



The Role of Information and Communication Technology in Increasing Work Creativity through Transformational Leadership Between Generation X and Y Employees: A Bibliometric Analysis using Publish or Perish

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ARTICLE INFO

Article history:

Received 2 March 2024

Received in revised form 9 July 2024

Accepted 28 August 2024

Available online 20 September 2024

Keywords:

Bibliometric; Computational mapping analysis; Transformational leadership; VOSviewer

ABSTRACT

This study aims to examine the development of research on the role of information and communication technology in enhancing work creativity through transformational leadership among Generation X and Y employees using bibliometric approach with computational mapping analysis VOSviewer. The article data was obtained from the Google Scholar database using publish or perish reference manager application. The titles and abstract of the articles were used to guide the search process by referring to the keyword "Transformational Leadership". 957 articles were found that were considered relevant. The study period used as the study material is the Google Scholar indexed articles for the last 5 years (2018 to 2023). The results show that the role of information and communication technology in increasing work creativity through transformational leadership research can be separated into 3 terms: transformational leadership, communication, and creativity. The term "Transformational Leadership" is associated with 103 links with a total link strength of 3876. The term "Communication" has 35 links with a total link strength of 81 and the term "Creativity" has 49 links with a total link strength of 125. Results of the analysis of the role of information and communication technology in increasing work creativity through transformational leadership research in the last 5 years show quite frequent fluctuations. The number of studies declined from 176 in 2018 to 153 in 2019. Following that, it witnessed another severe fall in the last three years, with as many as 191 articles in 2021, 165 articles in 2022, and 51 pieces in 2023. We determined how many articles have been published on the role of information and communication technology in increasing work creativity through transformational leadership and its relation to problem areas using VOSviewer. This review can serve as a starting point for further related studies.

1. Introduction

Creativity in the workplace has become a crucial prerequisite to overcoming the changes and challenges in any industry [1-4]. With sufficient creativity, it will be easier for an organization to

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<https://doi.org/10.37934/araset.52.2.3556>

achieve its goals, especially in this current industrial world. Organizations need to elaborate on individual and organizational creativity with new ideas and innovation. Thus, creativity can improve performance and productivity.

A particular job characteristic or position may hamper creativity at work [5], and employees often feel there is no time for creativity, which management needs to reconsider, especially in the digital information and communication technology (ICT) industries [6-21,120]. Furthermore, the telecommunications sector, known for its rapid advancements and constant evolution, requires a workforce that can adapt and innovate to stay competitive. Understanding the differences in creative tendencies between Generation X and Y employees is essential for leaders in the telecommunications sector, as it enables them to leverage each generation's unique strengths and perspectives to foster a culture of innovation and creativity [22].

Enhancing and fostering creativity in the workplace may have some benefits. Employees are inspired to work together if they are creative, which promotes better teamwork. The creative process encourages collaboration. A unique idea can come from just one employee and then be formed by a team to become fully realized. Employees should be encouraged to seek information, knowledge, and new ways to do things. Embracing a continuous learning mindset will help businesses succeed [23]. Creativity also improves attracting and retaining the best employees. Employees are more loyal to a company when creativity is encouraged and more satisfied with their jobs [24]. Besides that, creativity may increase the ability to solve problems. Thinking creatively and outside the box allows employees to discover unique and innovative solutions to challenges. By eagerly solving problems, organizations can find creative ways to accomplish tasks and become more efficient [25]. Moreover, fostering creativity in the telecommunications sector can create a competitive advantage by enabling organizations to adapt swiftly to industry disruptions and capitalize on emerging opportunities. Also, an environment that encourages creativity cultivates a sense of empowerment among employees, fostering their intrinsic motivation and job satisfaction and positively impacting overall organizational performance.

In today's rapidly evolving telecommunications sector, where innovation is vital to success, the role of leadership in fostering creativity has garnered significant attention. Leading employees at the individual and team levels to be more creative means needing creative leaders [26]. Leadership may predict employee, team, and organizational creativity and innovation [27]. Many extensive studies on organizational behaviour have discussed creativity in the workplace, which may foster corporate innovation. Several factors determine creativity at work, such as leadership, organizational culture, job characteristics, and motivation [28]. Most studies affirm that leadership is positively related to creativity and affects corporate and individual creativity [29-32]. According to researchers, the most significant factor in enhancing employee creativity is leadership that focuses on transformational leadership, which emphasizes creativity and innovation [33]. Organizations' leaders must cultivate employees' creativity by understanding the relationship between transformational leadership and creativity. The effect of transformational leadership on motivation and creativity is significant in the communication sector nowadays [34]. Organizations in the telecommunications sector can drive innovation and stay ahead in the dynamic market by exploring the link between transformational leadership and creativity, unlocking their employees' full potential.

