NOVA IMS Information Management School

MDDM

Master's Degree Program in

Data-Driven Marketing

The Integration of Artificial Intelligence in Search Engine Optimization: The benefits and the challenges for marketers

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Master Thesis

presented as partial requirement for obtaining a Master's Degree in Data-Driven Marketing

NOVA Information Management School

Instituto Superior de Estatística e Gestão de Informação

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The Integration of Artificial Intelligence in Search Engine Optimization: The benefits and the challenges for marketers

by

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Master Thesis presented as partial requirement for obtaining the Master's degree in Data-Driven Marketing, with a specialization in Digital Marketing and Analytics

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July, 2025

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[Lisbon, 14/07/2024]

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ABSTRACT

In recent years, the digital environment has experienced significant transformation, largely driven by the increasing influence of artificial intelligence (AI) in shaping search engine optimization (SEO) strategies and transforming the role of marketing professionals. This study investigates the impact of AI integration in SEO by comparing AI-driven and human-driven approaches through an experimental research design. The findings indicate that while AI-based SEO significantly enhances marketers' perceived productivity, it does not improve perceived efficiency. Mediation analyses revealed that neither ethical concerns nor fear of replacement significantly accounted for this relationship. Similarly, moderation analysis showed that the level of AI knowledge did not significantly affect the influence of AI integration on productivity or efficiency. These results suggest that although AI contributes positively to output quality, its effects on perceived effort reduction and psychological drivers may be more limited than previously assumed. The findings highlight important theoretical and managerial implications, emphasizing that the benefits of AI in SEO depend not only on its capabilities, but also on users' perceptions, trust, and practical integration into existing workflows. The study offers new insights into the complex and evolving role of AI in digital marketing workflows, with implications for both theory and practice.

KEYWORDS

Search Engine Optimization; Artificial Intelligence; Productivity; Efficiency; Ethical Concerns; Fear of Replacement

Sustainable Development Goals (SDG):

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
SEO	Search Engine Optimization
DV	Dependent Variable
IV	Independent Variable
B2B	Business-to-Business
NLP	Natural Language Processing
AIO	Artificial Intelligence Optimization
GEO	Generative Engine Optimization
AEO	Answer Engine Optimization
E-E-A-T	Experience, Expertise, Authoritativeness, Trustworthiness
ML	Machine Learning
AWS	Amazon Web Services
RNN	Random Neural Networks

1. INTRODUCTION

In today's digital era, search engines have become the primary tool through which users access information, products, and services. Their central role in the online experience makes visibility within search results a critical factor for business success. According to Semrush, a leading digital marketing and Search Engine Optimization (SEO) analytics platform, Google processes approximately 5.9 million searches every minute, translating into nearly 8.5 billion searches per day (Padrig Jones, 2024). This exceptionally high level of search activity highlights how frequently and heavily users depend on search engines, while also revealing the immense competition for visibility in the digital space. As a result, Search Engine Optimization (SEO) has evolved into a fundamental component of digital marketing strategies, directly influencing brand visibility, website traffic, and consumer engagement.

Artificial intelligence (AI) has radically changed digital marketing, modifying traditional methods and creating opportunities for innovative strategies that improve efficiency, personalization and engagement. AI, once considered an innovative concept, has now entered marketers' everyday lives, influencing their habits and expectations. Recent studies confirm this trend: (IBM, 2022) surveyed 7,502 respondents worldwide and found that 35 percent of firms used AI, while a 2023 McKinsey & Company report indicated that one-third of organizations regularly apply AI technologies in their operations (McKinsey, 2023). In the marketing industry, AI-based technologies, enhanced by big data, advanced algorithms and powerful computing systems, have become necessary tools for marketers (Davenport et al., 2020; Overgoor et al., 2019).

Among the various uses of AI in digital marketing, its integration into SEO is a highly transformative development by enhancing website visibility, content optimization, and search rankings (Goodwin, 2023; Yalçın & Köse, 2010). Once focused on keywords and backlinks, SEO now prioritizes content quality, user experience, and technical optimization (Matta et al., 2020). AI-driven tools like Google's RankBrain and BERT use machine learning and natural language processing to analyze user behavior, predict search trends, and optimize content dynamically (Akay et al., 2018; Go, 2024).

These advancements allow marketers to decode search algorithms, refine keyword targeting, and enhance on-page and off-page SEO. AI also improves voice search and image optimization, enhancing user interactions and accessibility (Amara et al., 2024; Ziakis & Vlachopoulou, 2024). With 61% of marketers prioritizing SEO for organic growth, AI-driven SEO remains a key strategy for boosting brand awareness, attracting traffic, and increasing conversions (Cushman, 2018; Southern, 2024; *The Ultimate List of Marketing Statistics for 2024*, 2024) Beyond these technical enhancements, AI also delivers measurable improvements in marketer productivity and efficiency. Studies show that 80% of employees using AI tools report increased productivity, with professionals saving up to 1.75 hours per day—time that can be redirected toward higher-value marketing tasks. Furthermore, over 54% of businesses

surveyed by IBM reported cost savings and notable productivity gains following the adoption of AI in their operations (Gustav Westman, 2024; William Arruda, 2024).

However, while the integration of AI into SEO provides significant opportunities, it also brings challenges. Ethical concerns, such as algorithm transparency, data protection and potential biases, create significant barriers for marketers wishing to implement responsible and efficient strategies (Rajawat Manisha, 2024). The "black box" nature of AI systems often complicates accountability and decision-making, while the reliance on high-quality data raises questions about consumer consent and regulatory compliance (Akter et al., 2022; Lindebaum et al., 2020). In addition to ethical concerns, marketers increasingly express anxiety about AI's potential to replace human roles. There is growing evidence that the more professionals interact with AI tools, the more likely they are to fear being displaced by them. According to a 2023 CNBC/SurveyMonkey Workforce Survey, 60% of employees who use AI regularly worry about its impact on their job security, despite acknowledging its benefits for productivity (Jack Kelly, 2024).

1.2. Purpose and Research Questions

While the integration of AI into various areas of marketing and its impact on marketers' perceived efficiency and productivity has received considerable academic attention, empirical research specifically focused on the integration of AI into SEO remains limited (Haleem et al., 2022; Mohamed Riyath & Eid, 2025). SEO is a core element of digital marketing strategy, yet its transformation through AI technologies has not been extensively studied in academic literature. In addition, scientific literature directly addressing the challenges that SEO practitioners face with AI integration is limited. Nevertheless, the broader link between SEO and digital marketing points to several recurring challenges—such as the lack of transparency in AI algorithms, the dependence on high-quality data, and concerns over data privacy and ethics (Ziakis & Vlachopoulou, 2024). Another key concern is the fear of replacement due to automation, which can create psychological barriers that reduce motivation and hinder the adoption of AI tools (Mirbabaie et al., 2022). Moreover, while research highlights the role of AI knowledge in facilitating adoption and user engagement, its moderating effect on the successful integration of AI into SEO practices remains underexplored. This is particularly important given that only 37% of B2B marketers report effectively using AI, indicating a significant gap in AI literacy that could impact implementation outcomes (Moradi & Dass, 2022).

The aim of this master's thesis is to explore how the integration of AI is transforming SEO practices, with particular emphasis on its impact on marketers' perceived efficiency and productivity. At the same time, the study seeks to identify and analyze the key challenges that may hinder the effective implementation of AI in SEO, such as ethical concerns, fear of job replacement, and limited AI-related knowledge. By examining both the potential benefits and the barriers to adoption, the research aims to offer a comprehensive understanding of how

marketers can effectively apply AI technologies in SEO while addressing the practical and ethical challenges that arise during implementation.

To fulfill this purpose, this master's thesis seeks to answer the main research question:

How does the AI integration into SEO influence marketers' perceived efficiency and productivity, and what influencing factors affect the implementation of such strategies?

The findings of this research are expected to contribute to the theoretical understanding of how the integration of AI into SEO influences marketers' perceived efficiency and productivity. The study will enrich current literature by highlighting not only the benefits of AI-driven SEO practices but also the key barriers that affect their adoption—namely ethical concerns, fear of job replacement, and limited AI knowledge. In practical terms, the research will provide actionable recommendations for businesses and marketing professionals aiming to implement AI-based SEO strategies more effectively. These recommendations may include approaches to address employee concerns, improve internal AI capabilities, and ensure ethical and transparent use of AI technologies. Ultimately, the study aims to support organizations in adopting AI tools in SEO in a way that enhances performance while managing the human, ethical, and operational complexities involved.

2. LITERATURE REVIEW

2.1. THE EVOLUTION OF SEO

SEO has evolved significantly from its inception, adapting to changes in search engine algorithms and user expectations. Initially introduced in 1991 with the launch of the first webpage, SEO began as a basic practice involving keyword stuffing and link-building to manipulate rankings (Kowalczyk & Szandala, 2024). Over time, advancements by search engines, particularly Google, transformed SEO into a sophisticated discipline emphasizing content quality, user experience, and relevance (Almukhtar, 2021; Matta et al., 2020). Modern SEO integrates foundational strategies like keyword research, on-page, and off-page optimization to drive high-quality traffic and achieve sustainable growth. Keyword research remains essential, guiding content development through tools like Google Analytics and SEMrush to align with user intent (Sheffield, 2020). On-page optimization focuses on creating high-quality, user-centric content while adhering to Google's E-E-A-T principles (Experience, Expertise, Authoritativeness, Trustworthiness), enhancing credibility and search visibility (Southern, 2024). Complementing this, off-page SEO builds a website's authority through backlinks and social signals, with high-quality links serving as endorsements to boost rankings and trustworthiness (Roumeliotis & Tselikas, 2023). Together, these elements have established SEO as an indispensable component of digital marketing, continuously evolving to meet the demands of an ever-changing online landscape.

