

Effective Knowledge Creation and Transfer in e-Learning Using SECI Model

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Abstract: With the growing use of e-learning in corporate environments, it is essential to explore its potential and limitations in the context of effective knowledge management. This study investigates how online courses facilitate the creation and transfer of explicit and tacit knowledge, employing the SECI (Socialization, Externalization, Combination, and Internalization) model as a theoretical framework. Based on exploratory interviews with e-learning designers conducted in early 2025, the study reveals that each SECI phase requires different strategies and tools. In the socialization phase, "learning by interacting" is key. Online interactions must be thoughtfully designed and moderated, as the lack of spontaneous dialogue can reduce learning effectiveness. In the externalization phase, "learning by exchanging" is essential, yet can be hindered by limited incentives, LMS constraints, and the absence of open environments for knowledge sharing. Including motivators like graded forum activity can help. The combination phase emphasizes "learning by creating," but assessing creativity online—especially in large courses—is challenging. This can be addressed through collaborative tasks and AI-supported feedback. The internalization phase focuses on "learning by doing," requiring opportunities for practical application, such as XR simulations or prototype development. A key insight is that the main barrier to applying the SECI model in e-learning is not technology itself, but limited instructional design expertise. Technology should support, not drive, the learning process. These findings offer practical guidance for trainers, instructional designers, HR specialists, and leaders aiming to improve e-learning strategies for knowledge management.

Keywords: e-Learning, Online learning, Knowledge management, SECI model, Instructional design

1. Introduction

E-learning refers to the use of digital technologies and internet-based resources to deliver educational content, support interaction, and facilitate learning processes independent of time and location (Garrison 2003; Moore et al, 2011). The global corporate e-learning market size is calculated at USD 10.20 billion in 2025 and is forecasted to reach around USD 14.63 billion by 2034, accelerating at a Compound Annual Growth Rate (CAGR) of 4.09% from 2025 to 2034 (Precedence Research 2024). An increasing number of organizations worldwide are adopting e-learning as a strategic tool for employee training, driven not only by the need to reduce training costs but also by the demand for greater flexibility in terms of time and location. E-learning enables scalable and consistent delivery of content, making it particularly effective for training geographically dispersed teams operating across different institutions, regions, or even countries. Moreover, it facilitates access to high-quality instructors and educational materials (Wysłocka 2015, Strother 2002, Woźniak-Zapór 2013), which traditional training methods may not consistently provide. Several factors contribute to this growing trend, including increased employee mobility, the prevalence of remote and hybrid work arrangements, broader societal acceptance of digital technologies (Koderi and Kesuma 2023) and the rapid adoption of artificial intelligence, which can significantly improve the quality of remote learning through personalized learning, adaptive assessment and intelligent tutoring (Pattnayak 2017). For this reason, e-learning has become a common component of corporate training programs (Grabania-Mukerji 2011). Companies recognize e-learning as a tool for employee development, increasing productivity (Czarnecka 2015) and the COVID-19 pandemic has only accelerated its implementation (Milic et al 2020, Gamage et al 2022).

Meanwhile, the use of e-learning goes beyond just a tool to support the acquisition of employees' knowledge and skills. In combination with an integrated online learning environment, it has the potential to support knowledge management processes, including creation and transfer of knowledge within an organization. However, accomplishing this requires diagnosing how e-learning can support those processes, as well as identifying specific areas where barriers exist and determining effective strategies to overcome them. Though limited, recent studies increasingly highlight e-learning's potential to support organizational knowledge management (KM). Integrated e-learning significantly enhances knowledge management and positively influences innovation performance (Lau & Tsui 2009, Oloruntoyin 2020, Zahari et al 2024). By combining e-learning platforms with knowledge management practices, organizations can capture, organize, and distribute both training content and organizational knowledge more effectively. E-learning enables organizations to systematically record, store, and archive valuable knowledge, ensuring its accessibility for future use. An online

learning environment facilitates the efficient dissemination of information across diverse organizational levels, departments, and geographical locations. Additionally, online analytics and assessment tools enable managers to evaluate the effectiveness of their training initiatives, measure knowledge retention, and adjust content to meet evolving organizational needs (Derouin et al 2005). Also artificial intelligence can revolutionize e-learning, but collaboration between educators, learners, and technology developers—as well as attention to ethical and pedagogical aspects—is essential (Tanjga 2023). Recent studies highlight that e-learning has become a powerful medium for disseminating knowledge, stimulating innovation, and enhancing organizational intelligence (Soltani et al 2019).