Nevertheless, an organization's leadership style may affect the creativity and performance of multigenerational employees [35-39], such as the differences between current Generation X and Generation Y. Generations are a group of people with the same year of birth, age, location, and historical experiences or events within the same individual, significantly influencing their growth phase [40]. So, it can also be said that a generation is a group of individuals who experience the same events during the same period [41]. The generation born between 1965 and 1980 is called Generation

X (currently between 42 and 57 years old), while the generation born between 1981 and 1995 is called Generation Y, or millennials (now between 26 and 41 years old). Each generation has some specific characteristics. Leaders looking to boost creativity in the workplace must understand the unique characteristics and preferences of Generation X and Y employees. These generational differences can impact their work approaches, communication styles, and motivations. By leveraging these employees' diverse perspectives and strengths, telecommunications organizations can create a collaborative and inclusive environment. It can help nurture creativity and drive innovation.

Generation X is the generation that was born in the early years of technological and information developments, such as the use of personal computers (PCs), video games, cable TV, and the internet. Generation X can adapt and accept change well enough to be an "awkward" generation. They are resourceful, independent, need emotional comfort, prefer something informal, and have business and trade skills compared to baby boomers. Meanwhile, Generation Y uses many instant communication technologies, like e-mail, SMS, and instant messaging. This is because Generation Y is the generation that grew up in the booming internet era. Generation Y is more open to political and economic views [42], so they appear to be very reactive to changes in the environment around them. They are more committed to the company. The job is one of the priorities, but not the top priority, like uncomplicated rules like openness and transparency. Team orientation is the focus at work. They also need feedback. The most significant characteristic difference between generations X and Y is mastery of information and technology. For Generation Y, the advances of ICT have become part of their lives because they were born where access to the internet has become a global culture that influences their values and views of their life goals. One thing that stands out in Generation Y is that they like something "out of the box." Those differences can affect the type of creativity at work, especially in the ICT industry.

PT Telkom Indonesia (Persero) Tbk, referred to as Telkom, is Indonesia's most crucial state-owned information and communication technology and telecommunications network. As a digital telecommunications company, Telkom develops a customer-oriented business strategy and operating plan to achieve this goal while enhancing its human resource capabilities. The enterprise has many divisions, including digital connectivity, digital platform and IT, digital service, sales, customer engagement, business strategy and development, finance, human capital, general affairs and support, corporate affairs, marketing, supply chain management, and internal audit. Here, it is the sales division of a company responsible for selling its products or services, which involves the collaboration of the sales team to increase sales, maintain customer relationships, and encourage repeat business through brand loyalty. A strong sales team increases revenue, develops long-term customer relationships, retains customers, and enhances overall business growth [43]. This research focuses on the sales division in PT Telkom Region III (West Java).

This study aims to identify the aspects of creativity at work and transformational leadership in the sales division in PT Telkom Region III (West Java), moderated by the differentiation of generations X and Y. This study also confirms the effect of transformational leadership on employees' creativity at the sales division. By examining the interaction between creativity, transformational leadership, and generational differences within the sales division of PT Telkom Region III, this study seeks to provide valuable insights into strategies that can enhance creativity and leadership effectiveness in a dynamic and diverse workforce. The findings from this study are expected to contribute to the existing body of knowledge by offering practical recommendations for organizations in the telecommunications sector to optimize the potential of their sales division, create a culture of innovation, and drive sustainable growth.

Creativity is an old concept that refers to the ability owned by everyone to create new things or products and is also used to find solutions to a problem [10]. Every human being has creative

capabilities, but only some people want and have the opportunity to hone these abilities. With creativity, someone can find and create something new, new ways, and new models that are helpful for themselves and society. New things are not always something that has never existed; the elements may have existed before, but individuals find new combinations. These new constructs have different qualities from their previous states. So, the new thing is innovative. Creativity plays an essential role in human life and development based on intellectual abilities, such as intelligence, talent, and learning outcome skills, but is also supported by affective and psychomotor factors [44]. Thus, creativity is the ability to create something new, innovative, unprecedented, interesting, unique, and valuable for society. At least an organization should develop individual creativity to unfold new ideas and innovation [45]. The concept of creativity may go hand in hand with innovation to make meaningful progress in an organization.

Creativity and innovation are closely intertwined concepts that drive meaningful progress and success within organizations. While creativity refers to the ability to generate novel and valuable ideas or solutions, innovation involves practically implementing those ideas to bring about positive change [46]. The dynamic interplay between creativity and innovation is crucial for organizations striving to stay competitive and adapt to an ever-evolving business landscape. By nurturing individual creativity and fostering a culture that embraces innovation, organizations can unlock their full potential to develop groundbreaking products, services, and processes that meet their customers' changing needs and demands [47]. Furthermore, innovation can enhance efficiency, productivity, and profitability, allowing organizations to gain a competitive edge in the market [48]. Thus, cultivating an organization's creative and innovative mindset is imperative for long-term success and sustainability.

Creativity at work can be identified from three aspects:

- i. Expertise
- ii. creative thinking skills
- iii. motivation [49-51].

Knowledge, skills, and experience reflect expertise. Creative thinking skills may be reflected by thinking outside the box, solving problems, and divergent thinking. Finally, motivation can be seen as intrinsic and extrinsic motivation.