2.2. THE ROLE OF AI IN MARKETING

AI has transformed marketing by enabling businesses to analyze vast amounts of data, identify patterns, and optimize decision-making processes. AI-driven technologies, including automated systems, chatbots, and predictive analytics, have significantly enhanced efficiency, personalization, and customer engagement (Holzinger et al., 2023). These advancements have allowed businesses to acquire and utilize data more effectively without substantial human intervention, improving targeted marketing efforts (Chen et al., 2022). AI goes beyond automating repetitive tasks, facilitating complex functions such as decision-making, consumer behavior prediction, and strategic marketing optimization (Haleem et al., 2022). In both B2B and B2C markets, AI applications hyperpersonalize offerings, enhance customer loyalty, and improve marketing effectiveness (Davenport et al., 2020; C. Wu & Monfort, 2023). Through data-driven insights, businesses can reduce customer churn, refine ad targeting, and improve conversion rates (Latinovic & Chatterjee, 2022; Paschen et al., 2019a). Despite its potential, AI adoption in marketing presents challenges. The complexity of AI-driven decision-making, the need for skilled professionals, and the reliance on high-quality data create hurdles for organizations (Hanssens, 2020). Additionally, while AI-powered analytics improve efficiency, their effectiveness depends on integration with a comprehensive marketing strategy (Malthouse & Copulsky, 2023)

2.3. The Integration of Artificial Intelligence in Modern SEO

AI has redefined SEO practices in digital marketing by enabling search engines to process data more effectively and understand user intent with remarkable precision(Rajawat Manisha, 2024). Traditionally, SEO relied heavily on optimizing keywords and webpage structures to improve search rankings. However, modern search engines, such as Google, evaluate websites based on more than 200 undisclosed factors to determine their rankings(Evans, 2007). While the existence of these factors is known, their precise weighting and the algorithms used to assess them remain proprietary, adding a layer of complexity to SEO strategies. This opacity emphasizes the critical role of AI-powered tools like Google's RankBrain, which analyze language nuances and user behavior to refine rankings dynamically (Go, 2024). These AI advancements not only decode user intent but also prioritize high-quality, contextually relevant content, enabling marketers to align their strategies with search engine expectations(Nayak, 2019). AI integration in SEO has facilitated the development of advanced personalization techniques, crucial for digital marketing strategies. For example, AI tools analyze vast datasets—including search histories, demographic information, and browsing behaviors—to provide personalized search results tailored to individual users. According to Forbes, predictive search models, driven by machine learning algorithms, anticipate user queries even before they are fully typed, offering tailored recommendations and enhancing user engagement (Bider, 2023). These developments not only refine the search experience but also enable marketers to anticipate user needs, segment audiences more effectively, and customize content accordingly. Furthermore, recent data shows that traditional "click-through" behavior on search results is declining due to AI-generated summaries, highlighting the need for new optimization approaches that prioritize visibility within AI-driven interfaces (Patrick Coffee, 2025). In response to this shift, a new wave of practices has emerged, including generative engine optimization (GEO), answer engine optimization (AEO), and artificial intelligence optimization (AIO). These approaches aim to enhance content visibility within AI-generated responses and zero-click search environments, rather than focusing solely on traditional keyword-based ranking.

2.3.1. Efficiency in AI-Driven SEO

Efficiency serves as a foundational element of AI-driven SEO, revolutionizing how marketers optimize their processes by automating repetitive and complex tasks. For marketers, AI has significantly enhanced both on-page and off-page SEO strategies. In on-page SEO, AI tools enable real-time performance analysis, mobile responsiveness, and schema markup generation, streamlining optimization efforts. These tools not only aid search engines in understanding content structures but also improve user experience, allowing marketers to allocate their time to more strategic tasks (Patel, 2022).

AI-driven systems facilitate sophisticated content optimization by enhancing readability, relevance, and compatibility with search intent, transforming traditional SEO practices into

personalized, user-focused strategies (Mohammad, 2021). Additionally, McCoy (2024) highlights how AI has shifted SEO from simple keyword-focused approaches to semantic search, enabling marketers to understand and address user intent more effectively, which fosters personalized user engagement (Rajawat Manisha, 2024).

Off-page SEO has also been significantly impacted by AI, particularly in link-building and reputation management (Ziakis & Vlachopoulou, 2024). AI-powered tools analyze vast datasets to assess website authority, relevance, and trustworthiness, allowing marketers to prioritize impactful backlink opportunities without exhaustive manual evaluations. Furthermore, AI aids marketers by monitoring brand mentions and conducting sentiment analysis across multiple platforms, enabling swift identification and resolution of reputational issues. This ensures a positive online image and allows marketers to respond effectively to public perception (Roumeliotis & Tselikas, 2023). Automated processes in off-page SEO have made these tasks more strategic and efficient, reducing the workload while enhancing outcomes.

AI's scalability is another major advantage for marketers, as it allows them to manage large-scale SEO campaigns efficiently. Real-time optimization tools ensure that content remains relevant and adaptive to evolving search engine algorithms. For instance, tools like AWS Recognition automate image-related tasks such as alt-text generation, improving search visibility and accessibility (Amara et al., 2024).

Paschen et al (2019) discovered that AI in SEO and digital marketing improves efficiency by automating tasks and enhancing customer engagement. Valvic (2021) supported these findings, stating that AI's efficiency depends on the quality of data and proper integration into workflows.

2.3.2. Productivity and Efficiency in AI-Driven SEO

AI-driven SEO has revolutionized productivity for marketers by transforming core practices like content optimization, voice search, image optimization, and personalization. Advanced technologies such as neural network models like Random Neural Networks (RNNs) enable accurate predictions of search queries, helping marketers create content that directly addresses user needs and improves engagement (Serrano, 2017).

Generative AI technologies, such as ChatGPT, applied in marketing, simplify content creation by producing user-focused, high-quality material aligned with search intent, helping marketers maintain a competitive edge (Feuerriegel et al., 2024; C. Wu & Monfort, 2023). Additionally, AI's impact on voice search and image optimization further supports marketer productivity. Voice search, popularized by Alexa and Siri, shifted SEO from keyword-based to natural language queries, with AI models like BERT enabling more accurate interpretation of conversational intent (Ziakis & Vlachopoulou, 2024).

For image SEO, deep learning models such as AWS Image Recognition automate tasks like alt-text generation, improving discoverability and accessibility while reducing manual effort. By creating accurate, user-oriented metadata, marketers can ensure content remains optimized and adaptable to changing algorithms in real-time (Amara et al., 2024; Handley, 2024). AI-powered personalization also boosts productivity by tailoring content and SEO strategies to specific demographics. By analyzing user behavior, preferences, and intent, marketers can deliver experiences that resonate with audiences, enhancing user engagement and fostering trust. Local SEO applications utilize AI to target regional search patterns, maintaining consistency in business information like contact details and reviews, and increasing visibility in local markets (Ziakis & Vlachopoulou, 2024). This level of precision ensures that SEO strategies are not only scalable but also impactful, enabling marketers to achieve high-quality results with greater efficiency and creativity (D Pushpa Gowri, 2024).

Boulos (2024) discovered that AI significantly boosts productivity by reducing repetitive tasks and allowing marketers to focus on strategic efforts. The study also stated that AI improves content generation and workflow automation. Additionally, a survey cited in the research stated that 54.2% of participants who are working in the digital marketing field agreed AI helped them focus on bigger problems, with younger professionals viewing it as essential for tackling complex challenges. However, Boulos (2024) also discovered that initial inefficiencies exist as users adapt, but long-term benefits outweigh these challenges.

The advancements in AI-driven SEO demonstrate its strong potential to enhance both efficiency and productivity for marketing specialists. By automating repetitive tasks, improving strategic decision-making, and offering advanced personalization capabilities, AI allows marketers to optimize their workflows and achieve superior outcomes (Boulos, 2024; Paschen et al., 2019b; Valvic, 2021).

Based on these observations, the following hypotheses are formulated:

H1a: AI integration in SEO has a positive effect on the marketers' efficiency.

H1b: AI integration in SEO has a positive effect on the marketers' productivity.

2.4 Challenges of AI in SEO

The rapid development of AI has considerably impacted SEO, making it indispensable for marketers and practitioners to adapt to these changes. As a critical component of digital marketing, SEO must evolve alongside these advancements to remain effective. However, despite the numerous benefits AI has brought to the digital world, it has also introduced notable challenges (Rajawat Manisha, 2024). While there is limited scientific literature directly addressing the challenges SEO practitioners face with the integration of AI tools, the connection between SEO and digital marketing highlights several key issues. These include the lack of transparency in AI algorithms, the reliance on high-quality data, and concerns regarding

data privacy and ethics (Ziakis & Vlachopoulou, 2024). Concerns have also arisen regarding the fear of replacement by AI due to automation (Mirbabaie et al., 2022). These challenges not only influence the effectiveness of AI in SEO but also raise broader implications for the digital marketing field.

