



Research Article

What is the role of AI adoption opportunities in the relationship between intellectual capital and innovation?

Asiye Yüksel¹

Kocaeli University, Kocaeli, Türkiye

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Abstract

The pace of AI adoption varies significantly across countries and industries. With the transition to the information society, the importance of intangible assets in gaining sustainable competitive advantage for organizations is increasing. In this context, intellectual capital has become a fundamental element in the knowledge production capacity, innovation performance and strategic management processes of institutions. This study aims to examine the issue of "the role of artificial intelligence in intellectual capital" from the perspective of innovation through bibliometric and qualitative analysis. With the bibliometric method, 21. From the beginning of the century to the present, visualization analysis of 121 important publications from the Web of Science database has been made. Our findings suggest an increase in the number of publications after 2021, but it is insufficient. In the research, the relevant literature was systematically evaluated; the development trends, prominent themes, key concepts, research clusters and scientific collaborations of the field were analyzed. However, the study was not limited to numerical bibliometric indicators; The findings obtained were handled with a qualitative interpretation approach and the theoretical transformation and conceptual orientation of the field were also evaluated. The study aims to provide guiding contributions to researchers, managers, and policymakers by revealing the relationship between artificial intelligence and intellectual capital literature in a holistic manner. In addition, it is thought that this research will serve as a reference for future academic studies on information management, innovation and organizational sustainability in the age of digital transformation.

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Introduction

The rapid developments in artificial intelligence technologies in recent years have significantly transformed the structure and usage of intellectual capital. In particular, machine learning, big data analytics, natural language processing and generative artificial intelligence applications accelerate knowledge production processes, strengthen decision-making mechanisms and reshape organisational learning. Thanks to artificial intelligence-supported systems, organizations can not only use existing information more effectively but also increase their capacity for new knowledge production and innovation. This situation causes artificial intelligence to be considered not only as a technological tool but also as a strategic intellectual capital component.

¹ Dr., Hereke Vocational School of Higher Education, Kocaeli University, Kocaeli, Türkiye. Email:asiye.yuksel@kocaeli.edu.tr ORCID: 0000-0003-0749-3576

Ongoing research has suggested several factors associated with AI adoption. McElheran et al. (2023) highlight the roles of firm owners and clustering in "superstar" cities in the US. Calvino et al. (2022) document that AI adoption in the UK is clustered around London and driven by large firms with high efficiency.

A study of companies in China shows that artificial intelligence systematically improves their information management capacity; For example, it shows that businesses increase their competencies in the stages of knowledge acquisition, integration, implementation and transformation. In this way, artificial intelligence supports the development of both incremental and radical technological innovations. Additionally, the impact of learning-oriented AI technologies, especially on technological innovation, is more pronounced (Li et al., 2025).

It is seen that studies examining the relationship between artificial intelligence and intellectual capital in the literature have increased significantly in recent years. However, much of the current research focuses on specific sectors, applications, or technological outputs; It is noteworthy that studies that holistically examine the general development trends, conceptual structure and scientific networks of the field are limited. AI has a profound impact on intellectual capital, enhancing its creation, utilization, and preservation. Like this (Salmain, 2025):

Creativity: AI enables rapid analysis of vast amounts of data, offering insights that can fuel innovation and contribute to the creation of new intellectual capital.

Use Cases: AI helps extract value from intellectual capital by automating tasks, improving decision-making processes, and optimizing processes.

Protection: Intellectual capital often needs protection from theft or misuse. AI plays a crucial role here, augmenting traditional methods of intellectual property protection.

Furthermore, according to Salmein (2025), AI does not create new knowledge and therefore new intellectual capital on its own, but it is a very good tool for exploiting existing data flows and dependencies. The quality of the result produced by artificial intelligence depends entirely on the data it is taught.

According to the resource-based view, AI constitutes a unique and valuable resource that enhances the absorption capacity and adaptive capabilities of firms, thereby strengthening the impact of CSR on intellectual capital development and innovation (Bin-Nashwan and Li, 2025; Makki et al., 2026).

In the age of digital transformation, knowledge, innovation and technology-based production processes have become the determining factors for organizations to gain a competitive advantage. Especially with globalization, Industry 4.0 applications and the spread of data-oriented management approach, traditional production factors are gradually being replaced by information-based strategic resources. In this transformation process, intellectual capital; It stands out as a basic element that enables organizations to create value through their knowledge, employee competencies, corporate processes and stakeholder relations.

