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The role of generative AI search tools in educational research productivity among early-career scholars: A mediation-based multi-method study

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ABSTRACT
Background: Generative AI search tools has transformed how researcher access, interpret, and synthesize academic literature. For early-career scholars, these technologies offer potential support in addressing limitations related to research experience, particularly in literature comprehension and conceptual framework development. However, empirical studies explaining how and through what internal mechanisms generative AI supports educational research remain limited, especially those that account for psychological and cognitive mediating factors.
Aims: This study aims to examine the role of generative AI search tools in enhancing educational research productivity among early-career scholars by analyzing the mediating roles of academic self-confidence, literature comprehension, and research self-regulation.
Methods: A mediation-based multi-method approach with an explanatory sequential design was employed. Quantitative data were collected through a Likert-scale survey and analyzed using mediation modeling, followed by qualitative data collected through semi-structured interviews and analyzed thematically to elaborate and contextualize the quantitative findings.
Result: The findings indicate that the use of generative AI search tools is positively associated with educational research productivity. This relationship is primarily mediated by literature comprehension, academic self-confidence, and research self-regulation, with literature comprehension emerging as the strongest mediating pathway. Qualitative findings further reveal that generative AI functions as an intellectual companion that supports understanding of complex scholarly literature, strengthens research independence, and facilitates more effective management of the research process.
Conclusion: The study demonstrates that the contribution of generative AI to educational research extends beyond technical assistance, operating through researchers' internal cognitive and psychological processes. By adopting a mediation-based perspective, this study provides a more nuanced explanation of how generative AI search tools support early-career scholars' research productivity and contributes to a deeper theoretical understanding of AI-supported educational research practices.

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INTRODUCTION

The rapid advancement of Artificial Intelligence over the past decade has profoundly transformed the landscape of educational research. Among recent innovations, generative AI search tools have gained increasing attention due to their ability to integrate literature retrieval, information synthesis, and automated conceptual recommendations within a single research environment. As the volume of scholarly publications continues to grow exponentially, researchers face mounting challenges in efficiently identifying, evaluating, and synthesizing relevant academic knowledge. Consequently, the effective use of AI-based search technologies has become a critical factor in sustaining the rigor, relevance, and quality of educational research practices (Kumar & Gunn, 2025; X. Wang et al., 2023; Zhang et al., 2024).

These challenges are particularly pronounced among early-career scholars, including master's and doctoral students as well as novice researchers, who often have limited experience in conducting

systematic literature searches and constructing coherent theoretical frameworks. Prior studies indicate that early-career scholars frequently struggle with understanding complex academic argumentation, integrating diverse theoretical perspectives, and managing cognitive load during the literature review process (Dai et al., 2023; Kumar & Gunn, 2025; Suprobo & Basuki, 2024). Such constraints may hinder educational research productivity by reducing efficiency in knowledge acquisition, narrowing the scope of referenced literature, and increasing academic anxiety throughout the research process.

Response to these challenges, generative AI search tools have been proposed as potential enablers of more effective research practices. These tools offer functionalities such as thematic summarization, conceptual mapping, and context-aware literature recommendations that may assist researchers in navigating extensive and complex bodies of knowledge. Empirical evidence suggests that AI-assisted academic tools can improve information search efficiency and support analytical thinking in research-related tasks (Elkhodr & Gide, 2025; Gáspár, 2023; Întorsureanu et al., 2025). In addition, AI-based platforms, including semantic search engines and academic chatbots, have been shown to facilitate access to interdisciplinary knowledge in a more structured and systematic manner (Baskara et al., 2023; Cabrera-Arnau, 2024). Nevertheless, these potential benefits should not be regarded as automatic outcomes of technology adoption, as their effectiveness is closely linked to how researchers cognitively and strategically engage with AI-supported tools.