2.4.1 ETHICAL CONCERNS

The integration of AI in SEO has revolutionized digital marketing but also raises significant ethical challenges, particularly concerning transparency, data privacy, and algorithmic bias (Eid et al., 2024; Ziakis & Vlachopoulou, 2024). The "black-box" nature of AI limits predictability, complicates accountability, and risks prioritizing efficiency over fairness (Carabantes, 2020; Lindebaum et al., 2020).

Rajawat Manisha (2024) highlighted that AI's influence on SEO extends beyond optimization to broader digital marketing strategies, necessitating a balance between AI efficiency and human creativity to develop effective campaigns. While AI enhances automation and data-driven decision-making, its limitations in creativity and ethical judgment highlight the need for human oversight. Marketers must navigate this balance to ensure AI-driven campaigns remain transparent, fair, and aligned with ethical standards. Understanding AI's capabilities and constraints is crucial for leveraging its full potential while mitigating risks related to bias and consumer exclusion (Akter et al., 2022; Hermann, 2022).

Algorithmic bias remains a critical concern, as AI-driven SEO can reinforce social inequalities and distort content personalization (Eid et al., 2024). Studies show that 45% of SEO professionals worry about bias, while 50% cite data privacy as a key issue (Rajawat Manisha, 2024). Additionally, generative AI tools heighten risks related to data security and consumer trust, with concerns over the mishandling of sensitive information (Kshetri, 2023; Lance Eliot, 2023). Pelău (2019) stated that many applications access personal data, such as contacts and locations, without explicit user awareness, which can undermine trust and engagement. Moreover, Hermann (2022) highlighted that AI-driven marketing can lead to customer prioritization, demographic-based targeting, and the exclusion of vulnerable consumer groups, necessitating additional fairness and inclusivity measures.

Furthermore, unethical AI-driven SEO tactics, such as keyword stuffing and link schemes, weaken user trust and search engine integrity (Jha & Saraswat, 2018). To address these issues, researchers advocate embedding ethical principles like fairness, privacy, and accountability into AI-SEO frameworks, ensuring more transparent and responsible marketing practices (Akter et al., 2022). Recent research supports the idea that ethical concerns can act as mediating mechanisms in shaping how individuals respond to AI systems. For instance, Köchling et al. (2025) found that perceived fairness and privacy intrusion mediated the relationship between AI-based career decision systems and employees' turnover intentions. These findings highlight the critical role that ethical considerations—such as fairness and data privacy—play in influencing user reactions and outcomes when AI technologies are

implemented in organizational processes. Addressing these concerns is essential, as ethical considerations significantly mediate the relationship between AI adoption in SEO and the efficiency and productivity of marketing specialists. Therefore, there is a need to investigate the following hypothesis:

H2a: Ethical concerns mediate the relationship between AI integration in SEO and marketers' efficiency.
H2b: Ethical concerns mediate the relationship between AI integration in SEO and marketers' productivity.

2.4.2 FEAR OF REPLACEMENT

The AI integration into various industries, including marketing, has raised significant concerns about job displacement (Jack Kelly, 2023; Pagani & Wind, 2025). Mirbabaie et al (2022) found that AI adoption fundamentally alters job roles, leading to fears of replacement, which directly impact employee efficiency by reducing engagement and adaptability. Similarly, Jussupow (2018) emphasized that professionals experiencing job insecurity due to AI-driven automation are more likely to resist AI tools, which hinders their efficiency and ability to integrate AI into their workflow.

One of the main reasons for these fears is the increasing overlap in AI- and human-performed tasks. Craig et al (2019) found that the anticipation of AI-induced job loss results in stress and decreased motivation, which negatively affects employees' ability to work efficiently. Studies also indicate that high AI awareness or perceived AI threats can be associated with emotional exhaustion, as employees fear job replacement by machines, which fuels job uncertainty and psychological strain (Zheng & Zhang, 2025). Employees frequently compare their skills to AI's capabilities. Studies indicate that such comparisons lower self-confidence, particularly when AI demonstrates superior performance in data-driven tasks (Dustin Harding et al., 2019; Huang et al., 2019; Jussupow, 2018). Furthermore, Złotowski et al (2017) found that employees who feel their expertise is being replaced by AI-driven analytics experience reduced confidence and engagement, which ultimately leads to inefficiencies in adopting AI-powered tools. Prester (2019) highlight that status threats caused by AI integration reduce professionals' efficiency, particularly when AI is perceived as a replacement rather than a complement to their skills.

While concerns about AI replacement are valid, Forbes Agency Council emphasizes that AI cannot replicate human creativity, strategic thinking, or emotional intelligence, which remain crucial for developing engaging and ethical marketing campaigns (Mike Maynard, 2023). A common misconception fueling fear is the assumption that AI will eventually operate autonomously without human involvement. However, Huang & Rust (2018) argue that AI systems still require human-defined intentions, making full replacement unlikely. Additionally, Rust & Huang (2021) highlight that the demand for human-specific skills, such as interpersonal communication and creative problem-solving, is growing, reinforcing the idea that AI serves

as an augmentative tool rather than a replacement. However, with the extensive growth of generative AI, it is now increasingly able to support tasks involving creativity and emotional sensitivity, such as producing engaging content and simulating empathetic responses (Chaturvedi et al., 2025; Pagani & Wind, 2025)

Therefore, job insecurity remains a major challenge to AI adoption in SEO and digital marketing. Nach (2015) discovered that when employees perceive a loss of control over their work due to AI automation, they are less likely to effectively utilize AI-powered tools, which diminishes their efficiency. Similarly, a survey by the Conference Board (2023) found that 40% of participants expected a decline in marketing jobs due to Generative AI, further fueling uncertainty around AI's role in job security.

The fear of replacement plays a crucial mediating role in how marketers adopt AI tools and, ultimately, how these tools impact their efficiency and productivity. Employees who perceive AI as a threat to their job security often resist AI integration, which reduces potential efficiency and productivity gains (Craig et al., 2019; Jussupow, 2018). In contrast, reducing these fears enables employees to utilize AI as a supportive tool, enhancing their efficiency and productivity (Mirbabaie et al., 2022; Prester, 2019). This perspective is further supported by findings from D. Wu et al. (2025), who showed that job insecurity mediates the relationship between AI usage and employees' behavioral outcomes, such as disengagement and decreased performance. These findings confirm that fear of replacement can act as a psychological barrier to effective AI integration, limiting its potential benefits on productivity and efficiency.

Given the significance of fear of AI replacement in influencing AI adoption and its outcomes in SEO, the following hypotheses are proposed:

H3a: Fear of replacement mediates the relationship between AI integration in SEO and marketers' efficiency.

H3b: Fear of replacement mediates the relationship between AI integration in SEO and marketers' productivity.

2.5. Level of AI Knowledge

AI integration in marketing practices enhances marketing efficiency by automating processes and enabling faster decision-making (Mikalef et al., 2023; Paschen et al., 2020). Organizations leveraging AI for market insights can triple their B2B marketing efficiency (Bag et al., 2021; Mikalef et al., 2023). However, AI adoption is hindered by a lack of knowledge. Moradi & Dass (2022) found in their survey that only 37% of B2B marketers effectively use AI, demonstrating a significant gap in AI literacy. They also identified key challenges related to limited AI knowledge, including issues with unstructured data, costly digital transformation, and a shortage of skilled analysts. Firms with higher AI knowledge can better integrate AI, improving

efficiency through explainability and collaboration between AI and human expertise (Dwivedi & Wang, 2022). Botega & da Silva (2020) argues that knowledge-sharing fosters AI capability, leading to increased creativity and performance. Furthermore, Dong et al (2025) highlight that AI enhances employee autonomy by automating routine tasks, allowing marketing professionals to focus on complex problem-solving. However, its effectiveness is contingent on familiarity with AI tools.

Given these challenges, prior research has shown that AI familiarity significantly impacts user adoption, engagement, and decision-making.Tussyadiah & Park (2018) emphasized that familiarity with AI tools enhances their effectiveness, as knowledgeable users engage more actively. Similarly, Carlini & Wagner (2017) highlighted that AI system characteristics, like reliability and flexibility, shape user perceptions and trust. Prentice et al (2020) found that AI service quality influences customer satisfaction and engagement, moderated by AI preference, as those favoring AI services exhibit stronger positive attitudes toward AI-generated information. Their findings indicate that users who are more knowledgeable and comfortable with AI-powered tools exhibit stronger positive attitudes and engagement, ultimately enhancing trust in AI-driven processes.

While research highlights AI knowledge's role in user engagement and adoption, its moderating effect on AI integration in SEO remains underexplored. As SEO increasingly relies on AI-driven tools for optimization and analysis, marketers with higher AI knowledge may utilize them more effectively, while those with limited expertise may struggle. Previous studies have shown that AI knowledge can moderate key workplace relationships, such as between AI appraisals and job crafting or job insecurity (He et al., 2024), suggesting that similar moderation effects may emerge in digital marketing contexts like SEO. To address this gap, the following hypotheses are proposed:

H4a: The level of knowledge on AI moderates the relationship between AI integration in SEO and marketers' efficiency.

H4b: The level of knowledge on AI moderates the relationship between AI integration in SEO and marketers' productivity.

