Research Article

# Collaborative Creativity in Remote Work Teams: A Network Analysis of Digital Brainstorming Sessions

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**Abstract**

The shift to remote work has transformed the way teams engage in creative processes, making digital collaboration tools central to brainstorming and innovation. This study aims to investigate the dynamics of collaborative creativity in remote work settings by analyzing patterns of interaction during digital brainstorming sessions. A mixed-methods network analysis approach was employed, combining social network analysis with qualitative content analysis to map communication structures and creative idea flow across 18 virtual teams composed of 162 participants from diverse professional backgrounds. Data were collected from 54 recorded online brainstorming sessions conducted over a period of three months. Results indicate that teams with more decentralized interaction networks and balanced participation demonstrated higher levels of creative idea generation and convergence. Findings further reveal that the quality of creative outputs is influenced not only by individual contributions but also by the connectivity and diversity of collaborative ties within the team. The study concludes that fostering inclusive and distributed patterns of interaction is key to enhancing creativity in virtual environments.

**Keywords:** Collaborative Creativity, Digital Brainstorming, Network Analysis

## INTRODUCTION

The evolution of work environments over the past decade has been shaped by technological advancements, global interconnectivity, and the rise of distributed teams (He et al., 2025; Schmitz, 2025). Remote collaboration has shifted from being a supplementary practice to becoming a primary mode of organizational functioning, particularly in creative and knowledge-intensive industries. The adoption of virtual communication platforms and digital brainstorming tools has created new possibilities for idea generation, while simultaneously presenting challenges for maintaining high levels of collaborative creativity. Virtual settings alter the social dynamics of interaction, reducing the presence of non-verbal cues and spontaneous dialogue that often stimulate creativity in co-located teams. These changes make it necessary to study the mechanisms by which creative collaboration unfolds in distributed contexts, where collaboration depends on the effective use of digital networks and tools.

The notion of creativity has traditionally been associated with face-to-face collaboration, where rich, immediate exchanges can enhance cognitive diversity and innovation. The widespread transition to remote work has compelled organizations to adapt brainstorming and creative problem-solving to digital platforms, which raises critical questions about how creativity is fostered and sustained in such settings (Khalilzadeh et al., 2025; Schmitz, 2025). Digital brainstorming allows geographically dispersed individuals to connect and share ideas, yet it introduces constraints such as time delays, limited social cues, and variations in participation. These factors raise concerns about whether the potential of collaborative creativity can be fully realized in virtual environments, particularly when compared to the informal, dynamic interactions that occur in physical workspaces.

The increasing reliance on distributed teams also coincides with an expanding emphasis on collaboration as a cornerstone of organizational performance. As digital collaboration becomes a defining feature of modern work, understanding how remote teams interact to generate ideas is essential (Bai et al., 2025; Narong, 2025). It is particularly relevant in the context of brainstorming, a process inherently dependent on interaction patterns, openness, and the exchange of diverse perspectives. This focus highlights the importance of examining not just individual creativity but also the collective processes that emerge from networked team interactions in digital environments.

The research problem addressed in this study centers on the limited understanding of collaborative creativity in remote work teams, especially regarding how network structures in digital brainstorming sessions shape creative outputs (Chen et al., 2025; Tang et al., 2025). Existing studies provide evidence of the value of collaboration for innovation, but these studies are often based on co-located teams where interaction patterns differ significantly from those in virtual environments. The transition to digital settings has changed the way ideas are exchanged, making traditional models of creative collaboration less applicable to current realities.

The specific challenge lies in identifying the characteristics of digital interactions that either enhance or hinder the creative process in remote teams. Many organizations have adopted virtual brainstorming tools without a comprehensive understanding of how these tools influence interaction structures, participation equity, and the development of creative ideas (Fontoura et al., 2025; Suta et al., 2025). These uncertainties necessitate a deeper investigation of the underlying mechanisms that drive creative collaboration in digital spaces.

The issue also involves recognizing that creativity in remote environments is not merely a function of technological tools but depends significantly on the nature of social connections among team members (Okuyama et al., 2025; Troy et al., 2025). Unequal participation, isolated communication clusters, and dominance by certain individuals are challenges that can prevent remote teams from reaching their full creative potential. A systematic exploration of these issues using a network perspective offers a way to uncover how collaborative creativity operates in distributed contexts.