Expertise is the knowledge, abilities, and experience someone has in a specific field [52]. Expertise is essential for developing creative ideas and solutions in the context of creativity at work. Employees can better develop original viewpoints, insights, and approaches with a thorough understanding and command of their subject. Those with expertise may spot patterns, connect the dots, and spot creative potential within their fields of expertise. Experts can contribute to the creation and execution of new and beneficial ideas by utilizing their expertise and abilities.

Various cognitive skills and processes, known as creative thinking skills, enable people to tackle issues and challenges from novel angles. It entails thinking creatively, challenging presumptions, and investigating novel possibilities [53]. Divergent thinking is concerned with coming up with diverse ideas and exploring different choices, and convergent thinking, which is concerned with assessing and choosing the most promising ideas for further development, are examples of creative thinking skills. Those with persuasive creative thinking abilities can break free from ingrained thought patterns, welcome ambiguity, and overcome mental obstacles to find novel solutions.

When it comes to fostering and maintaining creativity at work, motivation is essential [54-64]. An individual's inner drive and satisfaction from partaking in creative pursuits are intrinsic motivations [65]. Genuinely motivated employees are passionate, enthused, and driven to experiment with new

concepts, take chances, and overcome challenges. On the other hand, extrinsic motivation refers to external stimuli that encourage and reinforce creative action, such as prizes, recognition, and incentives. An individual's propensity to devote time, energy, and resources to creative efforts can be strongly influenced by intrinsic and extrinsic motivation, which can foster the development of original and valuable ideas at work.

Leadership is one of the central factors that dynamics, drives, directs, and coordinates various other organizational factors. In other words, the success of an organization is primarily determined by the aspects of its leadership and leaders. Within organizational psychology, leadership is one of the most ambiguous and controversial research areas [66,119]. Despite various studies on this issue, a general conceptual definition of leadership has yet to be agreed upon or become a consensus concerning the nature of leadership and the processes involved [67]. Thus, leadership is a process for influencing others to understand and agree on what needs to be done and how tasks can be done effectively, as well as a strategy for facilitating individual and collective efforts to achieve common goals. This notion is used because leadership includes efforts not only to influence and encourage the current work of groups or organizations but can also be used to inspire and ensure that all are prepared to meet future challenges.

The understanding that leadership is a process for influencing others and facilitating collective efforts to achieve common goals paves the way for the concept of transformational leadership. *Transformational leadership* goes beyond transactional exchanges and focuses on inspiring and motivating followers to reach their full potential [68]. It involves creating a vision, setting high expectations, fostering positive relationships, and empowering individuals to innovate and excel.

Transformational leaders exhibit several vital behaviours that contribute to their effectiveness. They engage in individualized consideration, showing genuine care and support for their followers' needs and development [69]. They also provide intellectual stimulation by encouraging creative thinking, challenging assumptions, and promoting innovation within the organization. Furthermore, transformational leaders inspire and motivate through charismatic and inspirational communication, articulating a compelling vision and encouraging followers to align their efforts with that vision. They also act as role models, exhibiting high ethical standards and displaying behaviours that followers can emulate.

The idea that leadership involves inspiring others and preparing them to meet future challenges aligns with the principles of transformational leadership. Transformational leaders focus on the present tasks and goals and inspire followers to anticipate and adapt to future changes and challenges. By fostering a sense of purpose and shared vision, transformational leaders drive organizational change and innovation, encouraging employees to embrace new ideas, take risks, and strive for continuous improvement [70].

Researchers have broadly studied the role of transformational leadership in enhancing creativity more than any leadership type [23]. In some ways, transformational leadership is an extension of transactional leadership. Transformational leadership involves followers committing to a shared vision and goals of the organization, challenging followers to be more innovative in solving problems, and developing the leadership capacity of subordinates through coaching, mentoring, and providing challenges and support. Outline the components of transformational leadership, which have undergone various developments, known as the 4Is (Four I), namely:

- i. idealized influence
- ii. inspirational motivation
- iii. intellectual stimulation
- iv. individualized consideration [34].

Idealized Influence is related to the condition that transformational leaders can act as role models for their followers. These leaders are liked, valued, and trusted by their followers. In turn, followers aspire to be like the leader and even want to exceed it because the leader supports the followers to have extraordinary capabilities, including persistence and determination. *Inspirational Motivation* means that transformational leaders exhibit behaviours that can motivate and inspire those around them by providing meaning and challenges to the work of their followers, including increasing enthusiasm and optimism. Leaders involve followers in envisioning the future, communicating expectations to be achieved, and demonstrating a commitment to shared goals and vision. *Intellectual Stimulation* refers to the leader stimulating the efforts of his followers to be more innovative and creative by proposing assumptions, creating problem frameworks, and new approaches/ways of working. New ideas and creative problem-solving are expected to emerge from followers who are involved in the process of problem-solving and finding solutions. Followers are encouraged to try new approaches, and followers' ideas are not criticized when they differ from those of the leader. In this case, the leader also encourages followers to see various problems from various points of view to trigger followers' innovation and creativity. Finally, *Individualized Consideration* means that the leader pays attention to each follower's needs for achievement and growth by acting as a coach or mentor. Followers and colleagues are developed towards higher potential. This individualized consideration is carried out when new opportunities arise in learning with a conducive climate. Individual differences in needs and expectations are recognized because leaders show acceptance of these differences. In essence, followers are considered as 'a person' rather than just employees or workers.