To visually represent the relationships examined in this study, a conceptual framework was developed based on the proposed hypotheses. As shown in Figure 1, the model investigates the impact of AI integration in SEO on marketers' efficiency and productivity, while also exploring the mediating roles of ethical concerns and fear of replacement, as well as the moderating role of AI knowledge. Each line in the model represents the proposed hypothesis.

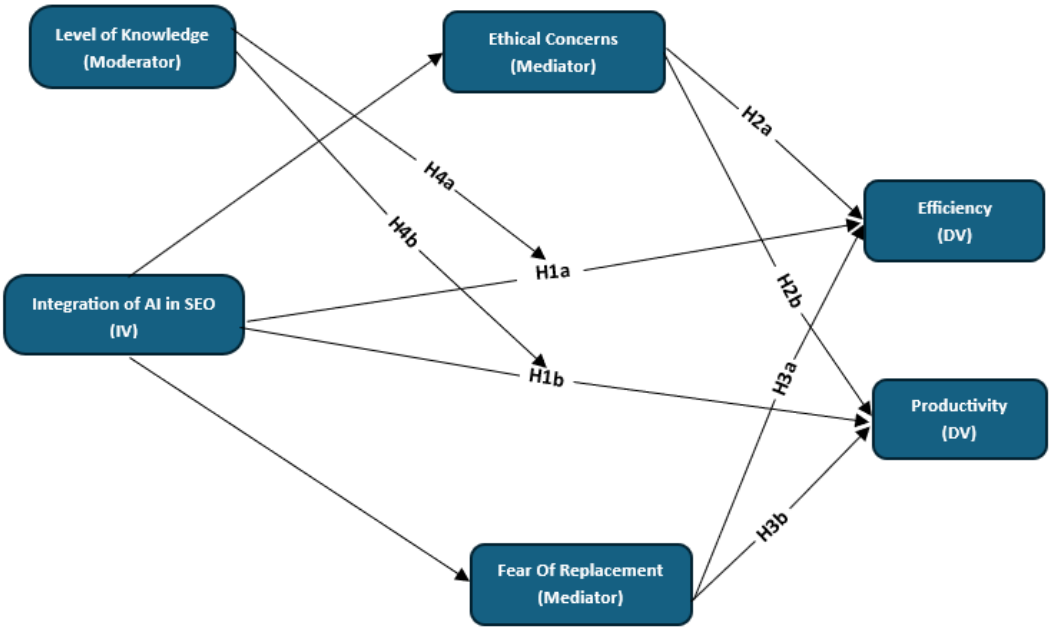

Figure 1 - Research Model

3. METHODOLOGY

3.1 Study Design And Measurement Items

Quantitative research was chosen as it is one of the most prevalent approaches and is widely applied in the study of social phenomena by the scientific community (Bryman, 1984). The sampling method was selected as the primary technique for quantitative research, enabling the collection of original data from a large population to directly observe its samples. . The study followed a between-subjects experimental design, in which participants were randomly assigned to one of two conditions: an AI-driven SEO scenario or a human-driven SEO scenario. Each participant was presented with a short scenario asking them to recall a work-related experience in SEO, where tasks were either performed with the assistance of AI tools (e.g., keyword research, content optimization, performance analysis) or executed manually by a human expert without AI support. This manipulation aimed to simulate realistic conditions of AI versus human involvement in digital marketing tasks and served to evaluate differences in perception across the two experimental groups (scenarios can be found in Appendix A). Following the scenario, participants asked to complete a questionnaire using a 9-point scale, ranging from 1 (strongly disagree) to 9 (strongly agree).The questionnaire assessed efficiency (Okela, 2025), productivity ,(Xiaojun Zhang, 2017), ethical concerns (Park et al., 2021),fear of replacement (Li et al., 2019), and level of knowledge as a moderator (Huisman et al., 2021). The scales and their details can be found in Table 1. Additionally, demographic information such as age, gender, education level, current job role in digital marketing/SEO, years of experience in digital marketing/SEO were collected to provide insights into the background of participants.

Table 1 - Summary of Measurement Items

The Original Scale	The Adapted Scale	The Source
Efficiency		
I find the chatbot useful in my daily life.	I will find the AI-driven SEO tools useful in my daily work.	Adopted from (Ashfaq et al., 2020)
Using the chatbot helps me to accomplish things more quickly.	Using AI-driven SEO tools will help me to accomplish tasks more quickly.	
Using the chatbot helps me to perform many things more conveniently.	Using AI-driven SEO tools will help me perform keyword research more conveniently.	

Using the chatbot helps me to perform many things more conveniently.	Using AI-driven SEO tools will help me perform content optimization more conveniently.	
If I use AI applications, I will spend less time on routine tasks.	If I use AI-driven SEO tools, I will spend less time on routine tasks.	
I became more efficient because of AI personal assistant.	I will become more efficient because of AI-driven SEO tools.	Adopted from (Jo, 2023)
Using AI personal assistant was beneficial to me.	Using AI-driven SEO tools will be beneficial to me.	
Productivity		
Using AI helps me find solutions to work problems.	Using AI-driven SEO tools will help me find solutions to work problems.	Adopted from (Xiaojun Zhang, 2017)
Using AI applications improves the quality of my teaching and educational resources.	Using AI-driven SEO tools will improve the quality of my SEO tasks.	
Using AI applications makes designing and delivering engaging learning experiences easier.	Using AI-driven SEO tools will make accomplishing my SEO tasks easier.	
Using AI applications increases my productivity as an educator.	Using AI-driven SEO tools will increase my productivity as an SEO practitioner.	
Ethical Concerns		
I think my personal information is safe when using the robot	I think my data will be safe when using AI-driven SEO tools.	Adopted from (Park et al., 2021)
My data will be kept secured in using the service robot.	My data and analytics will be kept secured in using AI-driven SEO tools.	
The robot will not transmit my information to a third party.	AI-driven SEO tools will not transmit my data to a third party.	
The robot will protect my financial-transaction records.	AI-driven SEO tools will protect my business and marketing data.	

Fear of replacement		
I think my job has a high risk of complying with automation and will be replaced by others	I think my job has a high risk of complying with automation and will be replaced by AI.	Adopted from (Li et al., 2019)
There is a high likelihood that my job will be taken by someone else	There is a high likelihood that my job will be taken by AI.	
I am quite pessimistic about my future due to the fact that could be easily replaced at my job	I am quite pessimistic about my future due to the fact that could be easily replaced at my job by AI.	
I am uncertain about my future due to the fact that many employees are being replaced	I am uncertain about my future due to the fact that many employees are being replaced by AI.	
Level of Knowledge		
Never heard of AI	Never heard of AI	Adopted from (Huisman et al., 2021)
Heard of AI	Heard of AI	
Basic knowledge of AI	Basic knowledge of AI	
Intermediate knowledge of AI	Intermediate knowledge of AI	
Advanced knowledge of AI	Advanced knowledge of AI	

3.2 SAMPLING TECHNIQUE AND DATA COLLECTION

A total of 128 participants were recruited through various platforms, including Facebook groups related to digital marketing, professional networks on LinkedIn, and the online research platform Prolific. Specifically, 67 participants (52.3%) were recruited via Prolific, while the remaining 61 participants (47.7%) were recruited organically through Facebook and LinkedIn.

Initially, a broader sample was gathered via Facebook and LinkedIn, but 42.6% of those initial responses were excluded from further analysis due to quality control issues. These included preview entries, incomplete responses, and cases with a completion time of under one minute—substantially shorter than the estimated average duration of approximately three minutes—indicating potential inattentiveness. To improve data quality and ensure relevance to the research topic, an additional 67 participants were subsequently recruited through Prolific. This platform enabled more targeted sampling of individuals working in the marketing sector, who were more likely to engage meaningfully with the survey content. Furthermore, 2.6% of the final sample failed the attention check. However, their responses were retained in the dataset due to the overall consistency and quality of their answers.

All participants were required to read and agree to an informed consent form before proceeding. Specifically, 63 participants were randomly allocated to the AI-driven condition, while 65 were assigned to the human-driven condition. Immediately after reading the assigned scenario, participants were asked to complete a questionnaire.

Table 2 summarizes the demographic characteristics of the participants in the study. The sample included individuals with diverse backgrounds in terms of gender, age, education, professional role, work experience, and level of knowledge about AI. The final sample included slightly more females (54.7%) than males (45.3%). Most participants were young adults, with the largest age groups being 26–30 (32.8%) and 19–25 (29.7%). The majority held a Bachelor's or Master's degree (82.8%). In terms of job roles, most were in entry-level (35.2%), specialist (22.7%), or managerial (21.1%) positions, and had 1–5 years of work experience (61.7%). Regarding AI familiarity, over half of the participants (51.6%) reported intermediate knowledge, while 25% had advanced understanding and 5.5% were actively involved in AI-related work.

