researcher by generating possibilities beyond what the researcher can directly request via a traditional search and makes the process more efficient by allowing researchers to focus more time on salient issues of concern and evidence for addressing those issues and less time on indirect academic activities (e.g., reading widely in economic theory to find an appropriate tool for investigating issues of teacher retention in a specific rural context or region).

While AI capacities are broad, it is important to examine the feasibility of using AI as a support for processes associated with conducting empirical research. For this exploratory study, we focus on the feasibility of AI in supporting rural education research and, more specifically, on research processes and activities that (1) can contribute to operationalising the research agenda developed by the National

Rural Education Association (Hartman et al., 2022), and (2) can better engage scholar-practitioners (Mullen, 2003; Perry et al., 2020) in conducting rural education research with the potential to inform policy and practice. As conceptualized here, AI is an especially salient tool for achieving these goals.

Materials and Methods

In this exploratory study, the potential of the ChatGPT-4 was investigated in order to operationalise the National Rural Education Association's (NREA) Research Agenda – 2022-2027. Therefore, the materials used to conduct the study were the ChatGPT-4 software and the NREA Research Agenda which are both available on the internet.

Sample and Participants

The ChatGPT-4 was selected from the pool of available Chat-bots using purposive criterion sampling. The criteria used for this selection included its frequent discussion in educational settings, user-friendly interface, researchers' familiarity with it, and availability.

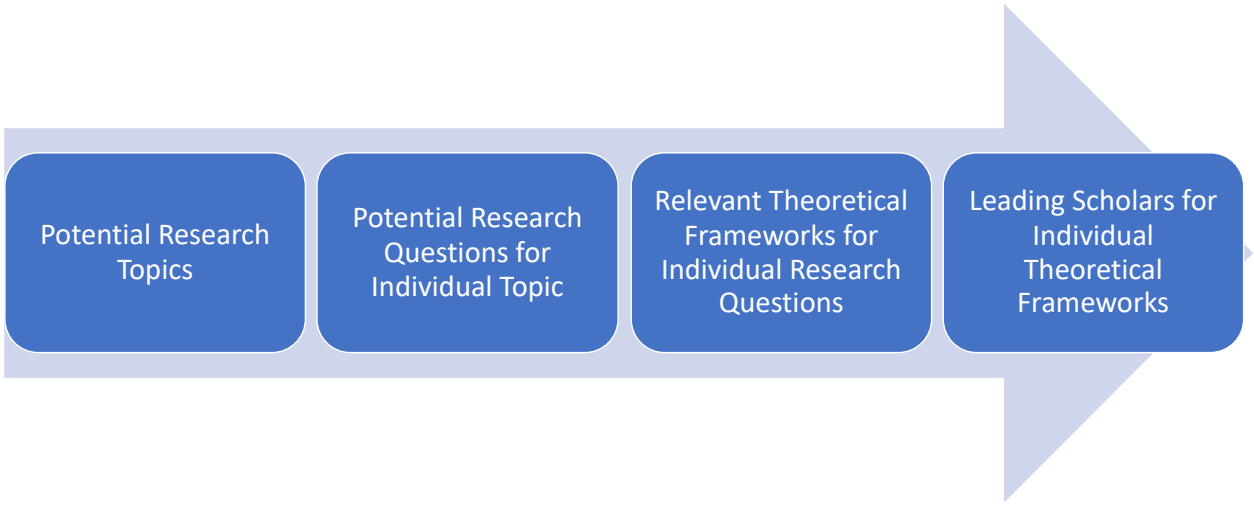
Instrument and Procedure

To generate ideas, a five-step process was utilised. This process included (1) clearly defining the goal, (2) providing context, (3) asking specific questions (including iterations with wording revised), (4) requesting the specific format for the output (bulleted list, detailed explanation, etc.), and (5) fact check responses. An alternate step in the ChatGPT-4 to regenerate responses from the AI was not utilised. This could be used if the user desired additional unique outputs from the same prompt.

The process of clearly defining the goal was established by the research team during two one-hour virtual meetings. The goal was to explore the feasibility of using AI to brainstorm potential research topics with the *NREA Research Agenda 2022 – 2027* (Hartman et al., 2022) and to use the results to answer the two research questions identified for the current inquiry. The output included four phases: (1) generating a bulleted list of potential research problems/topics, (2) generating research questions for that topic, (3) describing relevant theoretical frameworks and (4) listing leading scholars for those frameworks that align with the topic (see Figure 1).