The main purpose of this study is to reveal the scientific development of the field by examining the relationship between intellectual capital and innovation from a bibliometric and qualitative perspective through artificial intelligence. In the study, the relevant literature is systematically analyzed; publication trends, prominent research themes, influential authors, countries, keywords and scientific collaboration networks are evaluated. In addition, the findings obtained are discussed with the qualitative interpretation method and the strategic effects of artificial intelligence on intellectual capital and innovation are discussed.

In this respect, the research makes a theoretical contribution to both artificial intelligence and intellectual capital and innovation literature; It is also expected to create a guiding resource for researchers, managers and policymakers who want to manage digital transformation processes.

Conceptual Framework

Today, many studies on artificial intelligence define it as "a technology that makes computers or machines as intelligent as humans and enables them to perform tasks like the human brain" (Khatri, 2021). AI represents the pinnacle of human intellectual achievement, transforming its cognitive processes into a technical paradigm (Panichayakorn & Jermstiparsert, 2019) and imparting intelligence to machines (Belhadi et al., 2024).

Similarly, Panichayakorn and Jermstittiparsert (2019) examined the relationship between AI and economic performance, finding remarkable results. Wang et al. (2022) investigated that AI applications contribute to both internal and external agility and discovered a significant correlation with the use of chatbots. Additionally, it is suggested that firms can develop new capabilities by integrating AI-based resources to support their business models and operational practices (Khan, 2023; Dinh & Tran, 2025).

The term "AI adoption" describes how a company integrates AI technology into its products, services, or organizational operations (Badghish & Soomro, 2024). AI adoption plays a crucial moderating role in the relationship between corporate social responsibility and the dimensions of intellectual capital, including human, structural, and relational capital (Alromeedy & Alharethi, 2024). AI adoption empowers human capital by providing personalized learning experiences and skill development opportunities (Chowdhury et al., 2023).

McElheran et al. (2024) define AI adoption as a firm's use of at least one AI-related technology in production. Regarding the five artificial intelligence (AI) technologies documented in the 2018 Annual Business Survey, which surveyed 850,000 firms across the United States in its comprehensive study. It notes that less than 6% of firms are using any of the AI-related technologies, while, weighted by employment rate, it has an average adoption rate of just over 18%. They also found that startups that use AI tend to have younger, but more educated and more experienced leaders.

He suggests that the companies most ready to adopt AI are those that focus on knowledge and skill development (Infosys 2021). Thanks to the efforts of numerous researchers and practitioners, the field of intellectual capital is now widely explained through three dimensions: Human Capital, Relational Capital, and Structural Capital (Bontis, 1998; Urban & Joubert, 2017).

Intellectual capital describes the intangible assets of an organization (Bueno et al., 2004; Bontis et al., 2005a; Petty and Guthrie, 2000) and help organizations achieve sustainable success (Youndt et al., 2004; Subramaniam & Youndt, 2005) and contribute to organizational performance (Riahi-Belkaoui, 2003).

The concept of intellectual capital is generally discussed in three basic dimensions: human capital, structural capital and relational capital (Bontis, 1998). While human capital refers to the knowledge, experience, creativity and problem-solving competencies of employees, structural capital includes organizational processes, databases, institutional memory and technological infrastructure. Relational capital, on the other hand, includes customer relationships, brand equity, social networks, and strategic ties developed with stakeholders. Today, the sustainable success of organizations has become dependent on the effective management of these three components.

Artificial intelligence does not create new knowledge and therefore new intellectual capital on its own, but it is a very good tool for taking advantage of existing data flows and dependencies. The quality of the result produced by artificial intelligence depends entirely on the data it is taught. The AI development process, like the internet, must be carefully monitored to strengthen its role as a powerful information management and presentation tool. It creates enormous potential for countless applications in extracting and presenting information and creates entirely new ways of interaction between various actors in the metaverse (Salmelin, 2025).