Table 2 - Respondents' Profile

Demographics	**Results (%)**	
Gender	Male	45,3%
	Female	54,7%
Age	19-25	29,7%
	26-30	32,8%
	31-35	14,1%
	36-40	6,3%
	41-45	5,5%

	>45	7,0%
	Missing Values	4,7%
Level of education	Less than a high school diploma	0,8%
	High school diploma	14,1%
	Bachelor’s degree	43,0%
	Master’s degree	39,8%
	Doctoral or professional degree	2,3%
Job Role	Entry-Level / Junior Role	35,2%
	Specialist	22.7%
	Manager	21,1%
	Freelancer / Consultant	15,6%
	Business Owner / Entrepreneur	5,5%
Years of Experience	Less than 1 year	22,7%
	1 - 2 years	29,7%
	3 - 5 years	32,0%
	6 - 9 years	7,0%
	10+ years	7,0%
Level of Knowledge of AI	Never heard of AI	0,0%
	Heard of AI	0,8%
	Basic knowledge of AI	17,2%
	Intermediate knowledge	51,6%

of AI	
Advanced knowledge of AI	25%
Active AI research/development	5,5%

4. RESULTS

4.1. Methodological Approach Of the Data Analysis

The collected data was analyzed with the aid of SPSS Statistics version 29 (IBM). First, an independent samples t-test was conducted. The objective of this test was to assess potential differences in participants' evaluations of efficiency, productivity, ethical concerns, and fear of replacement depending on whether the SEO strategy presented was driven by artificial intelligence or a human expert.

Secondly, for a more in-depth analysis, we investigated the relationship between the independent variable (IV = type of SEO integration, AI-driven versus human-driven), the dependent variables (DV = marketers' efficiency (1) and (2) productivity), with mediators being ethical concerns and fear of replacement, and the moderator being the level of knowledge on AI. This analysis was conducted using the external tool PROCESS v4.3 developed by Andrew F. Hayes (Hayes, 2022), specifically applying Models 4 and 1. Model 4 was used to examine the mediation effect of AI integration on marketers' efficiency and productivity through ethical concerns and fear of replacement. Model 1 was applied for moderation analysis, assessing whether the level of knowledge on AI moderated the relationship between AI integration and marketers' efficiency and productivity. To evaluate the indirect and conditional effects, we utilized bootstrapping methods with 5,000 resamples. To assess the significance of the results, 95% confidence intervals (CI) were used.

4.2 Data Analysis

4.2.1. Main Effects (Efficiency and productivity)

An independent samples t-test was conducted to examine whether there were statistically significant differences in participants' evaluations of efficiency and productivity between the human-driven and AI-driven SEO conditions. Regarding efficiency, Levene's Test for Equality of Variances was not significant (F = 1.159, p = .284), indicating that the assumption of homogeneity of variances was met. The analysis revealed no statistically significant difference in efficiency scores between the AI-driven (M = 7.02, SD = 1.25) and human-driven (M = 7.23, SD = 1.38) AI groups, t(126) = -0.903, p = .368. In contrast, the results for productivity demonstrated a different pattern. Levene's Test was again not significant (F = 0.338, p = .562), confirming that the assumption of equal variances was satisfied. A statistically significant difference was observed in productivity scores between participants in the AI-driven (M = 6.47, SD = 1.37) and human-driven (M = 7.03, SD = 1.42) groups, t(126) = -2.252, p = .026. The mean difference was -0.55, with a 95% confidence interval ranging from -1.04 to -0.07. The corresponding effect size was Cohen's d = -0.398, 95% CI [-0.747, -0.047], indicating a small to moderate effect according to Cohen's conventions. To summarize, while no significant differences were found in perceived efficiency between the two conditions, participants in the human-driven SEO group reported significantly higher productivity compared to those in the AI-driven condition.

4.2.2. Mediation Effects of ethical concerns of the relationship between AI Integration and Efficiency

Moving forward, we tested the relationship between the type of SEO integration (AI-driven versus human-driven), marketers' efficiency, and the mediating role of ethical concerns. Hayes' PROCESS macro v4.2 (Hayes, 2022) (Model 4) was applied to examine whether ethical concerns mediate the relationship between AI integration and marketers' efficiency.

As presented in Table 3, bootstrapping analysis revealed that the indirect effect of AI integration on efficiency through ethical concerns was not significant (β = 0.061, Boot SE = 0.073, 95% CI = [-0.062, 0.233]). Since the confidence interval includes zero, no mediation was detected. Therefore, Hypothesis H2a was not supported.

Table 3 - Mediation Effect of Ethical Concerns on Efficiency – Model 4

Variable	Predictor	β	SE	t	p	LLCI	ULCI
Ethical Concerns	Constant	4.60	0.24	19.32	<.001	4.13	5.07
	IV	0.31	0.33	0.93	0.352	-0.35	0.97

Efficiency	Constant	6.12	0.32	19.22	<.001	5.49	6.75
	IV	0.15	0.23	0.66	0.508	-0.30	0.60
	Ethical Concerns	0.19	0.06	3.25	0.002	0.08	0.31
Direct Effect	AI Integration → Efficiency	0.15	0.23	0.66	0.508	-0.30	0.60
Indirect effect	AI Integration → Ethical Concerns → Efficiency	0.061	0.073	–	–	-0.062	0.233

4.2.3. Mediation Effects of ethical concerns of the relationship between AI Integration and Productivity

Moving forward, we tested the relationship between the integration of AI in SEO, ethical concerns, and marketers' productivity. The bootstrapping results (Table 4) revealed that the indirect effect of AI integration on productivity through ethical concerns was not significant (β = 0.087, Boot SE = 0.099, 95% CI = [-0.096, 0.300]). Because the confidence interval includes zero, this indicates that ethical concerns do not mediate the relationship between AI integration and productivity. Therefore, H2b was not supported.

Table 4 - Mediation Effect of Ethical Concerns on Productivity – Model 4

Variable	Predictor	β	SE	t	p	LLCI	ULCI
Ethical Concerns	Constant	4.60	0.24	19.32	<.001	4.13	5.07
	IV	0.31	0.33	0.93	0.352	-0.35	0.97
Productivity	Constant	5.19	0.32	15.98	<.001	4.55	5.83
	IV	0.47	0.23	2.04	0.044	0.01	0.92
	Ethical Concerns	0.28	0.06	4.56	<.001	0.16	0.40
Direct Effect	AI Integration → Productivity	0.47	0.23	2.04	0.044	0.01	0.92
Indirect effect	AI Integration → Ethical Concerns → Productivity	0.087	0.099	–	–	-0.096	0.300

4.2.4. Mediation Effects of Fear of Replacement of the relationship between AI Integration and Efficiency

Subsequently, we examined the mediating role of fear of replacement in the relationship between AI integration and marketers' efficiency. The bootstrapping analysis (Table 5) confirmed that the indirect effect of AI integration on efficiency through fear of replacement was not significant (β = -0.012, Boot SE = 0.029, 95% CI = [-0.086, 0.037]), as the confidence interval included zero. These findings indicate that fear of replacement does not mediate the relationship between AI integration and efficiency. Consequently, Hypothesis H3a was not supported.

Table 5 - Mediation Effect of Fear of Replacement on Efficiency – Model 4

Variable	Predictor	β	SE	t	p	LLCI	ULCI
Fear of Replacement	Constant	4.56	0.28	16.06	<.001	3.99	5.12
	IV	-0.33	0.40	-0.84	0.405	-1.12	0.46
Efficiency	Constant	6.86	0.29	23.62	<.001	6.29	7.44
	IV	0.22	0.23	0.95	0.345	-0.24	0.69
	Fear of Replacement	0.03	0.05	0.66	0.511	-0.07	0.14
Direct Effect	AI Integration → Efficiency	0.22	0.23	0.95	0.345	-0.24	0.69
Indirect effect	AI Integration → Fear of Replacement → Efficiency	-0.012	0.029	–	–	-0.086	0.037

4.2.5. Mediation Effects of Fear of Replacement of the relationship between AI Integration and Productivity

Continuing the analysis, we assessed the mediating effect of fear of replacement on the relationship between AI integration and marketers' productivity. Bootstrapping analysis (Table 6) revealed that the indirect effect of AI integration on productivity through fear of replacement was not significant (β = 0.00, Boot SE = 0.026, 95% CI = [-0.057, 0.056]). Since the confidence interval included zero, the mediation effect was not supported. Consequently, H3b was not supported, indicating that fear of replacement does not serve as a mediating mechanism through which AI integration affects marketers' productivity.

Table 6 - Mediation Effect of Fear of Replacement on Productivity– Model 4

Variable	Predictor	β	SE	t	p	LLCI	ULCI
Fear of Replacement	Constant	4.56	0.28	16.06	<.001	3.99	5.12
	IV	-0.33	0.40	-0.84	0.405	-1.12	0.46
Productivity	Constant	6.47	0.31	21.04	<.001	5.86	7.08
	IV	0.55	0.25	2.24	0.027	0.06	1.05
	Fear of Replacement	0.00	0.06	0.00	0.9996	-0.11	0.11
Direct Effect	AI Integration → Productivity	0.55	0.25	2.24	0.027	0.06	1.05
Indirect effect	AI Integration → Fear of Replacement → Productivity	0.000	0.026	–	–	-0.057	0.056

4.2.6. Moderation Effects of Level of Knowledge on the Relationship between AI Integration and Marketers' Efficiency

To further explore the proposed model, a moderation analysis was conducted to assess whether the level of knowledge about AI moderates the relationship between AI integration in SEO (IV) and marketers' efficiency (DV). Hayes' PROCESS macro (v4.2) Model 1 was utilized for this purpose. The moderation model included AI integration as the independent variable, efficiency as the dependent variable, and level of knowledge as the moderator. The model summary (Table 7) revealed a significant overall model (R^2 = 0.0682, F(3, 124) = 3.03, p = .0321), suggesting that the combination of the independent variable, moderator, and their interaction explains approximately 6.8% of the variance in marketers' efficiency. However, examining the interaction effect specifically, the interaction term (IV × Level of Knowledge) was not statistically significant (β = 0.19, SE = 0.29, t = 0.67, p = .507, 95% CI [-0.37, 0.75]). This indicates that the level of knowledge on AI does not significantly moderate the relationship between the integration of AI into SEO practices and marketers' perceived efficiency. Moreover, the direct effect of AI integration on efficiency was also found to be non-significant (β = -0.63, p = .604), suggesting no strong direct impact. Similarly, the moderator (level of knowledge) alone was not significantly associated with efficiency (β = 0.30, p = .158). Thus, hypothesis H4a was not supported.