Figure 1

Process for Using AI to Support Research Study Development



In the first phase, potential research problems/topics were generated. To provide context, several variables were included in the initial prompt. The initial prompt was as follows:

> *You are an educational researcher brainstorming ideas for rural research. The topics should be aligned around the Policy and Funding component of the National Rural Education Association Agenda. The Agenda calls for attention to issues ranging from inequitable funding to local and state governance to the adoption of policies that leverage the strengths of rural educational settings. The line of inquiry that topics should be generated for is "identifying nimble policy/funding responses to changing student racial and linguistic demographics."*

The initial prompt for the AI (ChatGPT-4) also included a statement with the specific request, "Generate a bulleted list of potential research problems that could be studied." In response to this prompt, five potential research problems were generated (see Appendix A).

During the second phase, one topic was selected from the output in step one and potential mixed methods research questions were requested. The selected topic was "Investigating the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings." Nine questions were generated in this step (three qualitative, three quantitative, and three mixed methods) (see Appendix B). The generation of quantitative, qualitative, and mixed methods questions when mixed methods was requested is in alignment with Creswell and Clark's (2017) assertion that researchers should advance all three types of research questions in a subdivided fashion to highlight that the results of qualitative and quantitative datasets are important when integrated into the mixed methods study. Although additional questions could have been generated using the "Regenerate response" function of ChatGPT-4, the authors determined the initial output was sufficient for analysis.

During the third phase, potential theoretical frameworks were generated along with brief descriptions of each (see Appendix C). The suggested frameworks were Critical Race Theory (CRT), Culturally Relevant Pedagogy (CRP), and Resource Dependency Theory (RDT). From these, Resource Dependency Theory, perceived by the researchers as highly relevant to the *Achieving Funding Formula Equity* line of inquiry in the *Policy and Funding* support theme, was selected for identifying key scholars in the fourth phase.

The fourth and final output phase involved generating a list of key scholars that focus on RDT (see Appendix D). The five scholars/research groups that the ChatGPT-4 identified included (1) Jeffrey Pfeffer, (2) Richard M. Cyert and James G. March, (3) Paul Lawrence and Jay Lorsch, (4) Michael Hannan and John Freeman, and (5) Oliver E. Williamson. Once the four phases were complete, a summary of the ChatGPT-4 Output for RP1 was generated (see Table 1). The summary table included selected examples from the full output for each phase of the study. To see the full outputs, see Appendices A, B, C, and D.

Data Analysis

After generating initial ideas, the output was analysed for accuracy and relevance by the researchers utilising a systematic qualitative analysis of the generated responses. This analysis relied on decades of experience of the researchers in rural contexts and expertise in research methodology. Data were examined by the individual authors to generate tentative inferences which were then questioned and tested by a second co-author using a process that parallels the use of audit trails and negative case analysis to promote confirmability in qualitative research (cf. Lincoln & Guba, 1985). The results of this internal process were used to examined and refine the tentative inferences to produce themes that answer the two research questions.

Results

Advantages and Opportunities of the ChatGPT-4

The established research question *What potential advantages and opportunities does the ChatGPT-4 provide during the initial stages of the research process?* The results obtained from the process described here indicate four main advantages and opportunities: (1) accuracy of the research problems/topics, research questions and theoretical framework elements of the output; (2) time savings; (3) reduction in cognitive workload; and (4) enhanced idea generation.

Accuracy

Upon conducting a review of the accuracy of the output, it was discovered that ChatGPT-4 effectively produced five pertinent research problems/topics, nine research questions, and highlighted three potential theoretical frameworks. It was noted that this information was useful for initial idea generation. However, the list of researchers that were generated were less accurate. This result is discussed further in the challenges and limitations of the ChatGPT-4 section.

Time Savings and Reduced Cognitive Workload

Once the researchers identified the specific prompts, the ChatGPT-4 was able to rapidly generate five relevant research problems/topics, nine research questions, and identify three possible theoretical frameworks, as well as significant researchers. Processes that can take days or weeks of the researcher's time were generated in less than a minute. Traditionally, researchers can spend a considerable amount of time conducting literature reviews and manually searching for relevant studies. However, the ChatGPT-4's ability to quickly scan and summarise large volumes of literature expedited this process. This not only saved time but also allowed researchers to dedicate more resources to other critical aspects of the research process, thereby reducing the cognitive workload at these initial stages. By offloading these cognitive tasks to the ChatGPT-4, researchers can focus more on critical thinking, data analysis, and interpreting research findings. This reduction in cognitive workload may contribute to an improved efficiency and productivity throughout the research process. Such an improved efficiency may allow for intellectual energy to be devoted to areas like critical thinking, data analysis, and interpreting research findings which could potentially improve the work quality.