Here, we focus on how AI adoption can bolster intellectual capital, contributing to more personalized innovative behavior. The findings are expected to have both theoretical and practical implications. In light of the above, this study focuses on how artificial intelligence affects intellectual capital and addresses the following questions:

- Trends: What are the trends in the use of AI adoption with a focus on intellectual capital and innovation?
- Time category: In which years has the use of artificial intelligence adoption increased, with a focus on intellectual capital and innovation?
- Placement category: In which countries have artificial intelligence studies been intensively examined with a focus on intellectual capital and innovation?
- Research Platform and Application Category: In which areas are artificial intelligence studies researched with a focus on intellectual capital and innovation?
- Research Platform and Academic Weight Category: What is the academic mapping of artificial intelligence studies with a focus on intellectual capital and innovation?

The rest of this article is structured as follows: In Part 2, the literature on artificial intelligence with a focus on intellectual capital is examined. Chapter 3 defines our research strategy and explains how our systematic review and analytical approach are applied. In Chapter 4, a filtered set of papers was analyzed to answer three research questions. In Chapter 5, the results are discussed, and the findings of our study and the opportunities and limitations for future research are highlighted.

Method

This study adopts a design that includes two models in which qualitative and quantitative approaches are integrated. In this study, bibliometric analysis was performed as a qualitative method in the first model. The bibliometric approach allows researchers to systematically examine the impact, trends, and connections between scholarly publications, providing insights into the evolution of research themes and collaborative networks within the field. These methods have been chosen to reveal both the breadth of topics covered and the intensity of research collaborations, providing a comprehensive and informative analysis of the literature (Chen et al., 2023). In addition, VOSviewer software was used for the answer to answer research question 5. VOSviewer software is used to interpret data from keywords, institutions, authors, and other sources through shared citation analysis and visualisation methods, resulting in a more comprehensive result (Lin & Yu, 2024)

Data Collection Tools

This research, in April 2026, studies the role of artificial intelligence in the focus of intellectual capital were found through a systematic search in various databases, including Web of Science, Scopus, and Google Scholar, and were searched without date limits. VOSviewer software is used to interpret data from keywords, institutions, authors, and other sources through shared citation analysis and visualization methods, resulting in a more comprehensive result (Lin & Yu, 2024). Table 1 lists the research procedures.

Table 1. Review procedures, tools, and corresponding purposes

Procedures	Tools or methods	Purposes (research questions addressed)
Literature search	Web of Science and SCOPUS	To search for raw publication records
	VOSviewer	To reveal the most-used keyword item list and the co-occurrence relationships between items through a visualisation map (<i>RQ1</i>).
Visualisation	Year-based publication counting	To reveal the year-based publication trend related to the topic with two publication databases merged (<i>RQ2-RQ3</i>).
Literature synthesis	systematic mapping study	To reveal details about related findings in individual included studies (<i>RQ4-RQ5</i>)

Showing procedures, tools, and related purposes, Table 1 search results included peer-reviewed scientific articles and conference proceedings without distinction of language or year. Following the latest developments in artificial intelligence technology, there is an increasing interest, especially in the human capital dimension. In fact, artificial intelligence technologies are also new in the literature.

Table 2. Quantity of papers according to the search string in the ISI Web of Science database.

Topic	Search Array	Quantity
About Intellectual Capital	Intellectual Capital	10.816
	Artificial intelligence	277
	“Intellectual Capital ”	7.683
	“Artificial intelligence”	111
About Intellectual Capital AI	Intellectual Capital AI	178
	“Intellectual Capital AI”	101
Combined	Intellectual Capital AI and Innovation	139
	“Intellectual Capital AI and Innovation”	121

This combination was addressed by combining the search strings "artificial intelligence in intellectual capital" and "innovation", excluding terms such as "human resources", "education" or "social sciences". This search yielded 101 articles, as shown in Table 2.

Table 3. WOS Database Search results

Keywords	"Intellectual Capital AI and Innovation"
Timespan	1945-2026.
Results found	121
Sum of the Times Cited	6855
Average Citations per Item	67,87
h-index	36

"Intellectual AI and Innovation" The WOS database search results of the keywords are shown in Table 3.

Findings

Through a comprehensive analysis, the selected 121 articles featured inclusive articles addressing various trends. It is seen that the weight of the articles is a literature review. However, fewer articles are related to firm performance or execution. Table 4 classifies the most cited articles.

AI Adoption Trends

The first 10 articles were selected. Makridakis' (2017) "*The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms*" has 943 citations (Figure 1).