The effect of transformational leadership on creativity at work has been examined extensively by researchers. Most of them reveal the significant effect of transformational leadership on creativity at work [23,71-73,118]. With the support of the suitable implementation of transformational leadership, creativity at work is expected to enhance. Furthermore, we also examined the generational differences (generation X and Y) in the relationship between transformational leadership and creativity at work.

The hypotheses of this study are:

- i. transformational leadership affects creativity at work
- ii. generational differences affect creativity at work
- iii. generational differences moderate the relationship between transformational leadership and creativity at work.

There have been many studies on bibliometric analysis, including bibliometric analysis in publication of Techno-Economic Education [40]. Therefore, this research was conducted to carry out computational research on mapping bibliometric analysis of articles indexed by Google Scholar using VOSviewer software. This research was conducted with the hope that it can be a reference for researchers to conduct and determine the research themes to be taken, especially those related to the field the role of information and communication technology in enhancing work creativity through transformational leadership. Table 1 shows previous studies on bibliometric.

Table 1

Previous studies on bibliometric

No	Title	Ref.
1	Involving Particle Technology in Computational Fluid Dynamics Research: A Bibliometric Analysis	[74]
2	Bibliometric Computational Mapping Analysis of Trend Metaverse in Education using VOSviewer	[75]
3	The Use of Information Technology and Lifestyle: An Evaluation of Digital Technology Intervention for Improving Physical Activity and Eating Behaviour	[76]
4	Strategies in language education to improve science student understanding during practicum in laboratory: Review and computational bibliometric analysis	[77]
5	How language and technology can improve student learning quality in engineering? definition, factors for enhancing students' comprehension, and computational bibliometric analysis	[78]
6	Mapping of nanotechnology research in animal science: Scientometric analysis	[79]
7	Scientific research trends of flooding stress in plant science and agriculture subject areas (1962-2021)	[80]
8	Introducing ASEAN Journal of Science and Engineering: A bibliometric analysis study	[81]
9	A bibliometric analysis of chemical engineering research using VOSviewer and its correlation with Covid-19 pandemic condition	[82]
10	A bibliometric analysis of materials research in Indonesian journal using VOSviewer	[83]
11	Bibliometric analysis of engineering research using VOSviewer indexed by google scholar	[84]
12	Bibliometric computational mapping analysis of publications on mechanical engineering education using VOSviewer	[85]
13	Research trend on the use of mercury in gold mining: Literature review and bibliometric analysis	[86]
14	Domestic waste (eggshells and banana peels particles) as sustainable and renewable resources for improving resin-based brakepad performance: Bibliometric literature review, techno-economic analysis, dual-sized reinforcing experiments, to comparison with commercial product	[87]
15	Bibliometric analysis of educational research in 2017 to 2021 using VOSviewer: Google scholar indexed research	[88]
16	Corn-cob-derived sulfonated magnetic solid catalyst synthesis as heterogeneous catalyst in the esterification of waste cooking oil and bibliometric analysis	[89]
17	The complete Lextutor application tool for academic and technological lexical learning: Review and bibliometric approach	[90]
18	Use of blockchain technology for the exchange and secure transmission of medical images in the cloud: Systematic review with bibliometric analysis.	[91]
19	Computational bibliometric analysis of research on science and Islam with VOSviewer: Scopus database in 2012 to 2022.	[92]
20	Digital transformation in special needs education: Computational bibliometrics.	[93]
21	Antiangiogenesis activity of Indonesian local black garlic (<i>Allium Sativum</i> 'Solo'): Experiments and bibliometric analysis.	[94]
22	Characteristics of tamarind seed biochar at different pyrolysis temperatures as waste management strategy: experiments and bibliometric analysis.	[95]

2. Methodology

The study utilised article data derived from studies published in journals indexed by Google Scholar. We used Google Scholar for this study due to its open-source nature. To obtain research data, a manager reference application was used, namely Publish or Perish. Publish or Perish software was used to conduct a literature review on our chosen topic. The research was carried out through several stages:

- i. collection of publication data using the publish or perish application
- ii. analysing bibliometric data for the obtained articles using the Microsoft Excel application
- iii. performing computational mapping analysis on the bibliometric publication data using the VOSviewer application

- iv. analysing the results of the computational mapping analysis [41]. Detailed information on how to use bibliometric analysis is explained elsewhere [96,97].