Enhanced Idea Generation

It was also noted in the research that the ChatGPT-4 has the potential to enhance idea generation. Researchers are limited in their perspectives and background knowledge in generating novel ideas and research topics. By utilising AI, researchers are provided with an external source of information that can generate unique ideas for the researcher. Considering that the ChatGPT also has a "Regenerate response" feature, the opportunity for enhanced idea generation was also clear. This may assist in stimulating the creative thinking and inspiring new research directions.

While four advantages and opportunities existed, it is also important to consider the limitations of using the ChatGPT-4 tool.

Challenges and Limitations of ChatGPT-4 for Initial Research

The research question two considered *What limitations existed in utilising the ChatGPT-4 during the initial stages of the research process?* Four limitations were identified: (1) inaccuracy of the leading scholars, (2) the lack of contextual understanding, (3) the lack of domain expertise, and (4) a potential over-reliance on automated assistance.

When reviewing the accuracy of the information provided by the ChatGPT-4, a limitation existed in identification of leading researchers. However, in the output response ChatGPT-4 only identified Pfeffer for RDT work. Additionally, the research conducted by Cyert and March (1963) has exerted a significant impact on the field of organizational theory in a general sense, but its primary focus was not specifically on RDT. The other researchers that were listed had some tangential connections to RDT, but it was clear from review of their work that a lack of contextual understanding was present when considering this information would be used for a rural educational study.

While the inaccuracy may be partially due to the input provided the ChatGPT-4 by the researchers, it also highlights that caution should be taken when utilising technology to support research. The ChatGPT-4 generates responses based solely on training data which can lead to inaccurate or incomplete information. In addition, the software does not have the domain-specific expertise (e.g., contextual understanding) required of researchers. This highlights the importance of the researcher in the process. Though AI is beneficial for generating ideas, researchers need to possess context and domain expertise to create specific inputs and to evaluate the content that is generated. This dovetails with the fourth limitation: the potential for over-reliance on automated assistance. If a researcher lacks grounding in foundational and structural literature, there is a high potential for over-reliance on the technology which would undermine the potential benefits of using the software. The next section will delve into the potential applications of these findings in furthering the NREA research agenda.

Discussion

First of all, it should be noted that the process used for this project could serve as a template for researchers seeking to use the ChatGPT-4 to generate initial research ideas within specific parameters. Researchers who have not yet used the ChatGPT-4 for their research can explore the prompts used in this study and the methods employed to generate ideas for future research. The results of the study also support previous research findings on the advantages and disadvantages of incorporating AI in educational settings.

Advantages and Opportunities Afforded by ChatGPT-4

Research question one involved investigating the benefits of using the ChatGPT-4 for generating research ideas in the early stages of a project. The results of this study highlight the potential of the ChatGPT-4 as an effective tool for researchers in the initial stages of their projects which builds upon prior research findings that suggest the ChatGPT is an effective tool for a wide variety of educational circumstances (Baidoo-Anu & Owusu-Ansah, 2023; Imran & Almusharraf, 2023). The accuracy of research problems/topics, research questions, and theoretical frameworks generated by the ChatGPT-4, along with the time savings, reduced cognitive workload, and enhanced idea generation showcase the advantages and opportunities that researchers can leverage aligns with existing literature (Crompton & Burke, 2024; Labadze et al., 2023). This also aligned well with the assertion by Kooli (2023) that AI-powered chat-bots can serve as excellent research assistants in the academic field. Without accurate output, none of the other benefits that were identified would be valuable. However, not all the information that was generated was accurate. This finding was reported as part of the research question two.

Challenges and Limitations of Chat-GPT4 Utilization

The challenges and limitations of the software included inaccurate information on leading scholars, a lack of contextual understanding, a lack of domain expertise, and the potential over-reliance on automated assistance. These findings align with previous reports from multiple researchers.