Table 4. Top 10 most cited articles

Title	Authors	Total Citations
The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms	(Makridakis, 2017)	943
Artificial intelligence and innovation management: A review, framework, and research agenda	(Haefner et al., 2021)	586
Artificial intelligence, firm growth, and product innovation	(Babina et al., 2024)	531
Influence of artificial intelligence on technological innovation: Evidence from the panel data of China's manufacturing sectors	(Liu et al., 2020)	505
Artificial intelligence in innovation research: A systematic review, conceptual framework, and future research directions	(Mariani et al., 2023)	351
Demystifying AI: What Digital Transformation Leaders Can Teach You about Realistic Artificial Intelligence	(Brock et al., 2019)	312
Artificial intelligence and industrial innovation: Evidence from German firm-level data	(Rammer et al., 2022)	295
Artificial intelligence and corporate innovation: A review and research agenda	(Bahoo et al., 2023)	223
Artificial intelligence in innovation management: A review of innovation capabilities and a taxonomy of AI applications	(Gama et al., 2025)	212
Digital innovation and the effects of artificial intelligence on firms' research and development: Automation or augmentation, exploration or exploitation?	(Johnson et al., 2022)	200

When Table 4 is examined, it is seen that the trends of the most cited articles provide a conceptual framework on the axis of social sciences (RQ1).

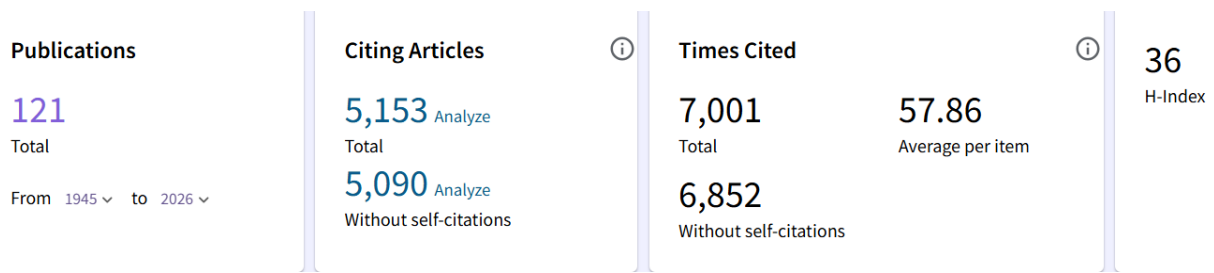


Figure 1. Citation map (prepared by the author via WOS)

Table 5. Refine by document types

Document Types	Count
Article	108
Review Article	13

When the literature was examined (Table 5), it was seen that the most publications in the study were of the type of article (108 pieces). Early access and editorial articles were removed.

AI Adoption by Year

Table 6. Refine by publication years

Publication Year	Count
2026	21
2025	30
2024	23
2023	14
2022	11
2021	9
2020	6
2019	3
2017	1
2016	1
2013	1
2007	1

When the literature is examined (Table 6), it is seen that the beginning of research publications was in 2007; this number increased to 2019 and reached its maximum in 2025. It is estimated that this number will increase in 2026. Looking at the time category, it is seen that the number of publications has increased since 2019, accelerated since 2021, reached its highest level in 2025, and this momentum will increase in 2026.

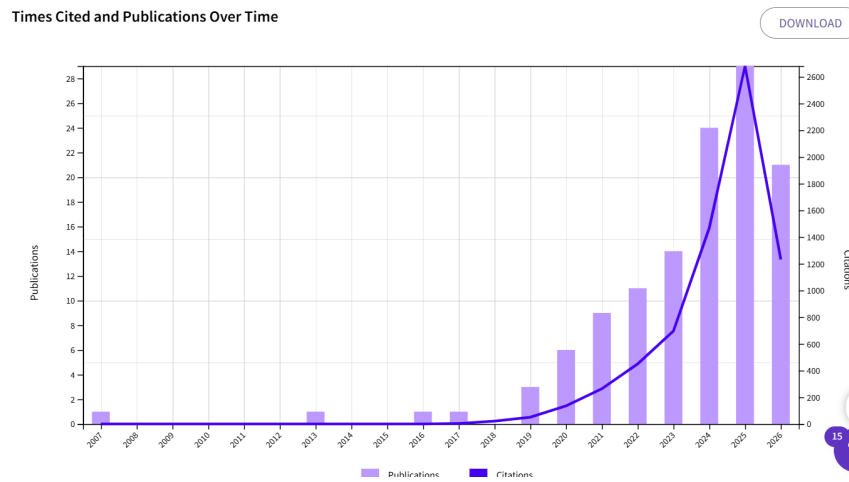


Figure 2. Times cited and publications over time (prepared by the author via WOS)

Geographical Distribution of AI Studies

When the literature is examined (Table 7), the China stands out as the country with the most research.