The article data search on Publish or Perish was used to filter publications using the keyword "Transformational Leadership" to meet the specific title requirements of the publications. The papers used were published between 2012 and 2021. All data was obtained in January 2022. The articles that had been collected and matched the criteria for this study's analysis were then exported into two file types: research information systems (.ris) and comma-separated value format (*.csv). VOSviewer was also used to visualise and evaluate trends using bibliometric maps. The article data from the source database was then mapped. VOSviewer was employed to create 3 variations of mapping publications, namely network visualisation, density visualisation, and overlay visualisation based on the network (co-citation) between existing items. When creating a bibliometric map, the keyword frequency was set to be found at least three times.

3. Results

3.1 Publication Data Search Results

The following is the result of searching for data through the Publish or Perish reference manager application from a database taken from Google Scholar. Table 2 shows some examples of published data used in the VOSviewer analysis from this study. From this data, twenty samples of the best articles were taken that had the highest number of citations. The number of citations from all articles used in this study is 48763, the number of citations per year is 9752.60, the number of citations per article is 50.95, the average author in the articles used is 2.88, and all articles had an average h-index of 107 and a g-index of 167.

Table 2

The research publication on the role of information and communication technology in enhancing work creativity through transformational leadership

No.	Authors	Title	Year	Cites	Source	Ref
1	Hoch, J. E., Bommer, W. H., Dulebohn, J. H., & Wu, D.	Do ethical, authentic, and servant leadership explain variance above and beyond transformational leadership? A meta-analysis	2018	1404	Journal of management	[99]
2	Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D.	Green innovation and environmental performance: The role of green transformational leadership and green human resource management	2020	897	Technological forecasting and social change	[100]
3	I Buil, E Martínez, J Matute	Transformational leadership and employee performance: The role of identification, engagement and proactive personality	2019	826	International journal of hospitality management	[101]
4	A Eliyana, S Ma'arif	Job satisfaction and organizational commitment effect in the transformational leadership towards employee performance	2019	789	European Research on Management and Business Economics	[102]
5	SA Boamah, HKS Laschinger, C Wong, S Clarke	Effect of transformational leadership on job satisfaction and patient safety outcomes	2018	737	Nursing outlook	[103]
6	S Andriani, N Kesumawati, M Kristiawan	The influence of the transformational leadership and work motivation on teachers' performance	2018	642	International journal of scientific & technology research	[104]

7	PB Le, H Lei	Determinants of innovation capability: the roles of transformational leadership, knowledge sharing and perceived organizational support	2019	402	Journal of knowledge management	[105]
8	K Breevaart, AB Bakker	Daily job demands and employee work engagement: The role of daily transformational leadership behaviour.	2018	393	Journal of occupational health psychology	[106]
9	MCJ Caniëls, JH Semeijn, IHM Renders	Mind the mindset! The interaction of proactive personality, transformational leadership and growth mindset for engagement at work	2018	347	Career development international	[107]
10	CA Yue, LR Men, MA Ferguson	Bridging transformational leadership, transparent communication, and employee openness to change: The mediating role of trust	2019	339	Public relations review	[108]
11	FY Lai, HC Tang, SC Lu, YC Lee, CC Lin	Transformational leadership and job performance: The mediating role of work engagement	2020	317	Sage Open	[109]
12	B Afsar, WA Umrani	Transformational leadership and innovative work behaviour: The role of motivation to learn, task complexity and innovation climate	2020	291	European Journal of Innovation Management	[110]
13	LK Jena, S Pradhan, NP Panigrahy	Pursuit of organisational trust: Role of employee engagement, psychological well-being and transformational leadership	2018	287	Asia Pacific Management Review	[111]
14	A Zuraik, L Kelly	The role of CEO transformational leadership and innovation climate in exploration and exploitation	2018	271	European journal of innovation management	[112]
15	AM Amor, JPA Vázquez, JA Faíña	Transformational leadership and work engagement: Exploring the mediating role of structural empowerment	2020	271	European Management Journal	[113]
16	Farahnak, L. R., Ehrhart, M. G., Torres, E. M., & Aarons, G. A.	The influence of transformational leadership and leader attitudes on subordinate attitudes and implementation success	2020	270	Journal of Leadership & Organizational Studies	[114]
17	Y Jiang, CC Chen	Integrating knowledge activities for team innovation: Effects of transformational leadership	2018	264	Journal of Management	[115]
18	K Hildenbrand, CA Sacramento...	Transformational leadership and burnout: The role of thriving and followers' openness to experience.	2018	263	Journal of occupational health psychology	[116]
19	M Shafi, Z Lei, X Song, MNI Sarker	The effects of transformational leadership on employee creativity: Moderating role of intrinsic motivation	2020	259	Asia Pacific Management Review	[31]
20	AH Aldholay, O Isaac, Z Abdullah, T Ramayah	The role of transformational leadership as a mediating variable in DeLone and McLean information system success model: The context of online learning usage in Yemen	2018	257	Telematics and Informatics	[117]

3.2 Research Development on the Role of Information and Communication Technology in Enhancing Work Creativity Through Transformational Leadership

According to the statistics presented in Figure 1 and Table 3, there were a total of 957 research publications published between 2018 and 2023 that focused on the impact of information and communication technology on work creativity through transformational leadership. In 2018, there were 176 articles. In 2019, there were 153 articles. In 2020, there were 221 articles. In 2021, there were 191 articles. In 2022, there were 165 articles. In 2023, there were 51 articles. Based on the frequency of publications, it is evident that research on the impact of information and communication technology in enhancing work creativity through transformational leadership is not extensively explored annually, particularly in the past five years (2018-2023). The growth of the subject is quite volatile, as evident from Figure 1.