Previously, Crompton and Burke (2024) cautioned that inaccurate information may also be generated. This information could be inaccuracies or a "hallucination", with a hallucination defined as the AI generating references or citations that do not exist which appear to be true. In this research inaccuracies were identified, but not hallucinations. The findings of this study related to a lack of contextual understanding and domain expertise reinforces concerns of Coladarci (2007) about the importance of understanding the rural context when conducting rural research. This concern was also shared by Kooli (2023) who claimed that chat-bots should be under the supervision and control of human experts to ensure that the information is accurate, reliable, and trustworthy. Ivanov (2023) further discussed negative aspects including factual incorrectness and the potential for an over reliance on AI. The findings of this research are consistent with these previous findings. As such, the authors caution that the ChatGPT-4 can be a useful tool, but it is not a replacement for the foundational knowledge and skills required for educational research in rural contexts. Additionally, human evaluation of the output is a crucial step in the appropriate use of the tool. While these findings largely confirm positive and negative findings in previous research this research also has implications related specifically to the rural context.

Advancing the NREA Research Agenda

This exploratory study offered an illustration of the potential for harnessing applications of AI technology to advance the NREA research agenda by examining one of the agenda's five support themes (Policy and Funding) and one of its 31 total lines of inquiry that are suggested for researchers, including scholar practitioners, as investigation topics or issues. Crompton and Burke (2024) reported that AI can provide benefits such as saving time through task automation. This research provides further evidence that AI applications offer time efficiencies in rapidly revealing researchable questions that maximise the researcher's time and creative capacity for designing research with more relevance to different rural contexts. Consequently, the research results could hold more impact and value for use by practitioners and policymakers, a national priority illustrated by the U.S. Department of Education's funding of a Center for Research Use in Education (https://www.research4schools.org/).

AI applications might also enable rural education researchers to create researchable questions within the agenda's lines of inquiry in order to acquire support of foundations focused on inequities in education. For example, the William T. Grant Foundation (n.d.) focuses on promoting the utilisation of research evidence to support the well being of young individuals aged 5-25 in the United States. These include: applying research evidence directly to a decision (instrumental use), influencing decision-makers' understanding of problems and potential solutions (conceptual use), supporting existing stances or positions (strategic use), building trust with colleagues or educating constituents (relational use) or mandating decision-makers to engage with research (imposed use). The Spencer Foundation (n.d.) seeks to support collaborative, interdisciplinary research designed to re imagine the transformation of education systems for equity. Specific research evidence on the geographically concentrated ethnic populations in rural regions of America—and within states—is needed to achieve equity expectations of the NREA research agenda.

AI technology could offer scholar practitioners important assistance in designing a problem of practice (PoP) project that addresses a line of inquiry in the NREA research agenda, particularly graduate students enrolled in educational leadership programs at institutions that are restructuring the EdD to include a dissertation of practice that aligns with core principles of the Carnegie Project on the Education Doctorate (Perry et al., 2020). A problem of practice is defined (Perry et al., 2020, p. 12) as "A persistent, contextualised, and specific issue embedded in the work of a professional practitioner, the addressing of which has the potential to result in improved understanding, experience, and outcomes." An international network of more than 135 graduate schools of education are engaged in transforming

the EdD into the Professional Practice Doctorate in Education. Using AI such as the ChatGPT-4 in design of dissertations of practice projects by practitioner scholars, with attention to the NREA research agenda, could advance the understanding of viable solutions for inequity challenges in rural schools and communities globally.

Advancing a Process for AI Use

In this exploratory study, the ChatGPT-4 as a research assistant in a five-step process to generate these ideas consistent with the research questions was used. The process included (1) clearly defining the goal, (2) providing context, (3) asking specific questions (including iterations with revised wording), (4) requesting the specific format for the output (bulleted list, detailed explanation, etc.), and (5) fact check responses. An unused alternative method to generate responses from the AI could be employed if the user sought additional distinct outputs from the same prompt. Some implications for using the process and the extant results of the research in initial stages of designing rural education research were offered.

Implications for Policymakers and Scholar Practitioners

The findings of this study also have broader implications for policymakers and scholar-practitioners in various other settings. For example, policymakers may need to consider implementing training programs for researchers and practitioners on the effective use of AI such as the ChatGPT-4 in research. This could include education on industry standards, ethical considerations, and constraints that may be present. Policymakers may also consider the incorporation of AI tools like the ChatGPT-4 into educational institutions and research facilities in order to assist and expedite the research process while considering issues such as access, regulation, data privacy, and ethical considerations. In addition to implications for policy makers, this study has implications for scholar practitioners.