Table 7. Refine by research areas

Countries/Regions	Count	Countries/Regions	Count
USA	28	South Africa	2
England	23	Sweden	2
Germany	13	Wales	2
Peoples R China	12	Austria	1
Italy	11	Belgium	1
Australia	7	Czech Republic	1
Switzerland	4	Denmark	1
Canada	3	Ireland	1
Cyprus	3	Kuwait	1
India	3	Liechtenstein	1
Netherlands	3	Luxembourg	1
Russia	3	Malaysia	1
Saudi Arabia	3	Montenegro	1
Brunei	2	Morocco	1
Finland	2	New Zealand	1
France	2	Nigeria	1
Norway	2	Scotland	1
Poland	2	Spain	1
Singapore	2	Uzbekistan	1
South Korea	2		

When Table 7 is examined, the People's Republic of China ranks first as the place where the research is concentrated on a country basis. This is followed by Italy, the USA, England and Germany.

AI Research Areas

Table 8. Refine by Web of Science category

Web of Science Categories	Count	Web of Science Categories	Count
Economics	18	Biochemistry Molecular Biology	1
Computer Science Artificial Intelligence Management	14	Biology	1
Computer Science Information Systems	12	Cell Biology	1
Business	11	Communication	1
Business Finance	10	Computer Science Cybernetics	1
Computer Science Theory Methods	10	Development Studies	1
Law	7	Green Sustainable Science Technology	1
Political Science	7	History Philosophy of Science	1
Computer Science Software Engineering	6	Humanities Multidisciplinary	1
Multidisciplinary Sciences	5	Mathematics Interdisciplinary Applications	1
Engineering Electrical Electronic	5	Medical Ethics	1
Information Science Library Science	4	Medical Informatics	1
Social Issues	4	Medicine General Internal	1
Ethics	4	Operations Research Management Science	1
International Relations	3	Philosophy	1
Social Sciences Interdisciplinary	3	Psychology Social	1
Computer Science Hardware Architecture	3	Radiology, Nuclear Medicine Medical Imaging	1
Computer Science Interdisciplinary Applications	2	Social Sciences Biomedical	1
Engineering Industrial	2	Social Sciences Mathematical Methods	1
Regional Urban Planning	2		
Sociology	2		
Telecommunications	2		

When the literature is examined (Table 8), with a focus on intellectual capital and innovation, artificial intelligence studies have mostly been conducted in the field of economics. Other social sciences also follow this intensity (management, business, and business finance). Artificial intelligence is still a new topic for the world, and hesitations continue.

Academic Mapping of AI Studies

Using VOSviewer, the concurrency analysis method was used to visualize research focuses related to artificial intelligence with a focus on intellectual capital and innovation. This method treats all keywords as separate units of analysis and uses all counting methods to measure concurrency.