Figure 1 shows the development of the role of information and communication technology in enhancing work creativity through transformational leadership research from 2018 to 2023. Based on Figure 1, it is known that research developments related to the role of information and communication technology in enhancing work creativity through transformational leadership have decreased from 2018-2019. This decrease can be seen from the 176 publications in 2018 to only 153 publications. Since the development of the role of information and communication technology in enhancing work creativity through transformational leadership in 2020, there has been an increase in this research, namely 221 publications. After that, it subsequently experienced a drastic decline in the last 3 years, namely in 2021 with as many as 191 articles, in 2022 with as many as 165 articles, and in 2023 with as many as 51 articles. The data shows that the popularity of research on the role of information and communication technology in enhancing work creativity through transformational leadership tends to be unstable and has recently been in demand.

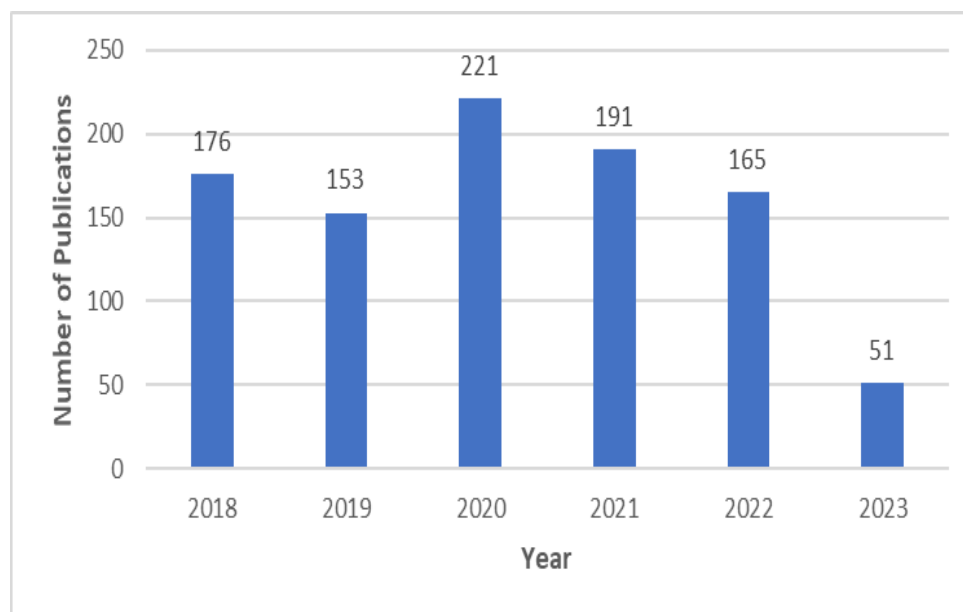


Fig. 1. Number of publications on the role of information and communication technology in enhancing work creativity through transformational leadership

Table 3

Development of research on the role of information and communication technology in enhancing work creativity through transformational leadership

Years of Publications	Number of Publications
2018	176
2019	153
2020	221
2021	191
2022	165
2023	51
Average	159.5

3.3 Visualization of Research on the Role of Information and Communication Technology in Enhancing Work Creativity Through Transformational Leadership Topic Area using VOSviewer

Computational mapping administered by VOSviewer was performed on the article data. From the results of the computational mapping, 104 items were found. The items related to the role of information and communication technology in enhancing work creativity through transformational leadership in data mapping are divided into 8 clusters, namely:

- i. Cluster 1 has 23 items and marked in green. The 23 items are behavior, ceo transformational leadership, china, corporate social responsibility, creativity, employee creativity, environment, evidence, firm, green transformational leadership, impact, innovation, mechanism, mediating role, mediator, moderating role, organizational innovation, organizational performance, paper, performance, role, smes, and study.
- ii. Cluster 2 has 19 items and marked in red. The 19 items are article, case, commitment, context, culture, education, importance, leadership, leadership style, model, order, organizational change, principal, self-efficacy, teacher, theory, transactional leadership, transformational leadership, and transformational leadership theory.
- iii. Cluster 3 has 16 items and marked in blue. The 16 items are data, effect, employee, employee performance, influence, job, job performance, job satisfaction, moderated mediation model, moderating effect, motivation, organizational commitment, organizational culture, work, work environment, and work motivation.
- iv. Cluster 4 has 15 items and marked in yellow. The 15 items are antecedent, emotional intelligence, follower, implication, leader, literature, manager, nurse, perception, present study, research, tfl, transformational leadership, understanding, and work engagement.
- v. Cluster 5 has 11 items and marked in purple. The 11 items are dimension, factor, indirect effect, mediation, ocb, organization, organizational citizenship, perspective, project success, transformational leadership, and turnover intention.
- vi. Cluster 6 has 8 items and marked in black. The 8 items are addition, innovative work behavior, knowledge, knowledge sharing, link, team, team performance, and trust.
- vii. Cluster 7 has 7 items and marked in orange. The 7 items are analysis, change, communication, covid, effectiveness, pandemic, and significant effect.
- viii. Cluster 8 has 5 items and marked in sky blue. The 5 items are association, employee engagement, mediating effect, psychological empowerment, and relationship.