Although research on e-learning continues to grow, a notable gap remains regarding how it specifically supports KM processes within organizations. The above gap has widened even further in recent times, due to the rapid development of AI. Our research contributes to the discussion on knowledge capture, transfer, and development processes, particularly in the context of courses and e-learning platforms, which are becoming increasingly significant tools in organizational knowledge management strategies. In particular, we aimed to demonstrate how online courses facilitate the creation and transfer of both explicit and tacit knowledge. The perspective taken behind the SECI model allowed the identification of key learning phases along with a set of tools and best practices that can be effectively implemented in an online environment. They also made suggestions for AI-based tools. Additionally, we identified significant barriers and challenges that can hinder participants' acquisition of knowledge. The findings offer insights into knowledge conversion and practical guidance for managers.

2. Literature Review

2.1 E-Learning and SECI Model in Knowledge Management

Numerous definitions of Knowledge Management (KM) can be found in the literature. This study adopts the perspective that KM is a systematic process of acquiring, sharing, and effectively utilizing knowledge to achieve an organization's strategic goals, while recognizing that continuous innovation emerges from the dynamic interplay between tacit and explicit knowledge (Davenport & Prusak 1998, Nonaka & Takeuchi 1995); these form the theoretical framework for this research.

One of the key theories in knowledge management is the SECI spiral model, which explains the processes of knowledge creation and transfer within organizations through the dynamic interaction between tacit and explicit knowledge (Nonaka & Takeuchi 1995). Importantly, these modes do not represent a one-time sequence; rather, each cycle builds on the previous one, allowing knowledge to evolve and deepen through a spiral process that leads to increasingly sophisticated levels of understanding (Nonaka, Toyama, & Konno 2000). The first phase – Socialization – refers to the process of transferring tacit knowledge through shared experiences, observation, imitation, and informal interaction. Externalisation is the process of converting tacit knowledge - personal, context-specific, and hard to formalize - into explicit knowledge that can be communicated and shared with others. Combination constitutes the process of synthesizing and systematizing different pieces of explicit knowledge into more complex and organized sets of information. Finally, Internalisation describes how tacit knowledge is created from explicit knowledge.

Despite its wide application in organizational contexts, there are relatively few studies focusing on the adaptation of the SECI model in e-learning environments. However, several works suggest that its application is both feasible and beneficial. Research indicates that e-learning can effectively support all four SECI processes (Wenhua & Fuhsu 2011, Ahmad et al 2012, Romadhon et al 2022). Empirical evidence further suggests that implementing SECI-based strategies in e-learning environments can enhance cognitive, affective, and psychomotor domains of learners, leading to improved overall educational outcomes (Prasetya & Taroreh 2018).

The SECI model has been applied to evaluate e-learning effectiveness, enhance knowledge management in online environments (Wenhua & Fuhsu 2011, Haag & Duan, 2011), and is increasingly recognized as a suitable framework for analyzing such processes in e-learning systems (Romadhon et al 2022). Moreover, specific metrics and frameworks have been developed to detect and measure SECI processes in virtual environments, enabling more systematic implementation and assessment (Battistoni et al 2011, Luoma et al 2008).

One study highlights that e-learning can foster collective knowledge creation by enabling interaction and collaboration, helping turn tacit knowledge into explicit (Kasem et al., 2015). Researchers have also proposed adaptations of the model, such as the EC-I framework, to better align with individual knowledge development in online learning. The framework focuses on the processes of Externalisation and Combination and the outcomes of Internalisation while excluding Socialisation as less relevant in the online context (Haag & Duan,

2012). Nonetheless, it has become evident since the COVID-19 pandemic that under some conditions, socialisation in e-learning environments is possible. Jihan & Kantola (2012) present a framework of hybrid e-learning, focusing on four key activities: Absorb (acquiring knowledge), Do (practical application), Connect (linking new knowledge with prior experience), and Create (generating new solutions). It should be noted, however, that the proposed categorization is not exhaustive; the selected activities are illustrative rather than comprehensive.