The primary aim of this study is to investigate the patterns of interaction in remote work teams during digital brainstorming sessions and to analyze how these patterns contribute to collaborative creativity (Mohd Radzi et al., 2025; Roy & Vasa, 2025). The focus is on uncovering the ways in which decentralized communication structures, balanced participation, and diverse connections within a team influence the generation and convergence of creative ideas. The study seeks to map the flow of ideas through these networks, identify structural features that foster creative collaboration, and generate insights that can inform the design of effective remote brainstorming practices.

The research also aims to extend the theoretical understanding of collaborative creativity beyond traditional co-located team settings (Mavruk, 2025; Sabir et al., 2025). By analyzing data from real-world digital brainstorming sessions, the study aspires to contribute new knowledge about the dynamics of creative collaboration in virtual work environments. These insights are expected to offer actionable recommendations for teams and organizations that increasingly depend on remote collaboration for innovation and problem-solving.

The study intends to offer a framework that integrates network analysis with qualitative exploration of team interactions (De Bernardi & Annesi, 2025; Xu et al., 2025). This framework will allow the identification of critical factors, such as interaction frequency, communication balance, and relational diversity, that enable teams to maximize creative potential in digital environments. Such an approach positions this study to bridge the gap between theoretical models of collaboration and the practical realities of distributed creative work.

A review of existing literature reveals a significant gap in research addressing the structure of collaborative interactions in remote work settings (Chava et al., 2025; De Bernardi & Annesi, 2025). Although studies on creativity have established the importance of collaboration, most research has concentrated on the individual-level predictors of creativity or on in-person collaboration. Limited attention has been given to how network structures within digital brainstorming sessions affect the collective creative process.

Empirical studies that do examine virtual collaboration tend to focus on technology adoption, efficiency, or productivity outcomes rather than on creativity as an emergent property of distributed team networks. As a result, there is a lack of nuanced understanding of how the relational patterns of remote teams contribute to idea generation, idea elaboration, and innovation (De Bernardi & Annesi, 2025; Tian et al., 2025). This absence of evidence-based insights restricts organizations from optimizing their remote brainstorming practices in a way that enhances creativity.

The literature gap also pertains to the absence of integrated methodologies that combine network analysis with qualitative perspectives. Network analysis provides a structural view of interactions, but without a qualitative lens, the content and meaning of these interactions remain unexplored. This study addresses this methodological gap by incorporating both

perspectives, offering a more comprehensive understanding of how creative processes unfold in distributed teams.

The novelty of this study lies in its focus on the intersection between collaborative creativity, remote work, and network analysis (Chava et al., 2025; Tian et al., 2025). Unlike prior studies that treat creativity as a static outcome, this research explores creativity as an evolving, networked process shaped by digital communication structures. The study moves beyond traditional metrics of brainstorming success to analyze the relational patterns that enable or constrain innovation.

The justification for this research also stems from its relevance to contemporary organizational practices. With remote work becoming increasingly permanent across industries, there is a pressing need to identify strategies that foster creativity in distributed settings (Yang & Xiang, 2025; Zeng et al., 2025). Insights from this study will provide both theoretical contributions to the literature on team creativity and practical guidance for organizations aiming to design effective remote brainstorming environments.

The contribution is expected to extend beyond the immediate context of digital brainstorming by providing a transferable framework that organizations can use to enhance collaborative creativity in diverse virtual settings. By examining how structural features of networks influence the quality of creative outputs, this study positions itself to inform future innovations in virtual collaboration and the development of remote work practices that are more inclusive and creative.

## RESEARCH METHOD

This study employed a mixed-methods research design combining social network analysis and qualitative content analysis to examine collaborative creativity in remote work teams during digital brainstorming sessions (Chan et al., 2025; Zeng et al., 2025). The mixed-methods approach was selected to capture both structural patterns of interaction and the contextual meaning of creative exchanges. The design enabled the investigation of how communication networks influence creative idea generation and convergence while providing qualitative insights into the processes that underlie those patterns.

The research population comprised professionals from diverse fields including education, technology, design, and management who actively engage in virtual collaboration. Eighteen remote work teams were selected using purposive sampling based on their experience with digital brainstorming as part of organizational innovation projects. These teams involved a total of 162 participants distributed across different geographical locations, ensuring a wide range of perspectives and backgrounds. Each team participated in three online brainstorming sessions, resulting in a dataset that reflected varied communication styles and interaction structures.

Data were collected using multiple instruments to ensure comprehensive coverage of the research objectives (Chan et al., 2025; Tian et al., 2025). Digital recordings of brainstorming sessions served as the primary source for network data, enabling the identification of nodes and ties within interaction networks. Transcripts of these sessions were used for qualitative coding and content analysis of idea flow and interaction patterns. Supplementary instruments included a post-session survey to collect demographic information and participants' reflections on their collaboration experiences, as well as session logs generated by the digital collaboration platforms.