Despite the growing interest in generative AI within educational and research contexts, existing studies have predominantly focused on technical features or general user perceptions, such as usability, satisfaction, and time efficiency (Yuan & Lipizzi, 2025). While these studies provide valuable preliminary insights, they offer limited explanations of how the use of generative AI search tools influences researchers' internal cognitive and psychological processes, which are essential for sustaining research productivity and research quality (Castillo-Segura et al., 2023; Zhou et al., 2024; Oliinyk et al., 2024). Recent perspectives in educational technology research emphasize that the effectiveness of digital tools is strongly shaped by internal user factors, including academic self-confidence and self-regulatory capacities in learning and research activities.

From a methodological perspective, prior investigations into generative AI usage in educational research contexts have largely relied on single-method research designs, either quantitative or qualitative. Such approaches tend to generate partial and fragmented explanations, limiting a comprehensive understanding of the complex interactions between technological affordances and researchers as active agents in the research process (Zhang et al., 2024; Wu, 2025). The limited integration of quantitative and qualitative approaches restricts deeper insight into how generative AI search tools are adopted, experienced, and utilized in authentic research practices, particularly among early-career scholars.

More critically, empirical studies that examine the mechanisms through which generative AI search tools contribute to research advancement remain relatively scarce. Existing research frequently emphasizes direct relationships between AI usage and academic outcomes, without adequately accounting for mediating processes that explain how technology influences educational research productivity and quality (Cabuquin et al., 2024; Franzoni Velázquez et al., 2024). Although mediating factors such as literature comprehension, academic self-confidence, and self-regulation have been discussed in isolated studies, they are rarely integrated into structured mediation models that explicate the underlying pathways linking generative AI usage to research outcomes (Trinovita, 2025; Zhou et al., 2024). Consequently, the internal mechanisms through which generative AI search tools support educational research remain theoretically underexplored.

Several previous studies have examined the role of digital technologies and AI-supported tools in higher education research environments. These include studies highlighting the contribution of AI-assisted tools to improving information-seeking behavior and research efficiency (Gáspár, 2023; Elkhodr & Gide, 2025), investigations into users' perceptions and acceptance of generative AI in academic contexts (Yuan & Lipizzi, 2025), as well as research exploring the potential of AI-based platforms to support

interdisciplinary knowledge construction (Baskara et al., 2023; Cabrera-Arnau, 2024). Collectively, these findings suggest that generative AI search tools hold promise for supporting educational research practices. However, their effectiveness appears to be highly contingent upon researchers' cognitive engagement, self-regulatory capacities, and confidence in utilizing such technologies. Empirical investigations that systematically integrate these internal processes into mediation-based analytical frameworks remain limited, resulting in an incomplete understanding of how generative AI search tools influence educational research productivity.

Therefore, this study aims to examine the role of generative AI search tools in enhancing educational research productivity among early-career scholars by analyzing the mediating effects of internal research-related processes through a mediation-based multi-method approach. By integrating quantitative mediation analysis with qualitative exploration of researchers' experiences, this study seeks to explain not only whether generative AI search tools contribute to educational research productivity, but also how and why such effects occur. this study contributes to the literature by shifting the analytical focus from technology-centered evaluations toward an examination of researchers' internal processes as key mechanisms in AI-supported educational research. the findings are expected to inform higher education institutions and research organizations in developing policies, capacity-building programs, and guidelines that promote the responsible and sustainable use of generative AI to support the development of early-career scholars.

METHOD

Research Design

This study employed a mediation-based multi-method approach using an explanatory sequential design, which integrates quantitative and qualitative methods in a structured sequence. This design was selected to enable statistical testing of hypothesized mediation relationships, followed by qualitative exploration to explain and contextualize the quantitative results (Creswell & Plano Clark, 2018). The explanatory sequential design is particularly appropriate when quantitative findings require deeper interpretation through participants' perspectives and lived experiences (Tashakkori & Teddlie, 2010). In this study, the quantitative phase was conducted first to test the mediation model, followed by a qualitative phase designed to elaborate on researchers' internal processes in utilizing generative AI search tools.