Although the scientific literature provides a few isolated references to the potential use of the SECI model for knowledge management in e-learning, many aspects remain unexplored and insufficiently defined. In particular, there is a noticeable lack of clarity regarding the conditions necessary for the model to function effectively in real online environments. As a result, e-course designers often lack insights into how to plan e-learning experiences that effectively support knowledge creation and transfer processes within companies or institutions. Common barriers also need to be clearly identified, along with practical strategies to overcome them. It is also essential to define structured instructional design recommendations to guide the effective integration of the SECI model into e-learning contexts.

3. Methodology

In our paper, we refer to the results of a study aimed at answering the following research question: how can the SECI model be applied in e-learning design for effective use of both tacit and explicit knowledge in an organization? Our intention was to assess the applicability of the SECI model to e-learning and primarily to explore how the various phases of the model can be effectively implemented in online environments. Additionally, we aimed to identify the primary tools and technologies supporting each phase and to pinpoint the issues and challenges associated with their implementation.

To answer the research question posed, we conducted an exploratory qualitative study. The sampling was purposive and based on typical cases. E-learning course designers were selected for the study, with the main criteria for sample selection being their experience in developing e-learning courses, including years of experience, the number, and type of courses they had designed. The study was conducted in the first quarter of 2025 and included three employees from the Faculty of Management and Economics at Gdańsk University of Technology. Respondents were experienced academic e-learning designers, each with 4–10+ years of experience, specializing in management, programming, and finance, and having designed between 5 and over 10 online courses. The study was based on in-depth, semi-structured personal interviews based on three thematic areas: 1) Conditions for the implementation of each phase of the SECI model, 2) Barriers to implementing a phase of the SECI model, and 3) Directions for developing the SECI model in e-learning. The interviews lasted an average of 70 minutes, and respondents were entitled to confidentiality and anonymity. The primary technique for data analysis and interpretation was conventional qualitative content analysis (Hsieh & Shannon 2005). During this analysis, three main thematic axes emerged within each phase discussed: the key resources and tools, barriers and methods for overcoming them. Then, within these categories, we identified even lower subcategories that allowed us to better understand the specifics of each phase and the conditions that must be met to make the learning process as effective as possible. Due to the nature of these phases and the KM processes occurring in it, we characterized each phase according to the dominant form of learning that came out of the research. Thus, the first phase, Socialization, is based on *learning through interaction*, which occurs between participants during e-learning. Externalisation is a phase that relies mainly on knowledge sharing, which promotes *Learning by Exchanging*. The third phase, Combination, is related to *learning through creativity*, while the fourth phase favours *learning through doing*.

4. Results

Socialization refers to the process of sharing tacit knowledge through common experiences, observation, imitation, and informal interactions. In traditional environments, this typically occurs through direct interpersonal contact, such as mentoring, informal group work and spontaneous face-to-face discussions. In e-learning contexts, however, Socialisation presents a greater challenge due to the lack of physical presence and informal meetings. The key activity that stimulates knowledge transfer in this phase is defined as *Learning by Interacting*. Interaction is a key element of meaningful learning, especially in online environments where traditional face-to-face communication is absent. As our research has shown, some foundational conditions for fostering this process are relatively straightforward to implement, like enabling students to exchange perspectives and engage in reflective dialogue (Tab. 1). In well-designed online courses, interaction can take various forms, including peer-to-peer discussions, collaborative tasks and participation in online communities.

The findings suggest that, despite the availability of digital tools, meaningful interaction in online learning encounters several significant barriers. One major challenge is the difficulty in building natural, spontaneous interactions that typically occur in face-to-face settings. The absence of informal spaces and unplanned conversations often leads to a sense of isolation among learners. Additionally, students may feel reluctant to share ideas publicly due to fear of negative evaluation, especially on discussion forums. Another barrier is the generally low motivation for online teamwork, which can result in passive participation or uneven task distribution. These issues are typically exacerbated when learners are unfamiliar with each other, or when there is no active facilitation from the instructor to encourage trust and engagement within the group. To address the challenge of limited spontaneous conversations and interactions, one effective strategy is to create informal communication spaces, such as dedicated chat channels on platforms like Discord, Slack, or MS Teams. This allows spontaneous conversations and peer interactions to emerge naturally. Virtual co-working spaces can simulate the sense of presence and encourage casual encounters that often lead to the exchange of tacit knowledge. To ease initial interactions and reduce social barriers, icebreakers, interactive activities and rotating small group tasks can help learners become more comfortable and engaged. Additionally, providing structured opportunities for peer feedback and personal introductions supports a sense of belonging. To address learners' fear of judgment, the use of moderated discussion forums, anonymous Q&A features, and collaboratively developed team norms can cultivate a psychologically safe environment. Sustaining motivation in online teamwork can be achieved by forming small teams with clearly defined roles, integrating gamification elements, and designing long-term projects tied to real-world outcomes. Regular monitoring of progress also reinforces commitment and accountability, further enhancing the socialization process in virtual learning contexts.