The research procedures involved four main stages. Initial orientation meetings were conducted to explain the purpose of the study, secure informed consent, and provide standardized guidelines for using digital brainstorming tools during the sessions. The second stage consisted of systematically recording three brainstorming sessions per team, each lasting 90 minutes, using uniform virtual collaboration platforms. The third stage included transcription, coding, and mapping of interaction data using specialized network analysis software to generate sociograms and calculate network measures such as density, centrality, and clustering (Li et al., 2025; Zhang et al., 2025). The final stage focused on thematic analysis of the qualitative data to interpret the patterns revealed by the network analysis, followed by triangulation of all data sources to strengthen the validity of findings.

## RESULTS AND DISCUSSION

The dataset comprised 54 digital brainstorming sessions conducted by 18 distributed teams consisting of 162 participants. Each session lasted 90 minutes and generated 243 hours of recorded interactions, which were transcribed for further analysis. Table 1 presents the descriptive statistics of participant distribution and key network metrics including network density, average degree centrality, and clustering coefficients across the three brainstorming sessions for each team. The table shows that teams with higher diversity of professional backgrounds displayed higher network density and more balanced participation.

**Table 1.** Summary of Network Metrics and Participant Composition Across Teams

| Team | Participants | Density | Avg. Degree Centrality | Clustering Coefficient | Ideas Generated |
|------|-------------|---------|------------------------|------------------------|-----------------|
| A1 | 9 | 0.62 | 4.3 | 0.58 | 47 |
| B3 | 10 | 0.68 | 5.1 | 0.61 | 54 |
| F5 | 8 | 0.49 | 3.6 | 0.52 | 32 |
| H2 | 10 | 0.71 | 5.6 | 0.65 | 58 |
| L7 | 9 | 0.56 | 4.1 | 0.54 | 41 |

Analysis of these metrics revealed that teams with a more decentralized communication structure and higher clustering coefficients exhibited higher levels of idea generation and a stronger capacity for refining and converging ideas. Qualitative examination of transcripts indicated that such teams relied on inclusive patterns of participation, where members took turns to contribute ideas and build on the suggestions of others. Teams with lower density and more centralized structures demonstrated fewer interactions outside dominant participants, which constrained the diversity of ideas.

The descriptive patterns from the data highlighted that 65% of the ideas proposed during the sessions originated from distributed interactions rather than dominant individuals. Sessions that encouraged balanced participation produced a wider variety of creative ideas, while sessions dominated by a few members generated repetitive or narrow solutions. Teams that employed collaborative tools effectively maintained continuous engagement, showing a steady pace of contributions throughout their sessions.

Inferential analysis revealed strong correlations between network density and the number of creative ideas generated ($r = 0.72$, $p < 0.01$). Regression models indicated that decentralization of communication was a significant predictor of idea diversity, accounting for 41% of the variance in the number of novel ideas. High clustering coefficients were associated

with improved elaboration of ideas, suggesting that subgroups within teams facilitated specialized exploration before reconverging with the broader team.

Examination of the relational aspects of the data demonstrated that cross-functional links between participants were critical for the emergence of innovative ideas. Teams with heterogeneous links connecting members from different professional backgrounds generated ideas that were more interdisciplinary in scope and richer in conceptual depth. These relational patterns suggest that network structures function as mechanisms for stimulating exposure to different knowledge domains.

A detailed case study of Team H2 illustrated the influence of decentralized interaction networks. This team achieved the highest density and clustering coefficients, with conversation patterns evenly distributed across participants. The team produced 58 unique ideas, of which 72% were co-developed by at least three members. The network analysis visualization revealed multiple overlapping clusters, indicating high connectivity and collaborative refinement.

A case study of Team F5 provided a contrasting picture with lower network density and centralized interaction dominated by two participants. This structure resulted in fewer novel ideas, with only 32 unique contributions and minimal collective development. The majority of ideas lacked refinement, and the discussion frequently returned to suggestions by the central figures, limiting collective creativity. Observations confirmed that the centralization reduced opportunities for balanced participation.

Explanations derived from the qualitative content analysis indicate that teams with distributed interaction networks foster an environment where members feel empowered to contribute and take risks with unconventional ideas. This sense of psychological safety enabled cross-pollination of ideas and rapid iterations during the sessions. Teams with centralized structures exhibited slower interaction cycles and less flexibility in exploring alternative solutions.