Participants

The participants consisted of early-career scholars, including master's and doctoral students in education as well as novice researchers actively engaged in academic research activities. Participants were recruited from multiple higher education institutions using purposive sampling, a technique commonly employed when specific experiential criteria are required (Palinkas et al., 2015). The primary inclusion criterion was prior experience in using generative AI search tools for academic literature searching and research management. For the quantitative phase, sample size determination followed methodological considerations for mediation analysis to ensure adequate statistical power for detecting indirect effects (Hayes, 2018). For the qualitative phase, participants were selected strategically from the quantitative sample to reflect variation in levels of generative AI use and mediator variable scores, allowing for maximum variation in experiential data.

Instruments and Measures

Quantitative data were collected using a structured questionnaire administered on a five-point Likert scale. The instrument was developed based on a comprehensive review of literature on artificial intelligence use in education and academic research. The questionnaire measured the use of generative AI search tools as the independent variable, educational research productivity as the dependent variable, and academic self-confidence, literature comprehension, and research self-regulation as mediating variables.

The selection of mediating variables was theoretically grounded in social cognitive theory and self-regulated learning theory, which emphasize the role of self-efficacy and self-regulation in shaping learning and performance outcomes (Bandura, 1997). Literature comprehension was included as a cognitive mediator based on theoretical models of text comprehension and knowledge construction in academic contexts (Kintsch, 1998). Content validity was evaluated through expert judgment involving scholars in education and educational technology, a common approach for establishing construct relevance in survey-based research (DeVellis, 2017). Instrument reliability was assessed using internal consistency coefficients to ensure measurement stability.

Quantitative Data Analysis

Quantitative data analysis was conducted using inferential statistical techniques based on mediation modeling. The analysis examined both direct and indirect relationships between the use of generative AI search tools and educational research productivity through the proposed mediating variables. Mediation analysis was employed to identify the psychological and cognitive mechanisms through which technology use influences research outcomes, consistent with contemporary recommendations for explanatory research in educational technology studies (Hayes, 2018). The significance of mediation effects was evaluated through indirect path testing to confirm the explanatory role of each mediator within the proposed model.

Qualitative Data Collection and Analysis

The qualitative phase involved semi-structured interviews aimed at exploring participants' experiences in using generative AI search tools, changes in research strategies, and perceptions of AI's influence on literature comprehension, academic self-confidence, and research self-regulation. Semi-structured interviews were chosen to balance consistency across participants with flexibility for in-depth exploration of individual experiences (Kallio et al., 2016). Interviews were conducted online, recorded with participants' informed consent, and transcribed verbatim. Qualitative data were analyzed using thematic analysis, following systematic stages of familiarization, coding, theme development, and interpretive analysis (Braun & Clarke, 2006). This approach enabled the identification of experiential patterns that complemented and explained the quantitative findings.

Integration of Quantitative and Qualitative Data

Integration of quantitative and qualitative data occurred at the interpretation stage through triangulation of findings. This strategy allowed statistical results from the mediation analysis to be enriched by qualitative insights into researchers' experiences, thereby strengthening the explanatory power of the multi-method approach (Creswell & Plano Clark, 2018). The integrated interpretation facilitated a holistic understanding of how generative AI search tools function as intellectual support instruments in educational research contexts.

RESULTS AND DISCUSSION

Results

This section presents the findings of the study based on a mediation-based multi-method approach with an explanatory sequential design. The results are organized to provide an integrated understanding of how generative AI search tools influence educational research productivity among early-career scholars. The section begins with an overview of the overall findings, followed by detailed quantitative results examining direct and mediated relationships among variables, and concludes with qualitative findings derived from interview data that further explain and contextualize the quantitative outcomes.

Quantitative Result

The quantitative phase involved 214 early-career scholars, including master's students (45.8%), doctoral students (34.6%), and novice researchers within the first five years of academic practice (19.6%). All participants reported prior experience in using generative AI search tools for academic

literature searching and research-related activities. Descriptive statistics for the main study variables are presented in Table 1.