Externalization is the process of transforming tacit knowledge into explicit knowledge that can be expressed, communicated, and shared with others. In traditional learning environments, this process often occurs through discussions, presentations, and written work, where learners articulate their understanding and make it accessible to their peers and instructors. This not only supports individual cognitive development but also contributes to the collective creation of knowledge. A key activity supporting this phase in e-learning is *Learning by Exchanging*, which emphasizes the importance of mutual engagement in transforming explicit knowledge into tacit understanding. Our research has revealed that in online learning environments, this process is facilitated through structured opportunities for learners to share insights, discuss interpretations, and collaboratively solve problems (Tab. 1). Some foundational conditions include the integration of communication tools—such as forums, chat functions, and video conferencing—within learning management systems, as well as the intentional design of collaborative activities that require critical thinking, knowledge sharing, and reflection. Research highlights that barriers in the externalization phase, such as difficulties importing data from external platforms, can hinder effective knowledge integration by limiting seamless aggregation and reducing the richness of shared content. Another common barrier is the lack of motivation to share knowledge, often stemming from limited incentives, unclear expectations, or the absence of a collaborative culture. Additionally, a lack of trust in peer-generated content can further impede knowledge exchange, as learners may question the credibility or accuracy of materials created by others, leading to reduced engagement. Addressing these issues is crucial for enabling meaningful knowledge transfer. To address common barriers in digital learning environments, various effective solutions can be implemented. For challenges related to importing data from external platforms, institutions can utilize tools that support automatic data synchronization, interoperability, and manual upload templates to streamline processes. When facing low motivation to share knowledge, strategies such as peer-to-peer teaching, graded contributions, and creating a culture of recognition can foster active participation. Establishing a shared and evolving knowledge base, along with peer feedback mechanisms, further encourages engagement. To overcome a lack of trust in peer-generated content, it is essential to implement clear evaluation criteria, assign content moderation roles, and use tagging or verification systems to ensure quality and credibility.

Combination is the process of organizing and integrating explicit knowledge to form more comprehensive understandings. In traditional learning, it occurs through tasks like group reports or projects that merge data and perspectives. Combination involves reconfiguring existing knowledge by sorting, adding, and connecting it in meaningful ways, often resulting in new documents, presentations, or models. In e-learning environments, Combination is closely aligned with process of *Learning by Creating*, where learners apply and synthesize knowledge through active, task-based engagement. From our research, we found that digital tools enable the facilitation of this integration through collaborative assignments, shared documents, and interactive projects (Tab. 1). Activities such as co-authoring reports, developing shared knowledge repositories, or designing user guides help learners reorganize and expand upon previously acquired knowledge. When structured effectively, these tasks can foster deeper understanding and enable the collective construction of new knowledge products.

The findings demonstrate that the combination phase in e-learning faces notable challenges, particularly in assessing learners' creativity and originality in open-ended or exploratory tasks. This challenge is amplified in large-scale online courses, where scalability issues limit the instructor's ability to provide personalized feedback or closely monitor individual contributions. Furthermore, organizing group work in online settings often proves problematic, as learners may struggle with coordinating schedules, dividing responsibilities, and maintaining consistent communication. To address these challenges, a proposition of possible solutions have been identified. Designing group tasks with staged or milestone-based assessments can improve the structure and monitor progress over time, making evaluation more manageable and transparent. Utilizing collaborative editing tools - such as cloud-based document sharing platforms with version tracking - supports real-time and rotational contributions, fostering a more seamless integration of individual efforts. Another effective strategy involves encouraging learners to create user-facing materials such as tutorials, guides, or handbooks, which naturally promote synthesis and application of explicit knowledge in a practical, useful format. Finally, supporting assessment with AI-assisted tools can enhance scalability by automating part of the evaluation process (e.g., detecting redundancy, structure, grammar, or originality), thereby allowing instructors to focus on qualitative aspects such as creativity and critical thinking.