Short interpretation of these findings indicates that collaborative creativity in remote work teams depends strongly on the configuration of their interaction networks. Decentralized, diverse, and highly clustered structures support richer creative processes and generate a higher volume of innovative ideas. The evidence highlights that the way teams communicate virtually is as critical as the content of their interactions for the success of digital brainstorming sessions.

The findings of this study revealed that collaborative creativity in remote work teams is closely related to the structural properties of their interaction networks during digital brainstorming sessions. Decentralized and balanced networks were found to encourage the generation of a greater number of unique ideas and the refinement of those ideas through collective engagement. Teams that exhibited high network density and clustering coefficients demonstrated more distributed contributions, while those with centralized networks tended to produce fewer ideas that were less collaboratively developed. Patterns from case studies reinforced that inclusive participation and diversified connections significantly shaped the creative outcomes of distributed teams.

The results also show that interaction diversity and connectivity within a team predict the quality and innovativeness of ideas. Teams that sustained cross-functional interactions demonstrated stronger interdisciplinary perspectives, which contributed to the novelty and depth of creative solutions. These findings point to the central role of participation equity and distributed communication patterns as critical drivers of effective digital brainstorming,

supporting the view that collaboration networks rather than individual contributions define the creative process in virtual contexts.

These results align with prior research that highlights the positive influence of collaborative processes on team creativity, yet they also introduce new insights into the structural mechanisms that drive these processes in remote environments. Previous studies have examined creativity predominantly in face-to-face settings, where interpersonal dynamics are influenced by physical proximity, non-verbal cues, and spontaneous exchanges. This study expands on those findings by providing empirical evidence that similar outcomes can be achieved in digital environments through network configurations that replicate inclusivity and openness virtually.

Comparisons with earlier studies on digital collaboration suggest that while technology enables the collection and exchange of ideas, it does not, on its own, ensure creative outcomes. These findings contrast with research that has emphasized tools and platforms as primary determinants of success, instead showing that the structure and nature of interaction patterns carry more weight than the features of the tools themselves. The emphasis shifts from technology as a static enabler to team networks as dynamic and adaptive systems of creativity.

The results of this study indicate that the observed patterns are a sign of how collaborative creativity in remote environments is evolving into a network-driven process. The findings highlight that creativity is no longer a product of isolated contributions but a collective phenomenon shaped by the diversity and structure of interactions. These patterns represent an emerging paradigm in which virtual teams build innovation not by relying on individual excellence, but through distributed participation and the cross-fertilization of ideas across digital platforms.

The emergence of interdisciplinary and inclusive collaboration in virtual environments signals a change in organizational culture. Teams increasingly prioritize equitable participation and psychological safety as conditions for creative work, which was evident in the behaviors observed in high-performing groups. These results suggest that digital collaboration is redefining creativity as a process that depends on how people connect rather than where they work. The prominence of network properties demonstrates that distributed teams can achieve high-quality creative results when they adopt collaborative structures.

The findings mark a significant moment for rethinking the role of team structure in the digital era. Remote teams that succeed in fostering creativity tend to embrace openness, multiple perspectives, and flexible connections, creating an environment that resembles a digital ecosystem. These outcomes signal that remote collaboration can be a powerful tool for generating innovation when designed intentionally around participation equity and diversity. The evidence indicates a departure from traditional hierarchical models toward decentralized systems of creative work.

These findings demonstrate the potential for new forms of leadership and facilitation in digital collaboration. Team leaders and facilitators who encourage broad participation and manage interaction structures contribute to the conditions that foster creativity. The study therefore offers evidence that the success of remote collaboration depends less on formal authority and more on creating a structure that supports co-creation and equal contributions from all team members.

The implications of these findings are significant for organizations, researchers, and practitioners seeking to optimize creativity in distributed work environments. Organizations

can apply these insights to design digital brainstorming practices that emphasize inclusivity and network diversity, which, in turn, enhance the range and novelty of creative ideas. The study provides a foundation for creating structures that enable teams to collaborate more effectively across distances, suggesting that investment in building these structures will result in better creative outcomes.

Educational and organizational training programs can use these results to build competencies in managing digital brainstorming processes. By focusing on interaction structures and participatory practices, remote teams can overcome the constraints imposed by physical distance. These findings also highlight the potential to use social network analysis as a diagnostic tool for understanding and improving the quality of creative collaboration in virtual settings.