There are three primary implications for scholar-practitioners including the efficiency, the need for training, and the control maintaining. The first implication are that there is a possibility to make the work of researchers more accurate and efficient. However, it should be noted that the accuracy should be verified. This means that having a strong knowledge of research methodology, context, and relevant literature is still necessary for the researcher. As such, the training to use the ChatGPT-4 as a tool remains a necessary component. In addition to the research training that scholar-practitioners already experience in degree programs, a training on ethical use of the technology should be included. The training should also cover strategies for generating effective inputs to produce desired outputs, comprehending and analysing the resulting outputs, and seamlessly incorporating them into the research process. The final implication is maintaining control of the research process. This can be accomplished by validating the generated content, checking for biases and inaccuracies, and maintaining an awareness of the potential for over reliance on the technology to mediate this potential limitation.

Limitations

While this study examined the potential of the ChatGPT-4, three limitations in the research methodology should be acknowledged including the limited scope, the specific time when this was conducted, and the specificity of the inputs. The study focused specifically on utilising the ChatGPT-4 for generating research ideas within rural education in the United States, thereby limiting the applicability of the results to other AI applications or contexts. Secondly, this research was conducted during a specific time period. Therefore, the findings of the study are limited to the performance of the software as it was at the time of the research and do not take into account any improvements or updates that may

have been made since then. Finally, the quality of the inputs has an influence on the relevance and accuracy of the generated output. These variations may introduce inconsistencies in the results limiting the reliability of the findings. Attempts to reduce this limitation were made by carefully constructing prompts and by presenting the inputs and outputs as raw data in the appendices so the reader can evaluate the connection between inputs and outputs.

Conclusions

In conclusion, AI technologies like the ChatGPT-4 offer notable advantages in the research process including time savings, reduced cognitive workload, and improved idea generation. While the focus here was on rural education research and the NREA research agenda these findings have implications beyond this application. However, it is important to recognise the possible lacks including misinformation, a lack of contextual understanding, and the danger of becoming too dependent on technology. By understanding these implications, policymakers and scholar-practitioners can leverage AI as a tool to enhance their research productivity and make informed decisions utilising this tool.

Suggestions for Future Research

This study opens up various paths for future research at the intersection of artificial intelligence and rural education. These tasks involve validating and enhancing ideas generated by AI, examining the ethical implications of using AI in initial research phases, analyzing possible biases in AI-generated content, creating criteria for researchers to assess and understand AI-generated ideas, and following long-term studies to assess the results of research projects started with AI-generated ideas. The goal is to determine any disparities in impact, relevance, or contributions to policy and practice compared to conventional research projects. In addition, the performance of the ChatGPT-4 with other AI models such as Google Bard or YouChat can be compared or the perspectives of various stakeholders (policymakers, educators, and community members) on the use of AI in educational research can be explored. Understand their attitudes, concerns, and expectations regarding AI-driven research initiatives could provide insight into challenges and opportunities using this technology moving forward. These suggestions aim to guide future research endeavors and contribute to the ongoing dialogue on the integration of AI in rural education research.

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Conflict of Interest

None.

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Appendix A

Research Problems Generation

User Input

You are an educational researcher brainstorming ideas for rural research. The topics should be aligned around the Policy and Funding component of the National rural Education Association agenda. The agenda calls for attention to issues ranging from inequitable funding to local and state governance to adoption of policies that leverage the strengths of rural educational settings. The line of inquiry that topics should be generated for is "identifying nimble policy/funding responses to changing student racial and linguistic demographics." Generate a bulleted list of potential research problems that could be studied.

Full AI output

Certainly! Here are five potential research problems aligned with the line of inquiry "identifying nimble policy/funding responses to changing student racial and linguistic demographics" within the context of the National Rural Education Association's agenda:

1. Assessing the impact of changing student racial and linguistic demographics on the resource allocation in rural schools and districts.
2. Investigating the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings.
3. Analyzing the role of community engagement and partnerships in supporting successful policy and funding responses to address the needs of racially and linguistically diverse students in rural schools.
4. Examining the implications of funding formulas and policies for resource distribution in rural areas with changing racial and linguistic demographics, considering factors such as poverty, language support programs, and special education services.
5. Investigating the potential benefits and challenges of collaborative approaches among rural schools, districts, and community organizations to address the educational needs of racially and linguistically diverse students.

These research problems provide a focused set of ideas that can contribute to understanding and developing nimble policy and funding responses to changing student racial and linguistic demographics in rural educational settings.

Appendix B

Research Question Generation

User input

Generate potential research questions for a mixed methods study Investigating the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings.