Table 7 - Moderation Effect Level of Knowledge of AI on Efficiency – Model 1

Outcome Variable	Predictor	β	SE	t	p	LLCI	ULCI
Efficiency	Constant	5.80	0.87	6.67	<.001	4.08	7.53
	AI Integration (IV)	-0.63	1.21	-0.52	.604	-3.02	1.77
	Level of Knowledge (W)	0.30	0.21	1.42	.158	-0.12	0.71
	Interaction (IV × W)	0.19	0.29	0.67	.507	-0.37	0.75

4.2.7. Moderation Effects of Level of Knowledge on the Relationship between AI Integration and Marketers' Productivity

As shown in Table 8, the overall model predicting marketers' productivity was statistically significant (R^2 = 0.0966, F(3, 124) = 4.42, p = .0055), indicating that the predictors collectively explained approximately 9.7% of the variance in productivity. However, the interaction term between AI integration and level of knowledge (β = 0.08, SE = 0.30, t = 0.28, p = .782, 95% CI [-0.51, 0.68]) was not statistically significant, suggesting that the level of knowledge did not moderate the relationship between the integration of AI in SEO and marketers' productivity. Furthermore, neither the direct effect of AI integration (β = 0.16, p = .904) nor the effect of level of knowledge (β = 0.38, p = .089) reached statistical significance. Consequently, hypothesis H4b was not supported, indicating that regardless of their AI knowledge level, marketers reported similar perceptions of productivity when using AI-driven versus human-driven SEO tools.

Table 8 - Moderation Effect Level of Knowledge of AI on Productivity – Model 1

Outcome Variable	Predictor	β	SE	t	p	LLCI	ULCI
Productivity	Constant	4.92	0.92	5.34	<.001	3.10	6.74
	AI Integration (IV)	0.16	1.28	0.12	.904	-2.38	2.69
	Level of Knowledge (W)	0.38	0.22	1.72	.089	-0.06	0.81
	Interaction (IV × W)	0.08	0.30	0.28	.782	-0.51	0.68

4.2.8. Effects of Control Variables On Efficiency And Productivity (Moderation Model)

To account for potential confounding effects, demographic variables such as age, gender, education level, job role, and years of experience were included as covariates in the moderation analyses for both efficiency and productivity. The results indicated that none of the demographic variables were statistically significant predictors of either outcome.

Specifically, in the model predicting efficiency, all control variables yielded non-significant effects (Age: β = 0.027, p = .155; Gender: β = 0.036, p = .884; Education Level: β = 0.107, p = .507; Job Role: β = 0.008, p = .941; Years of Experience: β = -0.016, p = .914), as shown in Table 9. Similarly, in the model predicting productivity, none of the demographic variables demonstrated a significant influence (Age: β = 0.017, p = .376; Gender: β = 0.072, p = .782; Education Level: β = 0.159, p = .339; Job Role: β = 0.103, p = .376; Years of Experience: β = 0.008, p = .959), as displayed in Table 10.

These findings suggest that individual differences in age, gender, education, job role, and professional experience did not impact participants' evaluations of either efficiency or productivity in the context of AI versus human-driven SEO practices.

Table 9 - Effects Of Demographic Variables on Efficiency – Model 1

Predictor	β	SE	t	p	LLCI	ULCI
Age	0.027	0.019	1.43	.155	-0.010	0.063
Gender	0.036	0.249	0.15	.884	-0.458	0.530
Education Level	0.107	0.160	0.67	.507	-0.210	0.423
Job Role	0.008	0.112	0.07	.941	-0.214	0.231
Years of Experience	-0.016	0.145	-0.11	.914	-0.303	0.271

Table 10 - Effects of Demographic Variables on Productivity – Model 1

Predictor	β	SE	t	p	LLCI	ULCI
Age	0.017	0.019	0.89	.376	-0.021	0.055
Gender	0.072	0.258	0.28	.782	-0.440	0.584
Education Level	0.159	0.166	0.96	.339	-0.169	0.487
Job Role	0.103	0.116	0.89	.376	-0.127	0.334
Years of Experience	-0.008	0.150	0.05	.959	-0.290	0.305

Table 11 summarizes the results of all tested hypotheses. Only H1b was supported, indicating a significant positive effect of AI integration on productivity. All mediation and moderation hypotheses were not supported, as their effects were statistically non-significant.

Table 11 - Summary of Hypothesis Testing Results

Hypothesis		**Relationship Tested**	**p-value**	**Significant**	**Supported**
H1a	Integration of AI in SEO has a positive effect on the marketers' efficiency.	AI Integration → Efficiency	.508	✗	No
H1b	Integration of AI in SEO has a positive effect on the marketers' productivity.	AI Integration → Productivity	.044	✓	No
H2a	Ethical concerns mediate the relationship between integration of AI in SEO and marketers' efficiency.	AI → Ethical Concerns → Efficiency	–	✗ (indirect)	No
H2b	Ethical concerns mediate the relationship between integration of AI in SEO and marketers' productivity.	AI → Ethical Concerns → Productivity	–	✗ (indirect)	No
H3a	Fear of replacement mediates the relationship between the integration of AI in SEO and marketers' efficiency.	AI → Fear of Replacement → Efficiency	–	✗ (indirect)	No
H3b	Fear of replacement mediates the relationship between the integration of AI in SEO and marketers' productivity.	AI → Fear of Replacement → Productivity	–	✗ (indirect)	No

H4a	The level of knowledge on AI moderates the relationship between AI integration in SEO and marketers' efficiency.	Moderation of AI → Efficiency by Knowledge	.507	✗	No
H4b	The level of knowledge on AI moderates the relationship between AI integration in SEO and marketers' productivity.	Moderation of AI → Productivity by Knowledge	.782	✗	No

5. DISCUSSION

Out of the eight hypotheses tested, none were supported. Although the analysis revealed a statistically significant effect of AI integration on marketers' productivity (H1b), this effect was in the opposite direction of the hypothesized relationship. No significant effect was found on efficiency (H1a), and none of the proposed mediation (H2a, H2b, H3a, H3b) or moderation effects (H4a, H4b) were supported. These results provide a comprehensive answer to the main research question:"How does the AI integration into SEO influence marketers' perceived efficiency and productivity, and what influencing factors affect the implementation of such strategies?"

The findings suggest that although AI is increasingly integrated into SEO practices, its benefits are not perceived equally across all dimensions of marketers' performance. Contrary to expectations, AI integration had a statistically significant positive effect on productivity, although this effect was lower compared to the human-driven condition, as participants in the human-driven condition reported higher productivity compared to those in the AI-driven condition. This indicates that AI tools, while potentially useful for generating insights or improving the quality of SEO outputs, may also introduce additional steps such as reviewing, adapting, and verifying AI-generated content, which could reduce marketers' sense of productivity. Moreover, no significant effect was found on perceived efficiency, suggesting that AI neither made tasks feel faster nor simplified daily work processes. Overall, participants appeared to view AI as supportive in idea generation but not yet as a factor that enhances overall performance.

Furthermore, the expected mediating roles of ethical concerns was not supported. Although ethical concerns were significantly related to marketers' productivity and efficiency, they did not mediate the impact of AI integration. This means that while marketers may be aware of risks such as data privacy, algorithmic bias, and transparency (Eid et al., 2024; Rajawat Manisha, 2024), these concerns do not directly shape how they experience AI in their daily work. Previous research has emphasized the ethical complexity of AI in marketing and SEO (Akter et al., 2022; Hermann, 2022), yet the current findings suggest that these concerns may remain secondary to marketers' performance perceptions, especially when they are not part of their immediate tasks or responsibilities.

A similar pattern was observed for fear of replacement. Despite literature indicating that job insecurity due to AI automation can negatively affect employees' engagement, adaptability, and willingness to adopt new technologies (Jussupow, 2018; Mirbabaie et al., 2022), the current findings suggest that this fear does not significantly shape marketers' perceived efficiency or productivity. One possible explanation is that participants do not yet perceive AI tools in SEO as direct threats to their employment but rather as supportive technologies (Grewal et al., 2025). Alternatively, the emotional impact of fear of replacement may exist but may not be strong enough to interfere with how marketers evaluate their own performance.

Additionally, the level of knowledge on AI did not moderate the relationship between AI integration and performance outcomes. This challenges existing assumptions that more knowledgeable users benefit more from advanced tools (Moradi & Dass, 2022; Tussyadiah & Park, 2018). Complementary analyses further revealed that demographic variables such as age, gender, education level, job role, and years of experience did not significantly affect participants' evaluations of productivity or efficiency. This indicates that the observed effects of AI integration were not confounded by individual background characteristics, enhancing the internal validity of the findings.