Table 1. Descriptive Statistics of Study Variables

Variable	Mean	SD
Generative AI Search Tool Use	3.87	0.61
Educational Research Productivity	3.74	0.58
Academic Self-Confidence	3.69	0.63
Literature Comprehension	3.91	0.55
Research Self-Regulation	3.76	0.60

As shown in Table 1, participants reported relatively high engagement with generative AI search tools and moderate to high levels of educational research productivity. Among the mediating variables, literature comprehension demonstrated the highest mean score, indicating that generative AI search tools were perceived as particularly supportive in facilitating understanding of scholarly texts and conceptual relationships.

Further analysis examined the relationship between generative AI search tool use and educational research productivity. The direct effect of generative AI search tool use on educational research productivity was examined using path analysis, with the results summarized in Table 2.

Table 2. Direct Effect of Generative AI Search Tool Use on Research Productivity

Path	β	t-value	p
AI Use → Research Productivity	0.28	4.62	< 0.001

Mediation analysis was subsequently conducted to examine the roles of academic self-confidence, literature comprehension, and research self-regulation as intermediary mechanisms linking AI use and research productivity. The indirect effects of generative AI search tool use on educational research productivity through academic self-confidence, literature comprehension, and research self-regulation were examined using mediation analysis, with the results summarized in Table 3.

Table 3. Indirect Effects through Mediating Variables

Mediator	Indirect Effect (β)	t-value	p
Academic Self-Confidence	0.11	3.14	0.002
Literature Comprehension	0.19	5.02	< 0.001
Research Self-Regulation	0.13	3.67	< 0.001

As shown in Table 3, all three mediating variables exhibited statistically significant indirect effects. Literature comprehension emerged as the strongest mediating pathway, indicating that improved understanding of academic texts plays a central role in linking generative AI search tool use to educational research productivity. When the mediating variables were included in the model, the direct effect of AI use on research productivity decreased but remained statistically meaningful ($\beta = 0.09$, $p < 0.05$), indicating partial mediation.

Qualitative Results

The qualitative phase was conducted through semi-structured interviews with selected early-career scholars to further explain the quantitative findings. Participants were drawn from the quantitative sample to reflect variation in levels of generative AI use and mediator scores. Thematic analysis of the interview transcripts yielded three major themes that illustrate how generative AI search tools influenced educational research productivity through internal cognitive and psychological processes.

Theme 1: Generative AI as a Cognitive Scaffold for Literature Comprehension

Participants consistently described generative AI search tools as cognitive scaffolds that supported their understanding of complex scholarly literature. Many interviewees reported that AI-assisted explanations, summaries, and keyword clarifications helped them grasp academic argumentation structures and conceptual relationships more effectively.

One participant explained:

"When I read international journal articles, I often feel lost at the beginning. Using AI helped me understand the main argument and how the concepts are connected, so I could read the article more confidently." (Participant 7)

This theme directly explains the strong mediating role of literature comprehension observed in the quantitative analysis, highlighting how improved understanding of academic texts facilitated clearer research direction and theoretical coherence.

Theme 2: Strengthening Academic Self-Confidence through Guided Research Engagement

Another prominent theme concerned the role of generative AI in enhancing participants' academic self-confidence. Interviewees reported that AI-supported guidance reduced uncertainty and hesitation during the research process, particularly when formulating research questions and theoretical frameworks.

As one participant noted:

"Before using AI, I doubted whether my understanding was correct. AI responses helped me confirm my ideas, and that made me more confident to continue my research." (Participant 12)

This increase in confidence encouraged participants to engage more actively with the literature and sustain their research efforts, thereby supporting the mediating effect of academic self-confidence identified in the quantitative model.