Full AI output

Certainly! Here are some potential research questions for a mixed methods study investigating the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings:

1. Quantitative research questions:
    - What are the disparities in academic achievement between racially and linguistically diverse students and their non-diverse counterparts in rural schools?
    - How do funding allocations differ between schools with varying proportions of racially and linguistically diverse students in rural areas?
    - To what extent do existing policies and funding models in rural educational settings address the specific needs of racially and linguistically diverse students?
2. Qualitative research questions:
    - What are the experiences and challenges faced by racially and linguistically diverse students in accessing educational resources and opportunities in rural schools?
    - How do educators perceive the effectiveness of existing policies and funding models in meeting the specific needs of racially and linguistically diverse students?
    - What strategies do rural schools and districts employ to leverage existing policies and funding models to support racially and linguistically diverse students?
3. Mixed methods research questions:
    - How does the allocation of resources and implementation of policies in rural schools correlate with the academic outcomes of racially and linguistically diverse students?
    - What are the perceived strengths and limitations of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students, as identified by both quantitative data and qualitative interviews?
    - What recommendations can be made to enhance the effectiveness of policies and funding models in meeting the needs of racially and linguistically diverse students in rural educational settings, based on a combination of quantitative and qualitative findings?

These research questions can guide the design and implementation of a mixed methods study to investigate the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings.

Appendix C

Theoretical Framework Generation

User Input

Write a brief description of potential theoretical frameworks that could be used for this study.

Full AI Output

When investigating the effectiveness of existing policies and funding models in addressing the specific needs of racially and linguistically diverse students in rural educational settings, several theoretical frameworks can be considered. Here are brief descriptions of three potential frameworks:

1. Critical Race Theory (CRT): Critical Race Theory explores the relationship between race, power, and structural inequality. It examines how policies and funding models may perpetuate or challenge racial disparities in education. CRT can provide a lens to analyze systemic inequities and understand how policies either address or contribute to the needs of racially and linguistically diverse students in rural areas.
2. Culturally Relevant Pedagogy (CRP): Culturally Relevant Pedagogy focuses on incorporating students' cultural backgrounds and experiences into the educational process. This framework emphasizes the importance of culturally responsive teaching practices and curriculum that reflect the diversity of students. CRP can inform the study by examining how existing policies and funding models support or hinder the implementation of culturally relevant practices in rural schools.
3. Resource Dependency Theory (RDT): Resource Dependency Theory examines how organizations depend on external resources to meet their needs and goals. Applied to education, RDT can help understand how rural schools and districts rely on policies and funding models to address the specific needs of racially and linguistically diverse students. This framework can analyze the interdependence between rural schools, policy-making bodies, and funding sources to identify factors that influence the effectiveness of existing policies and funding models.

These theoretical frameworks offer different perspectives and lenses through which to analyze the effectiveness of policies and funding models in addressing the needs of racially and linguistically diverse students in rural educational settings. Researchers can choose a framework or combine multiple frameworks to guide their analysis and interpretation of the study's findings.

Appendix D

Key Author Generation

User Input

List key researchers that study resource dependency theory.

Full AI Output

Here are some key researchers who have contributed to the study of Resource Dependency Theory:

1. Jeffrey Pfeffer: Pfeffer is a renowned sociologist and organizational theorist known for his work on resource dependence theory. He has conducted extensive research on the effects of resource dependencies on organizations and the strategies they employ to manage those dependencies.
2. Richard M. Cyert and James G. March: Cyert and March are credited with developing the foundational concepts of resource dependence theory. Their influential book, "A Behavioral Theory of the Firm," published in 1963, introduced the concept of organizations as entities dependent on external resources.
3. Paul Lawrence and Jay Lorsch: Lawrence and Lorsch expanded on resource dependence theory with their book "Organization and Environment: Managing Differentiation and Integration" in 1967. They examined how organizations adapt to their external environment, including resource dependencies.
4. Michael Hannan and John Freeman: Hannan and Freeman are well-known researchers in the field of organizational ecology. Their work often intersects with resource dependence theory, focusing on the evolution and survival of organizations in response to resource constraints and dependencies.
5. Oliver E. Williamson: Williamson, a Nobel laureate in economics, contributed to the understanding of transaction costs and governance structures within resource dependency theory. His research delves into the relationship between organizations, markets, and resource dependencies.

These researchers have made significant contributions to resource dependency theory, exploring the dynamics of resource dependencies and their impact on organizations. Their work has influenced our understanding of how organizations manage external resources to survive and thrive in their environments.