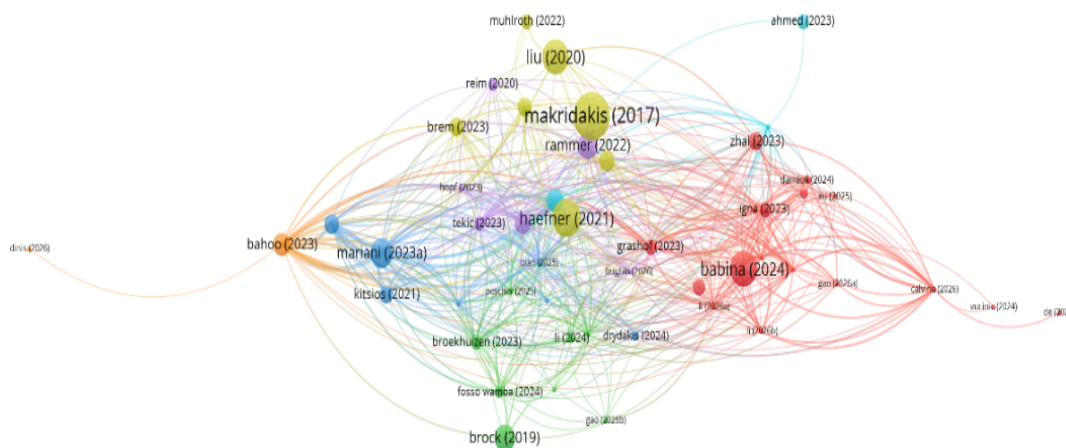


Figure 3. Author-driven mapping

Figure 3 shows the analysis of all authors (RQ5). Only keywords mentioned at least five times were included to ensure relevance. Authors were selected from 1306 keywords, 50 of whom met this threshold (Figures 3 and 4).

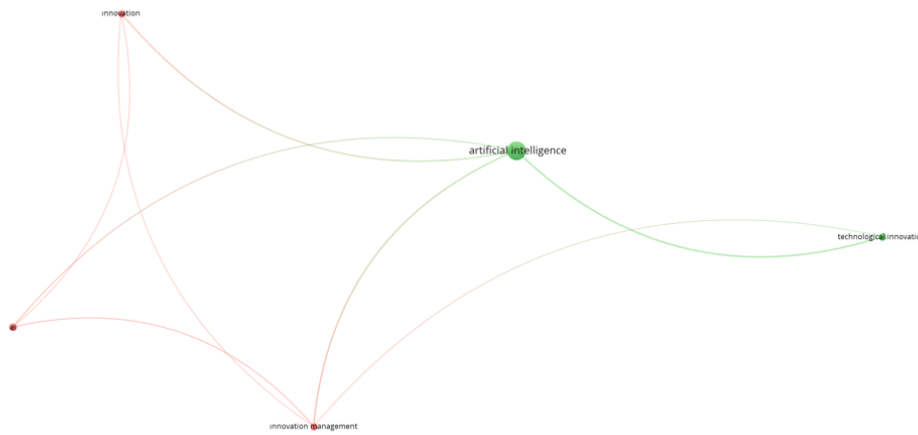


Figure 4. Keyword-driven map

The most cited and used keywords in these publications were artificial intelligence, technological management, innovation management and innovation (Figure 4).

Conclusion

Artificial intelligence does not create new knowledge and therefore new intellectual capital on its own, but it is a very good tool for taking advantage of existing data flows and dependencies. The quality of the result produced by artificial intelligence depends entirely on the data it is taught. The AI development process, like the internet, must be carefully monitored to strengthen its role as a powerful information management and presentation tool. It creates enormous potential for countless applications in extracting and presenting information and creates entirely new ways of interaction between various actors in the metaverse (Salmelin, 2025).

With the rapid development of artificial intelligence technology and the increasing interest in this field, the potential of this field has been recognized. Our research suggests that AI adoption can be expanded to replicate existing results and help more human capital be designed and used with AI technologies; Thus, it can contribute to the development in accordance with the age of artificial intelligence.

The first investment in artificial intelligence will enable innovative new ideas to be implemented quickly, cheaply and relatively comprehensively. However, it can be difficult to replace managers' judgment ability, and therefore, the transformation to a fully digitised organisation can be problematic. Furthermore, human-centred, traditional approaches to innovation management have limitations due to their inability to fully address information needs and handle complexity (Haefner et al, 2021).

Biodata of Author



Dr. **Asiye Yüksel**, who received his doctorate at Gebze Technical University, Institute of Social Sciences, Department of Business Administration in 2022 with his thesis on innovative literacy, has been working as a lecturer at Kocaeli University, Hereke Ö.İ.U Vocational School since 2006. He continues to work as a lecturer. She still teaches courses in the field of management and organisation at associate, undergraduate and graduate levels at Kocaeli University, where he is working. The courses he teaches include "R&D and Project Management", "Management and Organisation", "Business and Total Quality", "Career Planning", "Scientific Research Methods", "Entrepreneurship", "Quality Control", and "Public Relations and Communication". He has various articles in journals scanned in SSCI, Scopus and TR Index on topics such as innovation management, innovative literacy, entrepreneurship, R&D and project management, organisational behaviour and leadership, as well as papers, books and book chapters presented in Turkish and English at national and international conferences. The focus of his research topics is the field of innovation and management philosophy. Due to his personal interest, he also has history research, fine arts (photography) and sociology.

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