The relationship between one term and another is shown in each existing cluster. Labels are given to each term in coloured circles. The size of the circle for each term varies depending on the frequency of occurrence of the term [98]. The size of the label circle shows a positive correlation with

the occurrence of the term in the title and abstract [86]. The more often the term is found, the larger the label size. The mapping visualisation analysed in this study consists of 3 parts: network visualisation (see Figure 2), density visualisation (see Figure 3), and overlay visualisation (see Figure 4) [86].

Figure 2 shows the relationship between terms. The relationship between terms is depicted in an interconnected network. Figure 2 shows the cluster of each term that is often researched and related to the research topic the role of information and communication technology in enhancing work creativity through transformational leadership. From the clusters contained in the network visualization, it can be seen that the research on the role of information and communication technology in enhancing work creativity through transformational leadership can be separated into 3 fields, namely the transformational leadership term which is included in cluster 2 with 103 links total, 3876 total link strength, and 886 occurrences (see Figure 5). The second term is communication which belongs to cluster 7 with a total of 35 links, a total link strength of 81, and occurrences of 18 (see Figure 6), and a creativity term which belongs to cluster 1 with a total of 49 links, a total link strength of 125, and 26 occurrences (see Figure 7).

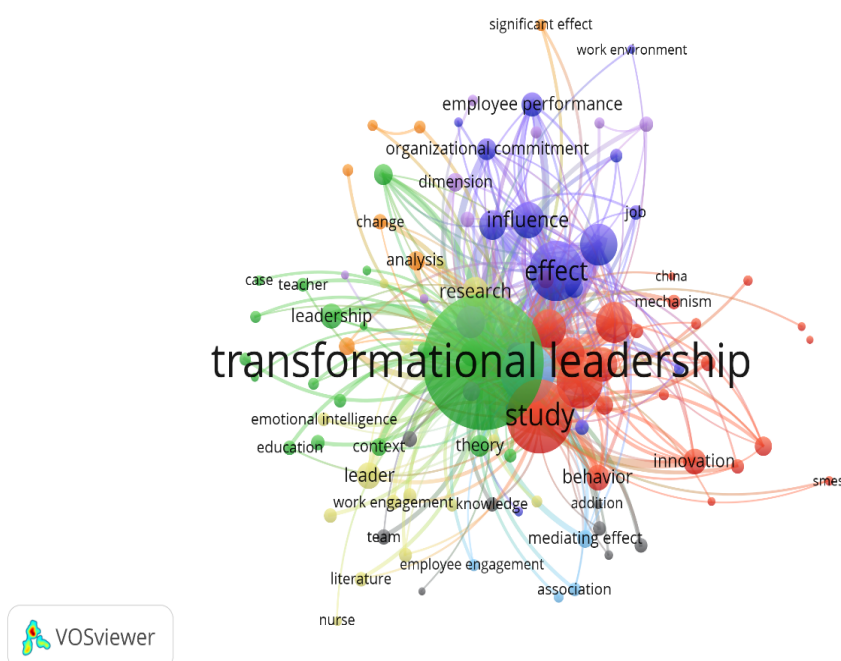


Fig. 2. Network visualization of research on the role of information and communication technology in enhancing work creativity through transformational leadership

Figure 3 shows the density visualization. Density visualization means that the brighter the yellow colour and the larger the diameter of the circle of term labels, the more often the term appears [86,98]. This means that a lot of research on related terms have been carried out. Conversely, if the colour of the term fades closes to the background colour, then the number of studies on the term is small. Figure 3 illustrates research related to the term's transformational leadership, effect, research, and study.



Fig. 3. Density visualization of research on the role of information and communication technology in enhancing work creativity through transformational leadership

Figure 4 shows the overlay visualization of research on the role of information and communication technology in enhancing work creativity through transformational leadership. This visualization overlay shows the novelty of research on related terms [86,98]. Figure 4, which is clarified in Figure 8, shows that research on the role of information and communication technology in enhancing work creativity through transformational leadership was mostly carried out during the period 2019 to 2020. The time for the popularity of the term transformational leadership in research has been quite long. Thus, we can easily create new research on transformational leadership.