5.1. THEORETICAL IMPLICATIONS

From a theoretical perspective, this investigation significantly extends the literature in several keyways. First, the study's findings have important theoretical implications for future research on the role of AI in digital marketing, particularly in the context of SEO performance and marketer–technology interaction. While some studies have addressed the use of AI in broader digital marketing contexts (Boulos, 2024; Paschen et al., 2019a; Valvic, 2021), this is one of the first studies to specifically examine the integration of AI tools into SEO and their impact on marketers' perceived productivity and efficiency. Previous studies have primarily focused on the technical aspects of AI integration into SEO without exploring its practical benefits on marketers' productivity and efficiency within everyday workflows (Amara et al., 2024; Roumeliotis & Tselikas, 2023; Serrano, 2017; Ziakis & Vlachopoulou, 2024). Given the increasing adoption of AI in digital marketing, this study offers useful insights into how such technologies affect marketers' performance in SEO-related tasks. Although none of the hypotheses were supported, the findings can inform future research aiming to refine the conceptual model and investigate alternative factors or conditions under which AI integration may have a stronger impact on efficiency and productivity.

In particular, the hypothesis that AI would increase marketers' perceived efficiency (H1a) and productivity (H1b) were not supported. A reasonable explanation is that using AI often adds extra mental and practical tasks, such as checking, correcting, and adjusting the system's suggestions. This agrees with research showing that AI tools in marketing work best when they support rather than replace human decision-making (Davenport et al., 2020). It also reflects evidence that human monitoring and correction of AI outputs require extra time and effort, which can reduce the feeling of being more productive or efficient (Langer et al., 2024)

Furthermore, the study found no evidence of mediation effects for ethical concerns or fear of replacement (H2a, H2b, H3a, H3b). Although these variables are widely examined in AI research (Mirbabaie et al., 2022; Ziakis & Vlachopoulou, 2024), they did not significantly influence marketers' perceived performance. A possible reason is that many professionals do not perceive AI as a personal threat in their current roles, or they may not be fully aware of ethical issues related to data use and automation in their day-to-day work.

Finally, the moderating role of AI knowledge (H4a, H4b) was not confirmed either, despite literature suggesting that technical literacy positively affects technology adoption (Dwivedi & Wang, 2022; Moradi & Dass, 2022). One explanation is that modern SEO tools are increasingly designed to be intuitive and accessible, even for users with basic or intermediate familiarity. Additionally, the benefits of AI may depend less on individual expertise and more on organizational-level factors such as support, training, and readiness to implement AI. This points to the need for future research to incorporate broader contextual moderators—like AI maturity or digital culture—when evaluating AI's impact on professional outcomes.

5.2. Practical Implications

With the increasing use of AI in digital marketing tasks and companies' ongoing efforts to improve performance, this study offers helpful insights for organizations thinking about or already using AI tools in SEO. The results may encourage marketing teams and software providers to rethink how AI-based SEO tools are made, used, and supported in real work situations.

First, the findings highlight the importance of aligning AI tools with the way marketers typically work. Although AI integration did not lead to higher perceived productivity or efficiency, it still influenced how participants experienced their daily tasks. This suggests that the effectiveness of AI in SEO depends not only on its technical capabilities but also on how it is perceived by users and how seamlessly it integrates into their existing workflows. Organizations should consider conducting user-centered evaluations during the early stages of AI implementation to identify usability issues, address workflow mismatches, and understand how employees experience these tools in practice. Additionally, providing targeted AI training can help ensure that users develop the confidence and skills needed to use AI systems effectively, minimizing resistance and improving long-term adoption (Maity, 2019).

Furthermore, based on the absence of significant results related to efficiency and productivity, the study shows the need to keep improving how easy AI tools are to use. Tool makers should focus on creating simple, easy-to-understand platforms that let marketers take advantage of automation without needing advanced tech skills. Things like clear explanations of how the tool makes choices, live feedback, and flexible suggestions can help users feel more confident and in control when using AI (Szymanski et al., 2024; Westphal et al., 2023).

Lastly, while ethical and job-related concerns did not directly impact performance in this study, they remain essential for long-term engagement and effective human–AI collaboration. Ethical and trustworthy AI teammates can enhance team dynamics by reducing uncertainty, promoting fairness, and increasing transparency. Clearly communicating the purpose of AI systems, establishing transparent usage policies, and promoting AI as a tool that augments rather than replaces human capabilities can reduce employee resistance and foster more cohesive collaboration (Patole, 2024).

5.3. Study Limitations And Future Research222

The current research exhibits several limitations. One of the key limitations of this study is that several of the tested hypotheses failed to show statistically significant effects. This may reflect a broader issue: many marketing professionals still appear to have a limited or unclear understanding of how AI tools actually function or impact their work. As AI becomes more integrated into marketing processes, users may develop generalized attitudes—positive or negative—without fully understanding the mechanisms or strategic implications of these technologies. This lack of conceptual clarity may have influenced participants' evaluations in the experimental scenarios, leading to responses based more on assumptions than on informed experience.

Another limitation relates to the sample of participants used in this study. Although a large portion of respondents reported working in the field of marketing, it is likely that many did not have direct experience with SEO. This may have influenced how realistically or accurately they evaluated the scenarios presented in the experiment. Participants without hands-on involvement in SEO processes might have relied more on assumptions or general impressions, rather than practical knowledge. Future studies could improve the validity of findings by targeting professionals who are actively engaged in SEO-related tasks, ensuring more informed and context-specific responses.

An additional consideration relates to the way the scenarios were written in the survey. In the AI-driven version, the text clearly mentioned the use of AI tools, which may have affected how participants thought about the situation. In contrast, the human-driven version also stated that AI was not used, making the comparison between the two conditions quite obvious. This could have influenced participants' answers. In future research, using more neutral or indirect wording could help keep participants unaware of the study's purpose and reduce biased responses.

Future research could also explore how AI affects marketers with different levels of experience, roles, and responsibilities, and how their perceptions evolve as they become more familiar with AI tools. It may be valuable to examine additional psychological and organizational factors that influence how AI is adopted and used in everyday marketing practice. For example, concepts such as technostress, digital self-efficacy, or algorithm aversion may help explain why some professionals embrace AI while others hesitate. Variables drawn from organizational behavior, such as role clarity, job crafting, or perceived autonomy, could also offer meaningful insights into how AI changes task ownership, workflow flexibility, and personal engagement at work. Finally, as AI-based SEO tools become more complex, there is a growing need to understand how marketers perceive and interpret these tools—especially when they are unsure how decisions are made. Future studies should examine how the level of user understanding, explainability, and perceived control over AI systems influences adoption and effectiveness in real marketing contexts.

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APPENDIX

APPENDIX A. AI-driven SEO scenario and human-driven SEO scenario

AI-driven SEO

In the next section, we will ask you to recall your current or previous job and evaluate how you felt while working.

Please think specifically about a situation where AI-driven SEO tools were used. These tools may have been applied to tasks such as keyword research, content optimization, search rankings optimization, website performance analysis, or technical SEO adjustments.

Human-Driven

In the next section, we will ask you to recall your current or previous job and evaluate how you felt while working.

Please think specifically about a situation where SEO tasks were performed manually, without AI-driven tools. These tasks may have included keyword research, content optimization, search rankings optimization, website performance analysis, or technical SEO adjustments.

APPENDIX B. Summary of t-test results

T-Test

[DataSet2]

Group Statistics

	IV	N	Mean	Std. Deviation	Std. Error Mean
Efficiency Mean	0	63	7.0181405896	1.2452654413	.15688869877
	1	65	7.2285714286	1.3840840926	.17167450308

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
Efficiency Mean	Equal variances assumed	1.159	.284	-.903	126	.184	.368	-.2104308390	.23295038346	-.6714327996	.25057112159
	Equal variances not assumed			-.905	125.315	.184	.367	-.2104308390	.23256439712	-.6706933520	.24983167403

Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate	95% Confidence Interval Lower	Upper
Efficiency Mean	Cohen's d	1.3176054966	-.160	-.506	.188
	Hedges' correction	1.3255137698	-.159	-.503	.187
	Glass's delta	1.3840840926	-.152	-.499	.196

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control (i.e., the second) group.

T-Test

Group Statistics

	IV	N	Mean	Std. Deviation	Std. Error Mean
Productivity Mean	0	63	6.4722	1.36644	.17216
	1	65	7.0269	1.41844	.17594

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance		Mean	Std. Error	95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Difference	Difference	Lower	Upper
Productivity Mean	Equal variances assumed	.338	.562	-2.252	126	.013	.026	-.55470	.24630	-1.04211	-.06729
	Equal variances not assumed			-2.253	125.996	.013	.026	-.55470	.24615	-1.04183	-.06757

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Productivity Mean	Cohen's d	1.39309	-.398	-.747	-.047
	Hedges' correction	1.40145	-.396	-.743	-.047
	Glass's delta	1.41844	-.391	-.743	-.037

a. The denominator used in estimating the effect sizes.
Cohen's d uses the pooled standard deviation.
Hedges' correction uses the pooled standard deviation, plus a correction factor.
Glass's delta uses the sample standard deviation of the control (i.e., the second) group.