Theme 3: Supporting Research Self-Regulation and Independent Work Practices

The third theme reflected participants' perceptions of generative AI as a tool that supported research self-regulation. Many participants reported improved time management, clearer prioritization of reading tasks, and greater consistency in research activities.

One interviewee stated:

"AI helped me plan my reading better. I could decide which articles were more important, so I didn't feel overwhelmed anymore." (Participant 3)

Participants also emphasized that generative AI encouraged greater independence in managing their research processes. However, several interviewees highlighted the importance of maintaining critical judgment when using AI-generated outputs.

As another participant cautioned:

"AI is very helpful, but I still need to check the sources carefully. If I rely on it too much, I'm afraid my analysis will become shallow." (Participant 15)

This theme aligns with the mediating role of research self-regulation, illustrating how reflective and strategic AI use contributes to sustained research productivity rather than superficial efficiency.

Overall, the qualitative findings provided explanatory depth to the quantitative mediation results. While the quantitative analysis identified literature comprehension, academic self-confidence, and research self-regulation as key mediating pathways, the interview data illustrated how these processes were experienced and enacted by early-career scholars in authentic research contexts.

Discussion

The findings of this study provide empirical evidence that generative AI search tools play a strategic role in supporting educational research conducted by early-career scholars, primarily through psychological and cognitive mediation mechanisms. Rather than functioning solely as technical aids for

information retrieval, generative AI tools appear to influence research productivity by reshaping how novice researchers comprehend academic literature, regulate their research processes, and develop confidence in their scholarly abilities. In this way, the present findings extend prior research that has largely focused on direct effects or general perceptions of AI use in academic contexts, and directly address the gap identified in the introduction concerning the limited examination of internal mechanisms through which AI influences research performance.

One of the most salient findings of this study is that literature comprehension emerged as the strongest mediating variable linking generative AI search tool use to educational research productivity. This result suggests that the core challenge faced by early-career scholars lies not merely in accessing scholarly sources, but in interpreting, synthesizing, and organizing complex academic knowledge. Generative AI search tools appear to mitigate this challenge by supporting researchers' understanding of argument structures, conceptual relationships, and disciplinary terminology through features such as summarization and conceptual clarification (Choe et al., 2024; Fauzi et al., 2025; Fenske & Otts, 2024). These findings reinforce the view that generative AI functions as a form of cognitive scaffolding, enabling novice researchers to move beyond surface-level reading toward more coherent and structured engagement with the literature.

In addition to cognitive support, the mediating roles of academic self-confidence and research self-regulation underscore the psychological dimensions of generative AI use in educational research. The results indicate that when early-career scholars experience greater confidence in their ability to understand academic texts and manage research tasks, they are more likely to engage persistently and systematically in the research process. This finding aligns with existing evidence that confidence and self-regulatory capacity are critical determinants of sustained academic engagement and task completion among novice researchers (Shen & Tao, 2025; Suárez-Pizzarello et al., 2024). The present study further corroborates the argument advanced by Brown et al. (2025) that effective educational technologies are those that empower users not only cognitively but also affectively, supporting both understanding and motivation within complex learning and research environments.

The integration of quantitative and qualitative findings provides additional depth to the interpretation of these mediation effects. While the quantitative analysis identified literature comprehension, academic self-confidence, and research self-regulation as key mediating pathways, the qualitative interview data illustrated how these processes are enacted in authentic research practices. Participants' narratives revealed that generative AI tools supported reflective reading strategies, reduced uncertainty when engaging with dense theoretical texts, and facilitated more deliberate planning of research activities. These qualitative insights help explain why the influence of generative AI on research productivity is not linear, but operates through interconnected internal processes that shape how researchers interact with knowledge and manage their scholarly work.