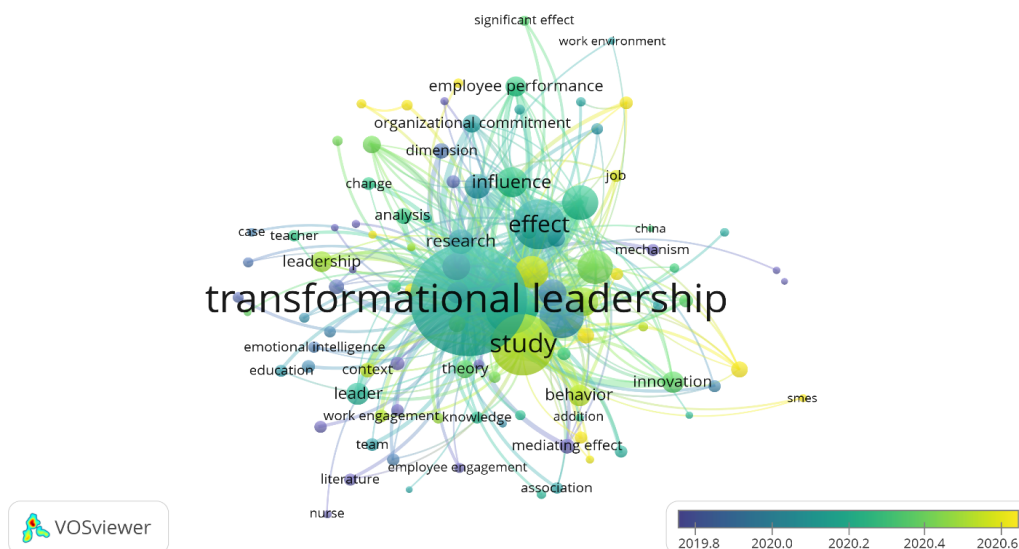


Fig. 4. Overlay visualization of research on the role of information and communication technology in enhancing work creativity through transformational leadership

Figure 5 shows a network of terms for transformational leadership with other terms, namely study, behaviour, innovation, theory, context, leader, work engagement, knowledge, literature,

nurse, team, association, mediating effect, research, effect, analysis, case, teacher, change, commitment, work environment, employee performance, organizational commitment, significant effect, and pandemic covid.

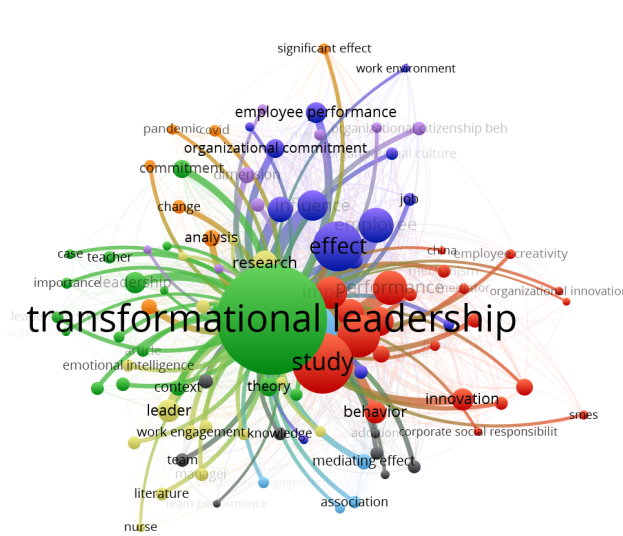


Fig. 5. Network visualization of transformational leadership term

Figure 6 shows the network of relationships between communication terms and existing terms, including transformational leadership, study, research, and effect.

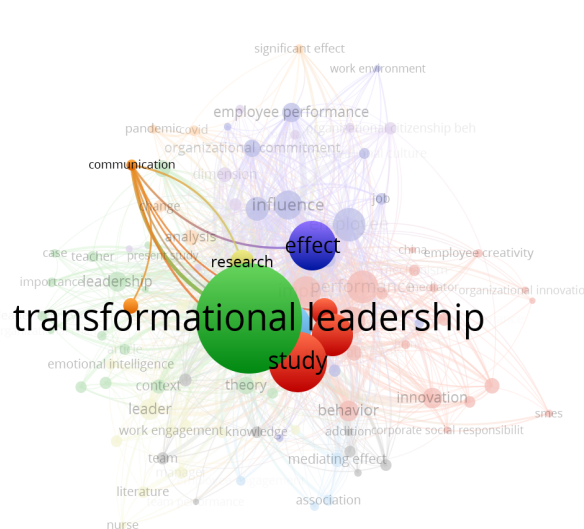


Fig. 6. Network visualization of communication term

Meanwhile, Figure 7 shows a network of creativity, which is connected with the term's transformational leadership, study, research, effect, and mediating effect. From these data, it can be seen that the term transformational leadership tends to have a high degree of relevance and is often associated with various terms. It can also be concluded that the field of transformational leadership is still very likely to be researched and associated with other terms, and this will have a higher impact on research novelty.

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