APPENDIX D. Moderator Efficiency and Productivity - Regression result (Model 4)

```
OUTCOME VARIABLE:
 EthMean

Model Summary
         R       R-sq        MSE          F        df1        df2          p
      .0829      .0069     3.5753      .8722     1.0000   126.0000      .3521

Model
             coeff         se          t          p       LLCI       ULCI
constant    4.6032      .2382    19.3228      .0000     4.1317     5.0746
IV           .3122      .3343      .9339      .3521     -.3494      .9738

**************************************************************************
OUTCOME VARIABLE:
 ProMean

Model Summary
         R       R-sq        MSE          F        df1        df2          p
      .4196      .1760     1.6767    13.3534     2.0000   125.0000      .0000

Model
             coeff         se          t          p       LLCI       ULCI
constant    5.1903      .3248    15.9810      .0000     4.5475     5.8331
IV           .4678      .2297     2.0362      .0438      .0131      .9224
EthMean      .2785      .0610     4.5647      .0000      .1577      .3992


****************** DIRECT AND INDIRECT EFFECTS OF X ON Y ******************

Direct effect of X on Y
    Effect         se          t          p       LLCI       ULCI
     .4678      .2297     2.0362      .0438      .0131      .9224

Indirect effect(s) of X on Y:
           Effect     BootSE   BootLLCI   BootULCI
EthMean     .0869      .0994     -.0960      .2995
```

```
OUTCOME VARIABLE:
 EthMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0829      .0069     3.5753      .8722     1.0000   126.0000      .3521

Model
              coeff         se          t          p       LLCI       ULCI
constant     4.6032      .2382    19.3228      .0000     4.1317     5.0746
IV            .3122      .3343      .9339      .3521     -.3494      .9738

**************************************************************************
OUTCOME VARIABLE:
 EfMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2898      .0840     1.6134     5.7315     2.0000   125.0000      .0042

Model
              coeff         se          t          p       LLCI       ULCI
constant     6.1219      .3186    19.2161      .0000     5.4914     6.7524
IV            .1496      .2253      .6641      .5079     -.2963      .5956
EthMean       .1947      .0598     3.2535      .0015      .0763      .3131


****************** DIRECT AND INDIRECT EFFECTS OF X ON Y ******************

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI
      .1496      .2253      .6641      .5079     -.2963      .5956

Indirect effect(s) of X on Y:
            Effect     BootSE   BootLLCI   BootULCI
EthMean      .0608      .0727     -.0618      .2328


 OUTCOME VARIABLE:
  FearMean

 Model Summary
          R       R-sq        MSE          F        df1        df2          p
       .0742      .0055     5.0680      .6978     1.0000   126.0000      .4051

 Model
              coeff         se          t          p       LLCI       ULCI
 constant     4.5556      .2836    16.0617      .0000     3.9943     5.1168
 IV           -.3325      .3980     -.8353      .4051    -1.1201      .4552

 **************************************************************************
 OUTCOME VARIABLE:
  EfMean

 Model Summary
          R       R-sq        MSE          F        df1        df2          p
       .0994      .0099     1.7439      .6238     2.0000   125.0000      .5376

 Model
              coeff         se          t          p       LLCI       ULCI
 constant     6.8611      .2904    23.6229      .0000     6.2863     7.4359
 IV            .2219      .2341      .9478      .3451     -.2415      .6852
 FearMean      .0345      .0523      .6597      .5107     -.0690      .1379


 ****************** DIRECT AND INDIRECT EFFECTS OF X ON Y ******************

 Direct effect of X on Y
      Effect         se          t          p       LLCI       ULCI
       .2219      .2341      .9478      .3451     -.2415      .6852

 Indirect effect(s) of X on Y:
             Effect     BootSE   BootLLCI   BootULCI
 FearMean    -.0115      .0290     -.0862      .0366
```

```
OUTCOME VARIABLE:
 FearMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .0742      .0055     5.0680      .6978     1.0000   126.0000      .4051

Model
              coeff         se          t          p       LLCI       ULCI
constant     4.5556      .2836    16.0617      .0000     3.9943     5.1168
IV           -.3325      .3980     -.8353      .4051    -1.1201      .4552

**************************************************************************
OUTCOME VARIABLE:
 ProMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .1967      .0387     1.9562     2.5160     2.0000   125.0000      .0849

Model
              coeff         se          t          p       LLCI       ULCI
constant     6.4721      .3076    21.0395      .0000     5.8633     7.0809
IV            .5547      .2480     2.2371      .0271      .0640     1.0455
FearMean      .0000      .0553      .0005      .9996     -.1095      .1096


****************** DIRECT AND INDIRECT EFFECTS OF X ON Y ******************

Direct effect of X on Y
     Effect         se          t          p       LLCI       ULCI
      .5547      .2480     2.2371      .0271      .0640     1.0455

Indirect effect(s) of X on Y:
            Effect     BootSE   BootLLCI   BootULCI
FearMean      .0000      .0260     -.0566      .0562
```

APPENDIX D. Mediator Level of Knowledge - Regression result (Model 1)

```
Model  : 1
    Y  : EfMean
    X  : IV
    W  : LevelKn

Sample
Size:  128

**************************************************************************
OUTCOME VARIABLE:
 EfMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2612      .0682     1.6543     3.0275     3.0000   124.0000      .0321

Model
             coeff         se          t          p       LLCI       ULCI
constant    5.8026      .8705     6.6657      .0000     4.0796     7.5255
IV          -.6285     1.2097     -.5196      .6043    -3.0228     1.7658
LevelKn      .2957      .2080     1.4212      .1578     -.1161      .7075
Int_1        .1899      .2851      .6662      .5065     -.3744      .7542

Product terms key:
 Int_1    :        IV       x        LevelKn

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      .0033      .4438     1.0000   124.0000      .5065

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000


Model  : 1
    Y  : ProMean
    X  : IV
    W  : LevelKn

Sample
Size:  128

**************************************************************************
OUTCOME VARIABLE:
 ProMean

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3108      .0966     1.8532     4.4209     3.0000   124.0000      .0055

Model
             coeff         se          t          p       LLCI       ULCI
constant    4.9186      .9213     5.3385      .0000     3.0950     6.7422
IV           .1555     1.2803      .1215      .9035    -2.3786     2.6897
LevelKn      .3779      .2202     1.7163      .0886     -.0579      .8137
Int_1        .0837      .3017      .2773      .7820     -.5136      .6809

Product terms key:
 Int_1    :        IV       x        LevelKn

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      .0006      .0769     1.0000   124.0000      .7820

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000
```

APPENDIX E: Effects of Demographic Variables On Efficiency And Productivity - Regression result (Model 1)

```
OUTCOME VARIABLE:
 EffMEAN

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3070      .0943     1.6775     1.4568     8.0000   112.0000      .1811

Model
             coeff         se          t          p       LLCI       ULCI
constant    4.9187     1.1646     4.2235      .0000     2.6112     7.2263
IV          -.5454     1.3570     -.4019      .6885    -3.2342     2.1434
KnowAI       .2155      .2481      .8686      .3869     -.2760      .7070
Int_1        .1857      .3180      .5838      .5605     -.4445      .8158
Age          .0266      .0186     1.4323      .1548     -.0102      .0634
Gender       .0364      .2493      .1460      .8842     -.4576      .5304
EdLevel      .1065      .1598      .6660      .5068     -.2103      .4232
JobRole      .0083      .1121      .0737      .9414     -.2139      .2305
Years       -.0158      .1447     -.1089      .9135     -.3025      .2710

Product terms key:
 Int_1    :        IV       x        KnowAI

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      .0028      .3408     1.0000   112.0000      .5605

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000
```

```
OUTCOME VARIABLE:
 ProMEAN

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .3505      .1228     1.8026     1.9607     8.0000   112.0000      .0579

Model
             coeff         se          t          p       LLCI       ULCI
constant    4.1638     1.2073     3.4489      .0008     1.7717     6.5558
IV           .0680     1.4067      .0483      .9615    -2.7193     2.8552
KnowAI       .2234      .2571      .8689      .3868     -.2861      .7329
Int_1        .1123      .3297      .3408      .7339     -.5409      .7656
Age          .0171      .0193      .8895      .3757     -.0210      .0553
Gender       .0718      .2584      .2780      .7816     -.4402      .5839
EdLevel      .1590      .1657      .9594      .3394     -.1694      .4873
JobRole      .1034      .1162      .8892      .3758     -.1270      .3337
Years        .0077      .1500      .0514      .9591     -.2896      .3050

Product terms key:
 Int_1    :        IV       x        KnowAI

Test(s) of highest order unconditional interaction(s):
       R2-chng          F        df1        df2          p
X*W      .0009      .1161     1.0000   112.0000      .7339

************************ ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output:
  95.0000
```

APPENDIX F: Use of Generative AI Tools During the Research Process

Tasks	**NO, I did not use genAI**	**YES, I did use genAI**	**genAI Tools**
Better understand issues related to the research		✔	ChatGPT
Summarizing text from bibliography / resources		✔	ChatGPT
Summarizing the method(s) used			
Translating text		✔	ChatGPT
Grammar check		✔	ChatGPT
Paraphrase or rewriting text from other people / resources		✔	ChatGPT
Coding in R, Python, etc.			
Get help on a software			
Creating and editing images, maps, videos, etc.			
Data analysis			
Other (please, state the task(s) and tool(s))			

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