Internalization is the stage of the SECI model that explains how explicit knowledge is transformed into tacit knowledge. Traditional learning environments focus on individuals absorbing and embodying explicit knowledge, such as documents, manuals, or online courses, and transforming it into tacit knowledge through practice, reflection, and experience. A key activity supporting the Internalization phase within the SECI model in e-learning is *Learning by Doing*, which focuses on active engagement and practice. Our research has indicated that in online learning environments, this involves applying theoretical knowledge in practical contexts such as simulations, interactive exercises, case studies, or real-world projects (Tab. 1). These activities help learners internalize concepts by experiencing them firsthand, allowing knowledge to be absorbed through a combination of action and reflection. Foundational conditions for effective learning by doing include well-designed digital tasks that mimic real-life scenarios, clear feedback mechanisms, and opportunities for self-assessment. This experiential approach ensures that knowledge becomes embedded in the learner's own cognitive framework, enhancing both retention and the ability to apply skills in future situations. A significant barrier in the Internalization phase of the SECI model is limited personalized feedback, which prevents learners from adequately reflecting on and assimilating new knowledge. Without personalized guidance and constructive critique, learners may struggle to fully internalize complex concepts, resulting in superficial understanding. Additionally, technical and cost-related difficulties in providing practical experiments and simulations further impede experiential learning. To overcome these barriers, educational practitioners can adopt targeted strategies such as AI-supported evaluation systems, structured peer-review activities, and regular online mentoring sessions. These solutions ensure that learners receive timely, individualized, and meaningful feedback. Practical challenges related to cost and technology can be effectively addressed through leveraging ready-made simulation platforms, integrating comprehensive case study-based assignments, and utilizing virtual laboratory environments, interactive STEM simulation tools, and augmented or virtual reality educational platforms.

Table 1: Implementation conditions, barriers, and solutions in each phase of the SECI model

Phase	Resources and tools	Barriers	Solutions
Socialisation: <i>Learning by Interacting</i>	Team communication tools Video conferencing platforms Collaborative tools Platforms for sharing personal profiles	Lack of spontaneous conversations and interactions	Informal chat channels Virtual co-working spaces Icebreakers Rotating small group work Peer feedback Personal introductions
	Discussion forums Interactive tools for live quizzes	Fear of being judged	Moderated discussions Anonymous Q&A and feedback Co-created team norm
		Short-lasting motivation for online teamwork	Small groups with clear roles Gamification elements Regular progress monitoring

Phase	Resources and tools	Barriers	Solutions
			Long-term projects with real-world outcomes
Externalisation: <i>Learning by Exchanging</i>	Collaboration forums Shared spreadsheets Blogs and reflective journals Platforms with breakout rooms Mind-mapping tools Data transformation tools Online presentations Video/audio recording tools Peer feedback platforms	Difficulty importing data from external platforms and tools	API-based integration tools, Automatic data synchronization, Platforms that support interoperability, Manual upload templates
		Low motivation to share knowledge	Graded contributions Peer-to-peer teaching Culture of recognition and sharing
		Lack of trust in peer-generated content	Clear evaluation criteria Content validation tools Moderators or content curators Tagging and verification systems
Combination: <i>Learning by Creating</i>	Project management platforms Collaborative documentation tools Visualization tools Video production editors Shared knowledge base	Difficulties in assessing creativity	Designing group tasks with staged assessment Creative portfolios
		Challenges with multi-user evaluation	Collaborative document editing AI-supported evaluation Rubrics based assessment
		Problems with self-organization of online teamwork	Creation of guides and instructions Contribution tracking systems Partially AI-assisted evaluation
Internalisation: <i>Learning by Doing</i>	Virtual laboratories STEM simulation platforms Video conferencing platforms Interactive prototyping apps Peer evaluation tools	Limited personalised feedback	AI-supported evaluation Peer-review Online mentoring sessions
		Technical and cost difficulties in providing experiments and simulations	Ready-made simulation platforms Case study-based assignments

Source: Authors

The key findings of the study are mapped in the figure below (Figure 1), further distinguishing a set of desirable resources, tools, and activities common to all phases analysed.