From a theoretical standpoint, the findings of this study contribute to the growing body of literature on artificial intelligence in education by emphasizing the centrality of mediating variables in technology–outcome relationships. The results challenge simplified assumptions that technological adoption directly translates into improved research performance. Instead, they support a more nuanced conceptualization in which the effectiveness of generative AI is contingent upon its interaction with users' cognitive and psychological capacities. This perspective is consistent with multi-method research emphasizing the importance of examining technology use as a dynamic process involving individuals, tools, and contexts rather than as a unidirectional causal mechanism (Mhlanga, 2024; C. Wang et al., 2025).

Overall, this study advances understanding of generative AI use in educational research by demonstrating that its contribution to research productivity among early-career scholars is primarily mediated through improvements in literature comprehension, academic self-confidence, and research self-regulation. By elucidating these internal mechanisms, the findings provide a clearer explanation of how and why generative AI search tools support scholarly work, thereby strengthening the theoretical foundation for future investigations into AI-supported research practices.

IMPLICATIONS

The findings of this study have implications for both theory and practice regarding the use of artificial intelligence in educational research. From a theoretical perspective, the results confirm that the impact of generative AI search tools on research advancement is not solely direct, but is mediated by researchers' psychological and cognitive factors, particularly literature comprehension, academic self-confidence, and self-regulation. This perspective enriches conceptual frameworks for educational technology by positioning researchers as active agents who interact dynamically with technology rather than as passive users. From a practical perspective, these findings provide a foundation for higher education institutions and research organizations to design AI literacy programs that extend beyond technical proficiency to include the development of critical thinking skills, research independence, and academic ethics. Through such an approach, generative AI can be optimally leveraged as a supportive instrument for strengthening the research capacity of early-career scholars.

LIMITATIONS

Despite its significant empirical contributions, this study has several limitations. First, the quantitative data relied on participants' self-reported perceptions, which may be subject to subjective bias. Second, the study sample was limited to early-career scholars in the field of education, and therefore the generalizability of the findings to other disciplinary contexts should be approached with caution. Third, the cross-sectional research design was not able to fully capture longitudinal changes in the use of generative AI or the development of research capacity over time. In addition, this study did not differentiate in detail between specific types or features of generative AI search tools used by participants, which may exert varying influences on the research process.

SUGGESTIONS

Future research is recommended to incorporate more objective indicators of research performance, such as publication quality or academic outputs, to complement perceptual data. Subsequent studies may also broaden the research context to include other disciplinary fields and adopt longitudinal designs to better understand the long-term effects of generative AI use on research development. In addition, future investigations are encouraged to compare different types of generative AI search tools and to examine more specifically which features contribute most to enhancing research capacity. Experimental or quasi-experimental approaches may further strengthen causal inferences regarding the role of AI in educational research, thereby supporting more targeted and responsible integration of these technologies.

CONCLUSION

This study concludes that generative AI search tools play a significant role in advancing educational research among early-career scholars. The findings demonstrate that AI use not only has a direct impact on the efficiency and quality of the research process, but also operates through mediation mechanisms involving researchers' psychological and cognitive factors. Academic self-confidence, literature comprehension, and research self-regulation were identified as key factors that explain how and why generative AI effectively supports research capacity in educational contexts. The mediation-based multi-method approach employed in this study provides deeper insights than previous research that has primarily assessed AI impacts in a direct or partial manner. The integration of quantitative and qualitative data reveals that generative AI search tools function as intellectual support instruments that strengthen novice researchers' abilities to navigate academic literature, construct conceptual frameworks, and manage research processes independently. Accordingly, this study underscores that the use of generative AI in academic contexts should be understood as an interactive process between technology and users, rather than as the mere adoption of a technical tool.

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AUTHOR CONTRIBUTIONS STATEMENT

All authors contributed meaningfully to this study. WSN conceptualized the research design, developed the methodology, conducted data analysis, and led the writing of the manuscript. AM contributed to instrument development, data collection, qualitative analysis, and critical revision of the manuscript. HHH supported data interpretation, integration of quantitative and qualitative findings, and editorial review to enhance the clarity and coherence of the manuscript. All authors reviewed and approved the final version of the manuscript.

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