The broader significance of this research extends to the understanding of how technology-mediated collaboration can serve as a pathway to inclusive innovation. These findings underscore that creativity in distributed teams is not hindered by geography but by the patterns of communication and engagement. When teams create decentralized, highly connected networks, they enable a type of creative performance that is robust, diverse, and contextually adaptable. This evidence shows that virtual work environments can be as effective as physical ones in producing high-quality creative outcomes when structured appropriately.

Applications of these findings extend beyond brainstorming to include other collaborative practices in innovation-driven organizations. The network principles identified in this study may be relevant to virtual project management, product development, and strategic planning, where complex problem-solving requires creativity across distributed teams. The insights therefore contribute to a growing body of work emphasizing that digital collaboration can be designed to promote sustainable innovation.

The patterns observed in this study arise from the convergence of three main factors: diversity of expertise within teams, structured opportunities for balanced participation, and the use of feedback loops embedded in digital collaboration tools. Teams that integrate these elements create spaces where participants feel valued and motivated to contribute actively. The variety of perspectives generated by these practices broadens the collective understanding of problems and leads to richer, more innovative solutions.

The findings also reflect the importance of psychological safety in creating conditions for participation. When teams establish trust and openness, individuals feel empowered to share novel or unconventional ideas without fear of criticism. This cultural factor explains why decentralized networks consistently produced a higher number of creative contributions compared to more centralized teams.

The study further indicates that technology acts as a platform rather than a driver of creativity. While digital tools enable distributed collaboration, the structural properties of networks, such as density and clustering, define how effectively teams leverage these tools. These network configurations encourage frequent, multidirectional exchanges that stimulate iterative idea development and refinement.

The success of distributed teams in this study can be attributed to the interaction between relational diversity and the structural dynamics of their networks. When expertise from different disciplines and cultural contexts converges, creative solutions become more comprehensive and innovative. These findings support the assertion that remote teams can be as effective as co-located ones when the right structural and cultural conditions are met.

The findings highlight several opportunities for future research on collaborative creativity in remote work teams. Subsequent studies could explore longitudinal changes in network patterns as teams gain experience with digital brainstorming, examining how structural adjustments influence creative outcomes over time. Such research could reveal how relationships evolve and whether sustained collaboration leads to increased innovation in distributed settings.

Research in other industries and cultural contexts could expand the generalizability of these findings. Studies comparing global virtual teams across sectors such as healthcare, education, and technology could provide insights into how specific contextual factors interact with network patterns. These comparisons would be valuable in identifying strategies that are effective across different organizational environments.

Future studies could also integrate additional analytical tools, such as machine learning algorithms, to predict patterns of creative collaboration based on real-time data from digital platforms. Such approaches could allow teams to monitor their own collaborative structures and make adjustments during live sessions. This adaptive model of collaboration could significantly enhance the efficiency of remote brainstorming.

Practical steps that arise from this research involve the intentional design of virtual collaboration environments that support balanced interaction. Teams can implement structured facilitation, inclusive participation guidelines, and visualization tools that monitor interaction patterns during brainstorming sessions. By using these insights, organizations can transform distributed work from a necessity into a deliberate and effective method for fostering creativity.

## CONCLUSION

The most important finding of this study is the identification of decentralized and highly clustered interaction networks as a primary driver of collaborative creativity in remote teams during digital brainstorming sessions. Evidence showed that balanced participation, cross-functional links, and distributed contributions generate a larger number of unique ideas and encourage refinement through iterative collaboration. This result differs from traditional assumptions that virtual collaboration limits creative outcomes by demonstrating that well-structured interaction patterns can enable innovation comparable to or even greater than that of co-located teams.

The main contribution of this research lies in combining network analysis with qualitative content exploration to conceptualize collaborative creativity as a dynamic process shaped by interaction structures rather than static outputs. This integrative methodological approach offers a novel lens for understanding how communication density, clustering, and cross-disciplinary connections influence the creative performance of distributed teams. The study advances the conceptualization of creativity in digital contexts by positioning structural patterns as a central factor in explaining how ideas emerge and evolve in remote collaboration.

The scope of the study is limited to 18 teams within a three-month observation period, which restricts the ability to generalize results across industries and over longer collaboration cycles. Findings are also shaped by the specific digital tools used, which may differ from those in other organizational contexts. Future research should include longitudinal studies across a wider range of industries, comparative analyses between different virtual platforms, and the integration of additional analytical models such as machine learning to predict creative network dynamics in real-time.

## AUTHOR CONTRIBUTIONS

*Look this example below:*

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest

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