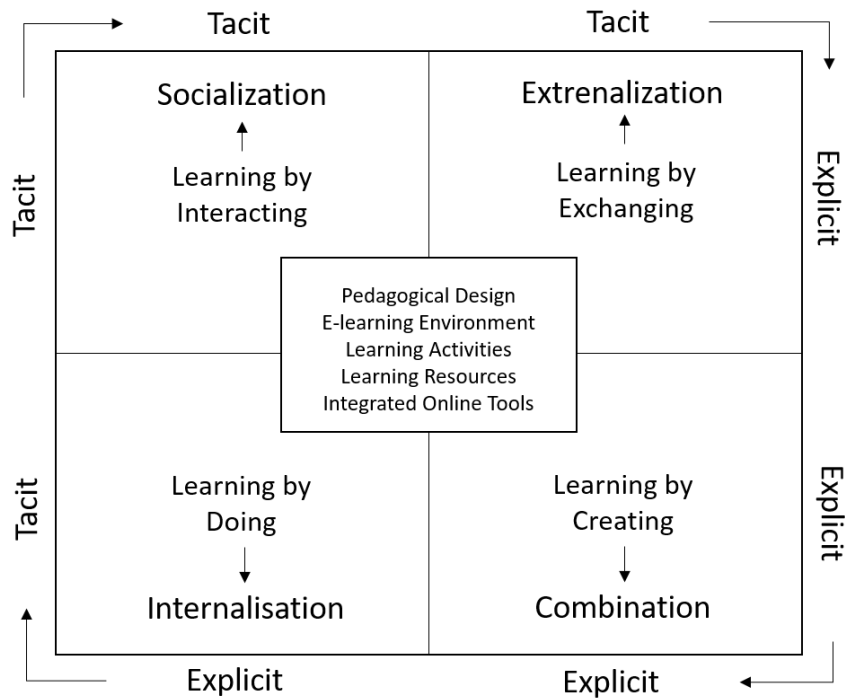


Figure 1: SECI Model for E-learning. Source: Authors elaboration

5. Conclusions and Discussion

Our research expands the existing understanding of KM processes within e-learning environments. It integrates themes related to the explicit and tacit conversion of knowledge while examining e-learning through the lens of various learning modalities. By bridging these perspectives, our study provides a more comprehensive view of how knowledge is created, shared, and internalized in digital learning contexts. Furthermore, it explores the dynamic interplay between formal and informal learning processes, emphasizing the role of technology in facilitating knowledge transfer and collaboration. Through this multidimensional approach, our findings contribute to both theoretical discussions and practical applications in the field of e-learning and knowledge management. Our research also carries significant practical implications. The framework adopted from the SECI model has identified key phases of the learning process, along with a set of tools and best practices that can be effectively implemented in online environments, among which were also tools based on AI. By systematically mapping these phases, our study provides actionable insights into how organizations can optimize knowledge conversion and dissemination in digital learning settings. By bridging theoretical models with practical applications, our research offers a valuable roadmap for educators, e-learning course designers, and managers seeking to enhance knowledge management strategies in digital education.

Our study represents an exploration of the designated area and, as such, creates a foundation for further, more in-depth research. Consequently, it has several limitations, including a small sample size, high contextual dependency, and limited research tools, which prevent broad generalizations. However, it provides valuable insights that can serve as a basis for future studies. Future research should focus on evaluating the effectiveness of the SECI model in e-learning environments. Importantly, future studies should also explore how emerging AI tools—including adaptive learning paths, AI-supported feedback systems, and AI-driven content generation—can enhance each phase of the SECI model, thereby advancing knowledge management in digital education. There is also a need to develop and test innovative didactic methods, experimenting with various instructional strategies tailored to the specific dynamics of online learning. Additionally, conducting case studies of SECI model implementation across various corporate sectors could provide valuable insights into its adaptability and impact in non-academic contexts. Such studies would contribute to a deeper understanding of how knowledge creation processes can be enhanced through e-learning across diverse organizational settings.

Ethics statement: Ethical clearance was not required for the research.

AI statement: AI (ChatGPT) was utilized to assist in refining grammar, enhancing language clarity, and improving overall readability. Authors confirm that AI tools did not contribute to generating the research data, analysis, or

core intellectual content presented herein. The final responsibility for the content and its accuracy rests solely with the author.

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